ENCYCLOPÆDIA BRITANNICA

THE UNIVERSITY OF CHICAGO

The Encyclopædia Britannica
is published with the editorial advice of the faculties
of The University of Chicago and of a
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and London universities and of a committee
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"LET KNOWLEDGE GROW FROM MORE TO MORE
AND THUS BE HUMAN LIFE ENRICHED."

A New Survey of Universal Knowledge

ENCYCLOPÆDIA BRITANNICA

Volume 9

EXTRADITION *TO* GAMBRINUS

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ENCYCLOPEDIA BRITANNICA, INC.

WILLIAM BENTON, PUBLISHER

CHICAGO · LONDON · TORONTO · GENEVA · SYDNEY

PRINTED IN THE U.S.A.

FOUNDED A.D. 1768

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EXTRADITION *TO* GAMBRINUS

EXTRADITION may be briefly described as the surrender of an alleged or convicted criminal by one state to another. More precisely, extradition may be defined as the process by which one state upon the request of another surrenders to the latter a person found within its jurisdiction for trial and punishment (including preventive measures) or. if he has been already convicted. only for punishment. on account of a crime punishable by the laws of the requesting state and committed outside the territory of the requested state. This purpose, direction and request by the receiving state differentiate extradition from other measures for the forcible removal of undesirable persons. such as banishment. expulsion and deportation.

Kinds of Extradition. — Extradition between independent nations not linked by any constitutional ties is designated as international extradition as distinguished from interstate extradition. The latter is the surrender of criminals between states that form part of a federal system of government without unitary administration of criminal justice; as in the United States of America (see art. 4, sec. 2 of the U.S. constitution). In some nations with a federal government, however: the apprehension and transfer of criminals from one constituent member to another for trial or punishment is regulated by federal legislation of an inclusive and streamlined type. Thus, Australia (Service and Execution of Process act) and Canada (criminai code) require for an interstate or interprovincial surrender, respectively, merely that a warrant for apprehension and conveyance, issued in one state or province. be endorsed for execution by a qualified officer of the state or province where the person sought is found. In Switzerland the unification of criminal justice has eliminated the former need for intercantonal extradition. Within the British Commonwealth the surrender of accused persons from one part of the dominions of the crown to another is similarly accomplished by a broadly applicable and simplified procedure, regulated either directly by the British Fugitive Offenders act of 1881 or by separate dominion legislation modeled after that act, such as the Canadian Fugitive Offenders act (originally enacted in 1882).

Character and History. — Extradition plays an important role in the international battle against crime. It owes its existence to the so-called principle of territoriality of criminal law, according to which a state will not apply its penal statutes to acts committed outside its own boundaries except where the protection of special national interests is at stake. In view of the solidarity of nations in the repression of criminality, however, a state, though refusing to impose direct penal sanctions to offenses committed abroad. is usually willing to co-operate otherwise in bringing the perpetrator to justice lest he go unpunished. Some writers on the law of nations, including the celebrated Grotius, have asserted that states have an international duty either to punish or to extradite, as least in cases of common crimes. The preponderance of modern theory and practice, however, recognizes that extradition and the conclusion of extradition treaties are merely matters of comity and that customary international law establishes no obligations for a state to grant extradition.

While instances of the surrender of criminals and even of the conclusion of general treaties on the subject are reported for antiquity as well as for the middle ages, extradition as a legal institution developed chiefly after the end of the 18th century. Originally, extradition was treated as a question of diplomatic expediency and a matter within the general police powers of the executive. but gradually it was surrounded with legal safeguards for the protection of the individual and was placed under the superintendence of the judiciary. Many nations have passed comprehensive legislation regulating the subject.

Extradition Acts.—The pioneer in this development was Belgium. which passed a general extradition law on Oct. 1, 1833. The law specified seven extraditable crimes and a number of conditions to be stipulated in treaties concluded in accordance with this statute. It was supplemented and in part superseded by legislation of 1874, which greatly enlarged the catalogue of extraditable offenses. The United States adopted a statute regulating international extradition in 1848. It had the purpose of setting at rest certain doubts as to whether extradition had become a subject of judicial cognizance and of clarifying the procedure to be followed. It reirained from establishing limitations on extradition but restricted its applicability to cases arising under extradition treaties. Tht Setherlands followed the Belgian example with an act of 1849, which was replaced in 18; j by further legislation.

In Great Britain passage of a general extradition law was recommended by a select committee of the house of commons in 1868. Its proposals prompted the Extradition act of 1870, which has been amended many times. The statute was designated to facilitate the conclusion of extradition arrangements by the crown, to define extraditable offenses and to establish certain other limitations on surrender under such arrangements, as well as to establish proper procedure. The law was enacted for the United Kingdom as well as other dominions of the crown. It applied, for instance. in Australia, but Canada required separate dominion legislation (adopted in 1877) modeled after the British. Other nations also enacted extradition statutes. Legislation of this type was passed in Argentina (law no. 1612 of 1885), Switzerland (1892), Brazil (law no. 2416 of 1911, superseded by decree law no. 394 of 1938), France (1927) and Germany (1929). Italy regulated extradition in its code of criminal procedure.

Extradition Treaties.—In view of the ease and swiftness of modern transportation, many nations entered into extradition treaties with other countries, especially with close neighbours, to establish an over-all regulation of the mutual surrender of fugitive criminals. In some instances the enactment of general extradition laws, as well as the need for a formal international arrangement as prerequisite for extradition. has stimulated this development. The United Kingdom, for instance, which before enactment of the 1870 statute (mentioned above) had extradition treaties only with the United States. Denmark and France, later entered into more than 40 such arrangements. The experience of the United States was comparable. These treaties usually specify the extraditable offenses as well as other conditions for the surrender of persons accused or convicted of the commission of a crime. In most cases they establish an absolute duty to extradite, but in some instances extradition is left to the discretion of the requested state.

The relation in the various nations between the extradition treaties and the general extradition acts poses complex questions regarding the respective powers of the lawmaking and treaty-making departments under the governing constitutions. No uniform answer is possible. Furthermore, the law of the different countries varies greatly as to the legality of extraditions independent of an existing treaty. Thus, in the United States any extradition must fall under the provisions of a duly ratified and subsisting treaty, as least so long as congress has not legislated to the contrary. Similarly, in the United Kingdom, save for special parliamentary action, extradition can be granted only under an international arrangement concluded pursuant to the act of 1870. A similar situation is deemed to exist under the Belgian and Dutch laws, by virtue of their requirement of reciprocity coupled with their reference to treaties concluded pursuant to the act. On the other hand, the French extradition act applies. by its own terms, only in the absence of a treaty and to matters not regulated in the treaties, thus impliedly authorizing extradition in such cases.

The Federal Republic of Germany is satisfied with assurance of reciprocity without insisting on a formal treaty, except where the requesting country mould be so limited. Switzerland also will extradite apart from a formal convention, provided that its government and the requesting state have exchanged declarations of reciprocity. Canada permits extradition, regardless of treaty. with respect to a catalogue of offenses upon proclamation by the governor general to that eifect with regard to a particular nation. In general, the majority of countries grant extradition even in the absence of binding international obligations and do not base a right of asylum upon such lack.

Extradition Principles.—The conditions of or limitations on extradition are regulated by treaties and statutes and vary considerably from country to country. Nevertheless, in the course of time there has crystallized a core of extradition principles which are followed by many, though by no means all, nations.

Nonextradition of *Nationals*.—During the last 100 yr. most states have come to decline any obligation to surrender their own nationals and have even forbidden such extradition. In some countries this prohibition is elevated to a constitutional guaranty! as in Brazil (constitution of 1946, art. 141, sec. 33), West Germany (Bonn const., art. 16[2]) and the Netherlands (const., Art. 4), while in others it is anchored in extradition acts, as in Belgium, France and Switzerland. The Italian constitution permits extradition of nationals only if specifically agreed upon in international conventions.

Conversely, in Argentina, the United Kingdom and the United States no explicit rules against the surrender of citizens exist. In these countries nationals may be extradited, but only if the governing treaty either requires or authorizes such action. Thus the U.S. supreme court held in 1936 that a citizen could not be surrendered to France because the controlling treaty did not confer such power on the executive. Similarly, the supreme court of Argentina in 1956 barred extradition of a citizen to the United States under the treaty of 1896 because his personal circumstances rendered such surrender inconvenient (Matter of Milazzo, decision no. 18.607).

Double Criminality.—Another rule commonly found in statutes or treaties bars extradition unless the offense prompting the request is also punishable in the surrendering state, the principle of double criminality. It gained public attention in the Gerhart Eisler incident in 1949. The United States had convicted Eisler, a former German Communist, for knowingly making false statements in an application for an alien departure permit. He had fled on a Polish vessel. and while in the United Kingdom, was arrested on a warrant issued upon request by a U.S. official. The English magistrate freed him because the offense in question mas not tantamount to the extraditable crime of perjury. The U.S. supreme court! in a case decided in 1933, had not felt bound by this principle in the absence of a specific treaty clause.

Nonextradition of Political *Offenders*.—A generally recognized extradition principle is the right of asylum for political offenders. First asserted by France, it was incorporated in the Belgian extradition law of 1833 and from there found its way into many constitutions, into most extradition laws and scores of extradition treaties. The characterization of an offense as "political" is subject to widely divergent statutory or judicial definitions. A common crime may be considered as political (so-called relative political offense), but the criteria that render it political are a matter of controversy. Connection with a political disturbance, political purpose or even a primarily political motive has been declared sufficient to justify the right to asylum. The Swiss supreme tribunal so held in favour of Yugoslavian pilots who had diverted their plane to Switzerland because of force and threats. On the same ground, extradition of purported war criminals has been refused. The Netherlands did so in the case of the German kaiser and a U.S. court of appeals in 1957 barred extradition to Yugoslavia of an individual charged with responsibility for the slaughter of thousands of victims.

Principle of Specialty.—Extradition treaties and acts usually specify that the surrender is on condition that the requesting state must not convict or punish the individual for any crime different from that for which he was extradited. This protection may be restricted to a limited period and subject to naiver by the extraditing state if its internal law so permits.

Temporary or Conditional Extradition.—Sometilnes extradition is granted on condition of re-extradition to the surrendering state or is accorded subject to other limitations. Thus the supreme court of Argentina held in 1957 that the abolition of the death penalty in that country permitted extradition only on condition that no capital punishment would be imposed.

International Codification and Multilateral Treaties.—The committee of experts for the progressive codification of international law of the League of Nations (in 1926) and the International Law commission of the United Nations (in 1949) decided that extradition did not yet appear susceptible of codification or regulation by general convention. The Harvard Research on International Law, honever, published a Draft *Convention* on Extradztion (in 1935) to serve as basis for a common agreement. Several multilateral conventions on extradition, or certain aspects thereof, are in force among various American republics. They include three Pan American conventions: (1) on extradition (Montevideo, 1933) binding 12 countries; (2) on private international law, art. 344–381 (Havana, 1928) binding 15 countries; and (3) on territorial asylum, art. 4 (Caracas, 1954), binding 6 countries. In addition, mention should be made of the Montevideo treaty on international criminal law of 1889, operative in five South American republics and of the Caracas agreement on extradition of 1911, likewise in force in five South American countries. The Council of Europe prepared a European convention on extradition which was signed by 11 countries on Dec. 13, 1957.

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EXTRAPOLATION: see INTERPOLATION.

EXTRASENSORY PERCEPTION, commonly called ESP, the collective term for all the varieties of perception beyond the range of the known sensory processes. *See* PARAPSYCHOLOGY.

EXTREMADURA (ESTREMADURA), a region of western Spain, once economically important because of its rich winter pastures, comprising the provinces of Cáceres and Badajoz. Area 16,063 sq.mi.; pop. (1960 est.) 1,479,493. It is to be distinguished from the Portuguese province of Estremadura, which occupies the central coastal region of Portugal and represents the zone conquered by Afonso Henriques from the Almohads in the 12th century. Historically, this name—popularly supposed to derive from Latin *terra extrema et dura*—was given during static periods of the Christian reconquest of the Iberian peninsula to whatever then happened to be the zones bordering on Moorish territory. Thus in the 10th and 11th centuries the border approximated to the line of the Duero or Douro river from Soria in the east to the Atlantic coast near Coimbra. Then. during the reign of Alfonso VI of Lebn and Castile, the name Extremadura was transferred (*c.* 1086) to a newly conquered region to the south, which included Salamanca, Segovia and Ávila. This, at first, was described as "Extremadura beyond the Duero" to distinguish it from the older region of the same name. León, following its southern expansion between 1157 and 1230, also had a province called Extremadura which stretched southward from Ciudad Rodrigo to beyond Badajoz. In the 12th and early 13th centuries, therefore, both León and Castile possessed Extremaduran provinces administered as separate entities by each kingdom. Later in the reign of Ferdinand III of Castile and León this separate administration was abandoned and, irom the later middle ages, the term was applied to a region only slightly larger than the combined area of the two modern provinces. *See* also SPAIN; ESTREMADURA. (P. E. R.)

EXTREME UNCTION, the sacramental anointing. by a priest, of one in danger of death from illness. It was defined by the 14th session of the Council of Trent that "this sacred unction of the sick was instituted by Christ our Lord as truly and properly a sacrament of the New Law; there is a suggestion of it in Mark vi, 13 [where the Apostles 'anointed with oil many sick people and healed them']; moreover, it was commended and promulgated to the faithful by James, the Apostle and brother of the Lord. 'Is any man,' he says, 'sick among you? Let him bring in the priests of the Church, and let them pray over him. anointing him with oil in the name of the Lord; and the prayer of iaith shall save the sick man. and if he be in sins. they shall be forgiven him' (Tames v, 13–15)." The rite consists of the separate anointing of the five senses and also of the feet with olive oil blessed for the purpose by the bishop, together with the repetition at each anointing of the formula: "By this holy unction and His most loving mercy, may the Lord forgive thee all thy sins (of sight, hearing, etc.)." The special grace of the sacrament, as its symbolism implies, is that of a healinr and strengthening of the soul against the difficulties met in mortal illness—the grace. therefore, of hope in the face of anxieties, of patience under suffering and of fortitude under temptations. Other graces are those of bodily healing, if this should be for the good of the soul, and of the remission of sins and the punishment due to sin, ii the dispositions of faith and penitence are present. These graces are indicated in the liturgical prayers of the rite. (J. C. MY.)

EYBESCHUTZ, JONATHAN (1690–1764), German rabbi and Cabalist. was born in Cracow. After serving as rabbi of Eibenschitz. Moravia. and of Metz. Ger.. he became in 1750 chief rabbi of the German triple community of Altona, Hamburg and Wandsbeck. A man of erudition and personality. Eybeschutz became notorious because of a curious controversy concerning the amulets (for the aid of women in childbirth) which he was suspected of issuing. These amulets contained many sacred names of angels and Cabalistic formulas. which. according to Jacob Emden. included belief in Sabbatai Zebi (*q.v.*) as the Messiah. Eybeschutz was accused of heresy, and the ensuing controversy divided the rabbis of Germany and Poland into two contending parties. Though there is insufficient evidence against Eybeschutz. Emden may be credited with having crushed the lingering belief in Sabbatai current even in some orthodox circles. The controversy went on for years, however, and it weakened the authority of the rabbis.

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EYCK, VAN, the name of a family of Flemish painters in whose works the rise and mature development of art in Flanders are represented. An inscription on the frame of the Ghent altarpiece indicates that the work was begun by Hubert. and completed by his brother Jan. Since the discovery of this inscription in 1823, many art historians have tried to determine which part of the altarpiece could be ascribed either to Jan or to Hubert. Similar attempts have been made to discriminate between their two hands in Eyckish paintings not signed by Jan, as well as in the book of hours *Les Très Belles Heures de Jean de France, duc de Berry* (1911). Four records which could be applied to Hubert were discovered in the archives of Ghent, but they mention him only as "Meester Luberecht," "Meester Hubrechts." "Meester Hubrechte de scildere" and "Lubrecht van Heyke." On the basis of the inscription and the records already mentioned. together with some stylistic discrepancies within the Eyckish works, some art historians (mainly W. H. J. Weale. 1908; F. Winkler. 1921 and 1924; M. Dvořák, 1925; C. de Tolnay, 1938 and 1939; E. Panofsky, 1935, 1938 and 1953) have tried to reconstruct Hubert's production. Others (mainly E. Renders, 1933 and 1935; H. Beenken, 1935; M. J. Friedländer, 1937; J. Lavalleye, 1939; M. W. Brockwell, 1954) do not think it possible to make a distinction between two genial artists in the Eyckish group of paintings; some of them (especially E. Renders) even deny the very existence of Hubert. It must be remembered that the only evidence of Hubert being Jan's brother as well as a great artist lies in the inscription mentioned above; also that the physical and microchemical examination of the Ghent altarpiece at the Brussels laboratory in 1951 has shown that this inscription is not original, at least in its present state, and that, as regards painting technique, there is no evidence of a co-operation of two distinct personalities; furthermore, no literary source before Lucas de Heere (1565) mentions the name of Hubert, while many greatly praise Jan's art. Consequently nothing definite is known about Hubert's life and, except for the inscription on the Ghent altarpiece. there is no painting signed by him, while Jan's biographical data are numerous and well documented and several paintings are signed and dated by him. All this has to be kept in mind while reading the following notes.

1. HUBERT (Huybrecht) VAN EYCK (?1366–1426) was the older of the two brothers. The date of his birth and the records of his progress are unknown. Hubert was probably born about 1366, at Maeseyck, and grew up under the protection of a Benedictine convent. He became a painter, wandered to Flanders and there for the first time gained a name. At Ghent, where he settled, he painted pictures for the corporation, whose chief magistrates honoured him with a state visit in 1424. His principal masterpiece, the "Worship of the Lamb," at St. Bavon in Ghent, commissioned by Judocus Vijdt, lord of Pamele, is the noblest creation of the Flemish school, one upon which Hubert is said to have laboured until he died, leaving it to be completed by his brother. This great composition is almost unique as an illustration of contemporary feeling for Christian art. It represents, on numerous panels, Christ on the judgment seat, with the Virgin and St. John the Baptist at His sides, hearing the songs of the angels. He is contemplated by Adam and Eve and, beneath Him, the Lamb is shedding His blood in the presence of angels, apostles, prophets, martyrs, knights and hermits. On the outer sides of the panels are the Virgin and the angel annunciate, the sibyls and prophets who foretold the coming of the Lord, and the donors in prayer at

the feet of the Baptist and Evangelist. After this great work was finished it was placed, in 1432, on an altar in St. Bavon of Ghent, with an inscription on the framework describing Hubert as *maior quo nemo repertus* ("greater than whom nobody is found"). Jan van Eyck probably wished to guard against an error which ill-informed posterity showed itself but too prone to foster, the error that he alone had composed and carried out an altarpiece executed jointly by Hubert and himself. His contemporaries may be credited with full knowledge of the truth in this respect. and the facts were equally well known to the duke of Burgundy and the chiefs of the corporation of Bruges, who visited the painter's house in state in 1432, and the members of the chamber of rhetoric at Ghent, who reproduced the Xgnus Dei as a *tableau vivant* in 1458.

The solemn grandeur of church art in the 15th century never found, out of Italy, a nobler example than this altarpiece. The representation of Christ as the judge, between the Virgin and St. John, affords a fine display of realistic truth, combined with pure drawing, gorgeous colour and a happy union of earnestness and simplicity with the deepest religious feeling. Hubert died on Sept. 18, 1426, and is supposed to have been buried in the chapel on the altar of which his masterpiece was placed. According to a tradition as old as the 16th century, his arm was preserved as a relic in a casket above the portal of St. Bavon of Ghent.

2. JAN VAN EYCK (?1385–1441). The date of his birth is not more accurately known than that of his elder brother. But numerous details about his life are known to us through account books of his employers. About 1422, Jan became painter and *varlet de chambre* to John oi Bavaria, count of Holland; he was commissioned to decorate his palace at The Hague (1422–24). In May 1425, Jan left Holland (John of Bavaria had died in 1424) and was appointed painter and *varlet de chambre* to Philip the Good, duke oi Burgundy, at a salary of 100 livres per annum, and from that time until his death Jan van Eyck remained his servant. He was frequently employed in missions of trust, and appears for a time to have been in ceaseless motion, receiving extra pay ior secret services at Leiden, drawing his salary at Bruges, yet settled at Lille. In 1428 he joined the embassy sent by Philip the Good to Lisbon to beg the hand of Isabella of Portugal. His portrait oi the bride fixed the duke's choice. After his return he settled definitely at Bruges, where he married some time beiore 1434. His wiie bore him at least two daughters, one oi them known in after years as a nun in the convent of Maeseyck, and at whose christening the duke was sponsor. Jan's death in 1441 at Bruges is authentically recorded. He was buried in St. Donat, which was at the time the cathedral of Bruges.

Numerous altarpieces and portraits now give prooi of Van Eyck's extensive practice. As works of art and models oi conscientious labour they are all worthy of the name they bear. The panels of the Ghent altarpiece were completed in 1432. They show that Jan was quite able to continue the work of his elder brother. His own experience had been increased by travel, and he had seen the finest varieties of landscape in Portugal and the Spanish provinces. This enabled him to transfer to his pictures the scenery of lands more sunny than those of Flanders. Much of the success which attended his efforts to complete the altarpiece of Ghent may be ascribed to the cleverness with which he reproduced the varied aspect of changing scenery, reminiscent here of the orange groves of Cintra, there of the bluffs and crags of his native valley. In all these backgrounds, though lacking the scientific rules of perspective with which the Van Eycks were not familiar, there are such delicate perceptions of gradations in tone, such atmosphere, yet such minuteness and periection of finish, that our admiration never flags. Nor is the colour less brilliant or the touch less firm than in Hubert's panels.

BY COURTESY OF NATIONAL GALLERY, LONDON

"THE MARRIAGE OF GIOVANNI (?) ARNOLFINI AND GIOVANNA CENAMI (?)" BY JAN VAN EYCK. IN THE NATIONAL GALLERY, LONDON

Jan excels in two splendid likenesses of Judocus Vijdt and his wife, Elisabeth Borluut. The same vigorous style and coloured key of harmony characterizes the small "Virgin and Child" of 1433 at the National gallery, Melbourne, Austr., formerly at Ince hall, and the "Madonna," probably of about the same date, at the Louvre, Paris, executed for Rolin, chancellor of Burgundy. Contemporary with these, the male portraits in the National gallery, London, the "Portrait of a Young Man" (1432) and the "Man in a Turban" (1433), show no relaxation of power; but later creations display no further progress, unless we accept as progress a more searching delicacy of finish, counterbalanced by an excessive soitness of rounding in flesh contours. An unialtering minuteness of hand and great tenderness of treatment may be found, combined with angularity of drapery and some awkwardness of attitude in the full-length portrait couple ("The Marriage oi Giovanni [?] Arnolfini and Giovanna Cenami [?]"; 1434), at the National gallery, London, in which a rare insight into the detail of animal nature is revealed in a study of a terrier dog. (*See* PORTRAIT PAINTING.) A small triptych with the "Madonna Enthroned With St. Catherine, St. Michael and a Donor" at Dresden, equally soft and minute, is notable for the mastery with which an architectural background is put in. The bold and energetic striving of earlier days, the strong bright tune, are not eyualed by the soft blending and tender tints of the later ones. Sometimes a crude ruddiness in flesh appears to be a growing defect, an instance of which is the picture in the museum of Bruges, in which Canon van der Paelen is represented kneeling beiore the Virgin under protection of St. George (1434). First to last Van Eyck retains his ability in portraiture. Fine specimens are two male likenesses in the gallery of Vienna: "The Goldsmith Jan de Leeuw" (1436) and "Cardinal Niccolb Albergati," and a female, the master's wife, in the gallery of Bruges (1439). Two more pictures have been signed and dated by Jan: "St. Barbara," uncompleted (1437), and "The Virgin by a Fountain" (1439), both in the museum of Antwerp. Others have been ascribed to him on stylistic evidence: "The Annunciation," formerly in the Hermitage at Leningrad, now at the National gallery, Washington; a "Madonna and Child With Two Female Saints and a Carthusian Donor" (in cooperation with Petrus Christus?), formerly in the Rothschild collection, Paris, now in the Frick collection. New York; the "Portrait of Balwin de Lannoy" at Berlin and the "Portrait of a Goldsmith" at Cibiu. 'Rum. The following works of an earlier date 'are generally ascribed to Hubert, though some critics believe them to be by Jan: "The Crucifixion" and "The Last Judgment," two wings of an altarpiece in the Metropolitan museum in New York; the "Three Maries at the Sepulchre," in the D. G. van Beuningen collection at the Boymans museum in Rotterdam; the "Virgin" in the nave of a Gothic church at Berlin; two pictures oi St. Francis, one in the Johnson collection at Philadelphia, the other in the museum at Turin.

Petrus Christus, who copied some of Jan's works and imitated his style in a somewhat weaker manner, is supposed to have been taught by him. Rut if the personal influence of the Van Eycks was small, that of their works mas immense, and it is not too much to say that their example, taken in conjunction with that of Rogier van der Weyden, determined the current and practice of painting throughout the whole of Europe north of the Alps ior nearly a century.

A last word must be said about the legend. which has been alive since G. Vasari's *Vite* (1550), that Jan or Hubert van Eyck invented oil painting. This cannot be entirely true, for it was already mentioned in technical books oi the middle ages and was also occasionally used by artists. However, as all Flemish panel paintings since the Van Eycks have an oil medium, one can admit that they improved the pictorial characteristics of this medium to such an extent that the former tempera could be forsaken. This new painting technique corresponded in time with the arising of the school of Flemish Primitives and could therefore account to a certain extent lor its sudden development.

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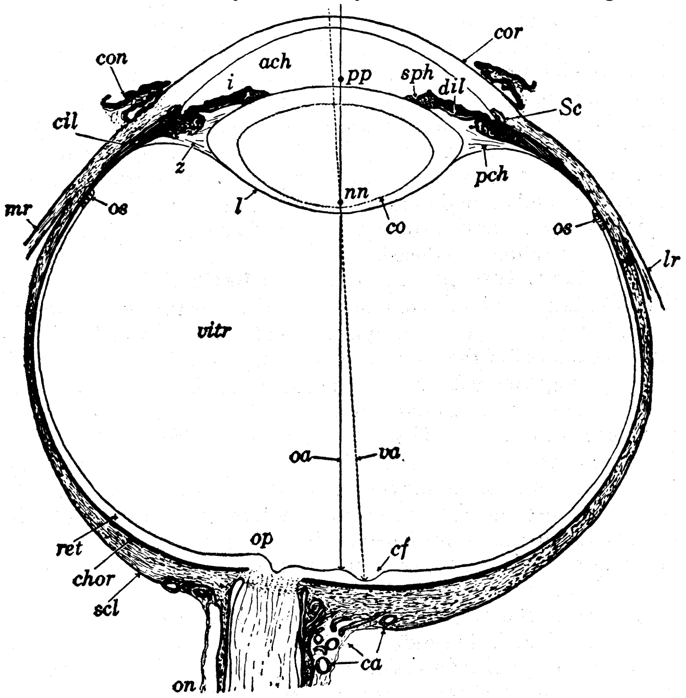
EYE, market town and municipal borough in Eye parliamentary division of northeast Suffolk. Eng.. 89 mi. N.E. of London. Pop. (1951) 1.631. Eye (X.S. "island") is surrounded by a network of tributaries of the Waveney. Brewing is the principal industry. The church of SS. Peter and Paul (Perpendicular flintwork) was formerly attached to a Benedictine monastery. Fragments of a Norman castle crown an earthwork already existing in 1066. Remains of a Roman villa and cemetery have been found. William the Conqueror gave the lordship of Eye to Robert Malet. a Norman. who built the castle and monastery, the first alien monastery to be subordinate to the abbot of Bernay in Normandy. In 1206 King John granted the townsmen a charter; later charters were granted by Elizabeth I and William III.

EYE, HUMAN. The eye is the peripheral organ of sight where light initiates a physiological process manifesting itself in the subjective sensation of vision (*q.v.*).

ANATOMY OF THE EYE

In all vertebrates, including man (fig. 1), the eye is built according to the plan of a dark chamber or camera obscura (see CAMERA LUCIDA AND CAMERA OBSCURA). It is essentially a spherical sac with opaque walls and a transparent front, cornea (*cor*), and is filled with transparent media. The most anterior inner space immediately behind the cornea is the anterior chamber (ach); next is the ring-shaped posterior chamber (pch); both are filled with aqueous humour. The spacious vitreal cavity (*vitr*) is filled with the gelatinous vitreous humour. In the front part is the crystalline lens (*l*), suspended by a number of delicate tendinous threads, the suspensory ligament or Zinn's zonule (*z*), by nhich it is attached to the wall. The lens is a transparent, elastic body of biconvex shape, consisting of a great number of fibres arranged in sheets, like the layers of an onion, and is enclosed in an elastic lens capsule as in a pillow casing. It has a firmer and more refractive core (co) and a softer outer rind, permitting it to change its shape under slight force. The perfectly smooth surfaces of the lens are curved, the posterior more so than the anterior.

Dioptrics of the Eye.—The eye as a dioptrical apparatus may be compared with a photographic camera. The photographic lens is represented by the refracting media, the cornea and the lens, the photosensitive screen by the retina (ret), the innermost of the eye's coats or tunics. The rays of light coming from without enter the eye where they are distributed according to the laws of geometrical optics. First. they are collected and refracted by the cornea. proceeding farther to the lens where additional refraction takes place In terrestrial vertebrates most refraction is by the cornea, in the aquatic (because of the equal index of refraction of the outside water and the intraocular media) by the lens alone. The aqueous and vitreous have no influence upon refraction. On the retina the refracted rays of light form a real image which is much smaller, and is symmetrically inverted. The focusing is accomplished by the lens which changes its shape, and thus its power of refraction, by the action of the ciliary muscle (cil) under the influence of the brain—this is called accommodation for near and distant vision.



BY COURTESY OF DR. STEPHEN L. POLYAK

FIG. 1.— HORIZONTAL SECTION OF THE HUMAN EYE OF THE RIGHT SIDE SLIGHTLY MORE THAN 3X MAGNIFIED

Abbreviations; ach anterior chamber; ca ciliary arteries; cf central fovea; chor chorioid; *cil* ciliary body; co lens core; con conjunctiva; *cor* cornea; dil dilator muscle of pupil; *i* iris; *l* lens; *lr* lateral or external rectus muscle; *mr* medial or internal rectus muscle; nn double nodal point; oa optical axis; on optic nerve; op optic papilla or disk; os ora serrata; pch posterior chamber; pp double principal point; *ret* retina; Sc Schlemm's canal; *scl* sclera; *sph* sphincter muscle of pupil; va visual axis; *vitr* vitreal chamber; *z* suspensory ligament of lens or Zinn's zonule

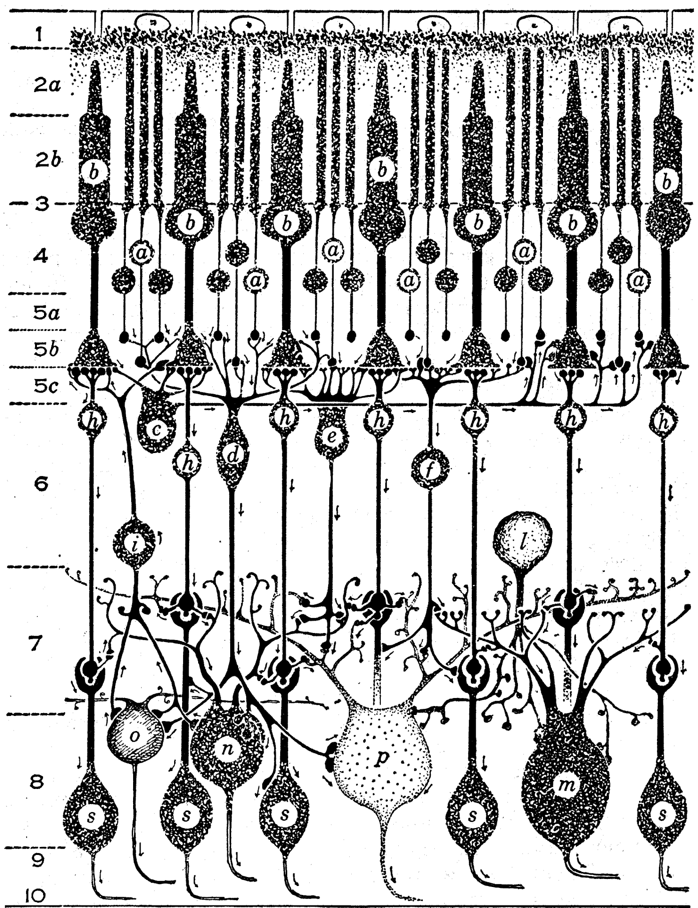
Coats of the Eyeball.— The outer shell of the eyeball is made up of three coats. Most outward is the tough fibrous tunic composed of variously arranged connective tissue fibres. The larger posterior segment of this tunic, called sclera (scl), is opaque; the anterior smaller segment fitted into the first is the transparent cornea (*cor*). The curvature of the latter is much sharper than that of the sclera. The thickness of the fibrous tunic varies in different localities. The next inward is the uveal tunic, so-called because of its similarity with a grape (Lat. uva). Its thinner and larger posterior segment is represented by the chorioid membrane (chor) which is largely made up of numerous minute blood vessels and chromatophore cells containing pigment. The function of the chorioid is to supply the photosensitive rods and cones of the inner tunic, the retina, with nutritive blood, and to form a dark lining on the inside of the eyeball. Toward the front end of the eyeball the uvea is thickened into a special structure called the ciliary body (*cil*). This is a series of minute, radially arranged processes or ridges, in mammals containing smooth muscle fibres and blood vessels. The inner surface of the ciliary body is lined by the retinal epithelium from which the aqueous humour is secreted. The muscle fibres are partly arranged more or less radially, or they are circular, the function of all being the relaxation of the suspensory ligament of the lens, and thus the increase of its refractive power.

The most anterior portion of the uvea is the iris (*i*), the coloured diaphragm or curtain surrounding the black pupillary opening in the centre, visible through the transparent cornea; in different persons the iris is coloured differently. The iris contains two minute sets of smooth muscle fibres; circular sphincter or constrictor (*sph*) close to the pupillary margin, and dilator ***(dil)*** by which the pupil is dilated. The two muscles are antagonistic in function, being regulated by different nerves and centres: sphincter by the oculomotor or third cranial nerve (parasympathetic), dilator by the cervical sympathetic. When strong light stimulates the retina and the visual pathway, the sphincter muscle contracts, reducing the pupillary aperture and thus the amount of light falling in the eye; the opposite takes place when the light stimulus decreases, which allows dilator muscles to prevail, expanding the pupil and thus permitting more light to enter the eye. The action of both muscles is automatic, regulated by the reflex centres of the brain stem and the spinal cord.

Retina.— The innermost of the eye tunics is the retina, a netlike membrane (ret). It lines most of the large, posterior cavity, the vitreal chamber. The anterior limit of the retina is serrated and is therefore called ora serrata or serrated margin (*os*); beyond it only a microscopic epithelial vestige containing pigment continues on the inner side of the ciliary body and the iris as far as the pupillary margin. The functional part of the retina, or the retina proper, is extremely delicate, being principally made up of nerve cells and fibres, the neuroglial supporting framework holding the first in place, and numerous delicate blood vessels. These latter represent the system of the central retinal artery and vein, independent of the blood supply of the remainder of the eyeball including the chorioidal system.

In the living person the colour of the retina is more or less pink because of the blood contained in its blood vessels and the chorioid partly visible through it. The freshly dissected retina is perfectly transparent, but soon it assumes a milky opacity as a result of the precipitation of the albumen in its nervous tissue.

Retinal Layers.— The retinal membrane is the actual organ within which the stimulation of the living substance by physical light takes place and where the sensation of vision is initiated; the remainder of the eyeball being merely a supporting shell regulating the nutrition and serving as a dioptrical apparatus. As the early embryonic development shows (**fig.** j. C, D), the retina is merely a thin outpocketing of the brain around which the eye forms. In its finer make-up the structure of the retina bears the character of both a peripheral and a central organ. In microscopic sections vertical to its surface customarily ten layers may be dis-



BY COURTESY OF DR STEPHEN L. POLYAK

FIG. 2.— SCHEMEOF THE VARIETIES OF NERVE CELLS AND SYNAPTICAL RELATIONSHIPS IN THE HUMAN AND SIMIAN RETINA. FOR DETAILS see TEXT

tinguished (fig. *2*). Closest to the chorioid and farthest from the vitreous is the single-layered pigment epithelium (1), which is a transformed outer sheet of the secondary optic vesicle or cup of the embryo (*es,* in fig. 5, D). Beneath it follow in succession (fig. *2*): bacillary layer (consisting of outer *2a* and inner segments *2b*), segments formed of the rodlike outer parts of the so-called rods and cones, or photosensitive cells (photoreceptors), within which the first step in the physiological process of light reception takes place; *(3)* outer limiting membrane, a thin line formed by the joined upper ends of the supporting radial fibres of Mueller; (4) outer nuclear layer consisting of the bodies of the rod and cone cells; ***(5)*** outer plexiform layer made up of the filamentous expansions of the rods and cones and of the cells that form the sixth layer; (6) inner nuclear layer containing the bodies of the horizontal cells, bipolar cells, amacrine cells and some ganglion cells; (7) inner plexiform layer consisting of the expansions of both the preceding cells and of the ganglion cells; *(8)* ganglion cell layer; *(9)* layer of the optic nerve fibres or axons of the ganglion cells; *(10)* inner limiting membrane formed by the joining of the inner ends of the supporting radial fibres of Mueller.

Retinal Cells.—The cells that compose the retina are of several varieties (fig. 2): photoreceptors, which are represented by the rods (a) and cones (b); horizontal cells (c); four or five varieties of bipolars: mop (d), brush (e), flattop (f), midget (*h*) and centrifugal (i) varieties; at least five varieties of ganglion cells: parasol (*m*), shrub (*n*), small diffuse (o), garland (*p*) and midget ganglion (s); and several varieties of so-called amacrine cells (k, *l*). There are also terminations of nerve fibres in the retina. exogenous fibres *(t)*,whose origin is probably in the brain. The supporting tissue is chiefly represented by the radial fibres of Mueller (*u*) and a few astrocytes and microglial cells.

Classification of the Retinal Neurons.—The nerve cells or neurons of the retina may be classified into two groups: (1) the photoreceptors and conductors along which the impulses pass on to the brain; (2) integrators whose function is to influence the retinal tissue itself during the process of photoreception. The first group is represented by the rods (a) and cones (b), bipolars (d, e, f, h) and ganglions *(m*, n, o, *p*, r, s,) ; the other by horizontals (*c*), amacrines (k, *l*) and probably also by the centrifugal bipolar~(i).

Synapses and Dynamical Polarity of the Retinal Neurons.—The nerve cells of the retina are put together in an intricate pattern which is of fundamental importance for its function. Each neuron is related to another neuron by contact, the terminal branches or twigs, usually with a minute swelling at their ends, touching the body or expansions of another related neuron. The points of contact or attachment are called synapses, and are believed to function in the manner of valves, permitting the influences to pass in one direction and preventing them in the other. This constitutes the basis of the concept of dynamical polarity, according to which some parts of each neuron receive impulses (dendrites. cell body), and others discharge them (axis cylinders usually called nerve fibres and their terminal ramifications or teledendrons).

Synaptical Relations of the Retinal Neurons.—Each variety of retinal neurons has its particular synaptical relations to other varieties. The vitreal or lower ends of the cone cells (b), for example, are in contact with the centripetal bipolars in the following way: the filaments of the mop bipolars (d) touch the sides, those of the brush (e) and flattopped (f) bipolars touch the lower face of the cone terminations or pedicles in jb, whereas the minute, rosettelike dendritic expansion of a single midget bipolar *(h)* touches the same cone pedicle with all of its nodules from underneath. Simultaneously the first three bipolar varieties are related to the lower ends of spherules of the rod cells *(a)*, whereas the midget bipolar (h) has no such relation, being exclusively related to the cones. Again, the horizontal cells (c) are related by their short dendrites to the cones alone. whereas with the terminal arborizations or teledendrons of their axis cylinders they touch the lower ends of both the rods and cones. The ganglion cells likewise undergo different types of synaptical relationships with both the bipolars and the amacrines. The midget ganglion *(s)* is conspicuous—its single dendritic expansion forms a minute basket enveloping the lower end of the midget bipolar (h), its main shaft being in contact with one or the other branch of a brush (e) or flattopped (f) bipolar, whereas its body touches a twig or two of a mop bipolar (d). The described pattern is found in the central area. in and around the fovea; farther away. in the extra-areal periphery. more diffuse arrangements are found by which the isolation of conduction is reduced.

Functional Interpretation of the Retinal Structures.—The significance of the complex synaptical relationships, apparently, is the creation of multiple channels through which the impulses generated in the photoreceptors may be variously modified. Light coming from without is refracted in the dioptrical apparatus (cornea, lens) and distributed over the retina according to the lams oi geometrical optics. The rays finally pass through almost the entire thickness of the retina without causing any change in the dynamical status of its nervous elements. Only in the bacillary layer (2) does the light meet the photosensitive chemical substances which act as mediators initiating the nervous impulses. Specifically, it is the outer limbs of the rods and cones proper (which in the aggregate form the layer za) where the first step in the process of photoreception takes place. The photosensitive substance contained in the rods is rhodopsin or visual purple, an unstable compound of reddish colour easily bleached by the action of light and again regenerated in darkness. A similar but colourless substance has been assumed in the cones. less sensitive to light but more specifically responsive to particular wave lengths of the visible spectrum or colours. It is believed that the rods function principally in weak light as during twilight; they mediate the so-called scotopic vision, being responsive to neak stimuli but not being capable of distinguishing colours. The cones in turn function only in bright light and respond specifically to the various parts of the spectrum—to wave lengths or colours—and, besides, distinguish much finer details (acuity)—daylight or photopic vision. Accordingly, the retina is a composite organ capable of performing two different functions under various conditions of stimulation (duplicity theory, retina duplex).

Retinal Structures and **Colour** Vision.—The question of nhat factors, chemical and structural, are responsible for colour vision has been variously answered. Thomas Young and later Hermann von Helmholtz and others assumed the presence of three structural elements (cones, nerve fibres) or processes, each chiefly sensitive to one part of the spectrum (red, green, blue or violet), even though somewhat responsive to all hues (trichromatic hypothesis of colour vision). When two fibres are stimulated (red and green or green and blue or violet). this would cause the sensation of the intermediate portions of the spectrum (yellow or bluish-green); nhen all fibres are equally stimulated, the resulting subjective sensation would be that of white. Enald Hering believed that there are three sets of antagonistic processes arranged in pairs—red and green. yellow and blue or violet and black and white (hypothesis of opponent colours).

The modern electrophysiology of the living retina suggests a much more complex structural make-up and its working. According to R. Granit's dominator and modulator theory there are basically two groups of retinal sensory mechanisms. The first group called dominators. one for the photopic, the other for the scotopic condition, encompasses the entire spectrum. This group is instrumental in the reception of the nonspecific quality of whiteness, brightness, luminosity or brilliance. The other group. independent of the first. represented by a set of mechanisms called modulators, each specifically responsive to a narrow segment af the spectrum. mediates the reception of wave lengths or hues. There are three preferential modulator regions, one around 0.580–0.610, another at 0.520–0.540 and the third at 0.440–0.470 μ or micron lengths of the light waves. In this sense Granit's theory agrees with the classical trichromatic concept. It deviates from it in assuming several modulators in each of the three regions capable of eliciting separate elemental reactions on the stimulation by narrow bands of the coloured spectrum. The other point of difference is the postulation in Granit's theory of a separate mechanism for the reception of white or luminosity (dominators), independent from the modulator mechanism responsible for the reception of wave lengths or hues. In this respect it is concurred with by Henri Piéron.

The preceding attempts. largely based on psychological and physiological observations, may be amplified by a careful evaluation of data obtained from the study of retinal structures. The first fact is the exclusive presence of cones in the rodless foveal centre (fig. 3). This indicates—since all hues may be distinguished in the very centre of the field of vision—that the cones alone, and not the rods. are instrumental in colour vision in the strict sense. A further fact is the absence of concrete evidence in support of the thesis of several varieties of cones. In particular, the synaptical relationships of all cones in the fovea and close to it are all alike. All cones in the axial region are likely to be functionally equivalent, every cone being capable of responding to all nave lengths or hues in the same nay. The cones seem to be the mechanisms capable (in virtue of their chemical constitution, as yet undisclosed in the 1950s) of initiating similar trains of excitations causing ultimately subjective chromatic sensations. The utilization of the cone excitations seems honever, to be the incumbency of other retina! structures those related to the cones, in particular of the bipolars and ganglions (fig. 2). It is in these. apparently, that the principal function of processing the original cone excitations takes place whereby they are modificd in many ways: divided or selected, reinforced, combined, inhibited and so forth, as the case may be. The retina in this view, is an ingeniously organized sorting mechanism wherein the impulses generated in the photoreceptors are transformed, more so those of the cones than those of the rods, before being further transmitted to the centres of the brain for their final appraisal.

Regional Differentiation of the Retina and the Visual **Acuity.**—The structure of the retina, even though everywhere essentially the same. varies considerably in different localities. The most important is the region around the visual axis (*va* in fig. *1*). In fresh specimens this locality shows a yellow colouring—the yellow spot or *macula lutea*. Here the retina is much thicker because of the greater number of cells—central area. In its centre the central area is again much thinner, however, since most of the inner layers (*5–9*) are displaced here in a lateral direction to form an excabation—the central pit or fovea (*cf.* in fig. 1). Contrasting with this is the layer of photoreceptors which in the very centre. in the fovea, is exceptionally thick (fig. 3). This is caused by the lengthening of the cones proper which are here alone present—rodless area. This area measures approximately one-half millimetre across. There are no blood vessels here that might obstruct the free passage of light rays to the central cones—avascular central area. Conversely, the central cones are thinner in diameter than in any other region, being reduced in the very centre to one micron (one tnenty-file-thousandth part of an inch). This is the anatomical factor responsible for the fact that the highest visual acuity is in the centre of the field of vision. Viewed from the surface. the central cones show a solid mosaic of minute hexagonal fields corresponding to the individual cones, arranged in intercrossing rows. Not far from the central fovea is the optic papilla or disk (op in fig. 1), the locality where all axis cylinders of the ganglion cells, or optic nerve fibres, assemble before they leave the eyeball and form the optic nerve (on). Since there are no rods and cones here, the optic papilla is not sensitive to light—the blind spot in the field of vision. From the centre of the fovea nhere it is most refined. the structure of the retina gradually becomes cruder toward the periphery, especially close to the serrated margin (*os*). This agrees with the decrease of the acuity in the periphery of the field of vision. Other details. the connections of many more rods and cones with each bipolar cell and of many more bipolar cells with each ganglion cell than found in the central region of the retina, indicate a mechanism of convergence and summation by which the retinal periphery close to the *ora serrata* is made more sensitive to slight visual stimuli, especially those in motion, than the axial region.

Accessory Structures of the Eye.—The eyeball is lodged in the bony socket of the skull together with other parts pertaining to it: seven extrinsic muscles. blood vessels. nerves. lacrimal gland arid the orbital fat. From outside it is

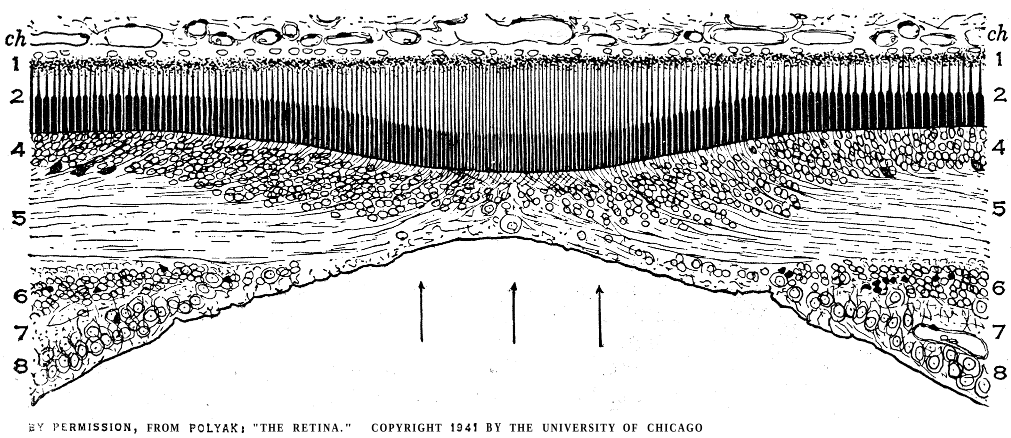
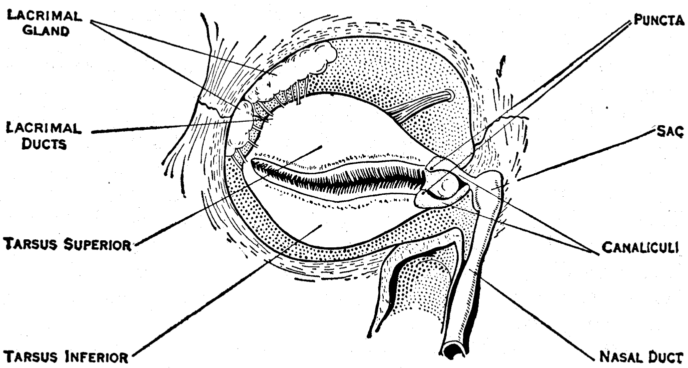


FIG. 3.—CROSSSECTION THROUGH THE DEEPEST PART OF THE HUMAN FOVEA SHOWING THE ATTENUATED, ELONGATED AND MORE NUMEROUS CONES IN THE CENTRE, INCREASING IN THICKNESS AND BECOMING LESS NUMEROUS TOWARD THE PERIPHERY

In the bacillary layer (2) a few rods are present at both ends. The inner layers *(5-9)* are practically absent in the foveal floor, permitting the rays of light, indicated by the arrows, to reach the photoreceptor layer (*2*) unhindered. The numbers of layers are the same as in fig. 2

protected by the fascia, mncous conjunctiva, skin, lashes and the brow. The tears secreted by the lacrimal gland moisten and wash the exposed parts, thus keeping the cornea clean and transparent. The surplus tears are carried through the two short lacrimal canals into the lacrimal sac, and from it through the nasal or nasolacrimal duct to the nasal cavity (fig. 4).



FROM JULER, "HANDBOOK OF OPHTHALMIC SCIENCE AND PRACTICE" (MURRY)

FIG. 4.— DIAGRAMSHOWING THE LACRIMAL APPARATUS OF THE EYE CONSISTING OF THE LACRIMAL GLAND, DUCTS, CANALICULI, SAC AND NASOLACRIMAL DUCT

Ontogeny and Phylogeny of the Vertebrate Eye.—The primordia of the eyes appear in the human embryo at a very early stage *(A*, in fig. 5, stippled). At first they lie widely exposed on the surface of the body. As the neural tube closes, the primordia come to face inward (B). Next, by further expansion, they become primitive optic vesicles (C). Finally, by a process of invagination, double-walled secondary optic vesicles are formed (*D*). From the surrounding mesenchymal tissue other structures are formed in and around the vesicle: the vitreous and the outside coats of the eye, and from the adjacent part of the skin the crystalline lens.

There are reasons to think that the vertebrate eye also originated on the surface of the body, and that it was the most potent single factor in the rise and further evolution of the vertebrate phylum.

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DISEASES OF THE EYE

Under this heading are included affections not only of the organ of vision itself but also of those parts connected with it which are necessary for its proper functioning.

It is customary to start with diseases of the conjunctiva. the transparent membrane which lines the posterior aspect of the eyelids and also covers the white of the eye. The exposed position of this membrane causes it to be more often affected than any other part of, or associated with, the eye.

It is necessary moreover to discuss the affections of the eyelids, since the eyelids both protect the eye and to a certain extent help to adjust the light to the retina, as in "screwing up the eyes," and also supply an oily secretion necessary for the well-being of the cornea.

Although each eye acts as a camera, under normal conditions only one image is seen. This is because the two eyes working together take almost the same picture from slightly different positions, exactly as in a stereoscopic camera. The images are fused and this forms the basis of stereoscopic vision. The perfect working of this mechanism depends in part on the delicate and accurate adjustment of movements of the eye muscles. If paralysis strikes one muscle, causing it to stop working, separate images are seen with the two eyes. These are no longer fused, and double vision results.

Finally it is necessary also to study the affections of the optic nerve and those parts of the brain concerned with the conduction and reception of the visual impulse. Apart from changes in the sight, these affections are often recognized by the alterations in the field of vision that they produce.

Diseases of the Conjunctiva.—Conjunctivitis.—The conjunctiva is a thin transparent sheet which lines the inner aspect of the eyelids and covers the white of the eye. Being thus exposed to dust, etc., the conjunctiva is very liable to inflammation. which may be of varying degrees of severity. This condition. known as conjunctivitis, is characterized by redness of the eye and discharge. The conjunctiva assumes a brick-red colour which must be distinguished from the rose-pink of deeper inflammations. Also the redness of conjunctivitis decreases in proportion to distance from the cornea while the deep redness forms a band encircling the cornea. The discharge, which is the characteristic symptom, may be mucoid or consist of mucus and pus or the eye may pour pus continually.

In practically all cases conjunctivitis affects both eyes. There is however a dangerous tendency to label all red eyes as having conjunctivitis. Where inflammation is confined to one eye a foreign body or some deeper inflammation is usually the cause. Many cases of conjunctivitis are so mild that they cause only the slightest inconvenience in an occasional feeling of heat and grittiness. The well-known "pink eye" is a form of conjunctivitis where the discharge is mucus mixed with pus. It is extremely contagious and may spread through homes and schools but eventually clears up without harming the eyes.

Purulent conjunctivitis, in which a continual stream of pus pours from the eyes. is much more severe and is most often, though not necessarily. caused by the gonococcus. The introduction of the sulfonamides and penicillin completely changed the outlook in this dreaded affection. Whereas at one time eyes were frequently lost through it, such a disaster now occurs only when treatment has been instituted too late.

Trachoma or *granular* conjunctivitis, although endemic in many countries, is but rarely seen in Great Britain or the U.S. in active form. It is characterized by granules or small elevations that stud the conjunctiva lining the lids and is chronic, taking a long time to cure and leaving sequelae of varying severity. It is produced by a filterable virus.

Pinguecula is a very common yellowish-white spot to one or other side of the cornea. It is of no significance and requires no treatment.

Pterygium is a triangular fold of conjunctiva which may gradually come down over the cornea. If it is advancing it requires surgery.

Diseases of the Cornea.—A corneal ulcer appears as a gray spot on the surface of the cornea. Such a spot, caused by the loss of some of the surface covering of the cornea, is distinguished from a scar by the fact that a drop of fluorescin will stain it green. The ulcer gives a good deal of pain. The essential treatment is to keep the eye covered by a pad and bandage and to enlarge the pupil with atropin. With treatment the ulcer usually heals, leaving, as a rule, a certain amount of opacity which may or may not be

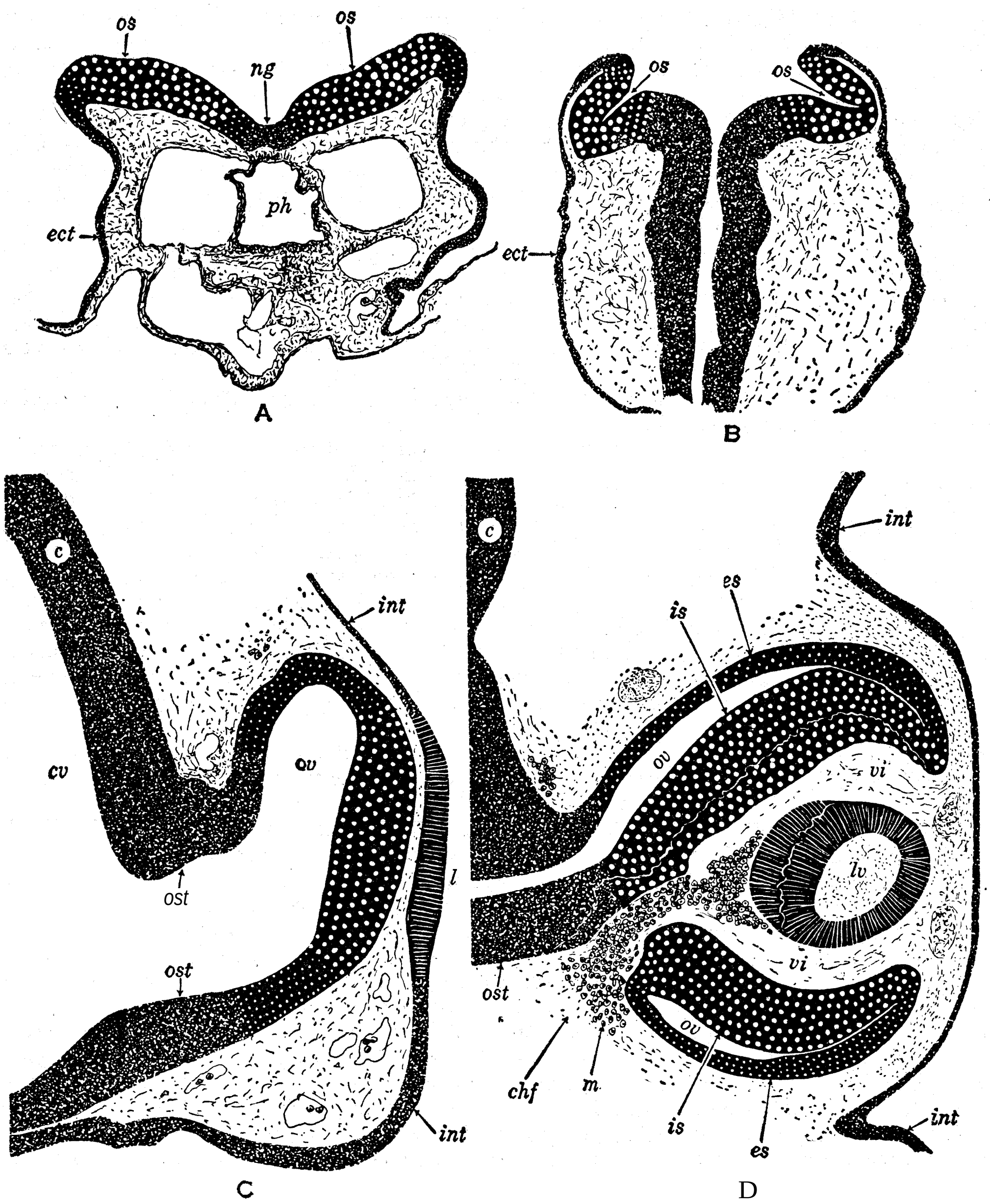

FIG. 5.— EARLY STAGES OF THE EMBRYONIC DEVELOPMENT OF THE HUMAN EYE

A 8-somite stage, the neural plate opened wide, with optic primordia (stippled) exposed; ***B*** 14-somite stage showing incipient invagination of optio primordia; ***C*** 33-somite stage, primitive optic vesicle and optic stalk formed, inception of the lens primordium; ***D*** 11-mm. length, age six weeks, showing double-wailed secondary optic vesicle or cup fully formed, with the lens vesicle in it, and the invasion of the cavity by the mesenchymal tissue through the chorioid cleft. Abbreviations: ***c*** cerebral wall: ***chf*** chorioid fissure; ***cv*** cerebral vesicle; ***ect*** ectoderm or integument; ***es*** external sheet or leaf of optic cup; ***int*** integument; ***is*** inner sheet or leaf of optic cup; ***l*** lens primordium; ***lv*** lens vesicle: ***m*** mesenchyme invading the optic cup; ***ng*** neural groove; **os** optic sulcus; ***ost*** optic stalk; ***ov*** optic vesicle; ***ph*** pharynx; ***vi*** vitreous. University of Chioago collection, preparations used by courtesy of Prof. **G.** W. **Bartelmez.** By permission, from **S. Polyak, *The Visual System***

serious. depending on its position and density. In rare cases, however, the ulcer spreads and may eventually cause a perforation of the cornea. The main types of corneal ulcer are described below.

Hypopyon ulcer is a severe affection in which the ulcer is accompanied by pus in the anterior chamber of the eye. The prognosis was much improved by the use of penicillin drops on the ulcer and one of the sulfonamide drugs taken by mouth.

A herpetic ulcer is characterized by little gray spots on the cornea. It often accoinpanies a cold or other respiratory affection.

A dendritic ulcer is so called because it branches like the branching of a tree. It also occurs in respiratory diseases.

Herpes ophthalmicus is an attack of shingles which affects the forehead and eye. It may be of varying severity and the eye may be almost unaffected or seriously damaged.

Neuroparalytic keratitis follows operations for the severe form of neuralgia known as tic douloureux, in which the cornea is rendered anaesthetic. As a result of this it may ulcerate and the eye be lost. The most effective treatment is to sew the eyelids together.

In *interstitial keratitis* the cornea assumes a ground glass appearance. There is no ulceration, and both eyes are usually affected. The disease takes about six to nine months to run its course and leaves a varying amount of opacity. It is most often caused by congenital syphilis.

Arcus senilis is a grayish ring or part of a ring near the periphery of the cornea. It occurs most frequently in the elderly but is often found before the age of 40 years. It is of no significance.

Corneal Grafting. — A very common result of affections of the cornea is to produce an opacity which reduces the vision according to its density and position. Thus it may hardly affect the sight or may make the patient to all intents and purposes blind. It is for the latter type of case that the operation of corneal grafting is done. A disk of the diseased opaque cornea is removed and then replaced by a transparent disk of the same shape taken from a cadaver eye or from the eye of another patient. that has had to be excised for a malignant new gron th.

Diseases of the Eyelids.— *Hordeolum* or *sty* is a small red swelling which forms at the base of an eyelash. It increases rapidly in size and forms a small abscess which discharges; and then heals. It is of no significance except for the disfigurement and the fact that there is the possibility of recurrence.

A *ckalazion,* popularly called a meibomian cyst, forms a rounded, usually painless swelling generally close to the line of the lashes. Again, it is of no importance and can be easily removed without leaving a visible scar.

In *blepharitis* whitish scales like dandruff collect round the roots of the lashes. These scales may be loose or somewhat adherent. When they are removed, the lid margin is found to be reddened but usually not ulcerated.

Diseases of the Iris and Ciliary Body.—The iris and ciliary body are structurally continuous and therefore both are usually affected at the same time. If the iris is mainly affected the disease is called iritis, if the ciliary body, cyclitis.

Iritis.—The movement of the iris on the front of the lens with dilatation and constriction of the pupil is much like that seen between joint surfaces. Indeed, iritis is often seen in joint disease and is caused by the same factors: septic foci, gonorrhoea. syphilis, tuberculosis, etc. It also results in adhesions between the margin of the pupil and the front of the lens.

Iritis causes a great deal of pain which is worst at night. The eye appears red, the redness differing from that seen in conjunctivitis in being rose pink and forming a band around the cornea. The pupil is small and irregular because of the adhesions to the lens. The eyeball is very tender to the touch. The essential treatment is to put atropin into the eye. This dilates the pupil and so breaks down the adhesions. Cortisone helped greatly in shortening the time taken for iritis to recover.

In cyclitis the essential sign is the formation of small gray spots behind the cornea. These cannot usually be seen by the naked eye and require some form of magnifying lens in order to make them visible.

Diseases of the Lens.—Cataract.—The lens, a bright crystalline body, forms the most obvious part when the eyeball is opened. It was this which caused the ancients to regard it and not the retina as the true seat of vision. In the past a cataract was thought to be an opacity which fell down like a cataract from above, between the iris and the lens. Now the term cataract is applied to any opacity of the lens. Cataract may roughly be classified as senile, congenital and secondary.

Senile cataract affects people over 50 years of age. Both eyes are always affected. Indeed, a cataract which remains confined to one eye is usually not a "good" cataract; and its removal, if this is at all advisable, is accompanied by many more risks than attend removal of the bilateral one. A cataract causes a varying amount of diminution of vision. A somewhat characteristic feature is that the patient sees better in the twilight than when the light is good. because the pupil is larger when the illumination is low and thus allows more light to enter the eye. A cataract causes the pupil to appear gray or white instead of black. It should be borne in mind, however, that in old people the pupil tends normally to be gray; and a great deal of unnecessary anxiety has been caused by such people being told they have a cataract when, in fact, no such thing has been present. Formerly a patient had to wait, often for years, until the cataract was ripe, before it could be operated on. Now no such waiting is necessary and the operation is done when the sight in the good eye no longer allows the patient to carry on his ordinary work. The ancients used to do the operation known as "couching." which is still performed in many parts of India. In this, the opaque lens is pushed back into the vitreous and out of the line of sight. The immediate effect of couching is often good but the eye is frequently lost later through inflammation. In normal practice the opaque lens is removed from the eye having the more serious condition. The prognosis here is by far the best, for in most cases good or useful vision is restored.

Congenital cataract is seen in babies. It usually affects both eyes and is of varying severity. If the loss of vision is great, the eyes are operated on but usually not before the age of one year. Latterly it was found that some cases of congenital cataract are the result of the mother's having had German measles in the early months of pregnancy.

Secondary cataract is the result of inflammation, increase of tension (glaucoma) or a new growth. It often affects one eye and removal of the cataract is not generally advisable.

Diseases of the Retina and Optic Nerve.—The retina is really a portion of the brain which grows out of the bony cranial cavity so that it may, literally, look upon the world. Its impressions are carried back to the remainder of the brain by the optic nerve with which it is continuous and which, therefore, is really not an ordinary nerve but a junction between one part of the brain and another.

With the ophthalmoscope minute changes can be observed in the retina and its vessels and in the termination of the optic nerve in the eye, known as the optic disk. A great deal of information may be obtained from an examination of the retina, especially about disease processes in the brain, kidneys and blood vessels of the body generally. Thus, one of the cardinal signs of tumour of the brain is that the optic disk becomes swollen, a condition known as papilloedema. In tabes, a form of creeping paralysis, and in general paralysis of the insane, the optic disk instead of being pink may be white or atrophic, as it is called. In certain severe forms of disease of the kidneys the first indication that anything is wrong may be found in the retina; haemorrhages and cloudy white spots may be seen with the ophthalmoscope. Where the general blood pressure is raised characteristic changes are seen in the retinal arteries which may later lead to haemorrhages and sharply circumscribed white patches. In diabetes also there are often changes in the eye such as cataract and retinal haemorrhages.

As might be expected, disease of the retina is accompanied by loss of vision. This is, however. of varying degree and is especially great when the macula or yellow spot. which is only the size of a pinhead, is affected. Sudden loss of vision occurs in the closure of the main artery or vein of the retina, in certain injuries of the optic nerve and retina, in some nervous diseases and in detachment of the retina. The loss of vision is greater when the central artery is closed than when the vein is. The latter may, however, be followed by a curious type of intractable glaucoma. In motor accidents it sometimes happens that when the injured person recovers consciousness he finds he cannot see with one or the other eye. Most often this is the result of injury to the optic nerve. Useful vision is only very rarely regained.

In detachment of the retina, fluid collects under the detached portion; this results in immediate loss of vision in the portion of the field subserved by the affected retina. Thus, if the detachment is below, the patient does not see the upper part of the object looked at; *e.g.*, a man may appear headless. Detachment of the retina is a very serious disease but the chances of recovery improved immeasurably after J. Gonin of Lausanne showed during the 1920s that in these cases there is a hole in the retina which must be closed for a cure to result. Before this discovery, detachment of the retina almost invariably led to blindness in the affected eye. By the 1950s the proportion of cures was variously given as from 40% to 80%.

In some cases detachment of the retina is caused by a malignant growth of the chorioid. Here the eye must be removed to effect a cure.

Glaucoma.—The word glaucoma is derived from the Greek word γλαύκωμα meaning sea-green; for, before the character of the disease was understood and adequate treatment became available, all cases of glaucoma resulted in blindness and the pupil took on a greenish hue. The term glaucoma is now applied to any condition where the tension of the eye is raised so that it becomes harder than normal. It is in most cases a very serious affection of the eye. Glaucoma may be acute or chronic.

In acute *glaucoma* the patient has an attack of severe pain in one of the eyes. The pain may radiate in many directions, so that he may complain of pain not in the eye but around it; may say he has a headache, or the pain may shoot down the nose or be attributed to toothache. The pain is usually so severe that the patient vomits. suggesting a bilious attack. The vision soon becomes very reduced and the eye stony hard. The eye assumes a dusky red colour and the cornea becomes steamy and the pupil dilated.

As treatment, oily drops consisting of 1% eserin are instilled repeatedly into the affected eye, and one drop is also put into the other eye because the anxiety may bring about an attack in this eye as well. The classical operation for acute glaucoma is a broad iridectomy in which a portion or sector of the iris is removed. This operation, devised by A. von Graefe in 1856, has since saved the sight of countless eyes.

Chronic glaucoma, on the other hand. is an insidious disease and may easily escape diagnosis in its early stages. Not infrequently it is found that the patient has had his glasses increased in strength at short intervals and that the underlying malady has been entirely overlooked. The patient may complain of gradual loss of vision, of transient attacks of misty vision or halos; *i.e.,* coloured rings around lights, which are very suggestive of glaucoma. The diagnosis is based upon the increase of tension which, however, may not be present continually, upon the loss of the inner portion of the field of vision and upon the fact that the entrance of the optic nerve into the eye is pushed back by the increase of tension to form a cavity, known as a cupped disk.

The treatment consists in the first instance of instilling pilocarpin or eserin which constricts the pupil. This may be continued so long as it controls the tension, the visual acuity and the field; but the majority of cases necessitate surgery sooner or later. In most cases a fistulizing operation is performed, by which a new drain is made in order that the intraocular fluid can escape to the outside of the eye and so reduce the tension. A careful watch must be kept on the other eye, as in nearly all cases the disease eventually affects both eyes Although, in general, glaucoma affects people over 40. it may occur in very young children. The result of tension in the baby's eye is quite different from that in the adult. For here the whole eye enlarges so that the parents often say that before they realized the seriousness of the disease they thought the child had large beautiful eyes. Indeed, the disease is known as buphthalmia or "ox eye."

Increase of tension in the eye may also be the result of certain other diseases of the eye. In cases of untreated iritis the pupil may become completely adherent to the lens, preventing the aqueous fluid from coming forward from the ciliary body where it is formed, through the pupil and then out of the eye by the canal of Schlemm. As a result of this the tension mounts. Increased tension may also accompany malignant growths inside the eye. This condition usually requires excision of the whole eye.

Injuries of the Eye.—The eye is protected by the bony orbit. the lids and the nose; further, its rounded form and socket of soft fat allow it to some extent to slip out of the way when hit. Yet injuries of the eye are very common; because of the eye's extreme sensitivity, traumata which would pass unnoticed elsewhere in the body here call for immediate attention.

Nonpenetrating Injuries.—An extremely common injury is a scratch or abrasion of the cornea. This may be very difficult to see; but it is very painful and is immediately shown up by a drop of fluorescin which stains the affected part green. Usually the abrasion heals quickly when treated with atropin ointment. After a blow to the eye, the anterior chamber may fill with blood. the iris may show a rent, the lens may be dislocated, the chorioid ruptured and the retina detached. If the blow is hard enough the whole globe may rupture.

Perforating injuries are always serious, not only so far as the affected eye is concerned but because they may also give rise to an inflammation of the fellow eye known as sympathetic ophthalmitis. If a piece of iris or ciliary body has prolapsed through the wound and non lies exposed, sympathetic ophthalmitis leads in most cases to blindness of both eyes. Sometimes the foreign body nhich caused the injury remains in the eye. If made of steel it can be removed by means of a giant magnet.

Burns ––Burns of the eye are usually produced by molten metal. steam, strong acids or caustics such as lime or alkalis. Burns from molten metal are usually rendered much less severe than mould be expected by the normal film of moisture on the front of the cornea.

Injuries Produced by Light.—Ultra-violet light causes intense pain in the eye which characteristically comes on about six to eight hours after the exposure. This is the cause of industrial photophthalmia in cinema workers. Snow blindness also is caused by ultra-violet light. Eclipse blindness is the result of heat rays producing a definite burn of the retina.

Affections of the **Pupil.**—Normally the pupils of the tno eyes are the same size. When a bright light is made to shine on one pupil, not only will it contract briskly but the pupil of the other eye will become small too. These changes are known as the direct and consensual reactions of the pupil. Any deviations from the normal may indicate not only serious trouble in the eye itself but also of the central nervous system. So, after severe head injuries, the direct reaction to light may be absent while the consensual remains. This indicates a severe lesion of the optic nerve.

The Argyll Robertson pupil is, typically. a small pupil which does not react to light directly or consensually, but becomes small when an object held close to the eye is looked at (reaction to convergence). It usually indicates tabes or other severe disease of the central nervous system.

The Field of Vision.—The vision of a normal person with one eye shut and looking straight ahead at a fixed point cannot go beyond a certain point upward. downward. inward and outward. The area that he can see is knonn as his field of vision. Usually the field is estimated nith an instrument called a perimeter and may give valuable information not only about diseases of the eye itself but also about the central nervous system. Thus, concentric diminution of the field is found in tabes, in general paralysis of the insane and in blindness caused by quinine. Loss of a portion of the inner or nasal field is found characteristically in glaucoma, whereas the temporal field is affected in pituitary tumour. When the visual tract is affected in front of the chiasma only one field is affected but lesions of the chiasma or of the visual fibres behind this affect the fields of both sides because they carry visual impressions from both eyes. Such bilateral loss is known as hemianopia. By a right homonymous hemianopia is meant the loss of the right halves of the visual fields; *i.e.*, the outer field of the right eye and the inner of the left. It is caused by a lesion of the left optic tract, optic radiations or visual cortex in the occipital lobe.

Strabismus or Squint.—In strabismus or squint the direction on which the affected eye looks bears an abnormal relation to the other. It is usually described as paralytic or nonparalytic.

In a paralytic squint one or other ocular muscle is paralyzed. Thus supposing that the muscle which normally makes the eye look outward is paralyzed. the unopposed muscle which makes the eye look inward will exert its pressure and an inward squint will result. Double vision is a distressing result of paralytic squint. There are a great many causes of such a squint; it may be an affection of the brain or of the nerves that supply the muscles or an affection of the muscle itself. *Nonparalytic squint* occurs as a rule in children about three years old; often after measles: scarlet fever, etc. They are usually highly strung and long sighted; but there is no disease of the eyes. Glasses are usually required and certain exercises to develop stereoscopic vision, known as trthoptic exercises, are useful in treatment of the squint. A certain number of cases require operation to put the eyes straight.

Nystagmus consists in rhythmic oscillation of the eyes typically not under control of the will. There are a number of types. *Infantile nystagmus* is found where a great defect of vision was present during the first weeks of life. *Miner's nystagmus* is common in miners working in poorly lighted mines. There is often an element of neurasthenia present in these cases. There is a nystagmus associated with disease of the inner ear (labyrinth), or central nervous system. Nystagmus may also be hereditary, physiological (as in looking out of a train) and. rarely, voluntary.

Intraocular **Tumours.**—Growths inside the eye are rare but, when they occur, are as a rule extremely malignant. They belong for the most part to the pigmented tumours (melanomata). Although the growth in the eye may be relatively small, it can produce secondary growths in all parts of the body. The only effective treatment is, as a rule, to remove the eye. The other great group of malignant growths in the eye occur in quite young children and are called glioma, or better, retinoblastoma. The pupils in these cases usually appear yellowish; hence the name amaurotic cat's eye. These tumours do not as a rule produce secondary growths but tend to spread back to the brain. In 25% of the cases both eyes are affected. Excision of the eye is the best treatment; but in rare cases where one eye has been removed it is justifiable to treat the remaining eye with radium.

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(E. WF.)

EYE, SURGERY OF, comprises operations on any part of the eye. Modern developments in general and local anesthesia. drugs. instruments and techniques have made eye surgery a far safer and less painful procedure than it once was. and have prevented much blindness.

Eyelids.—Drooping. or ptosis, of the upper eyelids may be a hereditary defect or the result of an injury. Ptosis is corrected by shortening the levator muscle which raises the upper eyelid if it is not completely paralyzed. A piece of the levator muscle is removed and the remaining muscle is sutured farther downward under the skin of the eyelid. In paralytic ptosis a strip of skin. muscle or wire is used to form a sling from the upper eyelid to the frontalis muscle above the eyebrow. This permits the patient to open his eyelid by raising his eyebrow.

In mild cases of ectropion (outward turning of the eyelids). passing a cautery through the tarsus from the conjunctival surface brings the eyelid into position. In severe cases. the eyelid is shortened by removing skin and tarsus. In mild entropion (innard turning of tarsus and eyelid), a cautery applied through the skin may correct the condition. In severe cases more extensive surgery is required.

Tear Apparatus.— Tearing, usually caused by some obstruction to the tear duct and most commonly seen in infants in whom the lower end of the duct in the nose has failed to open, is often cured by passing a probe through the stricture. Pus in the lacrimal sac is drained by incising the local abscess. If the lower part of the duct is blocked the sac may be carried into the nose. producing a new drainage channel.

Eye Muscle.--The six external eye muscles (two oblique muscles and four straight or recti muscles) rotate the eye in various directions. Crossed eyes result from defective medial recti muscles. which draw the eyes nasally. When glasses and eye exercises fail to correct this condition: the medial recti muscles may be freed and reattached farther back on the eyeball; this operation is combined in some cases with shortening of the lateral recti muscles which pull the eyes outward.

In exotropia. also resulting from muscle defects that. in this case, pull the eyes outward. the majority of cases require freeing one or both lateral recti (fig. 1[A]) and reattaching these muscles

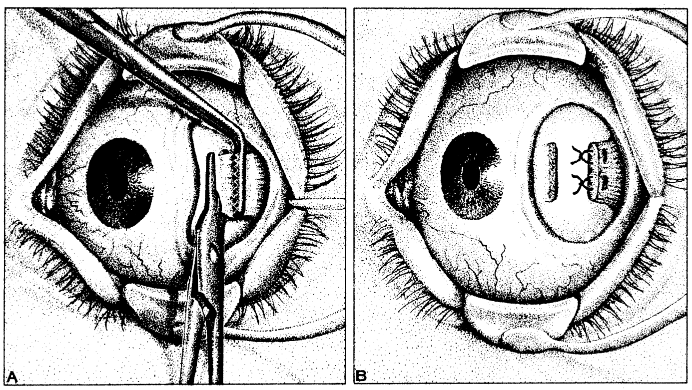

FIG. 1.—SURGERY TO CORRECT EXOTROPIA

(A) The muscle is severed from its normal insertion and (B) sutured farther back on the eyeball

farther back on the eyeball (fig. 1[B]). If the eyes are not straightened sufficiently, the medial recti muscles may be shortened.

Spasm of an inferior oblique muscle produces upward. inward turning of the eye, which is corrected by severing the muscle or by receding the muscle on the eyeball.

Cornea.— Scarring or clouding. whether caused by disease or injury. may involve all or part of the cornea. The opaque cornea may be merely tattooed (for cosmetic purposes). or partially or completely removed, replacing the opaque cornea n-ith a clear cornea from a donor's eye. This is accomplished by removing the opaque tissue with a tubular cutting instrument. the trephine (fig. 2[A]). A similar disc is cut from a transparent cornea of a donor's eye, transplanted to the patient's eye and sewn in place (fig, 2[B]).

Glaucoma.— This disease, a hardening of the eyeball, usually is caused by obstruction to the normal fluid outflow of the eye. Surgery becomes necessary when drugs iail to lower the eye pressure, and especially when the visual fields (side vision while looking straight ahead) contract. Operations creating artificial channels for the fluid outflow comprise iridencleiiis, in which a piece of the iris is drawn up into a wound made in the sclera; and iridocorneocclerectomy. wherein pieces of the sclera arc clipped away, allowing the fluids to escape under the conjunctiva.

In surgical treatment of congenital glaucoma. in which there is maldevelopment of the tissues in the angle between the cornea and iris, the tissues are cut with a knife to permit fluid outflow in

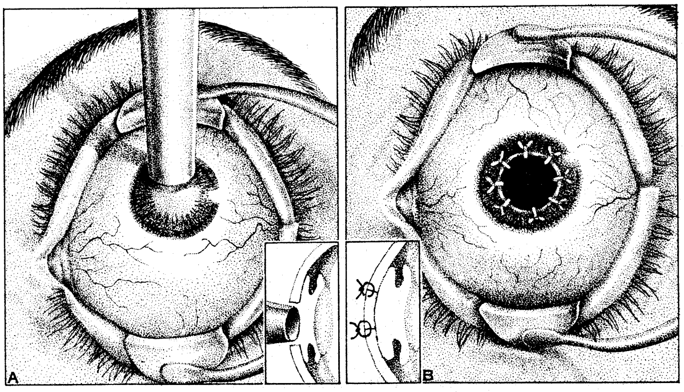

FIG. 2.— REMOVAL OF AN OPAQUE CORNEA

(A) A trephine cuts the opaque disc from the cornea. This disc is replaced by a similar disc of clear cornea from a donor's eye and (B) sutured in place

this area. When a decrease in the fluid production in glaucomatous eyes is necessary. parts of the ciliary body are destroyed chemically (cycloelectrolysis) or by heat (cyclodiathermy). (See also GLAUCOMA.)

Lens.—The lens is surgically removed when it has become opaque through disease or injury. An incision is made close to or in the cornea; the iris is cut and the lens grasped (fig. 3[A]) and gently pulled out of the wound. which then is closed with sutures (fig. 3[B]). In some case, an enzyme is injected to weaken the fibres which hold the lens in place. making removal by suction or by forceps easier.

Retina.—The retina (seeing membrane of the eye) may become partially or completely detached following injury or disease of the eye. Detachments are usually accompanied by tears. which must he carefully sealed off by applying diathermy punctures through the sclera over the tear; or by light coagulation. The eyeball is often shortened by folding or excising a strip of sclera. the fold being maintained by sutures.

Tumours.—Some small tumours on or within the eyeball may be excised or destroyed with radium or light rays. Diathermy applied to the sclera over a tumour has resulted in cures in some cases. Such tumours as glioma of infants and sarcoma of the choroid of adults usually necessitate removal of the eye.

(CD. BS.)

Artificial Eyes.—Artificial eyes are known to have been made in the 9th century B.C., when the Egyptians removed the eyes of the dead. poured wax or plaster into the orbits and inserted precious stones. In the 5th century B.C. Roman priests who practised surgery began to make artificial eyes for living patients. Glass eyes were first made in Venice in 1579, and important contributions to this art by French surgeons in the 17th and 19th centuries resulted in the artificial eye as it is known today. In the beginning of the 18th century the manufacture of glass eyes

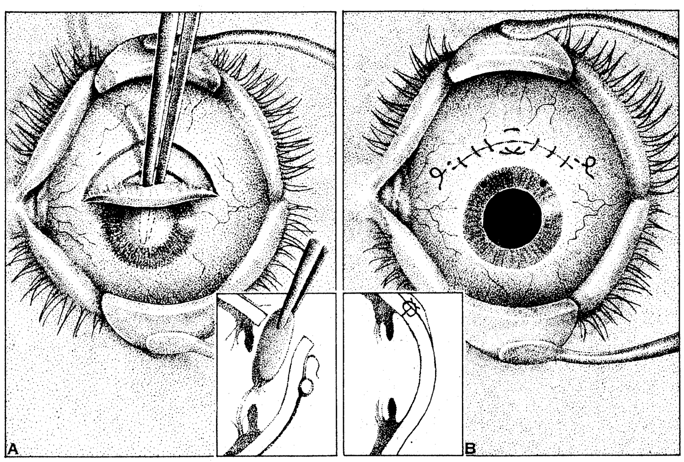

FIG. 3.— LENSURGERY

(A) The opaque lens is removed from the eyeball and (B) the wound closed with sutures was centred almost exclusively in Germany and Austria.

Originally, artificial eyes were made as oval shells. which were not only ill-fitting but also uncomfortable to wear. In 1898 an eye was developed that was in eifect a two-layered shell with space betneen the layers. Today the earlier type is used almost exclusively over deformed eyes or in evisceration cases, where the contents of the eye have been removed and the outer portion left intact. The tno-layered eye is used in cases of enucleation (removal of the entire eye).

Prior to 1939 artificial eyes were made from glass materials imported from Germany. Just before World War II. the *Reichsverband,* a government-controlled guild of eyemakers, established restrictions on shipments of glass and raised prices to a very high level. As a'result, U.S. manufacturers developed a glass comparable with the German product. In addition, a program sponsored by several commercial firms and the medical departments of the U.S. army and navy resulted in development of a plastic eye which would not break or crack.

After World War II several surgeons developed implants which could be inserted into the orbit after enucleation, imparting motility to the artificial eye through direct transmission, magnetic attraction or by leverage action The result is an artificial eye that moves to a degree in conjunction nith the good eye (S. W. R.)

EYEGLASSES, or spectacles, are optical devices intended to aid vision. Roger Bacon in 1268 recorded the earliest comment on the optical use of lenses, but magnifying glasses inserted in frames were used by the Chinese for reading as early as the 10th century. Marco Polo noted this custom also in the court of Kublai Khan (1270). Eyeglasses made their first European appearance in Italy, their introduction being attributed to Alessandro di Spina of Florence. The first portrait to show eyeglasses is that of Hugh of Provence by Tommaso da Modena, done at Treviso in 1352. Domenico Ghirlandajo in 1480 painted St. Jerome at a desk from nhich dangled eyeglasses, and from this detail St. Jerome became the patron saint of the spectacle makers' guild. At first only convex lenses were used for the aid of presbyopia (old-sight) and hyperopia (old-sight in young people). A concave lens for myopia is first evident in the portrait of Pope Leo X, painted by Raphael in 1517.

Originally lenses mere made of transparent quartz and beryl (of nhich aquamarine is a variety), but increased demand led to the adoption of optical glass, for which Venice and then Nurnberg were the chief centres. The availability of glass lenses not only aided ocular efficiency but led to the invention of the microscope (1590) and of the telescope (1608). In 1784 Benjamin Franklin invented bifocals, dividing his lenses for distant and near vision, the split parts being held together by the frame. Cement bifocals were invented in 1884. and the fused and one-piece types follow-ed in 1908 and 1910, respectively. Trifocals and new designs in bifocals nere later introduced. including the Franklin bifocal revived in one-piece form, to satisfy more adequately diverse optical problems and occupational needs When the corrections for the tno eyes vary significantly, there occurs in the reading field a disturbing prismatic efiect that can be nullified by a compensating prism in the bifocal area or by dissimilar bifocal segments.

In 1827 Sir George Airy, a British astronomer, made the first attempt to correct astigmatism (his own) by a suitable cylindrical lens. Astigmatism was considered a curiosity until its prevalence was firmly established by F. C. Donders, whose classic work (1864) created scientific clinical refraction and stimulated further improvement in both the subjective and objective determination of the glasses needed. Donders also popularized the adding of prisms to facilitate the muscular adjustments in binocular vision.

In 1804 William Wollaston of London found that the peripheral aberrations noted in "flat" lenses mere almost entirely eliminated when the corrections nere ground in appropriate convexo-concave forms. The virtues of these meniscus lenses were extended later to cylindrical corrections by incorporating the cylinder in a toric curve. Since the previously standardized toric surface proved inadequate when the spherical component was strongly plus, an extra series of "corrected curve" lenses was introduced in 1930. The proper toric form increases the effective field of view, but occasionally a person who requires a weak minus correction notes disturbing reflections. particularly in artificial light.

The varieties of fine optical glass essential for high-grade ophthalmic lenses resulted from a century of costly research. Ernst Abbe and Otto Schott in 188; demonstrated that the incorporation of sundry new elements into the glass melt led to many desirable variations in refractive index and dispersive power. Optical glass for ophthalmic lenses is first rolled into plate glass form. The bulk of spectacle lenses are made from clear crown glass of refractive index 1.523. However, in high myopic corrections a cosmetic improvement is effected if the lenses are made of dense flint glass (refractive index 1.69) and coated with a film of magnesium fluoride to nullify the surface reflections Flint glass or barium cronn. which has less dispersive power, is used in fused bifocals (see GLASS). The power of a lens was expressed by its focal length in inches until Monoyer of France introduced in 1872 the diopter unit. A lens of one diopter (1 D.) brings parallel rays to a focus at one metre; as the dioptric power increases, the principal focal length decreases proportionately. Prisms were measured originally by their refractive angle in degrees, but this was changed to the prism-diopter at the suggestion of Charles F. Prentice of New York (1890). A prism that causes a deflection of one centimetre at a distance of one metre is one prism-diopter ($1^{\triangle}$).

Visual discomfort and fatigue are commonly associated with errors of refraction or of oculomotor balance. Occasionally the disturbance is caused by inequality of the retinal images (aniseikonia), which is remediable by lenses that equalize the retinal image without altering the effective optical power.

Decreasing use of shading headgear promoted the popularity of sunglasses. Any sunglass that transmits more than 30% of light does not adequately prevent dazzling. Constant wearing of slightly tinted glasses is not desirable, since they tend to affect adversely normal adaptation, night vision and indoor working acuity.

Spectacle frames and the shape of lenses vary with fashion. George Washington more quadrilateral lenses in steel spectacles nith long jointed temples. After rimless spectacles were devised in 1840, this inconspicuous style was the vogue until supplanted by plastic frames The monocle is an irrational affectation.

About one-third of schoolchildren require eyeglasses for efficient far and near vision. Regular screening tests hence are desirable. (J. E. Ls.)

Contact Lenses. — Contact lenses are lenses worn on the eyeball. They can be made to correct all visual conditions correctible by regular eyeglasses. The first contact lenses to be used as refractive devices were made by A. E. Fick in 1887. The early lenses were made of glass, but after 1938 plastic, usually methylmethacrylate, was used. From 1938 to 1950 most lenses were made by taking impressions of the eye and forming the lens on this mold. Such lenses covered most of the eye, and a fluid was used under them. After 1950 smaller lenses were used which cover only the cornea (front surface of the eye) and float on a layer of tears It is not necessary to make an impression of the eye, as the curvature of the cornea can be measured by optical instruments. Such lenses. only 7 to 11 mm. in diameter and 0.1 to 1 mm. in thickness, usually can be worn all day without removal. Contact lenses are invisible, and they give a wider field of vision than eyeglasses do. Since they are not easily broken they can be worn while participating in active sports. Further, some visual conditions which cannot be corrected by regular glasses can be corrected by contact lenses. Contact lenses can be coloured for use as sun lenses; they also have been used by actors to change the colour of the eyes. In 1958 bifocal contact lenses were developed.

Contact lenses cost more than regular eyeglasses do, and many persons experience difficulty in learning to wear them.

See also LEKS: *Spectacle* Lenses. (E. E. TN.)

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EYEISH. A North American Indian tribe of the Caddo confederacy, the Eyeish, also called the Aas, Aays, Aes, Aix, Haish, Yayecha, and other names, lived on the Eyeish or Ayish creek, between the Neches and Sabine rivers in northeastern Texas.

By the beginning of the 20th century the tribe was virtually extinct. Twenty families of the "Ays" were reported in 1779 and 300 "Ahijitos" in 1785. There were only 20 living members of the tribe in 1805. according to John Sibley, but in 1828 160 families living between the Colorado and Brazos rivers were reported (Sociedad Mexicana de Geografia y Estadistica. *Boletin,* 1870).

History. — Luis Moscoso de Alvarado succeeded Ferdinando de Soto after the Spanish explorer's death in 1542, and in that pear Moscoso and his men visited the Eyeish.

Late in the 17th century the French explored the tribe's country, associates of René Robert Cavelier, sieur de la Salle, noting the tribe in 1686–87.

In 1716 Spaniards founded the Franciscan mission of Nuestra Señora de los Dolores de los Ais near the Sabine river. The mission was abandoned three years later and the Indians destroyed its property. Re-established in 1721, it was again abandoned in 1773.

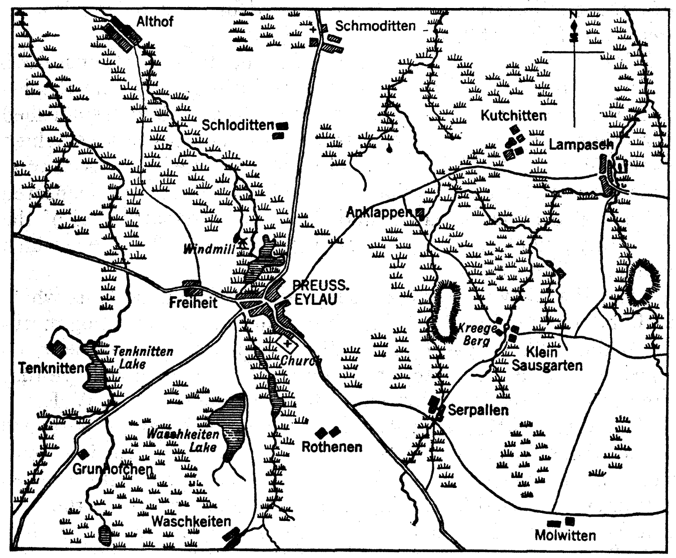
The Eyeish tribe. near both French and Spanish posts, suffered from the new diseases brought by the white people. The Eyeish who survived the ravages of war and disease during the 19th century were settled with other Caddoans on the Wichita reservation in Oklahoma.

EYEMOUTH, a small burgh of Berwickshire, Scot. Pop. (1951) 2.269. It is situated at the mouth of the Eye, $7\frac{1}{2}$ mi. N.N.W. of Berwick-upon-Tweed. The main occupation is seine-net fishing. with some boat-building and allied trades. Eyemouth was known as a port as early as the reign of Alexander II (1214–49); the harbour was enlarged in 1887. The rugged coast with its numerous ravines and caves was formerly infested with smugglers. St. Abb's Head is 3 mi. to the northwest.

EYLAU (BAGRATIONOVSK) a town of the Kalinin *oblast,* Russian Soviet Federated Socialist Republic, U.S.S.R., formerly in east Prussia, Ger., on the Pasmar, 23 mi. S. by E. of Kaliningrad (Konigsberg) by rail on the Pillau-Prostken line. It has an Evangelical church, teachers' seminary, hospital, foundries and sawmills. Eylau was founded in 1336 by Arnolf von Eilenstein, a knight of the Teutonic Order. It was the scene of a battle between the army of Napoleon and the Russians and Prussians commanded by Gen. Levin Bennigsen, fought on Feb. 8, 1807.

The battle was preceded by a severe general engagement on the 7th. The head of Napoleon's column advancing from the southwest, found itself opposed at the outlet of the Griinhofchen defile by a strong Russian rearguard which held the (frozen) lakes on either side of the Eylau road. The French turned both wings of the enemy, and Bagration, who commanded the Russian rearguard, retired through Eylau to the main army, which was now arrayed for battle east of Eylau. Barclay de Tolly made a strenuous resistance in Eylau itself, and in the churchyard, and these localities changed hands several times before remaining finally in possession of the French. It is very doubtful whether Napoleon actually ordered this attack upon Eylau, and it is suggested that the French soldiers were encouraged to a premature assault by the hope of obtaining quarters in the village. There is, however, no reason to suppose that this attack was prejudicial to Napoleon's chance of success, for his own army was intended to pin the enemy in front, while the outlying "masses of manoeuvre" closed upon his flanks and rear (*see* NAPOLEONIC CAMPAIGNS). In this case the vigour of the "general advanced guard" was superfluous, for Bennigsen stood to fight of his own free-will.

The foremost line of the French bivouacs extended from Rothenen to Freiheit, but a large proportion of the army spent the night in quarters farther back. The Russian army on the other hand spent the night bivouacked in order of battle. The cold was extreme, and food was scarce in both armies. The ground was covered at the time of battle with deep snow, and all the lakes and marshes were frozen, so that troops of all arms could pass everywhere, so far as the snow permitted. Two of Napoleon's corps (Davout and Ney) were still absent, and Ney did not receive his orders until the morning of the 8th. His task was to descend upon the Russian right, and also to prevent a Prussian corps under Lestocq from coming on to the battlefield. Davout's corps advancing from the south-east on Mollwitten was destined for the attack of Bennigsen's left wing. In the meantime Napoleon made preparations for the frontal attack. His infantry extended from the windmill, through Eylau, to Rothenen, and the artillery was deployed along the whole front; behind each infantry corps and on the wings stood the cavalry. The Guard was in second line south



MAP OF EYLAU AND SURROUNDING COUNTRY IN GERMANY

The scene of battle between the French army under Napoleon, who, advancing from the southwest, met the Russians and Prussians at Grunhbfchen. The action began at 8 A.M. on Feb. 8, 1807, and ended at nightfall with the retreat of the Russian and Prussian armies

of Eylau, and an army reserve stood near the Waschkeiten lake. Bennigsen's army was drawn up in line from Schloditten to Klein Sausgarten, the front likewise covered by guns, in which arm he was numerically much superior—having some zoo. A detachment occupied Serpallen.

The battle opened in a dense snowstorm. About 8 A.M. Bennigsen's guns opened fire on Eylau, and after a fierce but undecided artillery fight the French delivered an infantry attack from Eylau. This was repulsed with heavy losses, and the Russians advanced towards the windmill in force. Thereupon Napoleon ordered his centre, the VII. Corps of Augereau. to move forward from the church against the Russian front, the division of St. Hilaire on Augereau's right participating in the attack. If we conceive of this first stage of the battle as the action of the "general advance guard," Augereau must be held to have overdone his part. The VII. Corps advanced in dense masses, but in the fierce snowstorm lost its direction. St. Hilaire attacked directly and unsupported; Augereau's corps was still less fortunate. Crossing obliquely the front of the Russian line, as if making for Schloditten, it came under a *feu d'enfer* and was practically annihilated. In the confusion the Russian cavalry charged with the utmost fury downhill and with the wind behind them. Three thousand men only out of about fourteen thousand appeared at the evening parade of the corps. The marshal and every senior officer were amongst the killed and wounded. The Russian counterstroke penetrated into Eylau itself and Napoleon himself was in serious danger. His staff was seized with panic for his safety, and sent for the horses, but Napoleon himself, with the utmost coolness, judged the pace of the Russian advance and ordered up a battalion of the Guard at the exact moment required. In the streets of Eylau the Guard had the Russians at their mercy, and few escaped. Still the situation for the French was desperate and the battle had to be maintained at all costs. Napoleon now sent forward the cavalry along the whole line. In the centre the charge was led by Murat and Bessières, and the Russian horsemen were swept off the field. The Cuirassiers under D'Hautpoult charged through the Russian guns, broke through the first line of infantry and then through the second, penetrating to the woods of Anklappen.

The shock of a second wave of cavalry broke the lines again, and though in the final retirement the exhausted troopers lost terribly, they had achieved their object. The wreck of Augereau's and other divisions had been reformed, the Guard brought up into first line, and, above all, Davout's leading troops had occupied Serpallen. Thence, with his left in touch with Napoleon's right (St. Hilaire), and his right extending gradually towards Klein Sausgarten, Davout pressed steadily upon the Russian left, rolling it up before him, until his right had reached Kutschitten and his centre Anklappen. By that time the troops under Napoleon's immediate command, pivoting their left on Eylau church, had wheeled gradually inward until the general line extended from the church to Kutschitten. The Russian army was being driven westward, when the advance of Lestocq gave them fresh steadiness. The Prussian corps had been fighting a continuous flank-guard action against Marshal Ney to the north-west of Althof, and Lestocq had finally succeeded in disengaging his main body, Ney being held up at Althof by a small rearguard, while the Prussians, gathering as they went the fugitives of the Russian army, hastened to oppose Davout. The impetus of these fresh troops led by Lestocq and his stafi-officer Scharnhorst was such as to check even the famous divisions of Davout's corps which had won the battle of Auerstadt single-handed. The French were now gradually forced back until their right was again at Sausgarten and their centre on the Kreege Berg.

Both sides were now utterly exhausted, for the Prussians also had been marching and fighting all day against Ney. The battle died away at nightfall, Ney's corps being unable effectively to intervene owing to the steadiness of the Prussian detachment left to oppose him, and the extreme difficulty of the roads. A severe conflict between the Russian extreme right and Ney's corps which at last appeared on the field at Schloditten ended the battle. Bennigsen retreated during the night through Schmoditten, Lestocq through Kutschitten — unpursued. The numbers engaged in the first stage of the battle may be taken as—Napoleon, 50,000, Bennigsen, 67,000, to which later were added on the one side Ney and Davout, 29.000. on the other Lestocq, 7,000. The losses were roughly 15,000 men to the French, 18,000 to the Allies, or 21 and 27% respectively of the troops actually engaged.

EYRA, a name applied to the red colour phase of the jaguarondi (*q.v.*) (*Felis yaguarondi*). For a long time it was thought that these were different species, and much confusion arose. The colour varies from reddish yellow to chestnut, in contrast to the grizzled appearance of the norm-a1 variety. It occurs from Paraguay to southern Texas. (J. E. Hl.)

REDRAWN FROM A PHOTOGRAPH, NEW YORK ZOOLOGICAL SOCIETY

EYRA OR JAGUARONDI (FELIS YAGUARONDI)

EYRE, EDWARD JOHN (1815–1901), British explorer and colonial governor. remembered especially for his suppression of a Negro uprising in Jamaica (1865). was born at Hornsea, Yorkshire. on Aug. 5. 1815. He emigrated to New South Wales in 1832 and farmed sheep. becoming a pioneer "overlander" driving stock from Sydney to South Australia. He explored the central deserts of South Australia, where Lake Eyre bears his name; his most famous voyage was in 1840–41, when almost alone he made an expedition round the Great Australian Bight which proved the possibility of land communication between South and Western Australia. As early as 1836 Eyre was appointed a magistrate and protector of ahorigines. with whom he got on particularly good terms. He returned to England in 1845 and was appointed in 1846 lieutenant governor of New Zealand, where he served under Sir George Grey. After governing St. Vincent and the Leeward Islands in turn, he was appointed acting governor of Jamaica in 1861 and governor in 1864. In Oct. 1865 he suppressed a Negro uprising there with an efficient severity which earned him the warm gratitude of the local Europeans, but raised a storm in England: there were over 400 executions, and it was claimed that some of them had been illegal. The Whig government, after an inquiry, both thanked Eyre for putting the uprising down and blamed him for taking excessive reprisals; in July 1866 he was recalled. Several unofficial' attempts to try him failed, and he was acquitted in a civil case brought against him by a Jamaican. Eyre was finally granted the usual colonial governor's pension in 1874. He died near Tavistock on Nov. 30, 1901. (M. R. D. F.)

EYSTEIN (EYSTEIN ERLENDSSON) (d. 1188). one of the foremost ecclesiastical leaders of medieval Norway, came of an aristocratic family of Trondheim. On the death of Jon Birgisson, first archbishop of Nidaros, in 1157, King Ingi the Hunchback nominated Eystein to succeed him. Eystein received the pallium from Pope Alexander III four years later and returned to Norway in 1161. By that time King Ingi was dead and Norway was divided in a struggle for succession between Haakon II Broad-Shoulders and Erling, who claimed the throne for his infant son Magnus. Haakon was defeated and killed in 1162. The archbishop was meanwhile consolidating the position of the church. The cathedral of Nidaros, in which he took a special interest, was being built and there was need to increase the ecclesiastical revenues. Eystein reformed the system under which ecclesiastical dues were paid, demanding pure silver instead of debased coinage. and was thus led to hard bargaining with Erling. Each side gave the other generous concessions: though Eystein was the more astute. The power of the church was increased and the position of the infant king, whose claims to the throne were questionable. was temporarily secured. It was agreed that Magnus should receive the sanction of the church, and in 1163, at the age of seven, he was crowned. as Magnus V, by the archbishop in the presence of the papal legate Stephanus of Orvieto. This was the first time the ceremony of coronation had been performed in Norway.

Eystein stood for the universal power of the church and in some ways resembled Thomas Becket. His policy came clearly to light in his dealing with Iceland (part of his province), where he tried unsuccessfully to compel chieftains to hand over churches they owned.

When the upstart Sverre from the Faeroes, asserting claims to the throne, had driven Magnus from Norway (1180), Eystein who had sponsored the latter's cause. fled to England and formally excommunicated Sverre. He returned to Norway, however, in 1183 and made peace with Sverre.

Eystein was also remembered as the author of a lawbook, now lost. called *Guldfjaer* ("Golden-Quill") perhaps because of its illuminations; and of part, at least, of a work on the passion and miracles of St. Olaf.

See T. B. Willson, *History of the Church and State in Norway From the Tenth to the Sixteenth Century* (1903) ; E. Bull, *Det norske folks liv og historie,* vol. ii (1931). (G. T.-P.)

EYTH, MAX VON (1836–1906), German engineer, inventor and pioneer in the mechanization of agriculture. who founded the Deutsche Landwirtschafts-Gesellschaft (German Agricultural society) in 1884, was born on May 6, 1836, at Kirchheim unter Teck, Württemberg, and graduated in engineering at the Stuttgart polytechnic. His interest in the gas engine developed by E. Lenoir took him to Paris; and later, in England, he joined Sir John Fowler! the pioneer of steam traction engines. As a representative of Fowler's Steam-Plough works he spent some time in Egypt, the United States! India, Trinidad and most countries of Europe, where his expert knowledge of machinery and his enthusiasm did a great deal to introduce steam power and machinery for plowing, irrigation, earth moving and towing canal boats.

Eyth also wrote a play and a number of novels inspired by his experiences as an engineer and traveler, as well as some indifferent poetry. In his novel *Der Kampf um die Cheopspyramide* (2 vol., 1902), as also in *Der Schneider von Ulm* (2 vol., 1906). a story of early aviation, Eythe reveals an unusually balanced view for his period of the importance of machinery and technological achievements as opposed to that of the human element. His journals, *Wanderbuch eines Ingenieurs* (6 vol.), cover the years 1871–84. He died at Ulm on Aug. 25, 1906.

See T. Ebner, *Max Eyth, der Dichter und Ingenieur* (1906). (Er. H.)

EZEKIEL the prophet has recorded, or left us to infer, a few facts about himself. He had been a priest in Jerusalem, most likely a member of the clan of Zadok; while still young he was carried away to Babylonia in the First Captivity, 597 B.C.; his call to prophesy came in 593; after that, he lived in a house of his own, with his wife (xxiv. 18), among the Jewish exiles at Tel Abîb on the Grand canal ("the river Chebar" iii. 15), somewhere in the neighbourhood of Babylon or Kippur. His fellow-exiles evidently treated him with respect, and waited upon his words (viii. 1, xiv. 1, xxxiii. 31 f.); judging from xxix. 17, 571 B.C., his ministry lasted 22 years. Some notion of the man may be gathered from his book. He possessed in a high degree the prophetic temperament, a sensitiveness to the reality of the invisible world, which made him respond at once to the touch of the Divine hand (i. 3, viii. 1, etc.), a capacity for absorbed meditation, often passing into the state of trance. While in this condition he saw the moving throne (i.), performed a mimic siege of Jerusalem (iv.), felt himself transported from Babylonia to Jerusalem and back (viii.–xi.), saw the valley full of bones (xxxvii. 1–14), and the great temple of the future (xl. ff.). Often he made use of symbolic actions to enforce his message. At times these acts were performed in the presence of spectators; *e.g.*, xii. 3–16, xxiv. 15–24, xxxvii. 16–20; but some of them must have taken place in vision, while the trance lay on him; *e.g.*, iii. 1–3. Such, at any rate, seems the best account to give of the weird symbolism of ch. iv. and v. 1–4. He was subject to periods of speechlessness, iii. 25f., xxiv. 27; but when the impulse seized him, he would burst into poetry: xv. 1–5; xvii. 1–10; xix.; xxi. 14–22; xxvi. (in part); xxvii. (in part); xxxi. 2–9; xxxii. 2–16. These fine oracles stand out vividly from the monotonous background of his prose.

The Teaching of Ezekiel.—(A.) His conception of God is marked by a deep sense of awe: the holiness and sovereignty of Jahveh were impressed upon the prophet in the vision which constituted his call (ch. i.). Jahveh will brook no rival, and therefore will punish Israel for its disloyalty and the heathen for their false notions of His divinity and power; His motive, whether in punishment or mercy, is to bring about the recognition of His sole Godhead: "and they, or ye, shall know that I am Jahveh" sounds like a refrain throughout the book. Ezekiel thinks in symbols; the ultimate, according to his view, finds expression in the concrete. (B.) Far away in Babylonia, his attention was riveted upon the course of events at home. He denounces Israel's practical heathenism; he insists on the speedy overthrow of the Jewish state, in just requital for centuries of ill-doing (i.–xxiv.). That pessimism in reviewing Israel's past, which became characteristic of later writers, is strongly marked in Ezekiel. He rarely betrays any sympathy with his countrymen (except ix. 8, xi. 13). His hopes were fixed upon the exiles; they were not indeed wholly loyal, yet the future of the true faith lay with them. The message is stern and uncompromising; it was no time for half-measures; Israel's religion was at stake; that it survived at all was largely due to Ezekiel. (C.) As with Israel, so with the nations round, both the petty States that were nearest (xxv.), and the greater powers of Tyre (xxvi.–xxviii.) and Egypt (xxix.–xxxii., xxxv.): they deserve nothing but the severest judgment, and Nebuchadrezzar is to be the scourge (xxvi., xxx.). Curiously enough, Babylon itself comes in for no denunciation, probably because the prophet, in his bitterness against his own people, regarded the instrument of retribution as on the side of God. Ezekiel holds out no hope for the heathen. (D.) When the news reached Babylonia that Jerusalem had fallen ([586 B.C.] xxxiii. 21 f.), Ezekiel's tone changed. His prophecies of punishment had been fulfilled; he could now look forward to the restoration of the exiles. If he had previously argued the freedom and responsibility of the individual (xviii.), it was not with the aim of encouraging an individualistic type of religion, but of building up a community out of converted individuals. That is the ideal which henceforth occupies his mind: a new Israel, risen as it were from the dead, living in a land transformed, with Jahveh's sanctuary in the midst of them for evermore (xxxvi., xxxvii.). Yet there remains one more act in the Divine plan; the invasion and defeat of all the forces of heathenism, the acknowledgment of Jahveh by all, the final act of history (xxxviii., xxxix.). This apocalyptic conception had an immense influence upon subsequent thought. (E.) But Ezekiel was the most practical of dreamers. In the last section of the book, xl.–xlviii., he describes his vision of the restored temple, the centre of the new community, built on an imposing scale like one of the Babylonian sanctuaries (xl.–xlii.). The glory of Jahveh hallows it once more (xliii. 1–5); every source of defilement is removed; the only priests who minister there are to be the sons of Zadok (xliv. 15 ff.); and from the temple itself flows a mystic stream, cleansing, healing and beneficent (xlvii. 1–12).

Text and Authorship.—The textual criticism of Ezekiel was put upon a new footing by Cornill in 1888; and since that time progress has been made in the scientific use of the Greek and other versions for the correction of the Hebrew text, which is one of the most corrupt and obscure in the Old Testament. At present attention is being devoted to the higher criticism of the book, its literary structure, the origin of its ideas, the history and psychology which it contains. The book gives the impression of being arranged on a systematic plan, with four divisions, i.–xxiv., xxv.–xxxii., xxxiii.–xxxix., xl.–xlviii., in chronological order. Exact dates occur 13 times, but the sequence, though observed in the main, is broken on three occasions, xxvi. 1, xxix 17, xxxii. 1; the plan, therefore, is not so perfect as it looks On closer inspection, the four chief divisions turn out to be collections of oracles often independent of each other in time and contents; moreover, the date at the head of a section does not always hold good till the next date is given; for example, ch. vii, which stands under the year 593 (i. 1 f.), seems to belong to 586 B.C., and xl.–xlviii., headed 573 B.C., is mostly composed of far later material. In fact the impression of unity and chronological arrangement gives way under examination; the general plan may have been laid down by the prophet, but other hands have enlarged it. Editors must be held responsible for some, at least, of the headings, and for the double texts which are met with now and then, *e.g.*, ch. i. repeated partly in x., xxxiii. in iii., vii. 5–9=2–4, x. 19=xi. 22 f.

The element of conventionality and repetition which enters largely into the prose of Ezekiel may be in some measure due to scribes, who felt no scruple in glossing the text or altering it to suit their taste. A good instance of their methods is seen in ch. xxvii.; the splendid dirge over Tyre has been cut in two by the insertion of a prose passage, vv. 11–25*a*, which ruins the unity of the poem. Evidently Ezekiel's writings were studied with keen interest, as we may gather from the final section, xl.–xlviii. The first three chapters, with the additions of xliii. 1–12, xliv. 9–25, 28–30, xlvii. 1–12, are probably the work of the prophet; all that remains in xliii.–xlviii. is made up of fragments, which here and there reveal the technique of the priestly school. They are experiments in legislation. Most of them were never carried out, *e.g.*, the re-distribution of the land, xlvii. 13–xlviii. 35; some were modified later, *e.g.*, the two days of atonement, xlv. 18–20; in fact, what we come upon here is an early stage of the movement which in the end produced the Priestly Code. The task of reconstruction which Ezekiel had begun was carried on for years in priestly circles, and their tentative regulations were attached to his book, a natural place for them to find a lodging. Historically these enactments stand midway between Deuteronomy and P. Another law-book with which Ezekiel has relations is Lev. xvii.–xxvi., the law of holiness, as it is called; and in this case the relationship is so close that it points to a common time of origin and the same circle of ideas and interests.

The affinity between Ezekiel and Jeremiah is also remarkable. Thus both prophets insist, often in similar language, upon the overthrow of Jerusalem and the temple (*e.g.*, Jer. vii., xxvii.; Ezek. iv. f., vii., xix.–xxiv.); both give up the people of Judah in despair, and fix their hopes upon the exiles (Jer. xxiv., xxix. 10 ff.; Ezek. xi. 16–21, xxxvi. 24 ff.); both proclaim the responsibility of the individual (Jer. xxxi. 29 f.; Ezek. xviii.). They are equally certain that the dispersed will be gathered and return to their native land (Jer. xxiii. 3, xxix. 14, xxxi. 8 ff.; Ezek. xi, 17, xx. 34, 41 f.), and that a second David will come to rule over a united nation (Jer. xxiii. 5 f., xxxiii. 14–16; Ezek. xxxiv. 23 f., xxxvii. 24 f.); and while Jeremiah has not the priestly temper of Ezekiel, yet he too looks forward to the continuance of the Levitical ministry (Jer xxxiii. 18, 21 f.; Ezek. xliv. 15 ff.). Nevertheless. in spite of all these points of contact with other writings, Ezekiel has an impressive character of its own among the great books of prophecy; none exercised more influence upon subsequent thought and practice, and none perhaps baffles our understanding more.

A different conception from that outlined above has been worked out by Holscher (1924). Ezekiel. he maintains. was the prophet of doom and of nothing else; he saw but two visions: the one induced him to prophesy the fall of Jerusalem, the other revealed the idolatry in the temple, and roused his fury against the city and its allies, Tyre and Egypt. Ezekiel's own oracles are few, and invariably poetical in form; all else in the book is the work of a redactor, or of several redactors, who lived just before the time of Xehemiah (*c.* 444–430 B.C.). This view of the book does account for the difference, noticed by every reader, between the monotony of the prose and the passion of the lyrics; but the effect of Holscher's criticism is to empty the prophecies of all serious meaning, and it is applied on *à priori* principles in a ruthless way which excites distrust.

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EZION-GEBER, seaport of Solomon and the later kings of Judah, now Tell al Kheleifeh 3 mi. N.W. of Aqaba, at the extreme northern end of the Gulf of Aqaba. The boundary between Israel and Jordan crosses the site. About 2 mi. S.E. of Kheleifeh are the remains of Roman Aelana (biblical Elath; now probably buried under the sand). In the Bible Ezion-geber is mentioned beside Elath or in its immediate vicinity (Deut. ii. 8: I Kings ix. 26). The site of Ezion-geber was independently found by Fritz Frank and Nelson Glueck, who excavated it for three seasons (1938–40). Glueck proved that the site had been occupied by a fortified settlement surrounded by strong walls from the 10th to the 4th century B.C. It was almost certainly founded about 950 B.C. by Solomon. who used it both as a port for his trade with Ophir (Somaliland) and as a copper refinery. Large-scale refinery installations show its industrial importance.

See Nelson Glueck, *The Other Side of the Jordan* (1940), *Rivers in the Desert* (1959). (W. F. A.)

EZRA (Greek ESDRAS), a Babylonian Jew, in the 4th or 5th century B C .led a caravan of Jews to Palestine. where he promoted the establishment of an exclusive. legalistic type of religion that became dominant in later Judaism. The history of his reforms is given in the Old Testament books of Ezra and Nehemiah and in I Esdras (see also EZRA AND NEHEMIAH, BOOKS OF; ESDRAS, FIRST BOOK OF).

Ezra is called a priest (Ezra vii, 11–12), and Josephus, in the *Antiquities,* following I Esd. ix, 40, calls him chief priest, reflecting the tradition that supplied Ezra with a genealogy linking him to the pre-exilic high priests, back to Aaron (Ezra vii, 1–5). He is also called a scribe (Ezra vii, 11–12), which may mean that he was an official secretary of Jenish affairs in the Persian court; but, because of Ezra's concern for the Law. the title is usually understood in the later sense of one who is especially concerned with the preservation and propagation of Jewish religious law. It is said (Ezra vii, 7–8) that he began his aork in the seventh year of King Artaxerxes, but since the Bible does not specify which Artaxerxes, the date of Ezra's journey to Judea is uncertain. Either 458 B.C. or 398 B.C is defensible (see EZRA AND NEHEMIAH. BOOKS OF).

The Ezra story is now included in the Chronicler's history of Israel (Chronicles-Ezra-Nehemiah), where a considerable part of the Ezra narrative has been transposed to the Book of Nehemiah as the result of a copyist's mistake. Because the Ezra story shows some of the distinctive language and ideas of the Chronicler, there are some, notably C. C. Torrey, who mistrust its historicity and even doubt the existence of Ezra, regarding him as a fictional creation of the Chronicler, as the personification of the Chronicler's interests or as a symbol embodying legalistic, priestly Judaism. There is, however, an increasing tendency to regard the Ezra story as essentially historical.

On his arrival at Jerusalem Ezra read the Law to the people and instructed them in its meaning. When he had won its acceptance by the community he accomplished important reforms in accordance with it (Ezra x. 3). Chief among these was the purging of the community of all non-Jewish elements by prohibition of mixed marriages and the banishment of all persons who were even partially of non-Jewish stock.

Nehemiah rather than Ezra was lauded in early lists of Jewish worthies (Ecclus. xlix. 13 and II Macc. i and ii), but as Jewish religion developed along the exclusive, legalistic lines favoured in Ezra's reforms. Ezra's stature increased mightily until he was regarded as a second Moses who restored the Jewish Law, the founder of modern Judaism.

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EZRA, THIRD BOOK OF, is one of the two apocryphal Ezra books of the Bible. The title III Esdras is used for the so-called Greek Ezra (I Esdras) in Latin Bibles since Jerome. in the English Great Bible (1539) and in the Anglican Book of Common Prayer, art. vi. See ESDRAS. FIRST BOOK OF.

EZRA, FOURTH BOOK OF, commonly known as the Ezra Apocalypse, is one of the two apocryphal Ezra books of the Bible. It is appended to the Vulgate Bible as IV Esdras. In the English Bible it is the second of the apocryphal books and is numbered II Esdras. See ESDRAS. SECOND BOOK OF.

EZRA AND NEHEMIAH, BOOKS OF, two books of the Old Testament. ranking among the Hagiographa, or Writings. Along with the Books of Chronicles, Ezra and Nehemiah once formed a history of Israel from Adam to the 4th century B.C.. written about 350 B.C. by an anonymous "Chronicler." Its purpose seems to have been to trace the origin of the temple and to show the antiquity and authenticity of its cultus and of the formal, legalistic type of religion that dominated later Judaism. Most of this history is written in the distinctive language and style of the Chronicler. and it is permeated with his religious ideas. Later Jewish scholars severed the Books of Chronicles, which mere largely dependent upon earlier biblical books. from the postexilic history of the Persian period which did not duplicate material already in the Bible. The unique material was then called "Ezra," and talmudic tradition regarded the reformer Ezra as its author. At least as late as Melito of Sardes (A.D. 170) Ezra-Yehemiah formed one book called Ezra. In the Codex Vaticanus of the Greek Bible and in I Esdras the narrative proceeds directly from Ezra into the Book of Nehemiah without indicating a break (see ESDRAS. FIRST BOOK OF). Division into two books is first mentioned by Origen (3rd century A.D.), and the actual separation is encountered first in the Vulgate version, where the Book of Nehemiah appears as II Esdras. A separate Book of Nehemiah was not found in the Hebrew Bible until the Bomberg edition (A.D. 1525). (For a table outlining the Ezra literature, see ESDRAS, SECOND BOOK OF.)

Scholars have differed considerably in their opinions regarding the character of the books of Ezra and Nehemiah and their historical value. Some (*e.g.,* C. C. Torrey) have regarded the Chronicler as a novelist who freely composed his story for apologetic purposes, with little or no use of documentary sources. Such records as are quoted are believed to be forgeries, and the Chronicler's work is regarded as fiction with no value as history. Others consider the Chronicler to have been an editor rather than an author. His use of earlier biblical writings can be demonstrated in the Books of Chronicles, and works no longer preserved are cited in Ezra-Nehemiah (*e.g.,* Neh. vii, 5; xii, 23). It may be assumed. where the Chronicler's sources have disappeared, that he used the same editorial techniques of copying and rewriting, omission and supplementation, that can be observed where his biblical sources are still available to serve as a check. Undisputed is his use of the personal memoir of Nehemiah as a source (see below). Less clear is the nature of his Ezra source, since the Chronicler's own characteristics are most conspicuous in the Ezra story. The Chronicler's liking for lists, clearly indicated also in the Books of Chronicles, is demonstrated also in Ezra-Nehemiah. He presents not only inventories of animals and gifts to the temple but also genealogies, lists of leaders in civil projects. census reports and lists of temple ministrants.: designated by class. The lists are often such as may have been preserved as temple records.

Among the Chronicler's sources in Ezra is a collection of what purport to be official documents issued during the reigns of several Persian kings, written in Aramaic, one of the official languages of the Persian empire (Ezra iv. 7–vi, 18). These documents, reflecting the continual harassment of the Jews who were attempting to restore their city, have been called the Chronicler's forgeries, but they are probably an earlier assemblage of records which the Chronicler used to account for the delay in rebuilding the temple (Ezra iv, 23–24). He misunderstood his source. in part, for Ezra iv. 11–16 is concerned with the building of the city wall rather than the temple. The royal commission granted to Ezra (Ezra vii, 12–26) is also written in the Aramaic language.

The text of Ezra-Nehemiah is not in its original order. Its faulty Persian chronology may have been correct in the Chronicler's Aramaic source, but because he was more concerned with the history of the temple than with accurate chronology. the Chronicler arbitrarily shifted the text of Ezra iv. 6–23 (Artaxerxes) from its original place after Ezra v, 1–vi. 18 (Darius. who was in fact a predecessor of Artaxerxes) to its present location. This permitted his narrative to flow without interruption from the completion of the temple and its dedication (Ezra vi. 15–18) to the reinstitution of cultic services, as preliminary to the story of Ezra (Ezra vii, 1–x, 44). A later editor transposed three chapters of the Ezra story (Neh. vii. 73b–x. 39) from its position after Ezra viii, 36 to its present place in the Book of Nehemiah. Such dislocation may have been due to faulty transmission of the text by a copyist confused by the close resemblance of Ezra ii. 68–iii, 1 to Neh. vii. 70–viii. la. The correct original order is still maintained in I Esdras and in Josephus' narrative. The original order of the Ezra story was thus Ezra vii–viii. Neh. viii–x; Ezra ix–x. At an early date a pagan story was interpolated into the Book of Ezra to show how Zerubbabel won the right to rebuild Jerusalem. It is preserved in I Esd. iii, 1–v, 6 and in Josephus' *Antiquities* but not in the Hebrew Bible.

Book of Ezra. — Evidence for the original union of the Book of Ezra with the Books of Chronicles is found in the duplication of II Chron. xxxvi. 22–23 at the beginning of the hook (Ezra i. 1–3a). In the I Esdras translation of the Book of Ezra the duplicated material begins with II Chron. xxxv. 1. The Book of Ezra has two parts: (1) postexilic history prior to Ezra (Ezra i–vi), consisting largely of the Aramaic documents (see above) ; and (2) the Ezra story (vii–x). of which part has been transposed to the Book of Nehemiah (Neh. vii. 73b–x).

The former part includes an account of the decree of Cyrus and the return of Jews from Babylonia to Judea during his reign (Ezra i–ii) and the record of Jewish attempts to rebuild Jerusalem and its temple despite the opposition of neighbouring peoples and Persian officials (Ezra iii–vi). The story of Ezra the "priest" and "scribe" (Ezra vii. 11–12) records Ezra's journey to Palestine in the time of Artaxerxes with a royal commission to institute Jewish law there (Ezra vii–viii); the account of the reading of the Law in Jerusalem and its acceptance by the people. who then pledge to support the temple (now found in Keh. vii. 73b–x. 39) ; and the purging of the Jewish community of all non-Hebrew persons after the Jews promised to keep separate from the "people of the land" (Ezra ix–x).

Because of the difficulty of identifying the Artaxerxes of Ezra vii, 7. the date of Ezra is not fixed. The Bible places him in Jerusalem before Nehemiah, presumably under Artaxerxes I (458 B.C.; this Artaxerxes reigned 464–423 B.C.). Since Nehemiah, when he arrived in Jerusalem in 445 B.C. (Neh. ii, 1). found no evidence of Ezra or his reforms but rather a social. economic and religious situation as bad as or even worse than that which Ezra encountered, and since neither Ezra nor Nehemiah mentions the other, it is unlikely that they were contemporaries in Jerusalem. The references that seem to indicate that they were (Neh. viii, 9; xii, 36) are later additions to the text Ezra probably came to Palestine in 398 B.C. under Artaxerxes II (reigned 404 to 358 B.C). By arbitrarily emending Ezra vii. 7 to the 37th rather than the 7th year. some would place the arrival of Ezra in Jerusalem in 428 B.C., while Nehemiah was absent from Jerusalen~.

Since the Chronicler's language. style and ideas are encountered through the Ezra story, a genuine Ezra narrative, apart from the Chronicler's contribution, cannot be isolated. Some have regarded the portion of narrative written in the first person (Ezra vii, 27–28; viii, 1–34: cf. ix. 1–15) as an autobiographical nucleus; but others have called it a literary device of no significance, and there remains great diversity among scholars as to the extent of the genuine Ezra story. Judged by substance rather than style. the Ezra narrative seems to include Ezra vii. 11–x. 44 and Keh. vii. 73b -ix. 5.

Book of Nehemiah. — The only undisputed source for Jewish history between 520 and 175 B.C. is Nehemiah's memoir (Neh. i, 1–vii. 73a; xi. 1–2; xii. 27–43; xiii. 4–31). written not long after 432 B.C. (*cf.* Neh. v. 14: Artaxerxes I ascended the throne in 464). It is an accurate historical record preserved by the Chronicler with but little reworking or interpolation. As a memorial record it was perhaps intended to be placed before God in the temple nhere it would stir remembrance of Nehemiah's good works and assure a "name" for him who was probably a eunuch and who could not obtain it through descendants (Isa. lvi. 3–5). It is likely that the Nehemiah memoir circulated separately as late as about 180 B.C. (Ecclus. xlix. 13) and when II Macc. ii, 13 was written. probably between 100 B.C. and A.D. 70. Although I Esdras contains Neh. vii. 73–viii. 12 (I Esd. ix. 37–55) it does not have the Nehemiah story, and Josephus. who depends upon I Esdras. presents the Nehemiah memoir in a form somewhat different from that in the Bible. He gives the substance of Keh. i–vi; alludes to Neh. vii. 4 and. with no reference to Neh. ix–x. proceeds directly to Keh. xi, 1; xii, 27; and xiii. 10 ff.

The Book of Nehemiah includes (1) an account of how Nehemiah. a royal official in Susa. learned of the distress of Jerusalen~ and obtained a royal commission to rebuild the city (Neh. i, 1–ii. 10): 12) a record of the rebuilding of the wall of Jerusalem despite opposition by Samaritans. Ammonites and Arabs (Neh. ii. 11–iv. 23: vi. 1. 15; vii. 1) and of attempts to entrap and assassinate Nehemiah (Neh. vi. 1–14. 17–19); (3) a description of the repopulation of Jerusalem (Neh. vii. 2–73a; xi, 1–24) and the dedication of the city wall (Neh. xii. 27–43); (4) an account of the social and religious reforms instituted by Nehemiah. including the prohibition of usury leading to the enslavement of Hebrews (Neh. v. 1–13). the reinstitution and organization of temple services that had been neglected (Neh. vii. 1; xii. 44–47; xiii. 4–14. 30–31). Sabbath reforms (Neh. xiii. 15–22) and the purging of Jerusalem of all non-Hebrew persons (Neh. xiii. 1–3. 23–30). In Neh. v, 14–19 Nehemiah asserts the policies of his administration which reflected his generosity and self-sacrifice.

After 12 years as administrator in Jerusalem (Neh. v, 14). Nehemiah returned to his king in the 32nd year of Artaxerxes I (433–432 B.C.; Neh. xiii. 6). According to Neh. xiii. 6–7 something later induced him to return to Jerusalem for an indeterminate period. The reforms described in Neh. xiii are presumably those of his second administration. C. C. Torrey believed that Nehemiah's work was concluded with the completion of the city walls and that Neh. xiii is the Chronicler's fiction, utterly worthless as history. While Neh. xiii, 1–3 is certainly the Chronicler's work and his hand is observable elsewhere in Neh. xiii. which is concerned with such subjects as greatly appealed to the Chronicler. the vivid forcefulness of the chapter is in keeping with the activity of Nehemiah recorded in his memoir and it is probable that the kernel of Neh. xiii. 4–31 is part of Nehemiah's memoir—a description of his solving of problems that had arisen during his absence from Jerusalem.

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EZZELINO DA ROMANO (1194–1259). Ghibelline lord of Verona. Vicenza and Padua. was born on April 25. 1194. of a German family from Franconia that had been enfeoffed by the emperor Conrad II early in the 11th century with lands in northeastern Italy including the castle of Romano near Vicenza. A ruthless leader, feared and hated for his coldly deliberate cruelty, Ezzelino was prominent for nearly 40 years in the wars and factions of his native region and was also the first Italian despot to seize and hold authority successfully for any length of time (from 1236 to 1259).

His career began in 1226 when he became Ghibelline *podestà* of Verona. but four years later he lost the city. The fight went on uncertainly for several years until in 1236–37, acting in the name and with the help of the emperor Frederick II (*q.v.*), Ezzelino resumed control of Verona and took Vicenza and Padua as well. In Nov. 1237 he fought on the imperial side at Cortenuova; in 1238 he married Frederick's natural daughter, Selvaggia; and in 1230 he was appointed imperial vicar of the march of Treviso. Ezzelino thus built up his despotism less from within than by alliance with the emperor against their common enemies; and it was this more than loyalty that bound him to the Hohenstaufen dynasty. With little care for formal offices like that of *podestà*, Ezzelino sought and won actual power and independence, so that when Frederick II died in 1250 his position was not immediately affected. In spite of his ferocity, however, his rule was under constant challenge from hostile neighbours and the papacy. In 1254 he was excommunicated, and shortly after a crusade was proclaimed against him. Then. in 1259. he quarreled with the other Ghibelline leaders. Oberto Pelavicino and Buoso da Dovara. He was wounded and captured in battle at Cassano on Sept 27, 1259. and died four days later, refusing both medical aid and peace with the church He left no issue.

Ezzelino was commemorated as a tyrant in Dante's *Inferno* and in a tragic drama. the *Ecerinis,* written in the Latin manner by the early Paduan humanist Albertino Mussato.

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EZZO (EHRENFRIED) (*c.* 954–1024), count palatine in Lorraine. was the son of a certain Hermann (d. c. 1000). also a count palatine in Lorraine who had possessions in the neighbourhood of Bonn. Having married Matilda (d. 1025), a daughter of the emperor Otto II, Ezzo came to the front during the reign of his brother-in-law. the emperor Otto III (983–1002); his power mas increased owing to the liberal grant of lands in Thuringia and Franconia which he received with his wife, and some time later his position as count palatine was recognized as a hereditary dignity. Otto's successor. the emperor Henry II. was less friendly toward the powerful count palatine, though there was no serious trouble between them until 1011; but some disturbances in Lorraine quickly compelled the emperor to come to terms. and the assistance of Ezzo was purchased by a gift of lands. Henceforward the relations between Henry and his vassal appear to have been satisfactory. Ezzo died at Saalfeld on March 21, 1024. He left three sons, among them being Hermann, archbishop of Cologne from 1036 to 1056, and Otto, who was for a short time duke of Suabia; and seven daughters, six of whom became abbesses.

F THIS letter corresponds to the sixth letter of the Greek, Etruscan, and Latin alphabets. known to the Greeks as digamma. The sound represented by the letter in Greek was a labial semivowel similar to English *w*. This sound had disappeared early from the Ionic and Attic Greek dialects, so that the Ionic alphabet, which eventually came into general use in Greece, contained no digamma. It was retained, however, for some time in many local dialects and alphabets, including that from which the Etruscan (and through it the Latin alphabet) was derived.

The form of the letter in Greek was Ϝ, F, or Ϲ, none of which forms occur in the Semitic alphabets. Its origin in the Greek alphabet has been a matter of dispute, some maintaining

NAME OF FORM	APPROXIMATE DATE	FORM OF LETTER
PHOENICIAN	B.C 1.200	(Y)
CRETAN	1.100-900	3 Λ
THERAEAN	700-600	?
ARCHAIC LATIN	700-500	(F)
ATTIC	600	?
CORINTHIAN	600	ꟻ
CHALCIDIAN	600	F
IONIC	403	?
ROMAN COLONIAL	PRE-CLASSICAL AND CLASSICAL TIMES	F I'
URBAN ROMAN		F
FALISCAN		↑
OSCAN		8
UMBRIAN		3
CLASSICAL LATIN AND ONWARDS		F

THE DEVELOPMENT OF THE LETTER "F" FROM THE PHOENICIAN THROUGH THE CLASSICAL LATIN TO THE PRESENT FORM

that it descends from Semitic *vau* Y, others. far less convincingly, maintaining that it was merely differentiated from the preceding letter Ǝ by the omission of a horizontal stroke. In either case it is probable that the Greeks were not the innovators. since a form of the letter (ꟻ) occurs in the Lydian alphabet. The letter nas probably contained in an Asianic alphabet from which the Greek, Lydian and Etruscan were derived.

In some very early Latin inscriptions F was used in combination with h to represent the unvoiced labial spirant (English *f*), as in the word FREFEAKED "he made." The h was soon dropped, and the sound represented by the letter F alone. It was not required in Latin to represent the bilabial semivowel (w), for the Latins had taken the letter V to represent both this sound and the corresponding vowel (*u*). F has represented the unvoiced labial spirant ever since.

In the Faliscan alphabet the letter had the curious form ↑, and in Latin there was a form I' corresponding to the form II of the preceding letter. Latin cursive of the 5th century A.D. employed a lengthened form F, and the letter was generally extended below the line in uncial writing. F.

In Irish writing of the 7th century the form was F, and the Carolingian with further rounding of the top ʃ. From this developed the modern minuscule *f*. *See* also ALPHABET.

In music, F is the name of the sixth note of the musical alphabet, otherwise the fourth note of the scale of C. It also gives its name to the bass clef. whose distinguishing sign denotes the F line. Further, it serves as an abbreviation for *forte* (f) and *fortissimo* (*ff*).

In chemistry, F is the symbol for fluorine.

For a discussion of phonetic correspondences involving the letter f in Indo-European languages, *see* GERMANIC LANGUAGES. (J. W. P.)

FA, the name given in French and Italian nomenclature to the fourth note of the natural scale of C., *i.e.*, F. In the tonic-sol-fa system and others, employing what is called a "movable Do" or tonic it is given to the fourth note of any major scale.

FABBRONI, ANGELO (1732–1803), Italian biographer, was born at Marradi in Tuscany on Sept. 25, 1732, and died at Pisa on Sept. 22, 1803. His principal work is *Vitae Italorum doctrina excellentium qui saeculis XVII et XVIII floruerunt,* 20 vol. (1778–99, 1804–05).

The last two volumes, published posthumously. contain a life of the author.

FABER, a family of German lead-pencil manufacturers. The business was founded in 1761 by Kaspar Faber (d. 1784) near Nuremberg and remained in the Faber family until 1903. The founder's great-grandson Johann Lothar von Faber (1817–1896) established branches of the company in New York city, Paris, London and Berlin. and agencies elsewhere in Europe. Johann contracted for exclusive control of all graphite from the east Siberian mines. He also branched out into the manufacture of water colours and oil paints, inks, slates and slate pencils and drawing instruments. His factory became a model of efficiency for German and Austrian manufacturers. The German emperor gave him a patent of nobility and appointed him councilor of state.

Eberhard Faber (1822–1879), another great-grandson of the founder, in 1848 went to the United States and in 1849 established a business in his oun name and built the first U.S. pencil factory in 1861. (J. R. LT.)

FABER, FREDERICK WILLIAM (1814–1863), British hymn-writer and theologian, was born on June 28, 1814 at Calverley, Yorkshire. Educated at Harrow and at Balliol college, Oxford, he was elected fellow of University college in 1837. Meanwhile he had given up Calvinistic views, and had become an enthusiastic follower of John Henry Newman. In 1843, he became rector of Elton in Huntingdonshire, but after a prolonged mental struggle joined the Roman Catholic communion in Nov. 1845. He founded a religious community at Birmingham, called Wilfridians, which was ultimately merged in the oratory of St. Philip Neri, with Newman as Superior. In 1849 a branch of the oratory was established in London, first in King William street, and afterwards at Brompton, over which Faber presided till his death on Sept. 26, 1863. It is mainly as a hymn-writer that Faber is remembered. His other works include *Lives of Modern Saints* (1847 *sq.*); *The Blessed Sacrament* (1855); *The Creator and the Creature* (1858); *Growth of Holiness* (1854); *Spiritual Conference..* (1859); *The Foot of the Cross* (8 vols., 1853–60); and *Notes on Doctrinal Subjects*, 2 vols. (1866).

See J. E. Bowden, *Life and Letters of Fr. Faber* (2nd ed. 1888), and *A Brief Sketch of the Early Life of the late F. W. Faber, D.D.*, by his brother the Rev. F. A. Faber (1869).

FABER, FABRI or **FABRY** (surnamed STAPULENSIS), **JACOBUS** [Jacques Lefèvre d'Étaples] (c. 1455–1536), a pioneer of the Protestant movement in France, was born of humble parents at Étaples, Pas de Calais. He had already been ordained priest when he entered the university of Paris, where Hermonymus of Sparta was his master in Greek. He visited Italy before 1486, for he heard the lectures of Argyropulus, who died in that year; he formed a friendship with Paulus Aemilius of Verona. In 1492 he again travelled in Italy, studying in Florence, Rome and Venice, making himself familiar with the writings of Aristotle, though greatly influenced by the Platonic philosophy. Returning to Paris, he became professor in the college of Cardinal Lemoine. Among his famous pupils were F. W. Vatable and Farel; his connection with the latter drew him to the Calvinistic side of the movement of reform. At this time he began the publication, with critical apparatus, of Boëtius *(De Arithmetica)*, and Aristotle's *Physics* (1492), *Ethics* (1497), *Metaphysics* (1501) and *Politics* (1506). In 1507 he settled in the Benedictine Abbey of St. Germain des Prés, near Paris, where his former pupil, William Briçonnet, later cardinal bishop of Meaux, was abbot. He now began his Biblical studies, the first-fruit of which was his *Quintuplex Psalterium: Gallicum, Romanum, Hebraicum, Vetus, Conciliatum* (1509); the *Conciliatum* was his own version. This was followed by *S. Pauli Epistolae xiv. ex vulgata editione, adjecta intelligentia ex Graeco cum commentariis* (1512), a work of great independence and judgment. His *De Maria Magdalena et triduo Christi disceptatio* (1517) provoked violent controversy and was condemned by the Sorbonne (1521). At Briçonnet's invitation he went in 1520 to Meaux, and in 1523 published his French version of the New Testament. From this, in the same year, he extracted the versions of the Gospels and Epistles "à l'usage du diocèse de Meaux." Faber was protected by Francis I. and the princess Margaret, but Francis being in captivity after the battle of Pavia (Feb. 25, 1525), he was condemned and his works suppressed by commission of the parliament. With the other Meaux preachers he fled to Strasbourg, but, as soon as Francis returned, he with others, was recalled. Faber now became tutor to one of the king's sons. He issued *Le Psautier de David* (1525), and was appointed royal librarian at Blois (1526); his version of the Pentateuch appeared two years later. His complete version of the Bible (1530), on the basis of Jerome, took the same place as his version of the New Testament. Margaret (now queen of Navarre) led him to take refuge (1531) at Nérac from persecution. He is said to have been visited (1533) by Calvin on his flight from France. He died at Nérac in 1536.

See C. H. Graf, *Essai sur la vie et les écrits* (1842); G. Bonet-Maury, in A. Herzog-Hauck's *Realencyklopadie* (1898).

FABER (or LEFÈVRE), **JOHANN** (1478–1541), German theologian, styled from the title of one of his works "Malleus Haereticorum," son of one Heigerlin, a smith *(faber)*, was born at Leutkirch, Suabia, in 1478. He studied theology and canon law at Tübingen and at Freiburg im Breisgau, and became vicar of Lindau and Leutkirch and shortly afterwards canon of Basel. In 1518 Hugo von Landenberg, bishop of Constance, made him one of his vicars-general, and Leo X. appointed him papal protonotary. He was an advocate of reforms, in sympathy with Erasmus, and corresponded (1519–20) with Zwingli. While he defended Luther against Eck, he was as little inclined to adopt the position of Luther as of Carlstadt. His journey to Rome in the autumn of 1521 had the result of estranging him from the views of the Protestant leaders. He published *Opus adversus nova quaedam dogmata Lutheri* (1522), appeared as a disputant against Zwingli at Zürich (1523), and then put forth his *Malleus in haeresin Lutheranam* (1524). In 1526 he became court preacher to the emperor Ferdinand, and in 1527–28 was sent by him as envoy to Spain and England. He approved the death by burning of Balthasar Hubmeier, the Baptist, at Vienna on March 10, 1528. In 1531 he was consecrated bishop of Vienna, and combined with this (till 1538) the administration of the diocese of Neustadt. He died at Vienna on May 21, 1541. His works were collected in three volumes, 1537, 1539 and 1541.

See C. E. Kettner, *Diss. de J. Fabri Vita Scriptisque* (1737) Wagenmann and Egli in Herzog-Hauck's *Realencyklopädie* (1898).

FABERGÉ, PETER CARL (KARL GUSTAVOVICH FABERGÉ) (1846–1920), Russian goldsmith whose work, comparable to that of Benvenuti Cellini. ranks with the finest of all ages. Fabergé was born of Huguenot descent at St. Petersburg in 1846 and was educated in Dresden, Italy. France and England. Inheriting his father's establishment in 1870, he made a bold change from the exclusive design and manufacture of jewelry to the creation of objects of fantasy.

The workshop soon became famous for exquisite masterpieces: flowers. figure groups. animals and the celebrated imperial Easter eggs, which became the delight of Russian and other royalty throughout Europe and Asia. Alexander III commissioned the first of the eggs for his tsarina in 1884. The Fabergé studios in St. Petersburg and Moscow employed artists and skilled craftsmen who achieved wonders of imaginative. elfin delicacy until the revolution of 1917 ended the world of Fabergé. He died in exile in 1920. (M. C. Rs.)

FABERT, ABRAHAM DE (1599–1660), marshal of France, was the son of Abraham Fabert, seigneur de Moulins (d. 1638), a famous printer who rendered great services, civil and military, to Henry IV. At the age of 14 he entered the *Gardes françaises*, and from 1618 was almost constantly in service. He was a brilliant engineer, and at the siege of Stenay he introduced new methods of siegecraft which anticipated in a measure the great improvements of Vauban. In 1658 Fabert was made a marshal of France, being the first commoner to attain that rank. He died at Sedan on May 17, 1660.

See *Histoire du maréchal de Fabert* (1697); P. Barre, *Vie de Fabert* (1752); A. Feillet, *Le Premier Maréchal de France plébéien* (1869); Bourelly, *Le Maréchal Fabert* (1880).

FABIAN (FABIANUS), **SAINT** (d. 250), pope and martyr, was chosen pope in Jan. 236. He was martyred during the persecution under Decius on Jan. 20, 250, and was buried in the catacomb of Calixtus. He is said to have baptized the emperor Philip and his son, to have improved the organization of the church in Rome, to have appointed officials to register the deeds of the martyrs. and to have founded several churches in France.

FABIAN SOCIETY, a socialist society founded in 1883–84 by a small group in London who aimed at "reconstructing society in accordance with the highest moral possibilities." The name is derived from the Roman general Fabius Cunctator, whose elusive tactics in avoiding pitched battles secured his ultimate victory over stronger forces. The early members included George Bernard Shaw. Sidney Webb, Annie Besant (*qq.v.*), Edward Pease and Graham Wallas. Shaw and Webb, joined later by Webb's wife Beatrice, were the outstanding leaders for many years. In 1889, the society published *Fabian Essays in Socialism*, edited by Shaw; and since then it has sold in large numbers. It was reinforced in 1952 by *New Fabian Essays*, edited by R. H. S. Crossman. The

Fabians preferred John Stuart Mill and Stanley Jevons to Karl Marx; they put their faith in evolutionary socialism rather than revolution; and they considered that the utilitarian aim of the greatest happiness of the greatest number could be secured only by extensive action by the state in the economic field. They regarded the state, as a social machine to be captured and used for the promotion of social welfare, not as an instrument of class domination to be overthrown. At first, the Fabians attempted to permeate the Liberal and Conservative parties with socialist ideas, but later they helped to organize the separate Labour representation committee, which became the Labour party in 1906. The society is affiliated with the Labour party.

The rules of the society state that it consists of socialists: "It therefore aims at the establishment of a society in which equality of opportunity will be assured and the economic power and privileges of individuals and classes abolished through the collective ownership and democratic control of the economic resources of the community. It seeks to secure these ends by the methods of political democracy." However, all publications appear under the names of the individual authors who are alone responsible for the views expressed. and the rules require that research carried out by the society shall be free and objective. The society has thus attracted the intelligentsia of the Labour movement and provided it with the opportunity for expression and criticism.

The national membership reached a peak in 1946 with 5,089 members. Thereafter it declined sharply until 1956, but after that it rose gently again. The importance of the society has always been much greater than its size might suggest. Generally, nearly half the number of Labour members of parliament in the house of commons and a majority of the party leaders are Fabians; and in addition to the national society there are more than 80 local Fabian societies.

The principal activities of the society consist in the furtherance of socialism and the education of the public on socialist lines by means of meetings, lectures, discussion groups, conferences and summer schools; carrying out research into political, economic and social problems; and publishing books, pamphlets and periodicals. In 1931, the New Fabian Research bureau was established as an independent body. The bureau and the society amalgamated in 1938 to form a new and revitalized Fabian society. Since then research has formed an important part of the society's work, and many research pamphlets have been published.

In the first 20 or 30 years of its existence, much of the attention of the society was devoted to general arguments against capitalism and in favour of socialism. The tone was severely rational, practical and empirical. During this early period the society also stressed the importance of local government as a means of promoting collective ownership. The horizons have gradually widened, and Fabians have become as much interested in the social services as in the nationalization of industry. In 1940, the colonial bureau was established and thereafter produced a continuous stream of Fabian discussion and writing on colonial questions. The Fabian International bureau was started in 1941, as an integral part of the society, to cater to the growing concern of Fabians with foreign policy and the great issues of war and peace.

Many practical reforms can be traced in part to the work of Fabians: but much of the impact of Fabianism has been through the gradual permeation of Fabian ideas among teachers, civil servants, politicians, trade union officials and others in influential positions. The work of the society tended to become more specialized in dealing with such subjects as economic planning, social security, consumers' councils, leasehold enfranchisement, monetary policy and housing; but leaders of the society also encouraged it to deal with the problems of man in society in order to discover how iar people aspire toward equality, a classless society and a widely dispersed power of self-government. In approaching this problem, emphasis was less on doctrine than on sociological and psychological investigation.

See also SOCIALISM; SOCIALISM: PRINCIPLES AND OUTLOOK.

See E. R. Pease, *History of the Fabian Society,* rev. (1925); G. D. H. Cole, *The Fabian Society, Pnst and Present,* pamphlet, rev. (1946) and *British Working Class Politics, 1832–1914* (1941). (W. A. RN.)

FABIOLA (? –*c.* 399 A.D.), Christian noblewoman of Rome, credited with founding the first public hospital in western Europe, n-as a member of the great Fabian family. After her conversion to Christianity she worked closely with Jerome, like other women of her class who had accepted the new religion. Her immense wealth and energy she dedicated to the church with the intention of atoning for transgression against a church law in marrying a second time while her first husband, whom she had divorced, was alive. On the death of her second husband she began her career of charity. She not only founded the first general public hospital in the western part of the Roman empire, but, acting as physician and nurse, cared for the sick herself. According to Jerome no patient was so sick that she refused to nurse him. With Pammachius she also founded a hospice for pilgrims at Ostia and gave generously to other religious foundations throughout Italy and the Mediterranean islands. A woman of learning who knew Hebrew and Greek as well as Latin, she studied the Scriptures under the guidance of Jerome whom she followed to Bethlehem. There at her request, he wrote a treatise on the priesthood of Aaron and the priestly dress. Jerome's treatise on the 42 stopping places of the Israelites in the wilderness was also written for her, though she did not live to see it finished. When disturbances in the eastern empire made a sojourn there precarious Fabiola returned to Rome and died in her native city about 399 A.D. The Romans, remembering the solicitude she had displayed for them, attended her funeral in great numbers as a mark of the veneration in which they held her.

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FABIUS, the name of a number of Roman soldiers and statesmen. The Fabian gens was one of the oldest and most distinguished patrician families of Rome. Its members claimed descent from Hercules and a daughter of the Arcadian Evander. From the earliest times it played a prominent part in Roman history, and was one of the two gentes exclusively charged with the management of the most ancient festival in Rome—the Lupercalia (Ovid, *Fasti,* ii, 375). The chief family names of the Fabian gens or clan, in republican times, were Vibulanus, Ambustus, Maximus, Buteo, Pictor, Dorso, Labeo; with surnames Verrucosus, Rullianus, Gurges Aemilianus, Allobrogicus (all of the Maximus branch). The most important members of the family are the following:—

1. MARCUS FABIUS AMBUSTUS, *pontifex maximus* in the year of the capture of Rome by the Gauls (390 B.C.). His three sons, sent as ambassadors to the Gauls when they were besieging Clusium, subsequently took part in hostilities (Livy v, 35). The Gauls thereupon demanded their surrender, on the ground that they had violated the law of nations; the Romans, by way of reply, elected them consular tribunes in the following year. The result was the march of the Gauls upon Rome, the battle of the Allia, and the capture of the city (Livy vi, 1).

2. Q. FABIUS MAXIMUS, surnamed Rullianus or Rullus, master of the horse in the second Samnite War to L. Papirius Cursor, by whom he was degraded for having fought the Samnites contrary to orders (Livy viii, 30), in spite of the fact that he gained a victory. In 31j B.C., when dictator, he was defeated by the Samnites at Lautulae (Livy ix, 23). In 310 he defeated the Etruscans at the Vadimonian Lake. In 295, consul for the fifth time, he defeated, at the great battle of Sentinum, the combined forces of the Etrurians, Umbrians, Samnites and Gauls (see ROME: History, II "The Republic"). As censor (304) he limited the freedmen to the four city tribes.

3. QUINTUS FABIUS MAXIMUS, surnamed *Cunctator* ("the delayer," from his cautious tactics in the war against Hannibal), grandson of the preceding. He served his first consulship in Liguria (233 B.C.), was censor (230) and consul for the second time (228). In 218 he was sent to Carthage to demand satisfaction for the attack on Saguntum (Livy xxi, 18). According to the well-known story, he held up a fold of his toga and offered the

Carthaginians the choice between peace and war. When they declared themselves indifferent, he let fall his toga with the words, "Then take war." After the disasters of the Trebia and Lake Trasimenus, Fabius was named dictator (Livy calls him prodictator, since he was nominated, not by the consul, but by the people) in 217, and began his tactics of "masterly inactivity." Manoeuvring among the hills, where Hannibal's cavalry was useless, he cut off his supplies, harassed him incessantly and did everything except fight. His steady adherence to his plan caused dissatisfaction at Rome and in his own camp. Minucius Rufus. his master of the horse, during the absence of Fabius at Rome. made a successful attack upon the enemy. The people then divided the command between Minucius and Fabius (Livy xxii, 1 j. 24; Polybius iii, 88). Minucius was led into an ambuscade by Hannibal, and his army was saved only by the opportune arrival of Fabius. Minucius confessed his mistake and henceforth submitted to the orders of Fabius (Livy xxiii. 32). At the end of the legal time of six months Fabius resigned the dictatorship. and the result of the abandonment of Fabian tactics was the disaster of Cannae (216). In 21 j and 214 (as consul for the third and fourth times) he was in charge of the operations against Hannibal together with Claudius Marcellus (Livy xxiii, 39). He laid siege to Capua, which had gone over to Hannibal after Cannae, and captured the important position of Casilinum; in his fifth consulship (209) he retook Tarentum. which had been occupied by Hannibal for three years (Livy xxvii, 15; Polybius xiii, 4; Plutarch, *Fabizis).* He died in 203. Fabius was a strenuous opponent of the new aggressive policy, and did all he could to prevent the invasion of Africa by Scipio. In his later years he became morose, and showed jealousy of rising young men, especially Scipio *(Life* by Plutarch; Livy xx–xxx; Polybius iii, 87–106).

4. Q. FABIUS VIBULANUS, with his brothers Caeso and Marcus, filled the consulship for seven years in succession (485–479 B.c.). In the last year there was a reaction against the family, in consequence of Caeso's espousing the cause of the plebeians. Thereupon the Fabii emigrated from Rome under the leadership of Caeso, and settled on the banks of the Cremera, a feu' miles above Rome. For two years they defended the city against the Veientes, until at last they were surprised and cut off. The only survivor of the gens was Quintus, the son of Marcus, who apparently took no part in the battle. This Quintus was consul in 467, 465 and 459, and a member of the second decemvirate in 450, on the fall of which he went into voluntary exile (Livy ii, 42, 48–50, iii, 1, 9, 41, 58, vi, 1; Dion Halic. viii, 82–86, ix, 14–22; Ovid, *Fasti*, ii, 195).

The Fabian name is met with as late as the 2nd century A.D. A complete list of the Fabii will be iound in de Vit's *Onomasticon;* see also W. N. du Kieu, *Disputatio* de *Gente Fabia* (1856), containing an account of 57 members of the iamily.

FABLE. With certain restrictions, the necessity of which will be shown in the course ot the article, we may accept the definition of "fable" which Dr. Johnson proposes in his *Life of Gay:* "A *fable* or *apologue* seems to be, in its genuine state, a narrative in which beings irrational, and sometimes inanimate *(arbores loquuntur, non tantum ferae)*, are, for the purpose of moral instruction, feigned to act and speak with human interests and passions." The description of Jean de la Fontaine, the greatest of fabulists, is a poetic rendering of Johnson's definition:

> Fables in sooth are not what they appear;
> Our moralists are mice, and such small deer.
> We yawn at sermons, but we gladly turn
> To moral tales, and so amused we learn.

The fable is distinguished from the myth which grow and is not made, the spontaneous and unconscious product of primitive fancy as it plays round some phenomenon of natural or historical fact. The literary myth, such as, for instance, the legend of Pandora in Hesiod or the tale of Er in the *Republic* of Plato, is really an allegory, and differs from the fable in so far as it is self-interpreting; the story and the moral are intermingled throughout. Between the parable and the fable there is no clear line of demarcation. The soundest distinction is drawn by Neander. In the fable human passions and actions are attributed to beasts; in the parable the lower creation is employed only to illustrate the higher life and never transgresses the laws of its kind. There is an affinity between the fable and the proverb. A proverb is often a condensed or fossilized fable, and not a few fables are amplified or elaborated proverbs.

With the fable, as we know it, the moral is indispensable. As La Fontaine puts it, an apologue is composed of two parts, body and soul. The body is the story, the soul the morality. But in the primitive beast-fable, which is the direct progenitor of the Aesopian fable, the story is told simply for its own sake, and is as innocent of any moral as the fairy tales of "Little Red Riding-Hood" and "Jack and the Beanstalk." Thus, in a legend of the Flathead Indians, the Little Wolf found in cloud-land his grandsires the Spiders with their grizzled hair and long crooked tails, and they spun balls of thread to let him down to earth; when he came down and found his wife, the Speckled Duck, whom the Old Wolf had taken from him, she fled in confusion, and this is why she lives and dives alone to this very day. Such animal myths are as common in the new world as in the old, and abound from Finland and Kamchatka to the Hottentots and Australasians.

From these beast-fables of savages must be derived, through some common store of primitive moralizing, the fables of Greece and India. In the form in which we have them the Greek fables are the older: there is a fable of true type in Hesiod. In the latter part of the 5th century B.C. they became connected with the name of Aesop (*q.v.*). The first collection we hear of was made about 300 B.C. These Greek fables are best represented by the verse collection of Babrius (*q.v.*) made about AD. 200. An inferior version is found in the Latin of Phaedrus (early part of the 1st century). Phaedrus and a third ancient fabulist Avianus (4th century) were textbooks in medieval schools and were constantly imitated and expanded. The oldest Indian collection, the *Panchatantra*, goes back to Buddhist sources of the 4th century or earlier. The *Httopadesa* is a medieval form of the same work, the fables being strung together on a thread of narrative. As *Kalilah* and *Dimnah* or *Fables of* **Bidpni** *(Pilpay)* the Indian fables passed through Old Persian and Arabic into Latin, and joined the stream flouing from the Latin fabulists. thus fertilizing the rising vernacular literatures with a variety of *motifs* which could be used either for entertainment or edification. One of the most successful medieval collections is that of Odo of Cheriton. a Kentish preacher of the 12th century, who published separately the fables he had used in his sermons.

Modern Literature. — As the supremacy of Latin declined, the fable took a new life in the modern languages. Not only were there numerous adaptations of Aesop, known as Ysopets, but Marie de France in the 13th century composed many original fables, some rivalling La Fontaine's in simplicity and gracefulness. Later, also, fables were not wanting, though not numerous, in the English tongue. Geoffrey Chaucer has given us one, in his Nonne Preestes Tale, which is an expansion of the fable *Don Coc et don Werpil* of Marie de France; another is Lydgate's tale of The Churl and the Bird.

Several of Odo's tales, like Chaucer's story, can be ultimately traced to the History of Reynard the Fox. This great beast-epic is known to us in three forms, Latin, French and German, each with independent episodes, but all woven upon a common basis, and it probably took shape in Picardy in the 10th or 11th century. The Latin form is probably the earliest, and next the German versions. The French poem of more than 30,000 lines, the *Roman du Rénard,* belongs probably to the 13th century. In 1498 appeared *Reynke de Voss,* almost a literal version in Low Saxon of the older Flemish poem, *Reinaert de Vos.* Hence the well-known version of Goethe into modern German hexameters was taken. We have here no short and unconnected stories. Materials, partly borrowed from older apologues, but in a much greater proportion new, are worked up into one long and systematic tale. The moral, so prominent in the fable proper, shrinks so far into the background that the epic might be considered a work of pure fiction, an animal romance recounting a contest maintained successfully, by selfish craft and audacity, against enemies of all sorts, in a half-barbarous and ill-organized society.

France alone in modern times has attained any pre-eminence in the fable, and this distinction is almost entirely owing to one author. Marie de France in the 13th century, Gilles Corrozet, Guillaume Haudent and Guillaume Gueroult in the 16th, are now studied mainly as the precursors of La Fontaine, from whom he may have borrowed a stray hint or the outline of a story. The unique character of his work has given a new word to the French language: other writers of fables are called *fabulistes,* La Fontaine is named *le fablier.* He is a true poet; his verse is exquisitely modulated; his love of nature often reminds us of Virgil, as do his tenderness and pathos (*see,* for instance, "The Two Pigeons and Death and the Woodcutter"). He is full of sly fun and delicate humour; like Horace he satirizes without wounding, and "plays around the heart." Lastly, he is a keen observer of men. The nhole society of the 17th century, its greatness and its foibles, its luxury and its squalor, from *Le grand monarque* to the poor *manant,* from his majesty the lion to the courtier of an ape, is painted to the life. To borrow his own phrase, La Fontaine's fables are "une ample comédie à cent actes divers." Rousseau did his best to discredit the *Fables* as immoral and corruptors of youth, but in spite of *Émile* they are studied in every French school and are more familiar to most Frenchmen than their breviary. Among the French successors of La Fontaine the most distinguished is Jean Pierre de Florian: among foreigners who have worked in his vein are the Spaniard Tomás de Yriarte, the Russian Ivan Andreevich Krylov, and the Italian Pignotti. John Gay's *Fifty-one Fables in Verse* (1727) has much of the charm of La Fontaine. John Dryden's *Fables* (1699) are adaptations of Chaucer's and Boccaccio's tales and Ovid's *Metamorphoses* and are fables only in name.

The fables of Gotthold Lessing represent the reaction against the French school of fabulists. "With La Fontaine himself," says Lessing, "I have no quarrel, but against the imitators of La Fontaine I enter my protest." His attention was first called to the fable by Christian Gellert's popular work published in 1746 Gellert's fables were closely modelled after La Fontaine's, and were a vehicle for lively railings against women, and hits at contemporary follies. Lessing's early essays were in the same style, but his subsequent study of the history and theory of the fable led him to discard his former model as a perversion of later times, and the "Fabeln," published in 1759, are the outcome of his riper views. Lessing's fables, like all that he wrote, display his vigorous common sense, but he has little of La Fontaine's sly humour and lightness of touch. On the other hand, he has the rare power of looking at both sides of a moral problem; he holds a brief for the stupid and the feeble, the ass and the lamb; and in spite of his formal protest against poetical ornament, there is in not a few of his fables a vein of true poetry, as in the Sheep (ii, 13) and Jupiter and the Sheep (ii, 18). But the monograph which introduced the *Fabeln* is of more importance than the fables themselves. According to Lessing the ideal fable is that of Aesop. All the elaborations and refinements of later authors, from Phaedrus to La Fontaine, are perversions of this original. The fable is essentially a moral precept illustrated by a single example, and it is the lesson thus enforced which gives to the fable its unity and makes it a work of art.

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FABLIAU. The entertaining tales in eight-syllable rhymed verse which form a marked section of French mediaeval literature are called *fabliaux,* the word being derived by M. Littré from *fablel,* a diminutive of *fable.* It is a mistake to suppose, as is frequently done, that every legend of the middle ages is a fabliau. In a poem of the 12th century a clear distinction is drawn between songs of chivalry, mar or love, and *fabliaux,* which are recitals of laughter. A fabliau always related an event; it was usually brief, containing not more than 400 lines; it was neither sentimental. religious nor supernatural, but comic and gay. About 150 fabliaux have come down to us more or less intact; a vast number have doubtless disappeared. As early as the 8th century fabliaux must have existed, since the faithful are forbidden to take pleasure in these *fabulas inanes* by the *Paenitentiale* of Egbert. But the earliest surviving fabliau is that of *Richeut,* which dates from 1159. This is a rough and powerful study of the coarse life of the day, with little plot, but engaged with a realistic picture of manners. Such poems, but of a more strictly narrative nature, continued to be produced, mainly in the north and northeast of France, until the middle of the 14th century. It does not seem probable that any ancient or exotic influences were brought to bear upon the French jongleurs, who simply invented or adapted stories of that universal kind which springs unsown from every untilled field of human society. More remarkable than the narratives themselves is the spirit in which they are told. This is full of the national humour and the national irony, the true *esprit gaulois.* A very large section of these popular poems deals satirically with the pretensions of the clergy. There are also tales whose purpose is rather voluptuous than witty, and whose aim is to excuse libertinage and render marriage ridiculous. Among these are prominent *Court Mantel* and *Le Dit de Berenger.* Yet another class repeated, with a strain of irony or oddity, such familiar classical stories as those of Narcissus, and Pyramus and Thisbe.

The object of the writers was the immediate amusement of their audience; by reference to familiar things, they hoped to arouse a quick and genuine merriment. Hence in the fabliaux we get closer than elsewhere to the living diction of mediaeval France. Such scholars as Gaston Paris and Paul Meyer have praised, in the general laxity of style and garrulity of the middle ages, the terseness of the jongleurs; in the period of false ornament, their fidelity to nature; in a time of general vagueness, the sharp and picturesque outlines of their art. One feature of the fabliaux, however, cannot be praised and yet must not be overlooked. In no other section of the world's literature is the scorn and hatred of women so prominent. It is difficult to account for the antifeminine rage which pervades the fabliaux, and takes hideous shapes in such examples as *Le Valet aux deux femmes, Le Pêcheur de Pont-sur-Seine* and *Chicheface et Bigorne.* Probably this was a violent reaction against the extravagant cult of woman as expressed in the contemporary *lais* as well as in the legends of saints. We must remember, too, that those who listened were not nobles or clerks, they were the common people. The fabliaux were *fabellae ignobilium,* little stories told to amuse persons of low degree, who were irritated by the moral pretensions of their superiors.

The names of about 20 of the authors of fabliaux have been preserved, although in most cases nothing is known of their personal history. The most famous is the man uhose name, or more probably pseudonym, was Rutebeuf. He wrote *Frère Denyse* and *Le Sacristain,* while to him is attributed the *Dit d'Aristote,* in the course of which Aristotle gives good advice to Alexander. Fabliaux, however, form but a small part of the work of Rutebeuf, who aas a satirical poet of wide accomplishment and varied energy. Henri d'Andeli was an ecclesiastic, attached, it is supposed, to the cathedral of Rouen. Jean de Condé, who flourished in the court of Hainaut from 1310 to 1340, and who is the latest of the genuine writers of fabliaux, lived in comfort and security, but most of the professional jongleurs seem to have spent their years in a Bohemian existence, wandering among the clergy and the merchant class, alternately begging for money and food and reciting their mocking verses.

BIBLIOGRAPHY.—The principal authorities for the fabliaux are Anatole de Montaiglon and Gaston Raynaud, who published the text, in 6 vols., between 1872 and 1890. This edition supplemented the labours of Méon (1808–23) and Jubinal (1839–42). The works of Henri d'Andeli were edited by A. Heron in 1880, and those of Rutebeuf by Lion Clédat in 1891. *See* also the editions of separate fabliaux by Gaston Paris, Paul Meyer, C. D. Ebeling, August Schéler and other modern scholars. Joseph Bedier's *Les Fabliaux* (1925) is a useful summary of critical opinion on the entire subject.

FABRE, FERDINAND (1827–1898), French novelist who may be said to have founded the French regional novel with his studies of country life that seem to spring from the very soil of the Cévennes, was born at Bédarieux, Hérault, June 9, 1827. Brought up by his uncle, a country cure, he was sent to the seminary of Saint-Pons but, having no vocation, he began to write poems and went to Paris, where his *Feuilles de lierre* (1853) attracted attention. Illness sent him back to the country, where he wrote *Les Courbezon* (1862), describing the life of a country priest in the Cevennes. Of a score of similar novels—including *Julien Savignac* and *Mdlle de Malavielle* (1563) ; *Le Chevrier* and *Scènes de la vie rustique* (1868) ; *Barnabé* (1874) ; *Mon oncle Célestin* (1881) ; and *Lucifer* (1884)—the masterpiece is *L'Abbé Tigrane* (1873), which tells the story of an ambitious priest. who intrigues his way to a cardinalate, with such dispassionate realism that it mas attacked both by the church and by anticlericals. Fabre was appointed keeper of the Bibliothèque Mazarine in 1883 and died in Paris. Feb. 11, 1898. (R. DL.)

FABRE, JEAN HENRI (1823–1915), French entomologist who performed early research into animal behaviour, was born at St. Léons in Aveyron on Dec. 21, 1823. He taught successively at Carpentras, at the college of Ajaccio. Corsica, and in 1552 at the *lycée* of Avignon. Meanwhile he had taken his doctor's degree in Paris, devoting himself to the study of the life history, habits and instincts of insects, his sole occupation after his retirement to Serignan in 1871.

All his work was based on direct observation. Although the ways of all insects interested him, his attention was given chiefly to the Hymenoptera, Coleoptera and Orthoptera, as well as to spiders. Of the first: the wasps, with their skill in stinging their prey in the region of the nervous ganglia so as to paralyze it and preserve it living as food for their young, seemed to Fabre to show an intelligence irreconcilable with the theory of fixed habits. Other researches led him to oppose the theory of evolution. His observations and deductions concerning the relation between the animal and the human mind, and between entomology and agriculture, are detailed in *Annales des sciences naturelles* (1855–58) and in the 10 volumes of *Souvenirs entomologiques* (1879–1907; Eng. trans. by De bfattos. 1912 *et seq.*), which was crowned by the Institute of France. He was a member of many academies and scientific societies.

Fabre died at Sérignan, Provence, on Oct. 11, 1915.

See also BEE and INSECTS.

See A. Fabre, *Jean-Henri Fabre* (Eng. trans., 1921) ; C. V. Lepros, *Fabre, Poet of Science* (Eng. trans., 1913) ; and P. F. Bicknell, *The Human Side of Fabre* (1923).

FABRE D'ÉGLANTINE, PHILIPPE FRANÇOIS NAZAIRE (1750–1794). French dramatist and a prominent figure in the Revolution, mas born at Carcassonne in July 1750, the son of a draper. He added to his surname Fabre the appellation "d'Églantine," claiming without justification that he had won a golden eglantine in a literary competition organized by the academy of floral games at Toulouse. After publishing a poem, *L'Étude de la nature* (1783), dedicated to Buffon, he wrote a large number of comedies, the most celebrated being *Le Philinte de Molière* (1790), a self-styled sequel to Molière's *Le Misanthrope*, showing Philinte as a politically dangerous aristocrat and Alceste as a virtuous republican. Fabre's best-known work is the famous song, "Il pleut, il pleut, bergère." He was an energetic revolutionary, a close associate of Danton and Camille Desmoulins, a deputy in the National Convention and a member of the committee of public safety. He voted for the execution of Louis XVI, supporting his opinion with quotations from Rousseau. In spite of his meagre astronomical competence, he was *rapporteur* of the committee which drew up the republican calendar and was personally responsible for some of the nomenclature. Arrested on a charge of forgery in connection with the Compagnie des Indes, he was sentenced to death and guillotined on April 6, 1794. Opinion about his innocence has remained divided) but modern judgment denies it.

BIBLIOGRAPHY.—His *Oeuvres [dramatiques] choisies* mere edited by C. Nodier and P. Lepeintre (1824). His *Oeuvres politiques* were edited by C. Vellay (1914). *See* also C. Lenient, *La Comédie en France au XVIII^e siècle* (1888) ; H. d'Alméras, *Fabre d'Églantine* (1905) ; A. Mathiez, *Un Procès de corruption sous la Terreur. L'Affaire de la Compagnie des Indes* (1920) ; J. M. Thompson, *Leaders oj the French Revolution* (1929) ; L. Jacob, *Fabre d'Églantine* (1946). (RT. S.)

FABRIANO, GENTILE DA: *see* GENTILE DA FABRIANO.

FABRIANO, a town and episcopal see of the bfarche, Italy, province of Ancona, from which it is 44 mi. S.W. by rail, 1,066 ft. above sea level. Pop. (1951) 12,409. It has been noted from 1276 for its paper mills. A number of the churches, several of which are of the 13th century, contain works by Allegretto Nuzi (1308–85) and other local masters. His pupil Gentile da Fabriano (1370–1427) was a painter of greater skill.

The medieval Palazzo del Podestà (13th century) is picturesque, and there are other interesting buildings. The municipal picture gallery also contains an interesting collection of pictures. The Archivio Comunale contains documents on watermarked paper of local manufacture going back to 1293–94. Cement, pottery and vats are also made. A branch railway leads from Fabriano to Urbino (*q.v.*).

FABRICIUS, GAIUS LUSCINUS (*i.e.*, "the one-eyed"), Roman general, mas the first member of the Fabrician gens who settled in Rome. He migrated to Rome from Aletrium (Livy ix, 43). In 285 he was one of the ambassadors sent to the Tarentines to dissuade them from making war on the Romans. In 282 B.C. (when consul) he defeated the Bruttians and Lucanians, who had besieged Thurii (Livy. *Epit.* 12). After the defeat of the Romans by Pyrrhus at Heraclea in 280, Fabricius was sent to treat for the ransom and exchange of the prisoners. All attempts to bribe him were unsuccessful, and Pyrrhus is said to have been so impressed that he released the prisoners without ransom (Plutarch, *Pyrrhus*, 18).

In 278 Fabricius was elected consul for the second time and was successful in negotiating terms of peace with Pyrrhus. Fabricius afterward gained a series of victories over the Samnites, the Lucanians and the Bruttians, and on his return to Rome received a triumph. He died poor, and provision had to be made for his daughter out of the funds of the state (Val. Max. iv, 4. 10).

FABRICIUS, JOHANN ALBERT (1668–1736). German classical scholar and bibliographer, was born at Leipzig. His father. Werner Fabricius, director of music in the church of St. Paul at Leipzig. was the author of several works, the most important being *Deliciae Harmonicae* (1656). Johann Albert studied under J. G. Herrichen and afterward at Quedlinburg under Samuel Schmid. At Leipzig he published anonymously (1688) his first work. *Scriptorum recentiorum decas*, an attack on ten writers of the day. His *Decas Decadum, sive plagiariorum et pseudonymorum centuria* (1689) is the only one of his works to which he signs the name Faber.

In 1693 Fabricius settled at Hamburg as librarian to J. F. Mayer. In 1696 he accompanied his patron to Sweden; and in 1699 succeeded Vincent Placcius in the chair of rhetoric and ethics, a post which he held till his death.

Fabricius is credited with 128 books. but very many of them were only books which he had edited. One of the most famed and laborious of these is the *Bibliotheca Latina* (1697, republished in an improved and amended form by J. A. Ernesti, 1773). The divisions of the compilation are, first, the writers to the age of Tiberius; second, thence to that of the Antonines; and third, to the decay of the language; a fourth gives fragments from old authors and chapters on early Christian literature. A supplementary work was *Bibliotheca Latina mediae et infimae Aetatis* (1734–36; supplementary volume by C. Schottgen, 1746. edited by Mansi, 1754). His *chef d'oeuvre*, however, is the *Bibliotheca Graeca* (1705–28, revised and continued by G. C. Harles, 1790–1812), a work which has justly been denominated *maximus antiquae eruditionis thesaurus*. Its divisions are marked off by Homer, Plato, Christ, Constantine, and the capture of Constantinople (1453), while a sixth section is devoted to canon law, jurisprudence and medicine.

Of his remaining works we may mention *Bibliotheca Antiquaria*, an account of the writers whose works illustrated Hebrew, Greek, Roman and Christian antiquities (1713); *Centifolium Lutheranum*, a Lutheran bibliography (1728); *Bibliotheca Ecclesiastica* (1718). His *Codex Apocryphus* (1703) is still considered indispensable as an authority on apocryphal Christian literature.

The details of the life of Fabricius are to be found in *De Vita et Scriptis J. A. Fabricii Commentarius* (1737), by his son-in-law, H. S. Reimarus, the well-known editor of Dio Cassius; *see* also C. F. Bahr in Ersch and Gruber's *Allgemeine Encyklopadie*, and J. E. Sandys, *Hist.* Class *Schol.*, iii (1908).

FABRICIUS, JOHANN CHRISTIAN (1745–1808). Danish entomologist and economist, whose scientific reputation rested upon the system of classification which he founded upon the structure of the organs of the mouth instead of the wings. He was born at Tondern, Jan. 7, 1745. He studied at Altona and Copenhagen and at Uppsala under Linnaeus. In 1769 he lectured on political economy and in 1775 was appointed professor of natural history, economy and finance at Kiel.

Fabricius died March 3, 1808. It is as an entomologist that his memory survives.

FABRICIUS AB AQUAPENDENTE, HIERONYMUS (GERONIMO or GIROLAMO FABRIZIO or FABRICI) (1537–1619), Italian anatomist and embryologist, one of the founders of modern embryology, studied at Padua, where he succeeded his master, Gabriel Fallopius, as teacher of anatomy and surgery, on the latter's death in 1562. Fabricius' studies of the effect of ligatures and the valves in the veins influenced the discoveries of his famous pupil, William Harvey. Fabricius was greatest as a teacher; he failed to follow his own discoveries to their logical conclusion. He died at Padua on May 21, 1619.

Fabricius' collected works were published at Leipzig in 1687 as *Opera omnia Anatomica et Physiologica*, but the Leyden edition, published by Xlbinus in 1738, is more complete.

FABRITIUS, CAREL (1624?–1654), Dutch painter whose few surviving works reveal an artist of great power. The date and place of his birth are unknown. From a description of Delft dated 1667, stating that he was killed in an explosion at Delft on Oct. 12, 1654, at about 30 years of age, it is inferred that he was born about 1624. He was a pupil of Rembrandt and appears as a serious and cultivated artist in the conversation on art of Rembrandt's pupils as reported by S. D. van Hoogstraten. In 16jo he married Agathe van Pruyssen, a widow in Delft, and in 1652 he entered the painters' guild in that city.

He was a master of the first rank, an independent spirit who did not lose his own individuality while studying under the great Rembrandt. He seems to have first established a reputation in painting mural decorations with views of architecture in perspective. But of these works nothing remains.

The earliest extant work is the hali-length portrait of Abraham de Notte in the Rijks museum at Amsterdam. Dated 1640, it is the work of a mature artist. A portrait of a man in the museum at Rotterdam was attributed to Rembrandt until the signature of Fabritius was discovered. The National gallery, London, has a splendid hali-length portrait of a soldier. In the same collection is the picture of "A Musical Instrument Dealer With a View of Delft." The museum at Schwerin contains "The Sentinel," dated 1654, and the Ferdinandeum at Innsbruck the picture of "Tobias and His Wife." In the Mauritshuis at The Hague is the famous "Goldfinch," signed and dated 1654. In distinction to Rembrandt, whose figures emerge modeled by the action of light from a dark background, the figures of Fabritius are silhouetted against a light background, a scheme which was adopted and developed by Fabritius' pupil, Jan van Delft Vermeer.

FABRIZI, NICOLA (1804–1885), Italian patriot, was born at Modena on April 4, 1804 He took part in the Modena insurrection of 1831, and attempted to succour Ancona, but was arrested at sea and taken to Toulon, whence he proceeded to Marseilles. Afterward he organized with Mazzini the ill-fated Savoy expedition. Taking refuge in Spain, he fought against the Carlists, and was decorated for valour on the battlefield (July 18, 1837) At the end of the Carlist war he established a centre of conspiracy at Malta, endeavoured to dissuade Mazzini from the Bandiera enterprise, but aided Crispi in organizing the Sicilian revolution of 1848. He took part in the defense of Venice and of San Pancrazio. Upon the fall of Rome he returned to Malta, accumulating arms and stores, which he conveyed to Sicily, after having, in 1859, worked with Crispi to prepare the Sicilian revolution of 1860. While Garibaldi was sailing from Genoa toward Marsala, Fabrizi landed at Pizzolo, and after severe fighting joined Garibaldi at Palermo. Under the Garibaldian dictatorship he was appointed governor of Messina and minister of war. Returning to Malta aiter the Neapolitan plebiscite, which he had vainly endeavoured to postpone, he was recalled to aid Cialdini in suppressing brigandage. While on his way to Sicily in 1862, to induce Garibaldi to give up the Aspromonte enterprise, he was arrested at Naples by Lamarmora. During the war of 1866 he became Garibaldi's chief of staff, and in 1867 fought at Mentana. In parliament he endeavoured to promote agreement between the chiefs of the left, and from 1878 onward worked to secure the return of Crispi to power, but died on March 31, 1885, two years before the realization of his object. His life was characterized by ardent patriotism and unimpeachable integrity. (H. W. S.)

FABYAN, ROBERT (d. 1513). English chronicler, belonged to an Essex family, members of which had been connected with trade in London. He married Elizabeth Pake, by whom he had a large family. He was a member of the Drapers' company, and served as sheriff in 1493–94. In 1496 he was one of those appointed to make representations to the king on the new impositions on English cloth in Flanders. Next year he was one of the aldermen employed in keeping watch at the time of the Cornish rebellion. He resigned his aldermanry in 1502, and spent his latter years on his estate in Essex. He died on Feb. 28, 1513.

Fabyan's Chronicle was first published by Richard Pynson in 1516 as *The New Chronicles of England and of France*. In this edition it ends with the reign of Richard III, and this probably represents the work as Fabyan left it, though with the omission of an autobiographical note and some religious verses, which are first found in the second edition, printed by John Rastell in 1j33 with continuations down to 1509 A third edition appeared in 1542, and a fourth in 1559 with additions to that year. The only modern edition is that of Sir Henry Ellis, 1811. There is evidence that Fabyan had continued his Chronicle to 1511, but no trace of the manuscript can be found.

Fabyan's own merits are little more than those of an industrious compiler, who strung together the accounts of his different authorities without any critical capacity. Nevertheless he deserves the praise which he has received as all early worker, and for having made public information which through Hall and Holinshed has become the common property of later historians, and has only recently been otherwise accessible. John Bale alleges that the first edition was burned by order of Cardinal Wolsey because it reflected on the wealth of the clergy; this probably refers to his version of the Lollards bill of 1410, which Fabyan extracted from one of the London Chronicles.

FACCIOLATI, JACOPO (1682–1769), Italian philologist, was born at Torriglia, near Padua, on Jan. 4, 1682. As professor of logic and regent of the schools, Facciolati was for 45 years the outstanding teacher of the seminary of Padua. He died at Padua on August 26, 1769.

His magnum opus is the *Totius Latinitatis Lexicon* (4 vol., 1771; rev. ed. by De Vit, 1858–87). In the compilation of this work the chief burden seems to have been borne by Facciolati's pupil Egidio Forcellini. It has been said that the whole body of Latinity, if it were to perish, might be restored from this lexicon. In 1808 a volume containing nine of Facciolati's *Epistles* was issued at Padua.

FACE, a term anatomically denoting the front part of the head, which, in the higher animals with backbones (vertebrates), houses the sense organs oi vision and smell as well as the mouth and jaws.

During evolution from prehuman, apelike forms to modern man (Homo *sapiens*), the iace became smaller in relation to the over-all size of the head. While brain and brain case (cranium) nearly doubled in volume, the jaws became shorter and the teeth simpler in form and smaller in size. In consequence the face receded beneath the forehead. Thus modern man exhibits an essentially vertical profile, in marked contrast to the protruding snout or facial muzzle of the gorilla, the chimpanzee and, to a lesser extent, such extinct forms of early man as Java and Peking man. The recession of the tooth-bearing portion of the jaws beneath the forehead left two distinctively human features: a prominent, projecting nose and a clearly defined chin.

The reduction in size of the face is usually attributed to the development of intelligence, which made possible the making and use of tools and weapons that, in turn. eliminated any advantage from the possession of large, tusklike teeth; and also to the acquiring of erect posture. which favoured forms with smaller, less protruding faces, since in these forms the head is more easily balanced on the vertical spine.

The facial features characteristic of the major physical groupings of mankind (Caucasoid, Mongoloid: Segroid) resulted from the same evolutionary processes responsible for creating racial differences generally within the species.

Typically. the Caucasoid face is long. with width ranging from narrow to medium broad; the nose is prominent. the bridge high; the lips are thin; facial hair in the male is abundant; and the contour of the profile ranges from straight to convex. The Mongoloid face tends to be moderately long and very broad, with prominent cheekbones and a wide jaw; the nose is moderately wide. the bridge low; the inner corner of the eye is covered by a skin fold (epicanthus); facial hair is sparse; the contour of the prohle tends to be flat and straight. The Segroid face tends to be short and narrow; the nose broad, the bridge low; the lips are thick; facial hair is sparse; and the jaws protrude, creating a forward-slanting profile.

Facial traits are not exclusive to any one grouping; for example, some Caucasians have wider noses than some Negroes. In evolutionary advancement, each major grouping possesses "primitive" as well as "advanced" traits. Thus the protruding jaws of the Negro are a "primitive" trait, the thick everted lips an "advanced" trait.

In individual development, face and brain case follow difierent patterns of growth. The brain and brain case attain 90% of adult size by the age of six years, while the face grows more slowly in concurrence with the enlargement of the nasal passages and the eruption of both sets of teeth. Viewed in profile. the face at birth is less than one-fifth the size of the brain case; by adulthood it has increased to nearly one-half. Facial dimensions increase most in depth. next in height (length) and least in width. The more sturdy appearance of the male face, as compared with the delicate features of the female face, is produced by the greater development of facial musculature and the enlargement of the facial sinuses in adolescence.

A research technique widely adopted after 1931, consisting of the use of serial X-ray pictures of the living subject, permits a more exact investigation of facial growth changes than was possible with caliper measurements. With this technique, measurements of different facial dimensions can be taken directly from the X-ray film and compared at several stages of development. Data bearing on facial growth in man have been gathered also through investigations of bone growth in animals. In such studies normal growth may be interfered with surgically, or dyes may be injected to stain the living bone to show areas and extent of growth. See also PHYSIOGNOMY; SKULL; RACES OF MANKIND.

(M. J. BR.)

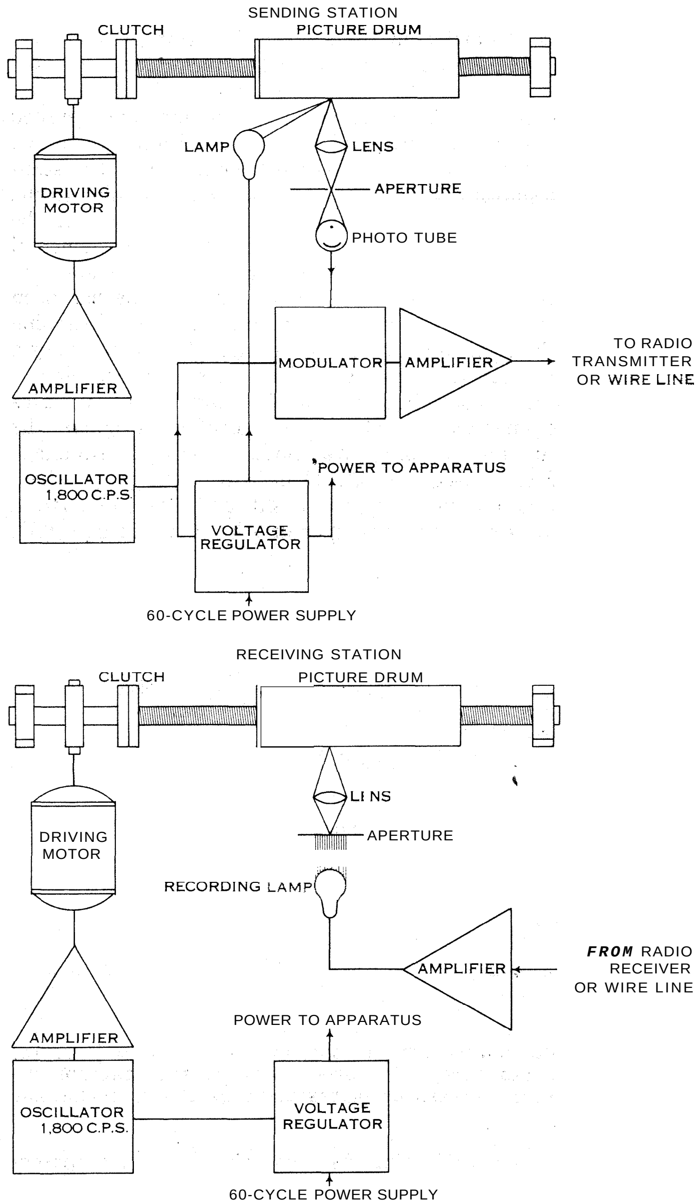
FACILITATION, a term used in neurology to designate the favourable influence exerted over a conduction path by the passage of an impulse having an identical end effect with the impulse favoured. This facilitation of one nerve impulse by another may be successive or simultaneous. Activation of any reflex path leaves that path in a more favourable "set" for subsequent repetitions of the same response. Subliminal stimuli, simultaneously applied, may facilitate one another sufficiently to produce an overt response if these impulses are allied in a final common path. Facilitation probably occurs at the synapse. The facilitating influence exercised by one impulse on another is generally known as bahnung.

See C. S. Sherrington, *Integrative Action* of *the Nervous System.*

FACSIMILE TRANSMISSION, the electrical transmission of pictures, maps and other printed matter. dates from the work of Alexander Bain, who outlined the principles in a British patent in 1843. Arthur Korn in Germany and Edouard Belin in France were outstanding European contributors, while in the Cnited States major advances were made by Maurice Artzt. Austin G. Cooley, John V. L. Hogan, Pierre Mertz, Raleigh J. Wise, Charles J. Young and many others.

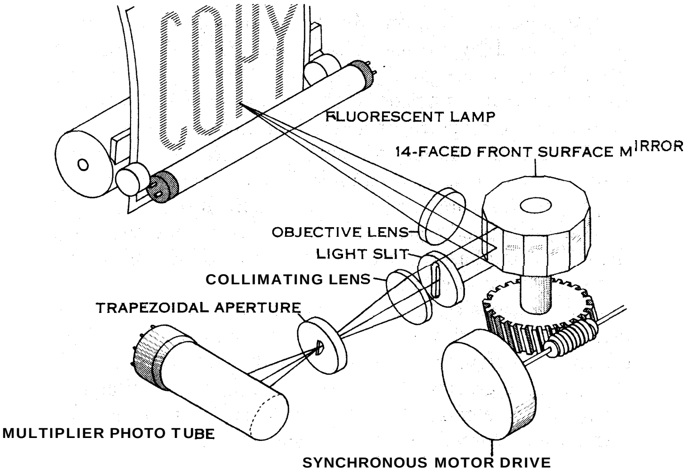
Many different equipment designs have been proposed, but practically all are based on the scanning of the original copy, one elemental area at a time, and representing the shade or tone of each area by a specified amount of electric current; this current then is used at the receiver to reproduce an image of the elemental area in the proper relative position and the correct shade of gray. The original is scanned by optical means, but recording may be accomplished by exposure of light-sensitive film, by electrothermal methods, by electrolytic action or through the use of carbon paper.

Fig. 1 is a block diagram of a telephotograph system typical of those used for transmission of news photographs. The original photograph is placed on the sending picture drum and unexposed photographic film on the receiving drum. Both drums are rotated at a very constant speed controlled by oscillators. and their rotation is synchronized or phased; that is, the edges of the film pass the recording position at the same time the edges of the original photo pass the scanning position. The lens and aperture combined with the rotational and axial movement of the sending drum dissect the picture into small elemental areas which are scanned one at a time. The photo tube converts the varying amounts of reflected light into corresponding electrical signals which are sent to the receiving station and there converted by the recording lamp, aperture and lens into a spot of light of proper intensity. Thus the film on



BY COURTESY OF BELL TELEPHONE LABORATORIES

FIG. 1.—TELEPHOTOGRAPH OR FACSIMILE TRANSMISSION SYSTEM the receiving drum is exposed, one elemental area at a time, until the whole picture is recorded. For wire line transmission a sending filter and delay equalizer give the signal the optimum wave form while a receiving filter blocks some of the incoming unwanted



BY COURTESY OF TIMES FACSIMILE CORP

FIG. 2.— FACSIMILE SCANNER OF THE ROTARY-MIRROR TYPE

noise to reduce distortion in the signal. For transmission over radio circuits, frequency-modulation (FM) techniques are used (see RADIO).

A significant advance in transmitting photographs and detailed graphic data was achieved by employing Polaroid film, which can be developed without the use of darkroom equipment. The scanning method is shown in fig. 2. A fluorescent lamp illuminates the original picture, and the lens and mirror focus an image of the original on the aperture plate. As the mirror rotates, one elemental area after another of one scanning line is presented to the aperture and then to the photo tube. When one complete line has been scanned, the next face of the mirror is in position to start scanning the next line, the original copy having advanced by the height of a line. The same technique can be used for facsimile recording.

Another form of continuous scanner is shown in fig. 3. This is an exploded view and actually the image of the original; the coarse spiral, slit and fine spiral are as close as practical. An image of the original is focused (fig. 3[A]) on a scanning plane where the intersections of the transparent slit and five transparent turns of the fine spiral form five apertures as shown in fig. 3(B).

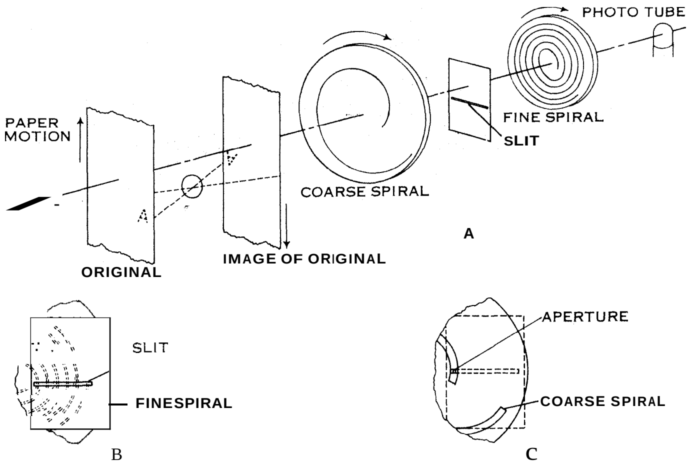


FIG. 3.— CONTINUOUS-FEED SCANNER SHOWING (A) EXPLODED VIEW; (B) DETAIL OF SLIT AND FINE SPIRAL WITH COARSE SPIRAL REMOVED; (C) DETAIL OF APERTURE FORMED BY INTERSECTION OF COARSE SPIRAL AND SLIT

However, the coarse scanning disk, containing one transparent spiral, is actually in front of the scanning plane, as shown in fig. 3(C), and the image reaches only one of the five apertures. The use of the fine spiral instead of a single-turn spiral improves scanning detail and minimizes a defect known as "jitter" which tends to make straight lines appear jagged.

In addition to photographic facsimile recorders, there is a large group of direct recorders, so named because a visible copy is produced during the recording process without need for subsequent photographic developing. Electrothermal. electrolytic or pigment transfer methods are usually used. The electrothermal process consists in the burning away of a white surface of a special recording paper. exposing a black subsurface. as current is passed through the paper. This type of facsimile recorder is used for transmission of telegrams, railroad ticket reservations and weather charts.

Electrolytic recorders depend upon chemical change as current is passed through an electrolyte impregnated in the recording paper. This change may utilize the metal of the electrode or may use chemicals entirely within the electrolyte. A helix wire wrapped around a drum in front of the paper and a straightedge behind the paper provide a traveling intersection of electrodes as the drum revolves. This type of recorder is often used as a monitor, enabling newspaper editors at their desks to view photos that are being received simultaneously in the darkrooms and to make a rapid selection of pictures to use in a newspaper edition.

Carbon paper recorders may be thought of as utilizing pigment transfer. Until the middle 1940s such recorders were extremely difficult to adjust and recording speed was slow. However. an improved system was developed using three recording heads mounted on a continuous belt. Carbon paper and ordinary paper feed from rolls. and marking takes place when the recording stylus applies pressure to the carbon paper.

Facsimile machines have been made which transmit a letter-size page in a fraction of a second. The operating speed for most facsimile equipment, however, is limited by the electrical characteristics of the circuit used for transmission. In most cases this is equivalent in signal-carrying capacity to a voice circuit but is specially designed to transmit a signal with minimum distortion. A typical picture machine operating over such a circuit might have the following characteristics: 96 scanning lines per inch, a rectangular elemental scanning area $\frac{1}{96} \times \frac{1}{138}$ in., 90 scanning lines per minute, copy size $8\frac{1}{2} \times 7$ in., transmission time about $7\frac{1}{2}$ min. (H. F. B.)

FACTOR, strictly "one who makes"; thus, in ordinary parlance, anything which goes to the composition of anything else is termed one of its "factors," and in mathematics the term is used of those quantities which, when multiplied together, produce a given product.

In a special sense, however—and that to which this article is devoted—"factor" is the name given to a mercantile agent (of the class known as "general agents") employed to buy or sell goods for a commission. When employed to sell the possession of the goods is entrusted to him by his principal, and when employed to buy it is his duty to obtain possession of the goods and to consign them to his principal. In this he differs from a broker (*q.v.*), who has not such possession, and it is this distinguishing characteristic which gave rise in England to the series of statutes known as the Factors Acts. By these acts, consolidated and extended by the act of 1889. third parties buying or taking pledges from factors are protected as if the factor were in reality owner; but these enactments have in no way affected the contractual relations between the factor and his employer, and it will be convenient to define them before discussing the position of third parties as affected by the act.

Factor and Principal

A factor may be appointed or he may be dismissed in the same way as any other agent. He may be employed for a single transaction or to transact all his principal's business of a certain class during a limited period or till such time as his authority may be determined. It does not matter that a factor carries on a separate business on his own account. either of. the same kind as that in which he is employed as factor, or of some other kind. A factor's duty is to sell or buy. as directed; to carry out with care, skill and good faith any instructions he may receive; to receive or make payment; to keep accounts and to render them to his principal regularly, or when requested to do so, and to hand over to his principal the balance standing to his principal's credit, without any deduction save for commission and expenses. A factor is bound to account for any moneys he receives for his principal, and if between receiving it and paying it over, the money is lost (as for instance if the factor deposited it with a banker who became insolvent), the loss must be borne by the factor. All express instructions he must carry out to the full. and generally speaking literally, provided they do not involve fraud or illegality, but under circumstances of emergency he may deviate from his instructions (as for instance when goods are perishing) and if in so doing he exercises reasonable and proper skill and care he will not be liable for any loss there may ensue. Where he is not given any express instructions, or on any point not covered by these, he must act bona fide and to the best of his skill and judgment. and he is bound to follow the usual practice of his particular business and any usages of the trade which may exist, if not inconsistent with his instructions or his position as factor, or unless. to a man of ordinary prudence, it would be manifestly disadvantageous to his employer's interests to do so. Many usages of businesses in which factors are employed have been proved in court, and may now be regarded as legally established. For instance, he may, unless otherwise directed. sell in his own name, and (apart from any express limit) at such price as to the best of his judgment he thinks proper, give warranties as to goods sold by him, sell by sample (in most businesses), give such credit as is usual in his business. receive payment in cash or as customary, and give receipts in full discharge, sell by indorsement of bills of lading, and insure the goods. He is not bound to insure goods unless to do so is according to the course of business with his principal. If he does effect an insurance he must see that all necessary risks are covered, satisfy himself as to the solvency of the underwriters. and disclose to them all material facts relating to the risk to be undertaken by them. It is his duty to clear the goods at the customs. take charge of them and keep them as safely as reasonable care and diligence will permit: give such notices to his principal and others as may be required, and in particular give punctual notice to his principal of all matters by which the rights or interests of the principal may be affected, as for instance the insolvency of a customer, or failure to effect an insurance. and if necessary take legal proceedings for the protection of the goods. On the other hand, he has not authority to delegate his employment, unless by usage of the trade or by express permission, or to barter, or to accept or negotiate bills of exchange except by authority of his principal and as between himsclf and his principal he has no right to pledge the goods, although as between the principal and the pledgee, an unauthorized pledge made by the factor may by virtue of the Factors Act 1889 be binding upon the principal. In the same way a factor has of course no right as between himself and his principal to sell goods in contravention of his principal's instructions, although as between his principal and the purchaser the sale may be binding upon the principal, It is, moreover. inconsistent with the factor's employment as agent that he should buy or sell on his own account from or to his principal.

On the due performance of his duties the factor is entitled to his commission, which is usually a percentage on the value of the goods sold or bought by him on account of his principal, regulated in amount by the usages of each business or by express agreement. Failing that, or any usage in the trade, the factor is entitled to a "reasonable" sum as commission. Sometimes the factor makes himsclf personally responsible for the solvency of the persons with whom he deals. in order that his principal may avoid the risk entailed by the usual trade credit. In such a case the factor is said to be employed on *del credere* terms, and is entitled to a higher rate of commission, usually $2\frac{1}{2}\%$ extra. Such an arrangement is not a contract of guarantee within the Statute of Frauds, and therefore need not he in writing. Besides his remuneration, the factor is entitled to be reimbursed by his principal for any expenses, and to be indemnified against any liabilities which he may have properly incurred in the execution of his principal's instructions. He cannot as a rule recover for any expenditure which is not expressly or impliedly covered by his instructions but he may do so in case of emergency if it is reasonable and in his employer's interests. For the purpose of enforcing his rights a factor has, without legal proceedings, two remedies. First, by virtue of his general *lien* (*q.v.*) he may hold any of his principal's goods which come lawfully to his hands in the course of his agency as security for the payment to him of any commission, out-of-pocket expenses, or even general balance of account in his favour, and in virtue of his particular lien he may hold any particular chattel in respect of which he has incurred expense. He may not sell the goods unless they have been entrusted to him for sale. in which case he may sell and claim a lien on the price. He can pledge the goods to the extent of his lien but no further. and exercise a lien on the money so raised. and by virtue of the Factors Acts the principal will not be able to recover the goods from the pawnbroker except by discharging the advance made by him The lien is lost if the goods are improperly sold or pledged, or the possession of them is parted with, or the factor takes security from his principal for the debt, or enters into any special arrangement with him, such as to give him credit Secondly, when by contracting in his own name he has rendered himself personally liable to pay for goods he has bought for his principal, and where he has consigned goods to his principal but not been paid, he may *"stop in transit"* subject to the same rules of law as an ordinary vendor; that is to say. he must exercise his right before the transit ends; and his right may be defeated by his principal transferring the document of title to the goods to some third person, who takes it in good faith and for valuable consideration (Factors Act 1839, and Sale of Goods Act 1893, s. 47). If the factor does not carry out his principal's instructions, or carries them out so negligently or unskilfully that his principal gets no benefit thereby, the factor loses his commission and his right to reimbursement and indemnity. If by such failure or negligence the principal suffers any loss, the latter may recover it as damages So too if the factor fails to render proper accounts his principal may by proper legal proceedings obtain an account and payment of what is found due; and threatened breaches of duty may be summarily stopped by an injunction. "An action will of course lie against a *del credere* agent for the price of goods sold to a purchaser who has failed to make payment." Criminal acts by the factor in relation to his principal's goods are dealt with by ss. 20 and 22 of the Larceny Act 1916.

PRINCIPAL AND THIRD PARTY

The rights of a third party as regards the power of a factor to bind his principal have been well-established at common law and amplified in the provisions of a special act.

(*a*) *At Common Law.*—The actual authority of a factor is defined by the same limits as his duty. the nature of which has been described; *i.e.*, firstly. by his principal's express instructions; secondly. by the rules of law and usages of trade. in view of which those instructions were expressed But his power to bind his principal as regards third parties is often wider than his actual authority; for it would not be reasonable that third parties should be prejudiced by secret instructions. given in derogation of the authority ordinarily conferred by the custom of trade; and, as regards them, the factor is said to have *"apparent"* or *"ostensible"* authority, or to be *held out* as having authority to do what is customary, even though he may in fact have been expressly forbidden so to do by his principal. But this rule is subject to the proviso that if the third party have notice of the factor's actual instructions, the "apparent" authority will not be greater than the actual. "The general principle of law." said Lord Blackburn in the case of *Cole* v. *North-Western Bank*, 1875, *LR.* 10, C.P.363, "is that when the true owner has clothed any one with apparent authority to act as his agent. he is bound to those who deal with the agent on the assumption that he really is an agent with that authority, to the same extent as if the apparent authority were real " Cnder such circumstances the principal is for reasons of common fairness precluded. or, in legal phraseology, *estopped,* from denying his agent's authority. On the same principle of estoppel. but not by reason of any trade usages, a course of dealing which has been followed between a factor and a third party with the assent of the principal will give the factor apparent authority to continue dealing on the same terms even after the principal's assent has been withdrawn; provided that the third party has no notice of the withdraual.

Such apparent authority binds the principal both as to acts done in excess of the actual authority and also when the actual authority has entirely ceased For instance, A. B receives goods from C D with instructions not to sell below 1s per lb ; A B sells at 10½d the market price; the buyer is entitled to the goods at 10½d because A B had apparent authority, although he exceeded his actual authority. On the same principle the buyer would get a good title by buying from A. B. goods entrusted to him by C D. even though at the time of the sale C. D had revoked A. B.'s authority and instructed him not to sell at all. In either case the factor is held out as having authority to sell, and the principal cannot afterwards turn round and say that his factor had no such authority. As in the course of his business the factor must necessarily make representations preliminary to the contracts into which he enters, so the principal will be bound by any such representations as may be within the factor's actual or apparent authority to the same degree as by the factor's contracts.

(b) Under the Factors Act, 1889.—The main object of the Factors Acts, in so far as they relate to transactions carried out by factors, has been to add to the number of cases in which third parties honestly buying or lending money on the security of goods may get a good title from persons in whose possession the goods are nith the consent, actual or apparent, of the real owners, thus calling in aid the principle of French law that "*possession vaut titre*" as against the doctrine of the English common law that "*nemo dat quod non habet.*" As regards sales by factors and the title which purchasers thereby acquire against the principal, the Factors Acts are mainly declaratory of the common law as stated above, but with this difference, that whereas at common law it was always an open question of fact to be determined by the court whether the principal had in truth held out his agent as having authority to effect the sale, the effect of the Factors Acts is that the principal is *deemed* to have authorized the agent by the fact of entrusting him with the goods. Under the act of 1889 it can be put even higher, and the agent is deemed to have authority by the mere fact of having the goods in his possession with the owner's consent, although there is no evidence of the owner having actually 'entrusted' them to him; the owner's 'consent' being presumed in the absence of evidence to the contrary (*Oppenheimer* v. *Attenboroztgh,* 1908, 1 K.B. 221, C.A ; *Oppenhcimer* v. *Frazer and Wyatt,* 1907, 2 K.B. 50, C.A.) The chief change, however, in the law relating specially to factors has been to put pledges by factors on the same footing as sales, so as to bind a principal to third parties by his factor's pledge as by his factor's sale. The Factors Act 1889 in part re-enacts and in part extends the provisions of the earlier acts of 1823, 1825, 1842 and 1877. Its most important provisions concerning sales, pledges and other dispositions by factors are as follows:—

Section II., s.s. 1. Where a mercantile agent is, with the consent of the owner, in possession of goods or of the documents or title to goods, any sale, pledge or other disposition of the goods made by him when acting in the ordinary course of business of a mercantile agent shall, subject to the provisions of this act, be as valid as if he mere expressly authorized by the owner of the goods to make the same; provided that the person taking under the disposition acts in good faith, and has not at the time of the disposition notice that the person making the disposition has not authority to make the same.

2. Where a mercantile agent has, with the consent of the owner, been in possession of goods or of the documents of title to goods, any sale, pledge or other disposition which would have been valid if the consent had continued shall be valid notwithstanding the determination of the consent; provided that the person taking under the disposition has not at the time thereof notice that the consent has been determined.

With regard to these provisions the following points should be noticed: (i.) the term 'notice' is stated by Chalmers (*Sale* of *Goods Act,* 10th ed. p. 166) to mean probably 'actual though not formal notice: that is to say, either knowledge of the facts or a suspicion of something wrong, combined with a wilful disregard of the means of knowledge.' The onus of proving good faith and want of notice is on the purchaser of the goods. (ii.) The 'consent' of the owner to the factor's possession of the goods is to be presumed in the absence of evidence to the contrary (s. 2, s.s. 4 of the Factors Act 1889). (iii.) Although the Factors Act may operate to make an unauthorized sale or pledge by a factor good as between principal and third party, nothing in the act makes such a sale or pledge good as between principal and factor, or operates to exempt the factor from civil or criminal liability (s. 12. s.s. 1 of the Factors Act 1889). (iv.) In order that s. 2, s.s. 1 and 2 of the Factors Act 1889 (quoted above) may apply, and a sale pledge or other disposition by the factor be good as between principal and third party, it is necessary that the goods should have been in the possession of the factor *in his capacity as such,* and not in some other capacity. If, for instance, a factor also carries on business as a warehouseman, and goods are entrusted to him not in his capacity as factor, but in his capacity as warehouseman, and solely to be warehoused, any disposition of the goods by him will not be covered by the Factors Act.

Enforcement of Contracts.—I. Where a factor makes a contract in the name of his principal and himself signs as agent only, he drops out as soon as the contract is made, and the principal and third party alone can sue or be sued upon it. As factors usually contract in their own name this is not a common case. It is characteristic of brokers rather than of factors.

2. Where a factor makes a contract for the principal without disclosing his principal's name, the third party may, on discovering the principal, elect whether he will treat the factor or his principal as the party to the contract; provided that if the factor contract expressly as factor, so as to exclude the idea that he is personally responsible, he will not be liable. The principal may sue upon the contract, so also may the factor, unless the principal first intervene.

3. Where a factor makes a contract in his own name without disclosing the existence of his principal, the third party may, on discovering the existence of the principal, elect whether he will sue the factor or the principal. Either principal or factor may sue the third party upon the contract. But if the factor has been permitted by the principal to hold himself out as the principal, and the person dealing with the factor has believed that the factor was the principal and has acted on that belief before ascertaining his mistake, then in an action by the principal the third party may set up any defences he would have had against the factor if the factor had brought the action on his own account as principal.

4. Where a factor has a lien upon the goods and their proceeds for advances made to the principal it will be no defence to an action by him for the third party to plead that he has paid the principal, unless the factor by his conduct led the third party to believe that he agreed to a settlement being made with his principal.

5. The factor who acts for a foreign principal will always be personally liable unless it is clear that the third party has agreed to look only to the principal, and equally the factor may always sue on the contract.

6. If a factor contract by deed under seal, or draws, accepts, or indorses a bill of exchange or promissory note, he alone can sue or be sued upon the contract. (L. Sc.)

See J. Story, *Commentaries on the Law of Agency* (Boston, **1882);** H. **F.** Boyd and *A.* B. Pearson, *The Factors Acts 1823 to 1877* **(1884)** ; **P. T.** Blackwell, *The Law relating to Factors* **(1897)** ; also Mechem, *Agency* (2d ed., 1914) ; Williston, *Sales* (2d. ed., 1924) ; Weld, *Marketing* of *Farm Products* (1914).

United States.—In only a few particulars does the American law differ from the English as set forth above, notably in regard to the Factors Act 1889. A number of U.S. States—chiefly on the seaboard—passed Factors Acts, and those Acts are hardly so far-reaching in their effects as the English, so that in general it is not law in the United States that a factor can effectively pledge his principal's goods — beyond the extent of his own interest by virtue of advances made to his principal — to secure his own debts. There is, however, an important qualification of the rule, derived from the widespread adoption of the uniform commercial Acts. Under the Sales Act and in certain States, without that Act, the factor (or any other person to whom an owner has entrusted a bill of lading running to order, and properly endorsed) can effectively pledge or sell the document, and so the goods represented by the document, although he does so in breach of duty; and under the Federal Bills of Lading Act the rule holds as well for all order bills of lading arising out of inter-State shipments. Moreover, under the Warehouse Receipts Act widely adopted in the United States, the same holds as to goods covered by warehouse receipts running to order. This is not true of documents which lack the word "order" or "negotiable," nor as to transactions involving goods in specie; but since most (not all) such attempted pledges involve such order documents: the old rule has been very substantially impaired.

The factor appears in the United States chiefly under the commercial designation "commission man"; goods sent to a factor, large or small, are commonly said to be shipped "on consignment," as distinguished from shipment pursuant to a contract for sale. In the main, such a commission man is a feature of a central market, to which sellers, especially of raw materials, are shipping: so especially agricultural produce such as fruits and vegetables, or cotton, coffee, live stock, etc. Factorage here serves as an alternative to the middle man who goes about among growers buying up their produce in advance. Both ways of dealing presuppose a seller who is relatively weak financially; hence the importance of factors' advances to their principals, and of factors' liens.

It should be noted that wherever the factor attains great financial power — as, in the United States, particularly in some phases of importing and in the merchandising of textiles — he tends to develop into a peculiar and specialized type of commercial (and even investment) banker, whose loans are limited to the one specific field in which he is skilled; whose earnings include commissions on his own selling of the merchandise delivered to him as security; and whose banking assets are not recruited by deposits, so as to subject him to state control. Along another line the factor, being located in a central market and becoming skilled in its operations, tends to branch out into independent trading — as do similarly situated brokers. Hence at times a conflict of interest between himself and his principals, as to whose goods shall get sold on a falling or fluctuating market; hence also some of those financial involvements which raise the question of how far the factor has power to pledge away his principal's goods; hence, finally, occasional legislation aimed at control of the commission man's business in the interest of his principals. (K. N. L.)

FACTORING: *see* BROKER.

FACTORS OF PRODUCTION. An economy's factors of production represent all those economic resources, both human and other, which if properly utilized will bring about a flow or output of goods and services. The availability of the factors of production is thus a necessary condition for production; without such factors: production could not take place at all.

However, not all the "inputs" that must be applied as the condition of there being an output are to be regarded as factors in the economic sense. Some of these inputs, in a normal situation, are "free": the organizing unit — the firm, or perhaps the economy — does not have to make any allo ance or take account of any cost for securing such inputs. Although atmospheric air, for example, or a substitute for it, must be at hand to enable production to go on, it is not counted among the factors since it is available in most circumstances in practically unlimited quantities. But if it is to be piped into a deep mine, or under water, it would then have to be treated like the other "economic resources." Incidentally, from the standpoint of the whole economy, a cost is involved in using a resource if as a result of this particular use the production of something else which depends upon the same kind of resource is hampered. Thus, if the input is scarce in relation to the need for it, it is regarded as a factor of production. The needed inputs may be scarce, and so constitute productive factors, either because they represent something which cannot be produced, like land (in the strictly economic sense), or because although their supply could be enlarged. like factories. to do so would be costly in terms of resources.

The productive factors are commonly classified into three groups: land, labour and capital. The first represents resources whose supply is low in relation to demand and cannot be increased as the result of production. The income derived from the o nership of this factor is known as economic rent. The factor of labour represents all those productive resources that can be applied only at the cost of human effort. The wage or salary is the form of payment for the use of this factor. And the effort which the economist regards as qualifying may be either manual or mental, although in earlier periods, and apparently under the Soviets, manual labour alone was considered a productive factor. The final category, capital, is a more complex one. In the simplest sense, it refers to all the "produced" instruments of production — the factories, their equipment, their stocks of raw materials and finished goods, houses, trade facilities, and so on. The owners of capital receive their income in various possible forms; profits and interest are the usual ones. w

It is generally assumed that the level of an economy's output depends directly and indeed simply, upon the amount of its productive factors in use. It is also supposed that in some degree one kind of factor can be substituted for another in production. The study of the level of factor employment, of the specific direction of their employment and of the rewards received for their use constitutes the greater part of economics. ***See*** also ECONOMIC PRODUCTIVITY. (L. Ts.)

FACTORY DESIGN: *see* INDUSTRIAL ARCHITECTURE.

FACTORY INSPECTION. The purpose of factory inspection as stated in most U.S. state laws is to ensure compliance with the applicable regulatory requirements for minimum standards of safety, health and welfare for employees. Although the inspection is carried out by factory inspectors. it usually applies to many places of employment other than factories, such as building sites and mercantile establishments.

Factory inspection in the United States is difficult to describe satisfactorily because of the many agencies having jurisdiction, the poorly defined limits of authority and the diversity of the regulatory requirements among the various agencies. This stems from the fact that the original 13 states formed a national government by assigning to it only the authorities and functions they considered vitally necessary to the successful functioning of the confederation as a whole. All powers not specifically so assigned were reserved to the respective states. The subsequent trend, however, was to strengthen and extend the federal authority at the expense of that of the states.

The constitutions of the respective states (with some exceptions which apply to a number of the older and more powerful cities such as Baltimore, Boston and New York) are sovereign over cities within their borders. A city may, and often does, act to control factories within its borders in advance of state action. But when the state legislates to cover the same field, as for example to control steam-power boiler construction and operation, such legislation automatically transcends the city authority unless the state legislation specifically exempts the city involved.

The definition of factory varies widely among the states, a fact which introduces its own element of confusion. Also, in many states entire types of industry are exempt from inspection as, for example, the lumbering industry in many of the southern states and the mining industry in certain western states.

Little control is ever exerted over farming — even farms or establishments whose employed personnel is large. Canneries are covered in some states but not in others. Some states exclude from their minimum safety and health requirements all establishments employing fewer than a fixed minimum number of persons, most frequently five.

While some of the states inspect all steam-power boiler and pressure vessels within all factories in the state, most of the large cities inspect all boilers in the city, and the state inspects those outside such cities. Some states accept the inspection of the insurance underwriters who carry the insurance against explosion. On the other hand, some of the states do not inspect boilers at all, nor do they seek to control their safety in any way. Almost all jurisdictions which make boiler inspections either apply or follow closely the provisions of the power boiler code of the American Society of Mechanical Engineers.

Elevator inspection is for the most part carried on by specialized personnel of either city or state regulatory bodies.

Few states seek to control the design and construction of factory buildings, though a few, notably New York, New Jersey and Pznnsylvania, require that plans be approved as to the conditions of safety and health for the employees and require their inspectors to resurvey them as needed to check on alterations and additions.

U.S. Federal Inspection.—Federal control is exercised over interstate commerce, the operation of vessels on navigable waters, the safety and health of stevedoring, the processing of imported products (such as wool, hair and hides) insofar as may be necessary to give protection against infectious diseases (such as anthrax), and over the slaughtering industry, insofar as it is necessary to ensure the wholesomeness of meat products. The control of child labour also is primarily a federal function.

Interstate commerce has included commercial transportation across state lines since the adoption of the federal constitution. Consequently, federal control was exerted successively over railroads, bus and truck haulage and air transport.

The passage of the Public Contracts (Walsh-Healey) act in 1936 extended federal inspection still further. It required that goods manufactured to fill contracts for the federal government be produced under safe and healthful working conditions. Enforcement of this act was combined with that of the Wage-Hour act, which specified minimum wage rates to be paid to workers engaged in the production of goods to be shipped across state lines. However, since the Public Contracts act also specified that compliance with the safety and health requirements of the respective states should be *prima facie* compliance with the requirements of the act, it meant that in the administration of this law the federal government was enforcing state standards on safety and health and did not apply standards of its own except in states lacking such standards as, for example, Louisiana, Maine or Mississippi. States deemed to have inspection personnel and procedures adequate for the purpose were requested to act as agents of the federal government in enforcing the Public Contracts act. By the 1950s, nearly half the states had accepted this arrangement by written agreements. Since during World War II, practically all of the productive industry of the United States was wholly or largely on federal contracts, federal inspection was almost universal in theory. In practice, federal inspection forces were far from adequate, and matters of safety and health of workers in factories built for the federal government or under federal control were handled by special forces, chiefly the services of supply of the United States army.

U.S. State Inspection.—The extent of state inspection has varied from practically nothing in the less industrialized states to extensive inspection systems in such states as California, Illinois, Ohio, Pennsylvania and New York. At mid-20th century the latter state maintained a force of about 300 inspectors who regularly visited about 200,000 work places: factories, mercantile establishments, construction operations and homes where factory work was carried on. They also were inspecting places of public assembly, particularly in regard to safety to life from fire. The factory inspections cover primarily safety and health, minimum wages, hours and child labour.

While New York at mid-century maintained the most detailed inspection and enforcement of its safety requirements, certain other states, notably Wisconsin and Oregon, were regarded by many authorities as having more progressive systems. They enforced what they regarded as essential, but put major emphasis on the education of employer and employee alike to appreciate the value of performance in accordance with good working standards and to comply voluntarily. A few states, notably Ohio, maintained one set of inspectors to enforce the laws and the codes thereunder and another force to render a consulting and advisory service on safety and health to such employers as felt a need for their services. These state authorities, recognizing that these consultants would be welcomed only if competent, set a reasonably high standard for them. They did not set the requirements as high for the enforcement group. The result was that the advisory group came to render a valuable safety service to the firms who were already at least moderately progressive as to safety and were, therefore, less in need of help than the firms which had to be forced into compliance. These firms were served by a less competent group.

The competence of the state inspection forces varied widely at mid-century. A number of the states had their inspectors under merit service on at least a reasonably good basis. The majority did not; hence, with each change in the political control of the state government, there was a complete or partial overturn of the personnel and often a major change of policy. This condition, however, was slowly but steadily improving because of two factors: first, the federal influence; second, the broadening realization by both employers and organized labour that the inspection service is important and that, given competent personnel and good administration, it can be a major factor in preventing work injuries and in fostering sound and constructive employer-employee relationships. The federal influence was being exerted through example (its inspection and professional forces all on merit service), through the administration of the Public Contracts act, but chiefly through safety courses which the bureau of labour standards set up for state factory inspectors. The bureau also established an advisory service for the states on safety code development.

(Ro. P. Be.)

Great Britain.—There is a uniform system of factory inspection throughout the country administered by the factory inspectorate of the ministry of labour and national service independent of political changes. Its duties consist broadly of the enforcement of the Factory and Workshop acts, the Truck acts (in factories and workshops) and acts dealing with poisons used in industry. Trades in which special or unusually high hazards exist are designated dangerous and receive extra attention.

Although concerned primarily with the enforcement of the statutory requirements regarding safety, inspectors have duties also in the inspection of sanitary and certain welfare arrangements, and in ensuring that conditions of employment, including hours of work and shift systems, particularly with regard to women and young persons, are properly observed. While enforcement of regulations is strict, emphasis is placed on positive measures of encouragement, and safety committees of employers and employees have been set up in many works. The competence of the inspectors is so well established that when they do find it necessary to prosecute, the courts almost always support them. (V. Cs.)

Bibliography.—Agencies publishing valuable safety materials in periodical or bulletin form include: American Standards Association, New York, list of "American Standard" safety codes on request; National Safety Council, Chicago, various publications; National Conservation Bureau, "Handbook of Industrial Safety Standards"; National Fire Protection Association, "Handbook of Fire Prevention"; National Society for the Prevention of Blindness, "Eye Hazards in Industry." United States government, numerous publications; the following agencies have considerable material on industrial safety: Bureau of Mines, Department of the Interior; Bureau of Labor Standards and Bureau of Labor Statistics, Department of Labor; National Bureau of Standards, Department of Commerce. *See* also Ministry of Labour and National Service, *Annual Report of the Chief Inspector of Factories.* Alfred M. Best Company, Inc., publishes *Maintenance and Safety* (monthly) and *Safety Directory—Safety, First Aid and Fire Protective Products* (annually).

Books on the subject include Frederick G. Lippert, *Accident Prevention Administration* (1947); National Safety Council, *Accident Prevention Manual for Industrial Operations* (1946); H. H. Berman and H. W. McCrone, *Applied Safety Engineering* (1943); American Engineering Council, *Safety and Production* (1928); L. A. DeBlois, *Industrial Safety Organization for Executive and Engineer* (1926); H. W. Heinrich, *Industrial Accident Prevention*, 3rd ed. (1950); H. H. Judson and J. M. Brown, *Occupational Accident Prevention* (1944); Vernon G. Schaefer, *Safety Supervision* (1941); H. M. Vernon, *Accidents and Their Prevention* (1936); T. K. Djang, *Factory Inspection in Great Britain* (1942); R. P. Blake (ed.), *Industrial Safety*, 2nd ed. (1953).

(Ro. P. Be.)

FACTORY PRODUCTION, HISTORY OF. The industrial factory first became dominant during the 19th century in Europe, North America and Australia and was making deep inroads into Asia by 1900. While it displaced various domestic types of production, in which work was done with simple equipment in the home or adjacent shed, it also incorporated certain well-established nondomestic forms of production.

From ancient times workers were gathered into central workshops. even though the equipment and processes were like those used in home or shed. Some of these workshops were set up by governments to produce large quantities of necessities for the armed forces; *e.g.,* local potteries, ordnance shops and textile plants for Roman legions stationed in Gaul. Others made luxury articles, such as fine silk fabrics, Gobelin tapestries or Sevres china for a royal court. But the more significant central workshops were those into which many an early modern merchant or manufacturer gathered his workers instead of putting out his material to be processed by them, perhaps with their own implements, in their homes. The "putting-out" system had the merit of enabling the entrepreneur to employ many urban and scattered rural workers, including women and children, without having to sink capital in working quarters or equipment. But its demerits were serious: much time was wasted putting out and collecting the material; standards of work were not easily maintained, much less raised; the worker could not always be relied on to finish his task on time: and the risk of embezzlement of material was very real.

These defects could be eliminated by gathering workers into a central workshop. In addition, division of labour could be intensified and new patterns, processes, or products introduced. The obstacles were also great. The employer would need to invest much capital in buildings, equipment and possibly houses; the total cost of rent, repairs, foremen's wages and other overhead or operating expenses might run high; and workers were unwilling to leave home or let their dependents do so. Yet the net balance of advantages had become so marked by 1750 that centralized production was gaining ground at the expense of the putting-out system.

By that time the invention'of new machines was gathering pace, especially in the metalware industries. In 1700 Christopher Polhem, a Swedish manufacturer, had 100 men, each trained for a special task, working in his factory with water-powered machines to cut bars, slit nail rods, roll metal into sheets and make cogwheels, pots, pans and plowshares.

In 1762 Matthew Boulton built a factory near Birmingham, Eng., with two waterwheels to turn rollers, grinding or polishing machines and lathes used by his 600 employees for producing buckles, buttons and other small metal articles. In 1775, taking James Watt into partnership, he began making the patented improved parts Watt had invented for steam engines (1769), then those which enabled the engine to turn wheels, thus offering factory operators a new source of power.

The textile industry opened factories gradually. The fulling of woolens and silk throwing had gone into mills before 1300, and dyeing and finishing were central workshop processes. But spinning and weaving remained strongholds of domestic industry. Between 1764 and 1779 three famous British inventions—Hargreaves' jenny, Arkwright's frame and Crompton's mule—expanded enormously the output of yarn per spinner and reduced the labour cost by at least nine-tenths. The jenny could be worked by hand in the home, but since the other two machines needed much power and floor space, spinning mills sprang up in Lancashire, Yorkshire, Lanarkshire and other textile counties, and yarn making became a factory process within about a generation.

Other textile processes and other industries moved into the factory later and more slowly. Though a power loom was invented in 1784, it was not satisfactory for weaving cottons until about 1825–30, worsteds until 1840 and woolens until at least 1850. By the latter date the factory was well on its way both in conquering former domestic occupations and in converting central workshops into factories. It was dominating the production of paper, books, glass, pottery, metalware, engines and machines. After 1850 it absorbed much of the production of clothing and shoes; the cutting of wood into furniture and building material; and such food industries as canning, butter making and, after 1900, baking. The factory was also the home of most new products, such as bicycles, automobiles, electrical appliances, chemicals and rubber goods.

The spread of factory production methods beyond Great Britain was most marked in Belgium, the United States, France and Germany. British laws forbidding the export, save under licence, of machines (until 1843) and the emigration of skilled artisans (until 1825) could not be rigorously enforced. Machines or models might be shipped in falsely labeled packing cases, and plans could go out in emigrants' heads. Artisans slipped out furtively or told port inspectors that they were farmers or labourers. Hence we find William Cockerill (*q.v*), a Lancashire mechanic, living in Sweden and Russia before he landed in Belgium (1798), there to make spinning frames, engines, rolling mills and other British machines as they came along. Samuel Slater (*q.v.*), who built, equipped and operated a spinning mill at Pawtucket, R.I. (1790–91), was the most publicized of many British technicians who reached the United States between 1783 and 1812, either by invitation or on their own initiative, to establish, manage or work in factories which spun yarn, printed calicoes, finished woolens, made paper or constructed machines. France, Germany, Italy, Russia, Canada, Asia and Australia all drew on British skill and equipment for initiating factory production.

The United States made outstanding adaptations and innovations to factory processes. Scarcity of labour, especially skilled, provoked an effort to design labour-saving, highly specialized machines. Factories so equipped for manufacturing guns, clocks, harvesters, doors, window frames and the like were by 1850 far ahead of anything known in Europe. They constituted a distinctively American factory system, and their descendants were the mass-production plants, equipped with one-purpose automatic machines, conveyer devices and the assembly-line technique. (See also INDUSTRIAL REVOLUTION.)

The Capital Supply.—The first problem confronting the factory industrialist was the raising of sufficient capital for buildings and equipment. The amount might be small, and often entire spinning mills cost less than the average of $6,000-$7,000 needed to equip a single North American factory worker in the 1930s; but many plants cost $50,000, and some at least twice that amount. While landlords helped sometimes by building and leasing mills and some merchants put considerable sums into factories, the main effort was made by the industrialist. He emptied his own pockets, raided the family purse, sought partners with cash, borrowed wherever he could, austerely rationed his personal spending and plowed much of his profits back into the firm.

This private financing was only slowly supplemented by public investment when, in the last third of the 19th century, the formation of limited-liability joint-stock companies became legally easy and investment bankers, especially in Germany and the United States, began to underwrite the issue of corporate stocks and bonds.

Labour Supply.—The second problem was the recruiting of a labour force. In the beginning this was difficult when domestic workers refused to leave home or when water-driven mills had to be located in remote, sparsely peopled spots. For a time some British spinning mills drew on supplies of pauper children from southern England; a mill at Lowell, Mass., induced farmers' daughters to come and work there in order to earn money for their trousseaus; but these temporary labour supplies soon dried up as steam-driven factories were planted in towns and as labour began to flow in of its own accord from nearby communities, from rural areas to urban, from Ireland to England and Scotland, from eastern Germany to western and from Europe to North America.

Factory working conditions quickly attracted public attention. The working day of 12 or more hours, child labour, physical strain, unhealthful environment, occupational diseases or accidents, personal cruelty and low wages had been common, though unnoticed, features of the domestic system, and the discipline of regular hours had been imposed in central workshops. Now they became mobilized, generalized and accentuated in a visible mass. New occupational risks emerged when operatives tended fast-moving machines. Long hours for six days a week were worked throughout the year once illumination by gaslight became possible.

State regulation, at first primarily on humanitarian grounds, therefore began with the first British Factory act (1802). Step by step, its range widened and its enforcement was improved in Britain, then in other countries. By 1914 it dealt with the minimum working age. maximum hours, the working environment, wages and insurance against sickness or unemployment. Alongside this growth of factory acts went the voluntary efforts of workers to improve their lot as wage earners by organizing trade unions and as wage spenders through consumers' co-operative societies. Those efforts began to achieve a measure of success after 1850.

The wider effects of the development of the factory are part of the general shaping of modern capitalistic industrialized society. The factory extended, but did not create, the proletariat, since many domestic workers were already propertyless wage earners. It tended to attract industry and population to regions favourably located in terms of access to fuel. raw materials or markets, thus causing heavy regional concentration in "black countries" and the rise of industrial towns, with all the consequent problems of housing, public health, local government and political controversies based in part on class conflict.

While the factory destroyed the value of some ancient skills, it created many ne skilled jobs.

Finally, in the controversies which swarmed around the social and economic problems created by the factory, sight was often lost of the fact that factory methods brought a greatly enhanced productivity of human labour as hours were reduced, working conditions improved and participation by children eliminated. Such rising productivity made it possible to feed, clothe and house populations that were expanding at a rate previously unknown.

See also MASS PRODUCTION.

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FACULAE: see SUN.

FADING is the variation of the signal intensity received at a given location from a radio transmitting station as a result of changes in the transmission path.

FAED, THOMAS (1826–1900), British painter, born in Kirkcudbrightshire, studied at the school of design, Edinburgh, was a member of the Royal Scottish academy and became a member of the Royal Academy in 1864.

Three of his pictures, "The Silken Gown," "Faults on Both Sides" and "The Highland Mother," are in the National Gallery of British Art (Tate gallery), London.

See William D. McKay, *The Scottish School of Painting* (1906).

FAENZA, a city and episcopal see of Emilia-Romagna, Italy (anc. Faventia), province of Ravenna, 31 mi. S.W. from the town of Ravenna by rail, 110 ft. above sea level. It is 31 mi. S.E. of Bologna by rail, on the line from Bologna to Rimini, and it is the junction of a line to Florence through the Apennines. Pop. (1951) 25,041. The town still preserves traces of the Roman rectangular plan and is surrounded by walls which date from 1456. The cathedral of S. Pietro stands in the centre of the town. It was begun in 1474 by Giuliano da Maiano; the façade is, however, incomplete. In the interior is the beautiful early Renaissance tomb of S. Savinus, with reliefs showing scenes from his life, by Benedetto da Maiano. Opposite the cathedral is a fountain with bronze ornamentation (1621).

The municipal buildings have been restored; the picturesque arcades of the Palazzo del Comune date from the 15th century and those of the Palazzo del Podestà from the 18th. The municipal art gallery contains fine specimens of majolica, a variety of which. faience, takes its name from the town. It was largely manufactured in the 15th and 16th centuries, and the industry was revived in modern times. (See POTTERY AND PORCELAIN.) There is an international museum of ceramics there with specimens of every date and country.

The name Faventia is clearly Roman. The town lay on the Via Aemilia; there Papirius Carbo and C. Norbanus were defeated by Q. Caecilius Metellus Pius in 82 B.C. Pliny speaks of the whiteness of its linen, and the productiveness of its vines is mentioned. In 740 it was taken by Liutprand. Desiderius gave it to the church with the duchy of Ferrara. It was a free city at the beginning of the 12th century and at first took the imperial side, but in 1240 it stood a long siege from Frederick II and was taken only after eight months. In 1313 the Manfredi made themselves masters of the place and remained in power until 1501, when the town was taken by Caesar Borgia.

FAEROE ISLANDS (also written FAROE or THE FAEROES, Danish FAEROERNE, Faeroese FOROYAR), a group of islands in the North Atlantic ocean forming a self-governing community within the kingdom of Denmark. They are situated between Iceland and the Shetland Islands, about 200 mi. S.W. of the latter. between latitude 62° 24' and 61° 26' N. and longitude 6° 15' and 7° 41' W. The total area of the group is 540 sq.mi., and there are 18 inhabited islands.

The principal islands are Streymoy, Eysturoy, Vagar, Suduroy, Sandoy and Bordoy (Danish forms: Stromo, Ostero. Vaago, Sudero, Sando and Bordo). Pop. (1955) 32,456. Capital, Thorshavn, on Streymoy; pop. 6,067.

Physical Features. — The islands were formed by submarine outpourings of basalt in Tertiary times, with thin, intercalated, reddish tuff. The layers of basalt are from 30 ft. to 100 ft. thick, those of tuff about 3 ft. thick. Upon the basalt rests the so-called coal formation, 35 ft.–50 ft. thick; the lower part is mainly fire clays and sandstone, and the upper part is weathered clay with thin layers of shale and brown coal. The latter occurs especially on Suduroy. Above this, over most of the surface, lie beds of dolerite. 15 ft.–20 ft. thick. All these beds of basalt, tuff and dolerite lie practically horizontally. During the glacial period the whole surface up to 1,500 ft. was covered by ice sheets, and the relief is mainly the result of the action of ice upon the horizontal beds.

The rocky ground of the islands is covered by a thin layer of moraine or peat soil, the latter being used for heating. The islands are high and rugged, with perpendicular cliffs and flat summits separated by narrow ravines. The coasts are deeply indented, and a series of fiords runs northwest-southeast. The narrow passages between the islands are made dangerous by very strong tidal currents. The greatest height is Slattaretindur (2,894 ft.) in Eysturoy. There are several lakes in which trout is abundant; the largest is Lake Sorvagur in Vagar, which discharges into the sea by a sheer fall of 108 ft.

The climate is oceanic, with mild but stormy winters and cool summers. Rainfall is heavy (59 in. a year), the maximum occurring in autumn and winter. There are 275 rainy days a year. The sky is generally overcast, and fogs are frequent. There are seldom long periods of frost, and the harbours are rarely icebound. At midsummer the sun is above the horizon for about 19¾ hours.

There are no indigenous land mammals. Rats and mice have come with ships, and the polar hare is imported. Toads and reptiles are also missing. Numerous sea birds, including the auk, puffin and eider duck, nest in the cliffs. Because of the strong westerly winds and frequent gales the islands are naturally treeless, but hardy conifers, maple and mountain ash have been planted.

History. — The oldest map mentioning the Faeroe Islands by name is the Hereford map (1280), where they are called Farei, perhaps a Celtic word akin to *fearand* ("area"), perhaps a Scandinavian word akin to faar ("sheep"). It seems probable that Irish hermits lived in the islands in the 7th and 8th centuries, but the population is descended from 9th-century Norse settlers. Olaf I Tryggvesson, king of Norway, introduced Christianity about 1000 and gave the islands to the Faeroese Sigmund Bresterson, but he was killed, as the islanders clung to their independence. In 1035, however, the islands became a Norwegian feoff and were associated with Denmark in the 14th century, when Norway and Denmark were united. In 1814, when Norway was separated from Denmark, the Danish king retained the islands. The name of Magnus Heineson, a native of Streymoy, who cleared the seas of English adventurers in the 16th century, is still celebrated in many songs and stories. So also is the period of Sigmund Bresterson, in the *Faereyinga Saga* and in popular songs and legends. This early native literature became the starting point of modern Faeroese nationalism. The folklorist Ulricus Hammershaimb formed in the 19th century a written Faeroese language, and in the 20th century Joannes Patursson made his farm an intellectual and national centre. In 1906 he formed the Sjalvstyrisflokkur. or Home Rule party. After 1912 the use of Faeroese in schools and churches was to some extent authorized. In 1938 the local language became the single teaching language, if the teacher wished it. The Sambandsparti was formed to maintain ties with Denmark, in opposition to the Sjalvstyrisflokkur. There was also a Social Democratic party.

The old Faeroese *lagting* (a combined jury and parliament), abolished during the absolutism, was restored in 1852 as an *amtsraud* (county council).

When the Germans invaded Denmark in 1940, Great Britain took over control of the islands until Sept. 1945. Thirty-nine fishing vessels were sunk and 131 fishermen and seamen lost their lives.

After the war Denmark proposed to give the islands a greater measure of self-government. but at a plebiscite in 1946 only 5,490 voted for the government proposal as against 5,656 for an independent republic, which was demanded by the new Home Rule party. the Folkaflokkurin. Election for the *lagting* displayed. in the same year, an opposite result, leaving the Folkaflokkurin as a minority (5.383 votes as against 7,470 votes to the other parties). In 1947 negotiations were renewed in Copenhagen, and as a result the islands were given self-government, their own flag and their own unit of currency, the krona (1 krona= 1 Danish krone).

A decline in the prices of fish products in 1952 caused economic troubles; the Sjovinnu bank suspended its payments, and the Danish government had to make loans and subscribe new shares in the bank in order to overcome the crisis.

Social Conditions and Administration. — The Faeroe islanders constitute a separate nationality and have preserved numerous ancient manners and customs. Faeroese is the main teaching language. Besides elementary schools there are five secondary schools, including a grammar school in Thorshavn. There are also a navigation school. technical schools and a high school. Most islanders are Lutherans, belonging to the Danish national church. The population rose from 5,200 in 1801 to 15,230 in 1901 and later more than doubled.

The Faeroe Islands form a self-governing community within the kingdom of Denmark. Matters of self-government are: electoral rules, municipal institutions, sanitation. schools. social services, trade laws and taxation. Self-government is exercised through the *landsstyre* (executive) and the *lagting* (parliament). All men and women over 21 may vote. The Danish government is represented by *rigsombudsmanden*. The islands elect two representatives to the Danish parliament *(folketing)*.

Agriculture and Industries. — The ground around the farms is used for hay, potatoes, turnips and barley crops, but less than 4% of the total area is under cultivation. Vegetables are grown, berry fruits flourish and even the strawberry ripens late in the summer. The uncultivated area offers good pasture, where sheep graze in summer and winter. The wool is exported or used by a small home industry in spinning and knitting. Two modern textile mills have been built. There are cows, but they give little milk because of their coarse feed. The puffin is caught for food, and the feathers of the eider duck are collected. About 300,000 sea birds are caught annually. Fishing. however, has become the main trade of the islands. The cod fishery is especially important, dried and frozen fish being exported in large quantities. The swim bladders are made into gelatin and the cod liver into liver oil. Salted herrings are also exported. The whaling industry became important toward the close of the 19th century.

About 40% of the population is engaged in fishing and less than 10% in agriculture; about 80% is dependent on fishing.

Exports from the Faeroe Islands, 1952

(In 000 kronar)

Item	Denmark	U.K.	Spain	Italy	Other countries	Total
Fresh and frozen fish	198	5,720	—	—	—	5,918
Salted herrings	1,284	—	—	—	2,122	3,406
Salted and dried fish	6,906	1,228	30,531	8,454	10,769	57,888
Cod-liver oil	1,407	—	—	—	142	1,549
Hides and skins	285	—	—	—	—	285
Wool and woolen goods	374	—	—	—	—	374
Salted sausage casings	69	—	—	—	—	69
Others	472	—	—	—	—	472
Total	10,995	6,948	30,531	8,454	13,033	69,961

The number of registered Faeroese ships in 1952 was 231, amounting to 33,281 registered tons. The islands have regular communication by ship with Denmark (Copenhagen), Scotland and Iceland.

During and after World War II Faeroese roads were improved, and in 1952 the islands had 462 cars and trucks. Hydroelectric power stations were constructed after the war.

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FAESI, ROBERT (1883–). Swiss poet, dramatist, story writer and literary critic, was born at Zurich on April 10, 1883. and became professor of German literature at the university of that town. His tragedies *Odysseus und Nausikaa* (1911) and *Opferspiel* (1925) and the comedy of *Die Fassade* (1918) attained a high level of excellence. His chief poems are *Aus der Brandung* (1917; an outcome of World War I) and *Der Brennende Busch* (1926).

The *Zürcher Idylle* (1908) and the *Konig von Ste. Pelagie* (1924) are attractive short stories.

Other works included studies of Carl Spitteler (1915), Rainer Maria Rilke (1919) and C. F. Meyer (1925), a volume entitled *Gestalten und Wandlungen schweizerischer Dichtung* (1922), *Der Magier* (1938) and *Ungereimte Welt gereimt* (1946).

FÁFNIR is the name of the dragon in the Norse version of Nibelung legend. Fafnir turned into a dragon after killing his father, Hreidmar, and after seizing the Nibelungs' hoard of gold. He lay on this until the hero Siegfried (*q.v.*) slew him, so that gold came to be called "the dragon's bed!' by Norse poets. *See* also NIBELUNGENLIED. (G. T.-P.)

FAGACEAE, the beech family, contains more than 800 species, including giant trees and prostrate shrubs. They are broad-leafed plants with deciduous or evergreen, alternate, simple leaves which are lobed, toothed or entire. The wind-pollinated flowers are inconspicuous, borne singly or in groups, the male usually in catkins. the female in small clusters.

The fruit is a nut borne singly in a cup as in the oak (an acorn) or several in burlike bracts as in the chestnut and beech.

(C. H. MR.)

FAGGING, in the English public schools, is the compulsory performance by junior boys of prescribed menial services for senior boys. The etymology of the word is obscure, but it is clearly connected with "fag" for weariness, hence drudgery. Like many other public school features popularly supposed to be of immemorial antiquity, fagging is in fact of quite late development. The custom developed rapidly after about 1785 and was in general recognized by the school authorities, and sometimes regulated by them. Probably, as A. F. Leach suggests, its growth was occasioned by the development of organized games and the introduction of extra meals.

By the mid-19th century fagging was customary in most of the great public schools. An illustration of how fagging worked at Rugby is to be found in T. Hughes' *Tom Brown's School Days* (1857). For details of its operation in the public schools generally, the best source is the report of the Clarendon commission (1864), where the returns to the commissioners' queries no. 29 and 30 and the (indexed) minutes of evidence and recommendations give full particulars of the heavy tax upon young boys' time involved by fagging, and lurid (perhaps not altogether reliable) details of the alleged "oppressive, degrading and brutal" abuses of the system. By the second half of the 20th century fagging had either been abolished or reformed beyond recognition.

(W. E. T.)

FAGUET, EMILE (1847–1916), French critic and man of letters, was born at La Roche sur Yon. He mas educated at the École normale in Paris; after teaching for some time in La Rochelle and Bordeaux he went to Paris. After acting as assistant professor of poetry in the university he became professor in 1897. He was elected to the Academy in 1900 and received the ribbon of the Legion of Honour in the next year. He acted as dramatic critic to the *Soleil;* from 1892 he was literary critic to the *Revue bleue* and in 1896 took the place of M. Jules Lemaitre on the *Journal des débats.* Among his works are monographs on *Flaubert* (1899), *Andre' Chénier* (1902), *Zola* (1903), *Balzac* (1913), *Mgr. Dupanloup* (1914); an admirably concise *Histoire de la Littérature française depuis le XVII^e^ siècle jusqu'à nos jours;* series of literary studies on the 17th, 18th and 19th centuries: *Questions politiques* (1899); *Propos littéraires* (3 series, 1902–05); *Le Libéralisme* (1902); *L'Anticléricalisme* (1906); *Le Paceficisme* (1908); and several works on Rousseau (between 1910 and 1912). He died in Paris on June 7, 1916.

FAHRENHEIT, GABRIEL DANIEL (1686–1736), German physicist who made important improvements in the construction of thermometers and introduced the thermometric scale known by his name (*see* THERMOMETRY). He was born at Danzig on May 14, 1686. For the most part he lived in England and Holland, devoting himself to the study of physics and making a living, apparently, by the manufacture of meteorological instruments. He also invented an improved form of hygrometer, a description of which, together with accounts of various observations and experiments made by him, was published in the *Philosophical Transactions* (1724). He died in Holland on Sept. 16, 1736.

FA-HSIEN (fl. A.D. 399–414), Chinese Buddhist monk and traveler in central Asia, India and Ceylon, whose record of his journeys and studies is valuable evidence for the history of Buddhism and its strength in central Asia and northern India before its eclipse by Islam and the resurgence of Hinduism. Born at Shansi during the 4th century A.D. Fa-hsien set out from China, traveled westward through Turkistan and, about A.D. 402, crossed the Hindu Kush into India. There, in the then central Buddhist realm, he stayed for ten years, visiting Afghanistan and the Ganges valley, conversing with Buddhist monks and scholars and copying Buddhist texts. From India he sailed to Ceylon, where he continued transcribing sacred texts that were unknown in China. About A.D. 414 he returned via Java to Nanking where he translated these texts (listed in P. C. Bagchi, *Le Canon bouddhique en Chine,* 1927) from Sanskrit into Chinese.

Translations of his narrative include S. Beal, *Travels of Fah-Hian and Sung-Yun* (1869); J. Legge, *Fa-hsien, a Record of Buddhistic Kingdoms* (1886); H. A. Giles, *The Travels of Fa-hsien* (399–414 A.D.) (1923). (R. L. HL.)

FAIDHERBE, LOUIS LEON CÉSAR (1818–1889), French general and colonial administrator, was born on June 3, 1818, at Lille. He received his military education at the École Polytechnique and at Metz and entered the engineers in 1840. From 1844 to 1847 he served in Algeria, then two years in the West Indies, and again in Algeria, taking part in many expeditions against the Arabs. In 18jz he was transferred to Senegal as sub-director of engineers and in 1854 became governor of the colony. He held this post with one brief interval until July 1865. The work he accomplished in West Africa constitutes his most enduring monument. At that time France possessed in Senegal little else than the town of St. Louis and a strip of coast. Faidherbe dreamed of creating a French African empire stretching from Senegal to the Red sea. By boldly advancing the French outposts on the upper Senegal he stemmed the Moslem advance on the middle Niger; and by an advantageous treaty with Omar al-Hadji, the ruler of these countries, in 1860 he brought the French possessions into touch with the Niger. He also conquered the country lying between the Senegal and Gambia. When he resigned his post the foundation of the French dominion in West Africa had been laid. In 1863 he became general of brigade.

From 1867 to 1870 he commanded the subdivision of Bona in Algeria; he was commanding the Constantine division at the commencement of the Franco-German War. Promoted to general of division in Nov. 1870, he was appointed (Dec. 3) commander-in-chief of the army of the north. The struggle between the I German army and that commanded by Faidherbe, in which were included the hard-fought battles of Pont Noyelles, Bapaume and St. Quentin, was perhaps the most honourable to the French army in the whole of the war. Elected to the national assembly for the *département* of the Nord, he resigned his seat in consequence of its reactionary proceedings. Faidherbe was made chancellor of the order of the Legion of Honour. In 1872 he went on a scientific mission to upper Egypt, where he studied the monuments and inscriptions. He was elected a senator in 1879. He died on Sept. 29, 1889, and received a public funeral. Statues and monuments to his memory were erected at Lille, Bapaume, St. Quentin and St. Louis, Senegal. His works include *Collection des inscriptions numidiques* (1870); *Epigraphie phénicienne* (1873); *Essai sur la langue poul* (1875); *Le Ze'naga des tribus sénégalaises* (1877); *Campagne de l'armée du Nord* (1871); *Le Soudan Français* (1884); *Le Sénégal* (1889).

See Brunel, *Le Général Faidherbe* (2 vol, *1892);* Riethy, *Histoire populaire du général Faidherbe* (1901); and Froelicher, *Trois Colonisateurs: Bugeaud, Faidherbe, Galliéni* (1903).

FAIENCE, a term applied generally to all kinds of glazed pottery, but properly the French word for the *porzellana di Faenza,* a fine kind of glazed and painted earthenware made in Faenza, Italy. *See* POTTERY AND PORCELAIN.

FAIN, AGATHON JEAN FRANÇOIS (1778–1837), French historian, was secretary and archivist to the *cabinet particulier* of Napoleon I from 1806 to 1815. He was born at Paris on Jan. 11, 1778. At the time of his appointment to the emperor's cabinet he had been working since 1795 in various state archives. Napoleon created him a baron in 1809 and in 1813 made him his private secretary. This office, lost at the first Bourbon restoration, was resumed during the Hundred Days. after which Fain retired into private life. He was recalled in 1830 by Louis Philippe, who appointed him first secretary of the cabinet and, on occasion, administrator of the civil list. He was also, from 1834 until his death at Paris on Sept. 16. 1837, the deputy for Montargis, Loiret.

Fain employed his years of retirement in publishing his reminiscences of Napoleon's reign. These works have remained important sources for the history of the first empire in France; the most notable are *Manuscrit de* 1814, *contenant l'histoire des six derniers mois du règne de Napoléon* (1823); *Manuscrit de* 1813, *contenant le précis des événements de cette année pour servir à l'histoire de l'empereur Napoléon,* 2 vol. (1824); *Manuscrit de* 1812, 2 vol. (1827); and *Manuscrit de l'an 111* (1794–1795) (1828). Fain's *Mémoires* were published posthumously in 1908.

FAIR: *see* EXHIBITIONS AND TRADE FAIRS.

FAIRBAIRN, ANDREW MARTIN (1838–1912), British Congregational theologian, an advocate of theological liberalism, was born at Inverkeithing, Fife, on Nov. 4, 1838. He was educated at Edinburgh and Berlin and at the Evangelical Union Theological academy in Glasgow; entering the Congregational ministry, he held pastorates at Bathgate, West Lothian and Aberdeen. From 1877 to 1886 he was principal of Airedale college, Bradford, a post which he gave up to become the first principal of Mansfield college, Oxford. In 1883 he was chairman of the Congregational Union of England and Wales. He resigned his position at Mansfield college in 1909 and died in London, Feb. 9, 1912.

Among his more important works are *Studies in the Philosophy of Religion and History* (1876), *Philosophy of the Christian Re-*

ligion (1902) and *Studies in Religion and Theology* (1909).

See W. B. Selbie, *Life of Andrew Martin Fairbairn* (1914).

FAIRBAIRN, SIR WILLIAM, BART. (1789–1874), British engineer who in 1845 collaborated with Robert Stephenson in the design of the famous early railway bridges over the Menai strait and the River Conway, and who made the tests that led to the adoption of the tubular design, was born at Kelso, Roxburghshire, on Feb. 19. 1789. Although for a time he ran a yard to build iron ships in Millwall, London, most of his working life was spent in Manchester, with James Lillie as partner from 1817 to 1832, thereafter on his own.

In 1844 Fairbairn introduced the Lancashire boiler with twin flues. He pioneered the use of wrought iron as a material for the hulls of ships and for bridges, and introduced it in preference to cast iron for mill shafting and for beams for buildings. From 1834 Fairbairn scientifically investigated the strength of iron, the relative merits of hot and cold blast, and how to abate smoke; with Eaton Hodgkinson he studied the strength of iron beams and columns. For Lord Kelvin he determined (1851) the melting points of many substances under great pressure. He conducted or guided experimental work for several government committees and was consulted on many and varied works both in Great Britain and abroad.

Fairbairn was president of the Institution of Mechanical Engineers in 1854, and of the British association in 1861. He received a gold medal from the Royal society in 1860 and was made a baronet in 1869. He died at Moor Park, Surrey, on Aug. 18, 1874. His youngest brother, Sir Peter (1799–1861), founded in Leeds an establishment to make textile machinery and machine tools: and was knighted in 1858.

See *The Life of Sir William Fairbairn,* partly written *by* himself, edited and completed by William Pole (1877). (S. B. HN.)

FAIRBANKS, CHARLES WARREN (1852–1918), U.S. politician, vice-president under Theodore Roosevelt (1905–09), was born in Unionville Center, Ohio, on May 11, 1852. He graduated from Ohio Wesleyan university, Delaware, in 1872, studied law in Cleveland and began practice in Indianapolis, Ind. He was the chief power in the Republican party in that state from 1896 until his death. He was temporary chairman and keynote speaker of the convention which nominated William McKinley, and was U.S. senator from Indiana: 1897–1905. A conservative and representing a doubtful state! he was the political choice as running mate to Theodore Roosevelt in 1904. In 1912 Fairbanks supported William Howard Taft instead of Roosevelt. He was again his party's nominee for vice-president on the unsuccessful ticket of 1916 headed by Charles Evans Hughes.

Fairbanks died June 4, 1918.

FAIRBANKS, DOUGLAS (1883–1939), motion-picture actor and producer, best known for his portrayals of ebullient and athletic heroes. was born in Denver, Colo., May 23, 1883. After college study he began a stage career. eventually becoming a leading man in New York (1906). Within a few years he turned to motion pictures: and in 1917 was head of his own producing company. Among his many popularly successful pictures were *Tlze Mark of Zorro* (1920), *The Three Musketeers* (1921), *Robin Hood* (1922), *The Black Pirate* (1926) and *The Iron Mask* (1929). He was married to Mary Pickford (*q.v.*) in 1920 and divorced by her in 1935. With Miss Pickford, Charlie Chaplin and others, he was a founder of the United Artists corporation. Fairbanks died in Santa Monica. Calif.. Dec. 12, 1939.

His son, DOUGLAS (ELTON) FAIRBANKS (1909–), also was a film star, served with distinction in World War II and later became a television producer in England. (M. S. BY.)

FAIRBANKS, ERASTUS (1792–1864), U.S. manufacturer, was born in Brimfield, Mass., on Oct. 28, 1792. In 1824 he formed a partnership with his brother Thaddeus for the manufacture of stoves and plows. Erastus was a member of the state legislature in 1836–38, and governor of Vermont in 1852–53 and 1860–61. His son HORACE FAIRBANKS (1820–88) became president of E. and T. Fairbanks and Co. in 1874, and was governor of Vermont from 1876 to 1878.

His brother THADDEUS FAIRBANKS (1796–1886), inventor, was born at Brimfield on Jan'. 17, 1796. He designed the models from which he and his brother manufactured stoves and plows at St. Johnsbury, Vt. In 1826 he patented a cast-iron plow which was extensively used. In 1831 he invented the famous compound-lever platform scale, which marked a great advance in the construction of machines for weighing heavy objects. He died at St. Johnsbury on April 12, 1886.

FAIRBANKS, the principal city of the interior of Alaska, U.S., is a mining and transportation centre located 250 mi. up the Tanana river from its confluence with the Yukon. A gold strike in 1902 brought stampeders to the vicinity; in 1906 the population may temporarily have reached 8,000. That year gold production surpassed $9,000,000. Expensive dredges soon became necessary to reach the gold-bearing gravels; a number were still operating in the second half of the 20th century.

The Richardson highway from Fairbanks to the coast at Valdez was completed in 1923. In the same year the Alaska railroad was completed from Anchorage. In the 1920s Fairbanks became a centre for Alaska's famed "bush pilots." During World War II construction of the Alaska highway linked Fairbanks with the major North American highways. Ladd and Eielson air force bases were built nearby.

The meeting of the mining frontier and the air age at Fairbanks is symbolized by sturdy log cabins nestling beside multistory steel buildings. The University of Alaska is noted both for its mining course and for its advanced geophysical institute. For comparative population figures *see* table in ALASKA: *Population.* (J. E. CL.)

FAIRCHILD, DAVID GRANDISON (1869–1954), U.S. agricultural explorer who supervised the introduction of many useful plants into the United States, was born on April 17, 1869, at Lansing, Mich. In 1888 he graduated from Kansas State college, Manhattan, and, after some graduate work at the University of Iowa, Iowa City, and Rutgers, New Brunswick. N.J.. he joined the section of plant pathology of the United States department of agriculture in Washington, D.C., in 1889. From 1893 to 1896 he studied in Italy, Germany and Java. He helped W. T. Swingle organize the section of plant introduction (then the section of foreign seed and plant introduction) of the department of agriculture in 1897–98. Fairchild served the section as agricultural explorer (1898–1903), as administrator in charge (1903–28) and, after retirement, as collaborator (1928–54). During his administration many thousands of kinds of plants were introduced into the country. In 1905 he married Marian, daughter of Alexander Graham Bell. Fairchild was the author of several books, including *Exploring for Plants* (1930), an account of the Allison Vincent Armour expeditions for the United States department of agriculture; the autobiographical *The World Was My Garden* (1938); and *The World Grows Round My Door* (1947), story of the Kampong, Fairchild's home in Coconut Grove, Fla. The Fairchild Tropical garden at Coconut Grove was named in his honour. Fairchild died in Coconut Grove on Aug. 6, 1954. (J. W. TT.)

FAIRFAX, EDWARD (*c.* 1575–1635), English poet. translator of Tasso and refiner of couplet verse, was born at Leeds, Yorkshire, *c.* 1575. His *Godfrey of Bulloigne or the Recoverie of Jerusalem* (1600), a translation of Tasso's *Gerusalemme Liberata,* achieved great fame, and was praised by John Dryden: "For *Spenser* and *Fairfax* both . . . saw much farther into the Beauties of our Numbers, than those who immediately followed them."

Although translating stanza by stanza. Fairfax freely altered poetic detail. His terminal couplets are often sonorous departures from the Italian, and from these especially Edmund Waller "deriv'd the Harmony of his Numbers."

For in the secret of her troubled thought,
A doubtful combat, love and honour fought;
(*Godfrey,* vi, 70)

is a typically well-balanced couplet which Waller copied in *Instructions to a Painter* (1666). Fairfax also influenced Milton, whose tonal harmony he often anticipated:

And counsellors of her old love, she made
Those vallies dumb, that silence and that shade.
(*Godfrey,* vi, 103)

Among Fairfax' other works were 12 eclogues, of which only 2 and most of a third have been found. The finest, "Hermes and Lycaon," is an apocalyptic singing match between worldly and spiritual lovers, and was published, with a curious account of the bewitching of the poet's daughters, in the Philobiblon society's *Miscellanies* (1858–59). Another eclogue appeared in *The Muses' Library* (1737). The complete manuscript of the eclogues still survived in 1789 and may exist unnoticed. Fairfax died in Jan. 1635. (C. G. B.)

FAIRFAX OF CAMERON, FERDINANDO FAIRFAX, 2ND BARON (1584–1648), English parliamentary general, was born on March 29, 1584, son of Thomas Fairfax of Denton (1560–1640; created Baron Fairfax of Cameron, 1627). He was M.P. for Boroughbridge during the six parliaments which met between 1614 and 1629 and also during the Short Parliament of 1640. In May 1640 he succeeded his father as Baron Fairfax, but being a Scottish peer he sat in the English house of commons as one of the representatives of Yorkshire during the Long Parliament from 1640 until his death; he took the side of the parliament, but held moderate views and desired to maintain the peace. In the first Scottish War Fairfax had commanded a regiment in the king's army; on the outbreak of the Great Rebellion in 1642 he was made commander of the parliamentary forces in Yorkshire, with Newcastle as his opponent. Hostilities began after the repudiation of a treaty of neutrality entered into by Fairfax with the royalists. At first he met with no success. He was driven from York, where he was besieging the royalists, to Selby; then in 1643 to Leeds; and after beating off an attack at that place he was totally defeated at Adwalton moor (June 30). He escaped to Hull, which he defended against the duke of Newcastle (Sept. 2–Oct. 11), and by means of a brilliant sally caused the siege to be raised. Fairfax was victorious at Selby (April 11, 1644), and joining the Scots besieged York, after which he was present at Marston moor. In July he was made governor of York, in December he took the town of Pontefract, but failed to secure the castle. He resigned his command on the passing of the Self-Denying ordinance, but remained a member of the committee for the government of Yorkshire. He died from an accident on March 14, 1648, and was buried at Bolton Percy. He was twice married, and by his first wife, Mary, daughter of Edmund Sheffield, 3rd Lord Sheffield (afterward 1st earl of Mulgrave), he had six daughters and two sons, Thomas, who succeeded him as 3rd baron, and Charles, a colonel of horse, who was killed at Marston moor.

FAIRFAX OF CAMERON, THOMAS FAIRFAX, 3RD BARON (1612–1671), parliamentary general and commander in chief during the English Civil War, the eldest son of the 2nd baron, was born at Denton, near Otley, Yorkshire, on Jan. 17, 1612. He studied at St. John's college, Cambridge (1626–29), and then served as a volunteer with the English army in the Low Countries under Lord Vere, whose daughter Anne he married in 1637. He was knighted in 1640.

The Fairfaxes, father and son, though they served in the royal army during the first Scottish War, sided with the Long Parliament in its quarrel with Charles I. When Charles endeavoured to raise a guard for his own person at York, intending it to form the nucleus of an army, Fairfax presented a petition asking him to discontinue the raising of troops. This was at a meeting of the freeholders and farmers of Yorkshire convened by the king on Heworth moor near York (June 1642). When war broke out, Lord Fairfax was appointed general of the parliamentary forces in the north, and his son, Sir Thomas, was made lieutenant-general of horse under him. Both father and son distinguished themselves in the campaigns in Yorkshire (*see* CIVIL WAR, ENGLISH). Sometimes severely defeated, more often successful and always energetic, prudent and resourceful, they maintained the struggle until the crisis of 1644, when York was held by the marquess of Newcastle against the combined forces of the English parliamentarians and the Scots, and Prince Rupert hastened with all available forces to its relief. The battle of Marston moor (*q.v.*) mas decisive of the struggle in the north. The younger Fairfax bore himself nith the greatest gallantry in the battle and, though severely wounded, managed to join Cromwell and the victorious cavalry on the other wing. One of his brothers, Col. Charles Fairfax, was killed in the action.

After the passing of the Self-denying ordinance Thomas Fairfax was selected to succeed Essex, as lord general, with Oliver Cromwell as his lieutenant-general and cavalry commander; and after a short preliminary campaign the "New Model" army justified its existence, and "the rebels' new brutish general," as the king called him, his capacity as commander in chief in the decisive victory of Naseby (*q.v.*). The king fled to Wales. Fairfax besieged Leicester and was successful at Taunton, Bridgwater and Bristol. Oxford surrendered in 1646, and it is characteristic of the man that the general's first act was to set a strong guard on the Bodleian library.

In Jan. 1647 Charles was delivered up by the Scots to the commissioners of parliament. Fairfax met the king beyond Nottingham and accompanied him during the journey to Holmby, treating him with the utmost consideration. In the confused negotiations between the various parties which followed, Fairfax was placed in the unpleasant position of intermediary between his own officers and parliament. He was more at home in the field than at the head of a political committee and, finding events too strong for him, he sought in vain to resign his commission as commander in chief. He remained the titular chief of the army party. and with the greater part of its objects he was in complete, sometimes most active, sympathy. Shortly before the outbreak of the second Civil War, Fairfax succeeded his father in the barony and in the office of governor of Hull. In the field against the English royalists in 1648 his operations culminated in the successful siege of Colchester, after the surrender of which place he approved the execution of the royalist leaders Sir Charles Lucas and Sir George Lisle, holding that these officers had broken their parole. At the same time Cromwell's great victory of Preston crushed the Scots, and the independents became practically all-powerful.

Milton, in a sonnet written during the siege of Colchester, called upon the lord general to settle the kingdom, but the crisis was now at hand. Fairfax approved, if he did not take an active part in, Pride's Purge (Dec. 6, 1648), but on the question of the fate of Charles he opposed the army officers. He presided over the judges who were to try the king at the preliminary sitting. Then, convinced that the king's death was intended, he refused to act. In calling over the court, when the crier pronounced the name of Fairfax, Lady Fairfax, from the gallery, cried out "that the Lord Fairfax was not there in person, that he would never sit among them, and that they did him wrong to name him as a commissioner." His last service as commander in chief was the suppression of the Leveller mutiny at Burford in May 1649. He had been reappointed lord general, but the council of state resolved to send an army against the Scots in 1650. Fairfax resigned his commission. Cromwell was appointed his successor. Fairfax received a pension of £5,000 a year, and lived in retirement at his Yorkshire home of Nunappleton till after the death of the Protector.

The troubles of the later Commonwealth recalled him to political activity, when Monk invited his co-operation against Lambert's army. When, in Dec. 1659, he appeared at the head of a body of Yorkshire gentlemen, 1,200 horse quitted Lambert's colours and joined him. That day secured the restoration of the monarchy. Fairfax was elected member for Yorkshire in the "free" parliament and led the commission appointed by the house of commons to wait upon Charles II at The Hague and urge his speedy return.

The remaining 11 years of the life of Lord Fairfax were spent in retirement at his seat in Yorkshire. He died at Nunappleton on Nov. 12, 1671, and was buried at Bilborough, near York. As a soldier he was exact and methodical in planning, in the heat of battle "so highly transported that scarce any one durst speak a word to him" (Bulstrode Whitelocke), chivalrous and punctilious in his dealings with his own men and the enemy. Honour and conscientiousness were equally the characteristics of his private and public character. But both in war and peace he was overshadowed by his associate Cromwell.

Lord Fairfax translated some of the psalms, and wrote poems on solitude, the Christian warfare, the shortness of life, etc. During the last year or two of his life he wrote two Memorials which have been published—one on the northern actions in which he was engaged in 1642–44, and the other on some events in his tenure of the chief command. At York and at Oxford he endeavoured to save the libraries from pillage, and he enriched the Bodleian with some valuable manuscripts. His only daughter, Mary Fairfax, was married to George Villiers, the profligate duke of Buckingham of Charles II's court.

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His descendant Thomas, 6th baron (1692–1782), inherited from his mother. the heiress of Thomas, 2nd Baron Culpepper, large estates in Virginia, U.S., and having sold Denton hall and his Yorkshire estates he retired there about 1746, dying a bachelor. He was a friend of George Washington's. Thomas found his cousin William Fairfax settled in Virginia and made him his agent; and Bryan (1737–1802), the son of William Fairfax, eventually inherited the title, becoming 8th baron in 1793. His claim was admitted by the house of lords in 1800. But it was practically dropped by the U.S. family, until, shortly before the coronation of Edward VII, the successor in title was discovered in Albert Kirby Fairfax (1870–1939), a descendant of the 8th baron, who was a U.S. citizen. In Nov. 1908 Albert's claim to the title as 12th baron was confirmed by the house of lords.

FAIRFIELD, a town of Fairfield county, Conn., U.S., on Long Island sound, adjoining Bridgeport on the southwest. (For comparative population figures *see* table in CONNECTICUT: *Population.*)

Although known as a summer resort, industries include the manufacture of batteries, chemicals, drugs, roller bearings and automobile accessories. Fairfield university, officially Fairfield University of St. Robert Bellarmine (Roman Catholic), a college of liberal arts for men, was founded there in 1942.

The town was settled in 1639 by Roger Ludlow, who in 1637 had been one of a band which defeated the Pequot Indians in the vicinity. During the colonial period it was a place of importance, but later it was overshadowed by Bridgeport. On July 8, 1779, Fairfield was burned by the British and Hessians under Gov. William Tryon.

FAIRHAVEN, a town of Bristol county, Mass., U.S., on Buzzards bay, across the Acushnet river from New Bedford. (For comparative population figures *see* table in MASSACHUSETTS: Population.) The town is a summer resort and a residential suburb of New Bedford and has factories which manufacture tacks, machinery and commercial fishing equipment. Whaling, the principal industry in mid-19th century, was replaced by shellfishing, deep-sea fishing and the building of fishing vessels. Fairhaven was the home port of Captain Joshua Slocum, the first man to sail alone around the world (1895–98).

First settled in 1670, Fairhaven was separated from New Bedford and incorporated as a town in 1812. In 1778, British forces dismantled the small fort and set fire to the town, but were driven off by militia under Maj. Israel Fearing. The fort was rebuilt at once and renamed Ft. Phoenix. In the War of 1812, it was a strong defense point on the New England coast. (CA. M. C.)

FAIR ISLE, a rugged island between the Orkney and Shetland Islands northeast of the Scottish mainland in Zetland county. It is composed of Old Red Sandstone and its highest point, Ward hill, reaches 400 ft. It has two lighthouses. Fewer than 100 crofters live on Fair Isle, many of whom still knit the multicoloured woollen garments which made the island famous. To ornithologists Fair Isle rivals Heligoland in its importance as a bird-migration station, and since 1949 it has belonged to the Fair Isle Observatory trust.

Pop. (1951) 73; area 3 sq.mi.

FAIR LAWN, a borough of Bergen county, N.J., U.S., 10 mi. from the George Washington bridge to New York city. The borough is separated from Paterson, N.J., by the Passaic river. The population was 36,421 in 1960. (For comparative population figures *see* table in NEW JERSEY: Population.)

A carefully planned community, the borough was incorporated in 1924, and in 1948 a council-manager form of government was established.

In 1929 a model garden apartment community named Radburn was built under the auspices of the Rockefeller foundation. This community served as an example of desirable apartment planning; its pattern was adopted in modified form in many places. An industrial park covering 175 ac. is another example of community planning. The park contains several light industries whose buildings have been integrated into the community without depressing property values. Local manufactures include airplane parts, dyes and concrete products. (S. HE.)

FAIRMONT, a city of northern West Virginia, U.S., 65 airline miles south of Pittsburgh, Pa., at the confluence of West Fork and Tygart Valley rivers, the head of navigation of the Monongahela river; seat of Marion county. (For comparative population figures *see* table in WEST VIRGINIA: Population.) First settled after the American Revolution, it was incorporated in 1820 as Middletown, and renamed Fairmont in 1843. After the arrival of the Baltimore and Ohio railroad in 1852 it became an important political, mercantile and bituminous coal-mining centre. At nearby Monongah a coal mine explosion took 359 lives in 1907. Since 1919 Fairmont has had a unique four-man bipartisan commission government. Fairmont State college was founded in 1867 as a state supported college. Industrial products include glass containers, aluminum sheets, fluorescent lamps, paper boxes, mining machinery and coke. (GE. W. SM.)

FAIR OAKS, a station on a branch (formerly famous as the York river railway) of the Southern railway, 6 mi. E. of Richmond, Virginia, U.S. It is noted as the site of one of the battles of the Civil War (*q.v.*), fought on May 31 and June 1, 1862, between the Union (Army of the Potomac) under Gen. G. B. McClellan and the Confederate forces (Army of Northern Virginia) commanded by Gen. J. E. Johnston. The attack of the Confederates was made at a moment when the river Chickahominy divided the federal army into two unequal parts—two corps on the south bank, three on the north—and was, moreover, swollen to such a degree as to endanger the bridges. Gen. Johnston stationed part of his troops along the river to prevent the Federals sending aid to the smaller force south of it, upon which the Confederate attack, commanded by Gen. Longstreet, was directed. Many accidents, due to the inexperience of the staff officers and to the difficulty of the ground, hindered the development of Longstreet's attack, but the Federals were gradually driven back with a loss of ten guns, though at the last moment reinforcements managed to cross the river and re-establish the line of defense. At the close of the day Johnston was severely wounded, and Gen. G. W. Smith succeeded to the command. The battle was renewed on June 1 but not fought out. At the close of the action Gen. R. E. Lee took over the command of the Confederates, which he held till the final surrender in April 1865. So far as the victory lay with either side, it was with the Union army, for the Confederates failed to achieve their purpose of destroying the almost isolated left wing of McClellan's army, and after the battle they withdrew into the lines of Richmond. The Union losses were 5,031 in killed, wounded and missing; those of the Confederates were 6,134. The battle is alternatively known as the battle of Seven Pines.

FAIR TRADE LAWS, a term applied to laws that allow manufacturers of branded, trade-marked goods, or, in some instances, distributors of such products, to fix the actual or minimum resale prices of these branded goods by resellers. Such price controls are more widely effective in retail sales to consumers than at other levels of marketing. Only a few types of goods have come under such controls, the leading examples being drugs and pharmaceuticals, books. photographic supplies, liquors, miscellaneous household appliances and various specialty goods.

By the 1960s "fair trade laws" had been enacted at various times in 45 states of the United States. The laws are rooted in a long, controversial history that began in the 1880s and has been paralleled by similar developments in other parts of the world, especially in the highly industrialized western countries.

The designation "fair trade law" became widespread in the United States following the adoption of the California Fair Trade law in 1931, and its amendment in 1933. The label probably was inherited from the American Fair Trade league, an association of manufacturers of branded goods organized in 1913, which attempted for some 20 years to obtain federal legislation sanctioning resale price maintenance contracts between manufacturers and their distributors. Prior to 1931 in the United States, and in other countries historically and currently, the recognized name for this important problem area was "resale price maintenance."

The Sherman Antitrust act of 1890 in the United States, with its prohibition of monopolies, early gave resale price maintenance a peculiar status. The U.S. courts, especially the supreme court, erected barriers to effective enforcement by prohibiting or casting doubts upon the means of enforcement. In other countries, and especially in Great Britain, resale price maintenance came into wide use, enforced by trade associations and groups of trade associations. Before enactment of the 1931 California Fair Trade law, resale price maintenance in interstate commerce in the United States was limited to the mere suggestion of prices to dealers without effective power of enforcement or to sale through bona fide agents and on consignment. The crux of the whole matter from the point of view of those wishing such controls was inability to enforce prices on unwilling independent dealers who chose to sell below the suggested prices of manufacturers. Under these conditions, the controls covered only a small proportion of total consumers' goods.

In 1933 California amended its 1931 statute to make the contractual prices agreed upon between a manufacturer and contracting dealers binding upon all resellers. This so-called "nonsigners' clause" with its coercive authority over unwilling dealers gave the fair trade movement enormous momentum. Although resale price maintenance historically is not a depression phenomenon, its legislative sanction was influenced very greatly by the depressed markets of the 1930s. In a few years following the 1931 and 1933 California acts, identical or similar statutes were enacted by 44 other states. In the meantime, the legal doubts and barriers were removed or relieved by a favourable 1936 review by the U.S. supreme court in Old *Dearborn Distributing Co.* v. *Seagram Distillers Corp.,* 229 U.S. 183 and passage of the Miller-Tydings act in 1937, which removed the barriers in interstate commerce between states with fair trade laws.

Thus, when World War II began, resale price maintenance had become widely accepted legally in the United States, as it had also in several other countries. The coercive pouer of the nonsigners' clause, in fact, gave manufacturers more specific authority over pricing in the U.S. marketing channels than was true in most other parts of the world, but, as it turned out, this was only a temporary peak in the United States. In the postwar years the entire issue was reopened in the United States and elsewhere.

In 1951, the U.S. supreme court raised serious doubts concerning the nonsigners' clause in *Schwegmann Bros.* v. *Culvert Distillers Corp.,* 341 U.S. 384. In 1952 congress passed the McGuire act in order to reestablish the position of the nonsigners' clause, and it was upheld by the U.S. supreme court in 1953. However, in subsequent years the fair trade laws of the states ran into increasing difficulties in state supreme courts. By the end of 1959, fair trade was without firm legal sanction or was in serious legal jeopardy in 20 states (including Vermont, Texas and Missouri, where such laws had never been enacted) and the District of Columbia.

During the postwar years, resale price maintenance as a business practice and organized movement weakened even more perceptibly in some other countries. It was prohibited in both Canada and Sweden and serious doubts about it existed in France. Developments in Great Britain were most interesting in light of the long British record of collective enforcement going back to 1890 and the relatively favourable reports on the subject by governmental committees in 1920 and in 1930. During the earlier period, British courts and governmental committees interpreted the right of contract broadly to permit manufacturers to make resale price maintenance agreements among themselves and with their distributors, provided undue restraint of trade was not shown. In the absence of outright prohibitions of collusive agreements or cartels, as in the United States, collective enforcement became widespread. In 1949, a third governmental committee, following an extended investigation and much more comprehensive treatment than in the earlier reports, recommended strongly against collective sanctions and enforcement. It also took a strong position in favour of the right of independent enforcement by individual producers.

In 1956 the Restrictive Trade Practices act prohibited the enforcement of resale prices by the collective withholding of supplies and related arrangements; it also strengthened the position of the individual supplier by giving him a right of recourse to the courts in enforcement against dealers who were not parties to the agreement. A review of law, regulation and practice throughout the leading nations of the world in 1960 disclosed that the issues and forces involved under "fair trade" and "resale price maintenances" were far from being resolved.

Actually, it seems unlikely that a stable equilibrium or solution can be achieved either in law or in business practice. The initial movement beginning in the 1880s reflected the impact of successful brand promotion by manufacturers upon relations in the distributive trades and the division of the market among competing brands. The very success of manufacturer brand promotion made for more active competition among retailers. The modern U.S. drug store, for example, with its shelves loaded with national brands is in much keener, more direct competition with other similar stores than was true of the former "chemists" and "apothecaries" who did their own mixing and labeling. Resale price maintenance by manufacturers might have become fairly widespread and effective, however, if retailing had remained in the hands of armies of unorganized small, local independent dealers. Large-scale retailing, together with the growth of strong dealer organizations, sets up strong conflicting interests within retailing and in the marketing channels. In most fields in highly industrialized countries. the marketing channels are both complex and highly overlapping. Consequently the establishment and enforcement of a single price or even of a minimum price by manufacturers is a complicated and burdensome business in the absence of collective enforcement efforts, limitation of numbers of enterprises or governmental intervention. In a few instances. as in the sale of alcoholic beverages in some jurisdictions, resale price maintenance has become mandatory and is enforced by governmental agencies. The long-run rationale of "fair trade" or resale price maintenance points either away from the unique traditional antitrust approach in the United States or toward governmental regulation. The conflicting interests of consumers, retailers, wholesalers and producers are so diverse and well organized as to allow no point of stable equilibrium in the absence of private or public limitations on free access to the market. Effective resale price controls act as magnets to attract excessive capital and manpower into distributive activities. Hence such a program is not workable in the long run without means of restricting numbers of enterprises.

Unfortunately, in the play of the competing forces and pressures on markets, occasional important injuries to individual enterprises or classes of enterprises occur. Thus, manufacturers of well known advertised brands may be injured if their products are featured as "leaders" or "loss leaders" or are used as "bait," insofar as distributors may be able to push the sale of other brands in higher regard with them. Small independent specialty dealers are unable to use "leaders" and "loss leaders" as effectively as are department stores and supermarkets. Sellers and the consuming public both are injured by deceptive price practices. It is generally agreed among impartial observers that resale price maintenance or "fair trade" is not a true solution to problems arising out of trade conflicts or unfair and deceptive practices. It is held that active enforcement of antitrust legislation and of laws curbing unfair and deceptive methods of competition provide adequate safeguards for all concerned — manufacturers, retail and wholesale distributors and consumer-buyers.

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Canada: see numerous reports of The Restrictive Trade Practices Commission. (E. T. G.)

FAIRŪZĀBĀDĪ (Abū-ṭ-Ṭāhir ibn Ibrahim Majd ud-Dīn ul-Fairūzābādī) (1329–1414), Arabian lexicographer, was born at Kārazīn near Shiraz. His student days were spent in Shiraz, Wāsit, Baghdad and Damascus. He taught for ten years in Jerusalem, and afterwards travelled in western Asia and Egypt. In 1368 he settled in Mecca, where he remained for 15 years. He next visited India and spent some time in Delhi, then remained in Mecca another ten years. The following three years were spent in Baghdad, in Shiraz (where he was received by Timur), and in Ta'iz. In 1395 he was appointed chief cadi (qadi) of Yemen, married a daughter of the sultan, and died at Zabid in 1414. During this last period of his life he converted his house at Mecca into a school of Mālikite law and established three teachers in it. He wrote a huge lexicographical work of 60 or 100 volumes uniting the dictionaries of Ibn Sida, a Spanish philologist (d. 1066), and of Sajānī (d. 1252). A digest of or an extract from this last work is his famous dictionary *al-Qāmūs* ("the Ocean"), which has been published in Egypt, Constantinople and India, has been translated into Turkish and Persian, and has itself been the basis of several later dictionaries.

FAIRY, the common term for a supposed race of supernatural beings who magically intermeddle in human affairs. (Fr. *fée*, faerie; Prov. *fada;* Sp. *hada;* Ital. fata; med. Lat. *fatare,* to enchant, from Lat. jatum, fate, destiny.) They are not the immediate product of one country or of one time; they have a pedigree. But mixture and connection of races have so changed the original folk-product that it is difficult to separate the different strains that have gone to the moulding of the result.

It is not in literature that the early forms of the fairy belief must be sought. Many of Homer's heroes have fairy lemans, called nymphs, but the fairy leman is familiar to the unpoetical Eskimo, and to the Red Indians, with their bird-bride and beaver-bride (see A. Lang's *Custom and Myth,* "The Story of Cupid and Psyche"). The Gandharvas of Sanskrit poetry are also fairies.

One of the most interesting facts about fairies is the wide distribution and long persistence of the belief in them. They are the chief factor in surviving Irish superstition. Here they dwell in the "raths," old earth-forts. They are an organized people, and their life corresponds to human life in all particulars, They carry off children and are generally the causes of all mysterious phenomena. Whirls of dust are caused by the fairy marching army, as by the beings called Kutchi in the Dieri tribe of Australia. The fairy changeling belief also exists in some districts of Argyll. In Ireland and the west Highlands neolithic arrowheads and flint chips are still fairy weapons. They are dipped in water, which is given to ailing cattle and human beings as a sovereign remedy for diseases. In the Highlands there is much more interest in second sight than in fairies, while in Ireland the reverse is the case The best book on Celtic fairy lore is still that of the minister of Aberfoyle, the Rev. Mr. Kirk (ob. 1692). His work on *The* Secret Comnzonwealth *of* Elves, Fauns, *and* Fairies, left in ms. and incomplete (the remainder is in the Laing mss., Edinburgh University library), uas published (100 copies) in 1815 by Sir Walter Scott, and in the *Bibliothèque* de Carabas (Lang) there is a French translation. There is a theory that the fairies survive in legend from prehistoric memories of a pigmy people dwelling in the subterranean earth houses, but the contents of these do not indicate an age prior to the close of the Roman occupation of Britain; nor are pigmy bones common in neolithic sepulchres. The "people of peace" (*Daoine Shie*) of Ireland and Scotland are usually of ordinary stature, only varying from mankind by their proceedings. (*See* J. Curtin, *Irish Folk-tales.*)

The belief in a species of lady fairies, deathly to their human lovers, was found by R. L. Stevenson to be as common in Samoa (see *Island Nights' Entertainments*) as on the banks of Loch Awe. The Greek sirens of Homer are a form of these fairies, as the Nereids, Oreads and Naiads are fairies of wells, mountains and the sea. The fairy women who come to the births of children and foretell their fortunes (Fata, Moerae, ancient Egyptian Hathors, *Fées,* Dominae Fatales), with their spindles, are refractions of the human "spae-women" (in the Scots term) who derive omens of the child's future from various signs. These women. represented in the spiritual world by *Fata,* bequeath to us the French *fée*, in the sense of fairy. Perrault uses *fée* for anything that has magical quality.

The nearest analogy to the shape which fairy belief takes in Scotland and Ireland—the "pixies" of southwestern England—is in *Jān* or *Jinnis* of the Arabs, Moors and people of Palestine. In stories which have passed through a literary medium, like *The Arabian Nights*, the *geni* or *Jān* do not so much resemble our fairies as they do in the popular superstitions of the East, orally collected. They chiefly differ from our fairies in their greater tendency to wear animal forms; though when they choose to appear in human shape they are not to be distinguished from mortals. Like the fairies everywhere they have amours with mortals. The herb rue is potent against them, as in British folklore. They, like the British brownies (a kind of domesticated fairy), are the causes of strange disappearances of things. To preserve houses from their influences rue is kept, and the name of Allah is constantly invoked.

They often bear animal names. Euphemistically they are addressed as *mubārakin*, "blessed ones." As our fairies give gold which changes into withered leaves, the *Jān* give onion peels which turn into gold. Like our fairies the Jan can apply an ointment. kohl, to human eyes, after which the person so favoured can see Jan, which are invisible to other mortals, and can see treasure wherever it may be concealed. (See Folk-lore *of* the Holy Land, by J. E. Hanauer, 1907.)

The enjoyment of love between a fairy and a mortal is generally qualified by some restriction or compact, the breaking of which is the cause of calamity to the lover and all his race, as in the notable tale of Melusine (*q.v.*, and see the chapter De *lamiis* et *nocturnis larvis* in *Otia Imperialia,* written early in the 13th century, by Gervaise of Tilbury). At the birth of Ogier le Danois six fairies attend, five of whom give good gifts, which the sixth overrides with a restriction. There is little in these fairies of romance to distinguish them from human beings, except their supernatural knowledge and power. To this class belong the fairies of Boiardo, Ariosto and Spenser.

There is no good modern book on the fairy belief in general. Keightley's *Fairy Mythology* is interesting; Rhys's *Celtic Mythology* is copious about Welsh fairies, practically identical with those of Ireland and Scotland. The works of Mr. Jeremiah Curtin and Dr. Douglas Hyde are useful for Ireland, for Scotland, Kirk's *Secret Commonwealth* has already been quoted. Scott's dissertation on fairies in *The Border Minstrelsy* is rich in lore, though Scott had not the benefit of recent researches. There is a full description of French fairies of the 15th century in the evidence of Jeanne d'Arc at her trial (1431) in Quicherat's *Procès de Jeanne d'Arc,* vol. i pp. 67, 68, 187, 209, 212; vol. ii pp. 390, 404, 450. In another vein is Sir A. Conan Doyle's *The Coming of the Fairies* (1922).

FAIRY RING, the popular name of the darker green circles occurring on lawns or meadows, in folklore supposed to mark the spots where fairies danced at midmght. They are the result of the growth in the soil of the mycelium (spawn) of certain fungi. The mycelium arises from a spore and radiates from the centre outward at an approximately equal rate, the resulting circle increasing in diameter annually. Fruiting bodies arise at the periphery of the ring. The darker colour is produced by a stimulation of the vegetation due to the increase of available nitrogen brought about both by the action of the fungus on the organic matter in the soil and by the decay of the old mycelium. Rings up to 65 m. (71.1 yd.) in diameter have been recorded.

JOHN H. GERARD

FAIRY RING MUSHROOMS (MARASMIUS OREADES)

FAISAL IBN HUSAIN (1885–1933), king of Iraq, was born at Taif, third son of Sherif Husain, a descendant of Fatima, only surviving child of the Prophet, through Hasan, her eldest son by marriage with 'Ali ibn Abi Talib, fourth amir al-Mu'-minin. After the custom of his house, Faisal was sent when only seven davs old to Rahab palace, the country seat of the al-'Aun family, in the territory of his clan, Beni 'Abadiyah and their confederates the 'Ataibah. There he remained until he was seven. In 1893, when Husain was ordered to Constantinople, Faisal accompanied him and was educated privately in that city. In 1905 he married his cousin. He returned to the Hejaz in 1909, when his father was appointed sherif.

In 1913 Faisal became deputy for Jidda and proceeded to identify himself with the Arab national movement. He commanded his father's forces in Asir in 1914 and was at Mecca on the outbreak of World War I. He was posted with the Turkish governor of Syria in 1915, but escaped to the Hejaz early in the folloaing year and there played a leading part in the Arab revolt, commanding the Arab forces with General Allenby's army until the capture of Aleppo in Oct. 1918. His influence with the tribes did much to keep Husain's tribal levies in the field. As commander in chief of the Arab army under the Allied commander in chief he then undertook the administration of the newly constituted Syrian state and, after attending the peace conference in Paris, returned to Syria in April 1919.

In September he again visited Europe and remained until Feb. 1920; in the following month he was proclaimed king of Syria, but being unable to come to terms with the French mandatory power he left Damascus in July 1920. After spending the winter in England he proceeded to Iraq as candidate for the throne in June 1921 and was elected king by a plebiscite in which he received 96% of the votes cast. He died suddenly at Berne on Sept. 8, 1933, after another visit to London.

For the events of his reign see IRAQ.

See P. W. Ireland, *Iraq: a Study in Political Development* (1937); George Antonius, *The Arab Awakening (1938).*

FAITH is an attitude of mind which, though not confined to religious experience, can best be examined by setting out from its manifestations within that sphere of experience. There we find in clearest form illustrations of the several shades of meaning which the word "faith" has borne. A classic definition is that presented in the Epistle to the Hebrews, xi, 1: "faith is the substance of things hoped for, the evidence of things not seen" (King James or Authorized version). In the Revised version the word for "evidence" is rendered as "proving," and for "substance" are offered the alternative translations "assurance" and "the giving substance to." In the Revised Standard version, "evidence" becomes "conviction," and "substance" is translated "assurance." Assurance, certitude or convincedness, and giving substance to what we do not perceive and as to which we, therefore, only entertain an idea or a supposition, may at first seem somewhat disparate meanings for one word; but the connection between them is revealed by a common signification of the word "realize." We speak of realizing what some event is when we discern its import, and when what was, so to say, "nothing to us" is found to be something with which we have to reckon or which can influence our thought and action. Personal certitude or conviction as to what as yet is not matter of scientific knowledge or proven with logical certainty is of the essence of faith; and action upon it may lead on to discovery of the actuality of the object; *i.e.,* to substantiation of the hoped for or the unseen. In the case of faith in God, whom "no man hath seen at any time," such certitude cannot issue in sight or sensibly verified knowledge; though it may develop into "proving" in the sense of establishing reasoned and reasonable belief, such as fact and experience corroborate. But in other spheres faith often issues in knowledge, such as can be characterized as seeing or perceiving what, without such exercise of faith, would have remained unseen or unknown. Thus the faith of Columbus ('realized" America for the European; and an idea of Stephenson's led to the actual locomotive engine. In neither case did faith create the reality, but in both it substantiated the unseen, and brought men into actual touch with what had been but conceived or supposed. Thus faith begins in creating or fashioning an idea; and it may issue in finding a real counterpart to the idea. There is, however, no necessity that it shall so issue; and frequently it does not: no one. *e.g.,* has realized the idea of a machine capable of perpetual motion, though many have experimented with the notion. The description of faith cited above from Heb. xi, 1 is only lacking in psychological completeness. in that it contemplates successful ventures alone, and is silent as to such as may fail. Otherwise it is of more general and exhaustive a nature than is any other conception met with in the New Testament. For instance, St. Paul considers the efficacy of faith only insofar as it is faith in Christ or in God; one of his central doctrines is that we are justified by God through faith in Christ. On the other hand the writer of Hebrews includes, among his illustrations of the faithful life, the case of Rahab who was one of "them that believed not" in the God of Israel; and the object of faith, with him, includes the whole region of the unseen, whatever it may contain. His teaching is aptly expressed in the lines of Hartley Coleridge: faith

> . . . is an affirmation and an act
> That binds eternal truth to present fact.

The long list of instances of the faithful given in Heb. xi is made up of prophets, kings, etc., who achieved the heroic life and victories of various kinds, in virtue of their souls being possessed by faith; their faith was verified by their lives. They are all concrete embodiments of the principle "nothing venture, nothing have." And that principle is not only the essence of religious faith; it underlies the acquisition of all human knowledge, such as, for the conduct of life, is most worth having. Thus the "father of the faithful" who obeyed his inward summons and went forward "not knowing whither" is an allegory of the intellectual progress of mankind. Man did not begin with scientific knowledge or knowing, but with learning through doing. He learned by failure as well as by success, and in either case he ventured before he came to have. The uniformity of nature, *e.g.,* was not written so legibly on natural phenomena that, in the time of man's primitiveness, he who ran could read it off. On the other hand, if it had not been tentatively assumed, here a little and there a little. it could never have got "substance" for man's knowledge or relevance to his life; had it not been trusted while as yet unverified, no evidence of its actuality could have emerged. And the most recent advance in logic consists in making clearer than ever before that this principle of uniformity, underlying all our inductive science, is, and must ever remain, a postulate incapable of logical proof. Thus faith, in its primary sense, is not a word to be confined to the vocabulary of theology. Philosophy, or theory of knowledge, requires it and so does science, if it would understand its own logical structure and the presuppositions on which it rests. Probability is not only "the guide of life"; it is also of the very texture of all ('knowledge" as to the actual world as distinguished from pure mathematics or truth as to the relations between ideas; and probability in the last resort, *i.e.,* in the case of the fundamental postulates underlying induction, is not a matter of numerical calculability or of formal logic, but of human hope, sanguine expectation, faith in the unseen. Instead of being logically certified it is but pragmatically "verified." The old hard and fast line between knowledge and belief or faith has disappeared. The very rationality of the world, which science would read and expound, is at bottom an idea of faith. Reason, if it include the discovery of true premises as well as the logical deduction of consequences from premises that may be either true or false, contains faith as well as logical linkage of sense data. Besides the primary meaning that has been set forth "faith" has borne others. Sometimes the word has been used as a synonym for "belief" or intellectual assent. But whereas belief is more or less constrained by fact already known, and which convinces us independently of any striving on our part, "faith" is generally used to emphasize the active or volitional element of experience, involved in venture reaching beyond the already known. Faith, again, is to be distinguished from credulity, with which it is apt to be confounded. The open mind and docility, personified in the New Testament as "the little child," are requisite for reception of truth; but there is no beatitude on credulousness. If faith, or the working to a lead or suggestion that experience suggests but does not warrant, is to issue in reasonable belief, credulity must be restrained by resort to the method of doubt, which is equally essential for acquisition of knowledge. And faith proper is doubt-sifted credulity. It proves all things before holding fast to them as true, and pursues no apparently open road after it has been shown to be closed; whereas credulity is interested belief, such as is often resorted to in order to escape the discomfort of uncertitude. Faith or belief worth calling belief must often "be purchased with the sweat of the brow." Another meaning of "faith" current in theological literature as well as in common speech, is that of trust. This resembles faith, as above described, and differs from belief in involving will and feeling: but it is rather an attitude issuing out of, and presupposing, the faith which creates its idea and then establishes belief in its actuality. Before we can trust in God, we must believe that He is; and that belief is acquired by a venture of faith. Lastly, it is unnecessary to narrow down faith to moral postulation, or to the attitude of valuation, exclusively. Religious faith was forthcoming before advanced morality appeared; moreover, it is not concerned with what ought to be real or realized, but with what is realizable. Theology founded on faith is dogma concerning ultimate reality, not pictorial recipes for pious conduct. When religious faith is conceived as but a particular case of the faith that is involved in all knowledge and reason, science and faith can be seen to be complementary, not mutually exclusive; they can lodge, without need of reconciliation, in brotherly relation within one mind, provided the mind is content with reasonableness, where logical rationality is unattainable.

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(F. R. T.)

FAITHFULL, EMILY (1835–1895), English reformer, who took great interest in the problems of working women, was born at Headley rectory, Surrey, in 1835. She set up a printing establishment for women in London (1860) and soon afterward was appointed printer and publisher to Queen Victoria. Her The Victoria Magazine (est. 1863) advocated the claims of women to remunerative employment. She published a novel, Change *Upon* Change (1868), and lectured widely and successfully both in England and the U.S.

She died in Manchester, May 31, 1895.

FAITH HEALING, a form of "mind cure," characterized by the doctrine that pain and disease really exist, but may be neutralized and dispelled by faith in divine power; Christian Science (*q.v.*) holds that pain is an illusion and seeks to cure the patient by instilling into him this belief. In the Christian church the tradition of faith healing dates from the earliest days of Christianity; upon the miracles of the New Testament follow cases of healing, first by the Apostles, then by their successors. After the 3rd century it became transformed into trust in relics, though faith cures still occur sporadically in later times. With the Reformation faith healing proper reappears among the Moravians and Waldenses, who, like the Peculiar People of the 19th and 20th centuries, put their trust in prayer and anointing with oil. In the 16th century faith cures were recorded of Luther and other reformers, in the next century of the Baptists, Quakers and other Puritan sects, and in the 18th century the faith healing of the Methodists in this country was paralleled by pietism in Germany. In the 19th century Prince Hohenlohe-Waldenburg-Schillingsfurst, canon of Grosswardein, was a famous healer on the continent; the Mormons and Irvingites were prominent among English-speaking peoples; in the last quarter of the 19th century faith healing became popular in London, and Bethshan homes were opened in 1881, and since then it has found many adherents in England.

Under faith healing in a wider sense may be included: (1) the cures in the temples of Aesculapius and other deities in the ancient world; (2) the practice of touching for the king's evil, in vogue from the 11th to the 18th century; (3) the cures of Valentine Greatrakes, the "stroker" (1629–83); and (4) the miracles of Lourdes and other resorts of pilgrims, including St. Winifred's well in Flintshire, Trêves with its holy coat, the grave of the Jansenist F. de Paris in the 18th century, the little town of Kevelaer from 1641 onward, the tombs of St. Louis, Francis of Assisi, Catherine of Siena and others.

An animistic theory of disease was held by several European faith healers. Used in this sense, faith healing is indistinguishable from much of savage leechcraft, which seeks to cure disease by expelling the evil spirit in some portion of the body. Although it is usually present, faith in the medicine man is not essential for the efficacy of the method. The same may be said of the lineal descendant of savage medicine—the magical leechcraft of European folklore; cures for toothache, warts, etc., act in spite of the disbelief of the sufferer; how far incredulity on the part of the healer would result in failure is an open question.

From the psychological point of view all kinds of mind cure depend on suggestion (*q.v.*). In faith healing proper powerful direct suggestions are used, while the religious atmosphere and the autosuggestions of the patient co-operate, especially where the cures take place during a period of religious revival when large assemblies and strong emotions are found.

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FAITHORNE, WILLIAM (*c.* 1616–1691), English engraver and portrait draftsman noted for his fine line engraving, was born in London. He was a pupil of the painter Robert Peake, Sr., and the engraver John Payne. During the Great Rebellion he was captured, imprisoned and exiled. In Paris he became the protégé of the print collector Michel de Marolles and may have worked in the studio of Philippe de Champaigne. He returned to London in 1650 to become a print seller, printer and engraver. In 1662 he published The Art *of* Graving *and Etching.* His early engraving style is derived from Claude Mellan; his middle period combines Mellan's line technique with delicate point work, and it was in this middle period that Faithorne raised English line engraving to a level on which it competed with the best French work. In 1658 Faithorne published his maps of London and he made also maps of Virginia and Maryland. Examples of his portrait drawings are in the Ashmolean museum, the Bodleian library and the British museum. He died on May 13, 1691, in London.

One of his sons, WILLIAM (1656–1710), became a mezzotint engraver.

See Louis Alexander Fagan, *A Descriptive Catalogue of the Engraved Works of William Faithorne* (1888). (C. H. C. B.; H. Es.)

FAIZABAD, a town of Afghanistan, capital of the province of Badakshan, situated on the Kokcha river. In 1821 it was destroyed by Murad Beg of Kunduz, and the inhabitants removed to Kunduz. But after Badakshan was annexed by Abdur Rahman, the town recovered its former importance, and became a considerable place of trade.

The chief cantonment for eastern Afghanistan and the Pamir region, it is protected by a fort built in 1904.

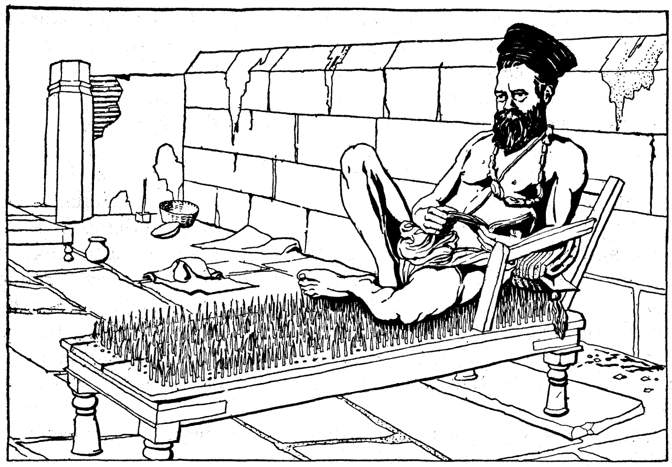
FAJANS, KASIMIR (1887–), Polish physical chemist, discovered (1913), simultaneously with Frederick Soddy, the displacement rule governing radioactive transformations resulting from alpha- and beta-ray emissions. He was born in Warsaw on May 27, 1887. After studying at Leipzig, Heidelberg (Ph.D. 1909), Ziirich and Manchester, he joined the faculty of the Technische Hochschule at Karlsruhe (1911–17). He rose from associate professor to director of the Institute of Physical Chemistry at Munich (1917–35). From 1936 Fajans served as professor at the University of Michigan, Ann Arbor. He became a naturalized U.S. citizen in 1942. Thermochemistry, theory of chemical forces, photochemistry and light absorption are areas in which he became an authority. With O. H. Gohring, he discovered uranium X_2. Author of *Radioactivity* and *Refractometry in Physical Methods of Organic Chemistry* with N. Bauch (1945), he was coeditor of *Zeitschrift für Kristallographie* (1924–29) and associate editor of *Journal of Physical and Colloid Chemistry* (1949).

His honours included the Victor Meyer prize (Heidelberg, 1909) and the Liège medal (1948). (V. Bw.)

FAJARDO, a town on the eastern coast of Puerto Rico. Pop. (1960) 12,424. The port of Fajardo has freight and passenger services to the off-lying islands of Vieques and Culebra. Water transportation is also available for the Virgin Islands of St. Thomas and St. Croix. A modern highway connects the town with San Juan, the island capital. Fajardo is the centre of one of the largest sugar corporations on the island. To the south of the toun is the U.S. naval air base Roosevelt Roads. (T. G. Ms)

FAKHR AL-DIN: *see* RAZI, AL-.

FAKIR, a generic term, synonymous with dervish (q v.), for a religious mendicant. A Mohammedan word, it has come to be applied also to Hindus. replacing *bhikshu* and older words. Fakirs are common to all the creeds of India, and in theory mostly belong to a religious order. But as a Moslem order does not usually profess celibacy and the Hindu and other orders do not always enforce it. the orders tend to form castes on the ordinary pattern. Where strict monasticism has been maintained, the influence of the orders has been on the whole good. But when discipline has been relaxed. many evils have ensued. Mendicancy has often become a pretext for extortion and occult poners a cloak for impudent swindling, sometimes assisted by murder. While many fakirs practise austerities of the severest kinds, others peregrinate the country with performing animals, selling love philtres, profess to transmute silver coin or other metals into gold and batten on



BY COURTESY OF THE BOARD OF FOREIGN MISSIONS

A NOMAD FAKIR OF INDIA READING HIS PRAYERS ON A BED OF NAILS

This class of fakir has little in common with the religious order of the same name, except a claim to sanctity. The beggars that compose it wander about the country, living on alms and subjecting themselves to unbelievable tortures

the credulity of the people. The chief Hindu orders are the Saniasis, Gosains, Jogis (who in theory profess yoga). bairagis. the Sikh Udasis, Nirmalas, Akalis, the Mohammedan Chishtis, Qadiris, Suharwardis, Naqshbandis, who owe much to Sufiism (*q.v.*); and minor fraternities. Several orders have militant branches.

FALAISE, a town of northwestern France, capital of an arrondissement in the *département* of Calvados, on the right bank of the Ante, 19 mi. S.E. of Caen by road. Pop. (1954) 5,289. The castle, now partly in ruins, was formerly the seat of the dukes of Normandy and the birthplace of William the Conqueror. It stands on a high crag overlooking the town, and consists of a square mass defended by towers and flanked by a small donjon and a lofty tower added by the English in the 15th century; the rest of the castle dates chiefly from the 12th century. Near the castle, in the Place de la Trinité, is an equestrian statue in bronze of William the Conqueror, to whom the town owed its prosperity. From 1417, when the town succumbed to Henry V of England, till 1450, when it was retaken by the French, Falaise was in the hands of the English. Falaise has populous suburbs, one of which, Guibray, is celebrated for its annual fair for horses, cattle and wool, which has been held in August since the 11th century. The town is the seat of a subprefecture and has tribunals of first instance and commerce, a chamber of arts and manufacture and a board of trade arbitrators. Tanning (from at least the 11th century) and some cotton manufactures are carried on.

FALASHAS, or "JEWS OF ABYSSINIA," a tribe of Hamitic stock, akin to Galla, who profess the Jewish religion and claim to be descended from the ten tribes banished from the Holy Land. Another tradition assigns them, as ancestor, Menelek, Solomon's alleged son by the queen of Sheba. It is uncertain when they became Jews: one account suggests in Solomon's time; another, at the Babylonian captivity; a third, during the 1st century of the Christian era. One of the earlier dates is in all probability correct since the Falashas know nothing of either the Babylonian or Jerusalem Talmud, make no use of phylacteries (*tefillin*) and observe neither the feast of Purim nor the dedication of the temple. They possess—not in Hebrew, of which they are altogether ignorant, but in Ethiopic (or Geez)—the canonical and apocryphal books of the Old Testament; a volume of extracts from the Pentateuch, with comments given to Moses by God on Mount Sinai; the Te-e-sa-sa Sanbat, or laws of the Sabbath; the Ardit, a book of secrets revealed to 12 saints, which is used as a charm against disease; lives of Abraham, Moses, etc.; and a translation of Josephus called Sana Aihud. A copy of the Orit, or Mosaic law, is kept in the holy of holies in every synagogue. Every newly built house is considered uninhabitable till the blood of a sheep or fowl has been spilt in it; a woman guilty of a breach of chastity has to undergo purification by leaping into a flaming fire; the Sabbath has been deified, and, as the goddess Sanbat, receives adoration and sacrifice and is said to have 10,000 times 10,000 angels to wait on her commands.

Under the monastic system, founded it is said in the 4th century A.D. by Aba Zebra, a pious man who retired from the world and lived in the cave of Hoharewa, in the province of Armatshoho, the monks must prepare all their food with their own hands, and no lay person, male or female, may enter their houses. Priests are allowed to marry once only, and no one is admitted into the order who has eaten bread with a Christian, or is the son or grandson of a man thus contaminated. Belief in the evil eye or shadow is universal, and spirit raisers, soothsayers and rain doctors are in repute. Education is in the hands of the monks and priests, and is confined to boys. Fasts, obligatory on all above seven years of age, are held on every Monday and Thursday, on every new moon and at the Passover (April 21 or 22). The annual festivals are the Passover, the harvest feast, the Baala Mazalat or feast of tabernacles (during which, however, no booths are built), the day of covenant or assembly and Abraham's day. It is believed that after death the soul remains in a place of darkness till the third day, when the first sacrifice for the dead is offered; prayers are read in the synagogue for the repose of the departed, and for seven days a formal lament takes place every morning in his house. No coffins are used, and a stone vault is built over the corpse so that it may not come into direct contact with the earth.

The Falashas live for the most part in villages of their own, or, if settled in a Christian or Mohammedan town, occupy a separate quarter. Their own kings, they pretend, were descended from David, but in 1800 the royal race became extinct, and they then became subject to the Abyssinian kingdom of Tigré. They do not mix with the Abyssinians. and never marry women of alien religions. They are even forbidden to enter the houses of Christians, and from such a pollution have to be purified before entering their own houses. Polygamy is not practised; early marriages are rare and their morals are generally better than those of their Christian masters. They have no liking for trade, but are skilled in agriculture, in the manufacture of pottery, ironware and cloth and are good masons.

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FALCÃO, CRISTÓVÃO (c. 1515–c. 1553), Portuguese poet whose most famous eclogue has achieved added interest by a dispute about its authorship. was born at Portalegre in the province of Alentejo, of a noble but impoverished family. The details of his life are uncertain but he is said to have fallen in love with a young heiress, Maria Brandão, to have married her, and to have been separated from her by hostile parents. Because of this he was imprisoned for about five years, but was later restored to royal favour and employed on a diplomatic mission in Rome. His love story is told in the Carta de *um preso* and the charming eclogue *Crisfal.* Falcão's poems have resemblances to those of Bernardim Ribeiro to whom some critics have ascribed Crisfal.

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FALCK, ANTON REINHARD (1777–1843), Dutch statesman, was born at Utrecht on March 19, 1777. He studied at the University of Leyden, entered the diplomatic service and became ambassador at Madrid. Under King Louis Napoleon he was secretary-general for foreign affairs, but resigned office on the annexation of the Batavian republic to France. He took part in the revolt of 1813 and in the organization of the new kingdom of the Netherlands. He was minister of education and of the colonies under William I, until the king tired of his counsels and sent him as ambassador to London.

The disturbances of 1830 convinced him of the necessity of the separation of Belgium from Holland. He consequently resigned his post and lived in close retirement until 1839, when he became the first Dutch minister at the Belgian court. He died at Brussels on March 16. 1843. Besiaes some historical works he left Brieven van *A.* R. Falck, *1795–1843* (2nd ed., 1861) and *Ambtsbrieven* van *A.* R. Falck (1878). His memoirs were edited by Colenbrander in 1913.

FALCÓN, a state in northwestern Venezuela, on the Caribbean bordering the Gulf of Venezuela. Area 9,575 sq.mi.; pop. (1950) a58,759. It consists of coastal lowlands and spurs which are outliers of the Andes. The state has a tropical wet and dry climate but because of the strong influence of the trade winds it is the dry period that dominates. Much of the land is quite useless for farming but the rearing of goats is important. Petroleum has been exploited on a large scale in the state but its importance stems from pipelines, refineries, storage facilities and loading terminals rather than production. There are some small oil-bearing formations in the barren north near the Caribbean, but the Falcón area is a declining one and has never produced more than a fraction of the total Venezuelan oil output. There are salt works at Mitare and fishing is carried on along the coast, mainly along the Paraguana peninsula (*q.v.*). In the interior, particularly in the area around Churuguara, sugar, coffee, cacao and other tropical crops are grown, and cattle are raised. Coro, the state capital (pop. 29,341), is the leading commercial and distributing centre. The chief ports are La Vela. Puerto Cumarebo and Tucacas. (L. WE.)

FALCON, the name applied to the long-winged birds of prey which take their quarry as they move. As in all the group of diurnal birds of prey, the female is larger than the male. As type of the family Falconidae may be taken the peregrine falcon (Falco *p.* peregrinus) and the scarcely separable duck hawk (F. *p.* anatum) of North America and F. *p. macropus* of Australia. The peregrine falcon inhabits practically every part of the world, about 16 races being recognized. For its size, it is perhaps the most powerful bird of prey that flies, and its courage is as great as its power. Famous in the days of hawking (see FALCONRY), the plumage of this bird is blackish-blue above and white with a more or less deep cream-coloured tinge below, barred, except on the chin and throat, with black. It nests on cliffs and trees, laying four or five eggs mottled with reddish-brown.

The gyrfalcon (F. *rusticolus*) is larger and inhabits the Scandinavian mountains. The Iceland falcon (F. r. islandus) is paler. The black gyrfalcon (F. r. obsoletus), with a pale phase, occurs in northeastern North America; the Asiatic gyrfalcon (F. r. *uralensis*) in northern Siberia to the Bering coast of Alaska.

The "desert" falcons differ from the preceding in that they retain the longitudinal barring on the breast throughout life, instead of changing it after the first molt to transverse bars. They include in the old world the lanner (F. *biarmicus*), the saker (F. cherrug) and the luggar or laggar (F. jugger) of India; in the new, the prairie falcon (F. mexzcanus) of the western plains of North America.

The hobby falcons are characterized by their bold upstanding position and long wings. The beautiful little English hobby (F. *subbuteo*) lives mainly on insects and is a summer visitor to most parts of Europe. About 30 other species of true falcons are found throughout the world, one in the genus leracidea of Australia, all others in the genus Falco, divided into ten subgenera, sometimes raised to generic rank. These all constitute the subfamily Falconinae. The pygmy falcons, 5 genera and 17 species, including the smallest raptorial birds of prey, no larger than a robin or sparrow, constitute the near-related subfamily Polihieracinae. (See MERLIN; KESTREL.)

A falcon is also a primitive light gun. 2½-in. bore, weighing about 6 cwt., and firing a 2-lb. shot. It takes its name from the bird of prey in accordance with an old fashion.

FALCONE, ANIELLO (1600–1665), Italian battle painter, was born in Naples. He studied under Ribera (Lo Spagnoletto), was influenced by Domenichino and later by the Dutch school. He decorated the cupola of a chapel in San Paolo del Padri Teatini at Naples. He painted a "Flight Into Egypt" in the sacristy of Naples cathedral (signed and dated 1641); and the frescoes in the sacristy of Gesu Nuovo, also at Naples. He was famous as a battle painter. two of his battle pieces being in the Naples museum and in the Prado, Madrid. His many pupils included Salvatore Rosa. Some engraved plates have been attributed to Falcone without sufficient evidence.

FALCONER, HUGH (1808–1865), British paleontologist and botanist, was born at Forres on Feb. 29, 1808. He studied at Aberdeen and at Edinburgh, where he took his M.D. in 1829. Proceeding to Calcutta in 1830 as assistant surgeon on the Bengal establishment of the East India company, he soon published his description of the fossil bones from Ava in the possession of the Asiatic Society of Bengal. In 1831 he was appointed superintendent of the botanic garden of Saharanpur. In 1834 he published a geological description of the Siwalik hills and subsequently brought to light a subtropical fossil fauna of unexampled extent and richness, including remains of Mastodon, the colossal ruminant Sivatherium and the enormous tortoise Colossochelys atlas. It was on his recommendation in 1834 that tea was introduced into India.

When illness required him to return to England, in 1842, he began his Fauna Antigua Sivalensis, of which part i was issued in 1846 and 107 plates during the years 1846–49. He was elected fellow of the Royal society in 1845. and in 1847 was appointed superintendent of the Calcutta botanical garden, and professor of botany in the medical college. In 1850 he published an important report on the teak forests of Tenasserim, and through his recommendation the cultivation of the cinchona bark was introduced into India. From 1855 he spent the remainder of his life in examining fossil species in England and on the continent corresponding to those found in India notably the species of mastodon, elephant and rhinoceros; he also described some new Mammalia from the Purbeck strata. and he reported on the bone caves of Sicily, Gibraltar. Gower and Brixham. He died on Jan. 31, 1865.

FALCONER, WILLIAM (1732–1769) British poet, sailor and lexicographer whose poem *The Shipwreck* achieved nide popularity, nas born in Edinburgh, Feb. 8, 1732. A poor barber's son he went to sea in 1746 His survival. at 18, of the nreck of the "Britannia" off Cape Colonna inspired *The Shipwreck* (1762: revised 1764 and 1769), a long, conventional poem. giving nonetheless a sailor's firsthand account of a storm at sea. On the advice of the duke of York, to whom he dedicated the poem. Falconer then joined the navy and sailed on the "Royal George," becoming the purser of the "Glory" in 1763. He continued to write attacking John Wilkes and Charles Churchill in *The Demagogue* (1765), and published his useful *Universal Dictionary of the Marine* in 1769. He had meannhile rejected an offer of partnership by the publisher John Murray in favour of the pursership of the frigate "Aurora," bound for India. She sailed on Sept. 20, 1769, reached the Cape of Good Hope on Dec. 27 and was never heard of again.

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FALCONET, ETIENNE MAURICE (1716–1791), French sculptor, the chief exponent of "Pompadour" artifice, yet capable of the sublime, as in his statue of Peter the Great, was born in Paris on Dec. 1, 1716. He was first apprenticed to a carpenter and later became a pupil of J. B. Lemoyne. In 1744 he was elected to the Academy of Fine Arts upon presentation of his statue of Milo of Crotona (Louvre). He was nominated director of sculpture at the Sèvres factory in 1757 through Madame de Pompadour's influence. He supplied numerous models to be executed in Sèvres biscuitware (*e.g.,* "Pendule des Trois Grâces," Wallace collection, London), which gave a character of delicate, mannered grace to a whole phase of his work. From 1766 until 1778 he was in Russia, summoned by Catherine the Great, and sculptured the impressive equestrian statue of Peter the Great at St. Petersburg. He died in Paris on Jan. 24, 1791.

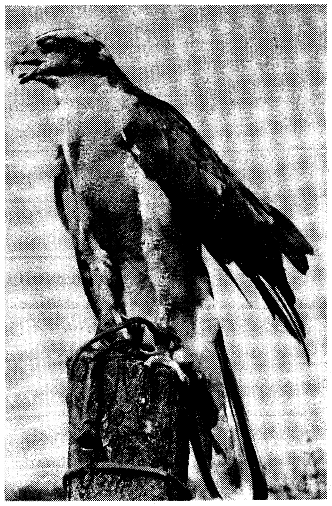
His writings were collected under the title of *Oeuvres Littéraires* (6 vol., 1781–82; 3 vol., 1787). A series of letters he exchanged with Diderot concerning the statue of Marcus Aurelius on the capitol in Rome was published in 1958. (P. LN)

FALCONIDAE: see FALCON; CARACARA.

FALCONRY. The art of employing falcons and hawks in the chase, often termed hawking (Fr. *fauconnerie,* from late Lat. *falco,* falcon). Falconry was a favourite recreation of the aristocracy during the middle ages, followed, as it seems, more as a sport than as a means of getting game for the table. The antiquity of falconry is very great. It appears to have been known in China some 2,000 years B.C. In Japan it appears to have been known at least 600 years B.C., and probably at an equally early date in India, Arabia, Iran and Syria. Sir A. H. Layard says that on a bas-relief found in the ruins of Khorsabad "there appeared to be a falconer bearing a hawk on his wrist" from which it would appear to have been knonn there some 700 years B.C. In all the above mentioned countries of Asia it is practised at the present day.

Persian and Arabic manuscripts attribute the origin of falconry to a pre-historic Persian king; certain it is that the Moguls gave a great impetus to hawking in India. From ancient carvings and drawings it seems to have been known in Egypt many ages ago. The older writers on falconry, English and Continental, often mention Barbary and Tunisian falcons. It is still practised in Egypt. The oldest records of falconry in Europe are in the writings of Pliny, Aristotle and Martial. It was probably introduced into England from the Continent about A.D. 860. and from that time down to the middle of the 17th century, falconry was followed with an ardour that perhaps no other English sport has ever evoked. Stringent laws and enactments were passed from time to time in its interest. About the middle of the 17th century its popularity began to decline in England, to revive somewhat at the Restoration; it never however recovered its former favour, a variety of causes operating against it, such as the enclosure of waste lands and the introduction of fire-arms into the sporting field. Yet it has never been even temporarily extinct, and it is practised at the present day. Falconry has made small progress as a sport in the United States, due largely to adverse legislation in many states on the use of hanks to kill game.


ERIC HOSKING
HOODED PEREGRINE FALCON (FALCO PEREGRINUS PEREGRINUS)


KARL H. MASLOWSKI
GOSHAWK (ACCIPITER GENTILIS) SHOWN WITH JESSES AND BELLS

In Europe the "quarry" at which hawks are flown consists of grouse (confined to the British Isles), black-game, pheasants, partridges, quails, landrails, ducks, teal, woodcocks, snipe, herons, rooks, crows, gulls, magpies, jays, blackbirds, thrushes, larks, hares and rabbits; in former days geese, cranes, kites, ravens and bustards were also flown at. Old German works make much mention of the use of the Iceland falcon for taking the great bustard, a flight scarcely alluded to by English writers. In Asia the list of "quarry" is longer, and in addition to all the foregoing, or their Asiatic representatives, various kinds of bustards, sand grouse, storks, ibises, spoonbills, jungle fowl, kites, vultures and gazelles are captured by trained hawks. In Mongolia and Chinese Tartary, and among the nomad tribes of central Asia the sport still flourishes; and a species of eagle known locally as the "berkute" is trained in those regions to take large game, such as antelopes and wolves. In Africa gazelles are taken and also partridges and wild fowl. The hawks used in England are the Greenland, Iceland and Norway falcons, the peregrine falcon, the hobby, the merlin, the goshawk and the European sparrow hawk. In former days the saker, the lanner and the Barbary or Tunisian falcon were also employed. The most efficient in the field are the American duck hawk, prairie falcon, goshawk and Cooper's hawk, and the European peregrine falcon and the goshawk. In all species of hawk the female is larger and more powerful than the male.

Hawks are divided by falconers all over the world into four classes. The first class comprises "falcons," *i.e.,* "long winged hawks," or "hawks of the lure." The falcons include, in order of size, the jer-falcons, native to Greenland, Iceland and Norway; the American prairie falcon and the duck hawk or peregrine, with its many closely related species throughout the world; the pigeon hawk, hobby and merlin and, finally, the European kestrel and the American sparrow hawk, both of which are too small for use in practical falconry. The second class, that of the *accipiter* or short-winged hawks or "hawks of the fist," includes the European and American goshawk, the American Cooper's hawk, the European and Asiatic sparrow hawk and the somewhat similar American sharp-shinned hawk. Both the falcons and short-winged hanks are primarily bird-hunting Raptores although the larger representatives of both types occasionally kill hares, rabbits or even larger animals, and the smaller species, particularly the American sparrow hawk, feed extensively on mice and insects.

The third category of hawks comprises the broad-winged or *buteo* hawks, the "buzzard" hawks of Europe and the rough-legged, red-tailed, red-shouldered and broad-winged American hawks. They are rodent-hunting hawks, slower and less aggressive than the falcons and short-winged hawks, much inferior to them for falconry, although the powerful red-tailed hawk has been trained to perform well against pheasants and rabbits. Eagles, likewise used for the chase, are closely related to the *buteo* hawks, and share their preference for animal prey. A fourth class of hawk, the ground-skimming, mouse-hunting harriers, which includes the American marsh hawk, is unsatisfactory for falconry. All birds of prey, including even the owls, can be trained to the basic task of falconry, nhich is to kill quarry and remain upon it until the falconer picks the hawk up, or calls it to his fist. While Chinese golden eagles are reported to kill foxes and carry them to their handlers, no hawk or owl can be trained to retrieve the kill. Its dominant instinct is to attack, kill and devour, and this can only be modified by training to the extent of permitting man to guide the timing of the attack, and prevent the hawk from flying off uith its quarry, or escaping if it fails to kill.

Capture of Hawks.—In certain parts of the continent and in the bazaars of North Africa, the near east and Asia, captive hawks are sometimes available for purchase at auction and otherwise. Damascus for centuries has been a market for trained hawks, brought in by the Arabs from the Syrian desert. However, in most parts of the world, the falconer must procure his own hawks by trapping wild adults, or taking nestlings before they learn to fly. The instinct of hawks is to nest in remote, inaccessible places, in caves on the sheer face of cliffs, or in high trees. There are few regions near human settlements where hawks are abundant. The capture of fledglings thus presents difficulties, increased by the fact that only during a few brief weeks in early summer can young hawks be found. The co-operation of watchful rural lads in locating hawk nests and the skilful use of ladders, ropes or climbing irons are required. The trapping of adult wild hawks provides an interesting feature of falconry. It can be practised in most parts of the northern hemisphere at all seasons, but most productively in the great southward migratory flight of the hawks in early autumn. **A** variety of traps has been developed through the centuries, the main objective being dependable operation, without injury to the hawk, since even a few lost or broken feathers seriously handicap a trained hawk in the field.

The Plains Indians, in quest of eagle plumes for decoration, devised an effective method of trapping birds of prey. Driving an eagle away from a bird or animal on which it fed, the Indian concealed himself in a hole or blind close by, or even within the carcass of a large animal. Upon the eagle's return to the kill, he seized it by the legs, and quickly rendered it helpless to attack him with its talons. Modifications of this "hand trap" have been successfully employed in the capture of large and small hawks, using as bait a tethered live pigeon, whose flutterings will attract a hawk from an incredible distance. Nets in many forms are used to capture hawks. The Dho-Gaza trap of India is a net of fine thread stretched between two vertical poles, with bait birds in a cage at the bottom of the net. A hawk diving down for the kill strikes the invisible net and falls with it to the ground, wrapped in its meshes. An American trap, used on falcons with good results, is a rectangular frame of lath, covered with netting. **A** bait bird is tied to a stake inside the trap. The hawk can reach its prey only through a tunnel-like entrance at each end, on the ground, and usually is unable to find its way out of the device uhen it seeks to fly away.

Most useful of all hawk traps, but difficult of operation, is the bow-net trap, employed for centuries by the famous falconers of Belgium and the Netherlands. A semicircular bow net on a wooden frame of about 6 ft. diameter is lightly pegged to the ground at its circular edge, and centred upon an axis along its diameter. When a hawk, attracted by a tethered pigeon nearby, makes the kill, the trapper, nho remains in a blind at a distance, drags the pigeon by a long wire or cord to a point along the edge of the net where the trapper's pull upon a second cord throws the net over the hawk while it is occupied in holding and depluming the pigeon. A modern, automatic variation of this trap employs springs or elastic cords which throw the net over the hawk when, in attacking a bait bird, it trips a trigger which releases the springs.

In India, short-winged hawks are trapped with small horsehair nooses fastened at the sides of a dome-shaped cage containing a live grouse or pheasant. A similar method in the United States employs steel spring or jump traps with padded jaws, placed above and around the cage. The pole-trap, most effective for owls and broad-winged hawks, is simply a steel trap placed at the top of a high pole in a field or clearing. No bait is required, as these birds by habit perch on poles and dead trees to wait for rodent quarry to appear in the surrounding grass or cover. The steel trap is fastened to the pole by a long cord, so that the trapped hawk can settle, uninjured, to the ground. While the principal modes of hawk trapping have been described here, it is worth pointing out that hawks have been captured by an almost infinite variety of other devices. The great difficulty in trapping birds of prey arises from the fact that they are by nature extremely shy and wary. They eat ravenously when hungry, perhaps only once or twice in a day, but at all other times they are indifferent to the most enticing prey. The trapper, therefore, should resign himself to the frustration of watching scores of hawks pass over his traps unheeding for every one which may be spurred by hunger to attack the bait. The scarcity of hawks in most areas during the greater part of the year, the obstacles which make a capture a rare event and the swiftness with which a migrant hawk passes through the falconer's trapping territory emphasize the desirability of types of traps which are ready for action at all times, are simple and certain of operation and cannot injure the captive hawk in its frenzied struggles to escape.

Training.—It is through the appetite principally that hawks are tamed; but to fit them for use in the field, much patience, gentleness and care are necessary. Slovenly taming necessitates starving, and low condition and weakness are the result. The aim of the falconer should be to have his hawk always keen, and the appetite, when it is brought into the field, should be such as would induce the bird in a state of nature to put forth its full powers to obtain its food, with, as near as possible, a corresponding bodily condition.

The process of training an adult wild falcon deserves description. When first taken, a rufter or easy-fitting hood should be put on her head, and she must be furnished with jesses, swivel, leash and bell; jesses are strips of light leather for the legs. A thick glove or rather gauntlet should be worn on the left hand. (Eastern falconers always carry a hawk on the right.) She must be carried on the fist for several hours at a time, and late into the night, at intervals being gently stroked with a bird's wing or feather. At night she should be tied to a perch in a room with the windows darkened, so that no light can enter in the morning. The perch should be a padded one placed across the room about $4\frac{1}{2}$ ft. from the ground with a canvas screen underneath. She will be easily induced to feed, in most cases, by drawing a piece of beefsteak over her feet, brushing her legs at the time with a feather, and now and then, as she snaps at it, slipping a morsel into her mouth. Care must be taken to use a low whistle as she is in the act of swallowing; she will very soon learn to associate this sound with feeding, and it will be found that directly she hears it, she will gripe with her talons and bend down to feel for her food. When the falconer perceives this and other signs of her "coming to," that she no longer starts at the voice or touch, and steps quietly up from the perch when the hand is placed under her feet, it will be time to change her rufter hood for the ordinary hood. This latter should be an easy fitting one, in which the braces draw closely and yet easily, and without jerking. An old one previously worn is to be recommended. The hawk should be taken into an absolutely dark room, and the change should be made if possible in total darkness. After this she must be brought to feed with her hood off; at first she must be fed in a darkened room, more light being admitted as she is able to bear it. The first day, the hank having seized the food and begun to pull at it freely, the hood may be gently slipped off, and after she has eaten a moderate quantity, it must be replaced as slowly and gently as possible, and she should be allowed to finish her meal through the hood Next day the hood may be twice removed, and so on; day by day the practice should be continued, more light being gradually admitted, until the hawk will feed freely in broad daylight, and allow the hood to be taken off and replaced without opposition. She must now be accustomed to see strangers, dogs, horses, etc., and to feed in their presence. A good plan is to take her into the streets of a town at night, at first where the artificial light is not strong, unhooding and hooding her from time to time, but not letting her get frightened. Up to this time she should be fed on lean beefsteak with no casting, but as soon as she is tolerably tame and submits well to the hood, she must occasionally be fed with pigeons and other birds. This should be done not later than 3 or 4 P.M., and when she is placed on her perch for the night in the dark room, she must be unhooded and left so, of course, being carefully tied up. The falconer should leave her unhooded until such time as she has "cast."

She must now be taught to recognize the voice—the shout that is used to call her in the field—and to jump to the fist for food, the voice being used every time she is fed. When she comes freely to the fist she must be made acquainted with the lure. Kneeling down with the hawk on his fist, and gently unhooding her, the falconer casts out the lure, which may be either a dead pigeon, or an artificial lure garnished with beefsteak tied to a string, to a distance of a few feet in front of her. When she jumps down to it, she should be allowed to feed a little upon it—the voice being used—while occasionally receiving morsels from the falconer's hand; and before her meal is finished she must be taken up on to the hand, being induced to forsake the lure for the hand by offering her a piece of meat. This treatment will help to check her inclination hereafter to carry her quarry. This lesson is to be continued till the falcon feeds boldly on the lure on the ground in the falconer's presence—till she will allow him to walk round her while she is feeding. All this time she will have been held by the leash only, but in the next step a strong, but light creance—a line attached to the swivel—must be made fast to the leash, and an assistant holding the hawk should unhood her, as the falconer, standing at a little distance from her, calls her by shouting and casting out the lure.

Day by day the distance will be increased, until the hawk will come 30, 60, 100 yd. and so on without hesitation: then she may be trusted to fly to the lure at liberty and by degrees from any distance, say 200 yards. This accomplished she should learn to stoop at the lure. Instead of allowing the hank to seize upon it as she comes up the falconer will snatch the lure away and let her pass by, and immediately put it out that she may readily seize it when she turns round to look for it. This should be done at hrst only once, and then progressively, until she will stoop backwards and forwards at the lure as often as desired. Next she should be entered to her quarry.

Eyasses, hawks which have been taken as fledglings on the nest, must be put into a sheltered place, such as an outhouse or shed The basket or hamper should be filled with straw. A hamper is best, with the lid so placed as to form a platform upon nhich the young hawks can come out to feed. This should be fastened to a beam or prop a few feet from the ground. The young hawks must be plentifully fed on the best fresh food obtainable—such as good lean beef and fresh killed birds and rabbits The food should be securely tied in separate portions to a board, or better to wooden blocks, one for each hawk. At this stage the young hawk should be interfered with as little as possible. The falconer should place the food down for them and then retire as quickly as possible. The wilder and more independent they become during the period of "hack" the better. As they grow older they will come out and perch about the roof of their shed, by degrees extending their flights to neighbouring buildings or trees, never failing to come back at feeding time to the place where they are fed. Soon they will be continually on the wing, soaring up and playing with one another, and later the falconer will observe them chasing other birds, such as pigeons or rooks, which may be passing by. As soon as a young hawk fails to return to the hack for its meal a note should be made of its absence, and it should at once be caught in a bow net or snare the first time it comes back, or it may absent itself for good. It must be borne in mind that the longer hawks can be left out "at hack" the better they are likely to be in the field—those hawks being always the best which have preyed a few times for themselves when "at hack." There is, of course, a great risk of losing hawks altogether when they begin to prey for themselves, but this is a matter for the falconer's judgment. As soon as the eyas knows the lure sufficiently well to come to it sharp and straight from a distance, she must be taught to "wait on." This is effected by letting the hawk loose, choosing the most open space available. It will be found that she will circle round the falconer looking expectantly for the lure—perhaps mount a little in the air, and advantage must be taken of a favourable moment when the hawk is at a little height, her head being turned inwards towards the falconer, to loose a pigeon with shortened wings which she can easily catch. When the hawk has taken two or three pigeons in this way, and mounts into the air immediately in expectation, in short, begins to "wait on," she should be given no more pigeons, but be tried at game as soon as possible. The young hawk must be given every possible advantage when first flown at wild quarry. The training of the great northern falcons, as well as that of merlins and hobbies, is conducted much on the above principles, but the jer-falcons will seldom "wait on" well, and merlins will not do so at all.

The training of short-winged hawks is a simpler but longer process, as they require long walks on the fist to accustom them to handling. They must be provided with jesses, swivel, leash and bell. European sparrow hawks can, however, scarcely carry a bell big enough to be of any service. The hood is seldom used for short-winged hawks—never in the field. They must be made as tame as possible by carriage on the fist and the society of man, and taught to come to the fist freely when required—at first to jump to it in a room, and then out of doors. When the goshawk comes freely and without hesitation from short distances, she should be called from longer distances from the hand of an assistant, but not oftener than twice in each meal, until she will come several hundred yards, on each occasion being well rewarded with some favourite food such as fresh killed birds. When she does this freely, and endures the presence of strangers, dogs, etc., a few bagged rabbits may be given to her, and she will be ready to take the field. Some accustom the goshawk to the use of the lure, for the purpose of recovering her if she refuses to come to the fist in the field, when she has taken stand in a tree after being baulked of her quarry, but this is not a good practice. For various reasons goshawks in England cannot be brought to the perfection to which they are brought in the east. In India, for instance. there is a far greater variety of quarry suited to them, and wild birds are much more approachable; moreover, there are advantages for training which do not exist in England. Unmolested, the eastern falconer carries his hawk by day and night in the crowded bazaars, till the bird becomes perfectly indifferent to men, horses, and vehicles.

Methods of Hawking.—Falcons or long-winged hawks are either "flown out of the hood" (*i.e.*, unhooded and slipped when the quarry is in sight), or they are made to "wait on" till game is flushed. Herons, rooks, magpies and crows are always taken by the former method. Passage hawks are generally employed for flying at these birds, though good eyasses are occasionally equal to the work. Though he has no chance in competing against a falcon in straightforward flight, the heron has large concave wings, and a proportionately light body, and he can rise with astonishing rapidity, more perpendicularly or, in other words, in smaller rings than the falcon can and with less effort. As soon as he sees the approach of the falcon, he makes for the upper regions. The falcon then commences to climb to get above him, but in a very different style. She makes wider circles or rings, travelling at a higher rate of speed, due to her strength, weight and power of flying, till she rises above the heron. Then she makes her attack by stooping with great force at the quarry, sometimes falling so far below him that she cannot shoot up to a sufficient pitch for the next stoop, and has to make another ring to regain her lost command over the heron, which is ever rising, and so on —the "field" meanwhile galloping in the direction the flight is taking, till the falcon seizes the heron aloft, "binds" to him, and both come to the ground together.

For game hawking eyasses are generally used, though undoubtedly passage or wild caught hawks are to be preferred. The best

BY COURTESY OF CAPTAIN C. W. R. KNIGHT

TRAINED EAGLE FLYING TO FIST

A golden eagle which has been trained to fly either to lure or to fist. The falconer is protected against the bird's strong talons with a fencing mask, and with horsehide glove of double thickness and an extra leather sleeve for the left arm

FALCONRY

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HAWKS AND FALCONS

1. Immature eyas tiercel, used for game hawking. An eyas is a hawk which has been trained from the nest. The male of any hawk, being a third smaller than the female, is called *tiercel.* 2. A cast (male and female) of merlins, on a lark which they have killed. Merlins are flown only at larks. 3. An adult eyas tiercel. A hawk is considered adult after the first moulting, when the marking of the plumage becomes horizontal instead of perpendicular. Tiercels are best used for partridges, magpies and gulls. Only the largest can kill grouse. 4. A female goshawk, flown at hares, rabbits or pheasants, shown sitting by a rabbit she has just caught. 5. Hocded falcons on the cadge, a wooden frame on which hawks are transported to and from the field. Their vision is cut off by leather hoods to ensure their sitting still. 6. Jack merlin, or male. The female is called the merlin. 7. An eyas peregrine tiercel (see fig. 3). This bird killed 504 head of game, principally partridge and grouse, in eight years. 8. Haggard peregrine falcon, the bird most successfully used in falconry. *Haggard* signifies a hawk caught wild in adult plumage. 9. A gerfalcon of the Greenland variety, the largest of the falcons. Modern falconers have not been successful in training this bird, having found it difficult to keep it in health and condition

game hawks are passage hawks, but there are difficulties attending their use. It may perhaps be fairly said that passage hawks can be trained to "wait on" in grand style, but until they have got through their first season, they are more liable to be lost than eyasses. The advantages attending the use of eyasses may be summed up as follows: they are easier to obtain. to train and to keep; they moult more regularly than passage hanks, and if lost in the field they will often return home by themselves, or remain in the country where they are accustomed to being flown. Experience and, we must add, some good fortune also are requisite to make eyasses good for "waiting on" at game. Slight mistakes on the part of the falconer, false points from dogs, or bad luck in serving, will cause a young hawk to acquire bad habits, such as sitting down on the ground, taking stand in a tree, raking out wide, skimming the ground, or lazily flying round at an insufficient altitude. A good game hawk in proper flying order mounts rapidly to a high pitch until she appears no larger than a swallow in the sky, keeping well over the falconer and dogs, and ready to stoop when the quarry is sprung. Hanks that have been successfully trained and judiciously worked become wonderfully clever, and soon learn to regulate their flight by the movements of their master. Eyasses were not held in esteem by the old falconers, and it is evident from their writings that these hawks have been much better understood and managed in modern times than in the middle ages. It is probable that the old falconers procured the aild-caught hawks with greater facility than at the present day. There was a hawk mart held at Valkenswaard in the Netherlands, where hawks were sold after the annual catch during the autumn migration. It was visited by falconers from all over Europe, large sums often being paid at auction for particularly choice birds.

Many European falconers in modern times have owned eyasses which have killed grouse, ducks and other quarry in a style almost equalling that of passage hawks. Moors, downs, open country where the hedges are low and weak are best suited to game hawking. Pointers or setters may be used to find the game, or the hawk may be loosed on reaching the ground where game is knonn to lie, and suffered, if an experienced one, to "wait on" till it is flushed. However, the best plan with most hawks, young ones especially, is to use a dog, and to "cast off" the hawk when the dog points, and to flush the birds as soon as the hawk has reached her pitch. The hawk should be well over the birds, and if possible a little up-wind of them when they rise, she will then be better placed for a down-wind stoop, as the game will not dare to fly up-wind under the hawk. The hawk will then turn over, and, flying headlong downwards with incredible speed, will, with the gathered impetus of her fall from the sky, rapidly overtake the bird she has from the first moment selected as her victim. As she reaches it, she strikes it a heavy blow with the hind talon of her foot, and the bird falls to the ground, often stone-dead, leaving a cloud of feathers in its track, or, just as she rushes up to it, the quarry may evade the stroke by a clever shift, and hurl itself into the nearest cover before the hawk has recovered from her stoop. The falconer will then come up as quickly as possible to "serve" the hawk by putting the bird out again while she "waits on" overhead. If this be successful. she is nearly certain to kill at the second attempt. Falcons, being larger and stronger, are to be preferred for grouse and tiercels for partridges. Woodcock afford capital sport where the country is sufficiently open; it will generally be found that after the first stoop at a woodcock, the cock will try to escape by taking the air, and will show a very fine flight. When beaten in the air it will try to get back to covert again, but when once a hawk has outflonn a woodcock, he is pretty sure to kill it. Snipe may be killed with first-class tiercels in favourable localities. Wild duck and teal are only to be flown at when they can be found in small pools or brooks at a distance from large sheets of water—where the fowl can be suddenly flushed by men or dogs, while the falcon is flying at her pitch overhead. For duck falcons should be used; tiercels will kill teal well. The merlin is used for flying at larks, and there does not seem to be any other use to which this pretty little falcon may fairly be put. It is very active, but far from being, as some authors have stated, the swiftest of all hawks. The peregrine has been known to attain a level speed of 70 m.p.h, and a diving velocity above 100 m p h. The hobby is swifter than the merlin, but cannot be said to be efficient in the field.

The three great northern falcons are not easy to procure in proper condition for training. They are difficult to break to the hood and to manage in the field. They can be flown, like the peregrine, at herons and rooks, and in former days were used for kites and hares. Their style of flight is magnificent: they are swifter than the peregrine, and are deadly "footers." They seem, however, to lack someuhat of the spirit and dash of the peregrine.

The distinctive hunting habits of each of the various types of hawks determine the way in which it must be handled for falconry in the field. In their uild state, the long-winged hawks, or falcons, are birds of the high and open sky, accustomed to take their prey from above, after a circling climb of pursuit or a headlong dive, often from a great height. The short-winged hawks, on the contrary, are silent assassins of the forest, which make a swift, short darting attack at low level, weaving among branches and tree trunks uith incredible dexterity. They kill by overtaking their prey in the air or on the ground, grasping it nith the needle-sharp talons of both feet. The broad-winged or *buteo* hawks, in turn, are rodent hunters, which locate their quarry by soaring flight, or from perches on posts or treetops, and glide down to seize it by surprise.

The true falcons are trained by man to follow their natural instinct by circling or "waiting on" high above the beaters, or flying from the falconer's fist when game is flushed to rise above it during what may be a high, prolonged chase of many miles before the falcon can make its spectacular diving kill. The short-winged hawks, and also the *buteos* and eagles are usually carried on the falconer's fist until the quarry is actually sighted near enough at hand to be overtaken in a short dash, much as though the falconer were using the hawk as a shotgun. Thus, while falcons are best adapted to hunting over open, unfenced country, where their long, free flights can be followed on horseback, short-winged hanks are more useful against birds found in wooded areas or heavy cover, with the falconer afoot, and the broad-aings are chiefly effective against animals and birds on the ground. in fields, swamps and meadows which are their natural hunting territory. In India falconry has always been a flourishing art. Indian falconers far surpass Iranians and Arabs. Eyasses are not used, and the system of flying "at hack" is unknown. Hanks are caught on the passage, manned and trained to the lure in a wonderfully short time, but very seldom is a falconer to be found who can maintain hanks in good flying condition. In the Punjab, sakers are the falcons chiefly used; haggard and young passage hawks are flown at hares and hubara. Successful falconers get these sakers into good wind by daily exercise at the lure giving them about 25 stoops in the morning, and about the same number in the evening They are then kept fit by daily stooping to the lure. Arabian falconers omit this exercise altogether, and keep their hawks in such poor condition that they are unable to kill hubara on the wing. Their hawks follow the quarry in the open desert, and when it settles, kill after a rough and tumble on the ground.

Hawks from which work in the field is expected should be kept in the highest health, and they must be carefully fed; no bad or tainted meat must be given to them Peregrines and the great northern falcons are best kept on lean beefsteak with a frequent change in the shape of fresh killed pigeons and other birds Freshly killed rabbits are a change to a lighter diet. The smaller falcons require small birds to keep them in health. For goshawks a coarser diet, such as rats or rabbits, suffices. The smaller short-winged hanks, like small falcons, require birds. All haaks need to be given castings. Hawks will exist, and often appear to thrive, on good food nithout castings, but the seeds of future injury to their health are being sonn. If it is more convenient to feed the hawks on beefsteak, they should frequently be given the wings, heads and necks of game and poultry, with the blood carefully removed. In addition to the castings which they swallow, tearing the pinion joint of a uing is good exercise for them, and biting the bones keeps their beaks in good trim. Most hawks, peregrines especially, require a bath. The end of a cask sawn to give a depth of about 6 in. makes a good bath, which should be permitted at least twice a week.

The best way, where practicable, of keeping hawks, is to tether them to blocks on the lawn. Goshawks are generally placed on bow perches, which ought not to be more than 8 or 9 in. high at the centre of the arc. It will be several months before passage or wild-caught falcons can be kept out of doors; they must be fastened to a perch in a darkened room, hooded, and, by degrees, as they get tamer, they may be put out on the lawn. In England (especially in the south) peregrines, the northern falcons and goshawks may be kept out of doors all day and night in a sheltered situation. An eastern aspect is best—all birds enjoy the morning sun and it is beneficial to them. The more hawks confined to blocks out of doors see of persons, dogs, horses, etc., moving about, the better.

Contrary to the prevailing notion, hawks that have been well handled show a good deal of attachment to their owners. It is true that by hunger they are in great measure tamed and controlled, and the same may be said of many undomesticated and many domesticated animals. Instinct prompts all wild creatures when away from man's control to return to their former shyness, but hawks certainly retain their tameness for a long time, and their memory is remarkably retentive. It is useless to bring a hawk into the field unless she has a keen appetite; if she has not, she will neither hunt effectually nor follow her master. Even wild-caught falcons, however, may sometimes become so attached to their owner that, when sitting on their blocks with food in their crops, they will, on seeing him, "bate" hard to get to reach him, till he either allows them to jump up to his hand, or withdraws from their sight. Goshawks too evince great attachment to their owner. Another error is that hawks are lazy birds, requiring hunger to stir them to action. The reverse is the truth; they are birds of very active habits and exceedingly restless. The wild falcon requires an immense amount of exercise to enable her to exert her speed and power of flight; instinct prompts her to spend hours daily on the wing, soaring and playing about in the air in all weathers, often chasing birds merely for play. When full gorged she takes a siesta; but unless she fills her crop late in the evening she is soon on the move again. Goshawks and sparrow hawks, too, habitually soar in the air at about 9 or 10 A.M., and remain aloft a considerable time, but these birds are not so active as the falcons. The falconer, therefore, should endeavour to give his hawks as much flying as possible, and he should avoid the mistake of keeping too many hawks.

The larger hawks may be kept in health and working order for many years. The writer has known peregrines, shaheens and goshawks to reach ages of 15 and 20 years. Goshawks, however, never fly well after four or five seasons, when they will no longer take difficult quarry; they may be used for rabbits as long as they live. Shaheens have been seen in the east at an advanced age, killing wild fowl beautifully. The shaheen is a falcon of the peregrine type, but smaller, which does not travel, like the peregrine, all over the world. It appears that the jerfalcons also may be worked to an advanced age. Old Symon Latham tells of these birds—"I myself have known one of them an excellent hearnor (killer of herons) and to continue her goodnesse very neere twentie yeeres, or full out the time."

(E. D.-Ra.; G. Dk.)

Modern Falconry.—With the advent of the shotgun and after the enclosure of the open lands and numerous social upheavals in the older countries, the sport of falconry nearly died out. A revival of interest occurred after World War II, however, and in the United States alone there were more than 1.500 enthusiasts after mid-century who were either full or part-time falconers or who were interested in the art and literature of falconry.

Falconry survived in Europe largely through the enthusiasm of members of hawking clubs in various countries. In Great Britain the Falconers' society of England was founded about 1770 but ceased in 1838 with the death of the then manager, Lord Berners. Because of the scarcity of herons (a main quarry of the club's peregrines in East Anglia) and also partly because of the plowing up of the heath land over which the falconers rode, the centre of English falconry moved to the Netherlands and in 1839 the Loo Hawking club, an Anglo-Dutch society under the patronage of King William II of the Netherlands, was formed; in the first eight years of its existence 1,500 herons were taken by its hawks. In 1853 the royal patronage was withdrawn and the Loo club came to an end. For the next ten years falconry was kept alive in England by a few amateurs and their professional falconers. Then, in 1864, the Old Hawking club of England was founded, mainly to hawk rooks on the Wiltshire downs. It was wound up in 1926 and the British Falconers' club was founded in 1927.

In the second half of the 20th century the British Falconers' club had a membership of about 150 but only half of these were resident in the United Kingdom, of whom only about 30 kept and flew hawks. The virtual disappearance of the rabbit due to myxomatosis and the placing of many of the traditional quarries on the protected list both had a profound effect on the sport after World War II. All British birds of prey, except the sparrow hawk, became protected by law and a licence was required from the home office before an intending falconer could take a young hawk for falconry.

Falconry clubs exist in other European countries. The French Club de Champagne went out of existence in 1870 but French falconers are organized in the Association Nationale des Fauconniers et Autoursiers Français. In Germany, the Deutscher Falkenorden was founded in 1923 and is a thriving club. Austria has its club, and Italy the Circolo dei Falconieri d'Italia.

Falconry is still practised by the Arabs in Cyrenaica, and oil-rich sheiks in Saudi Arabia and the Persian gulf still train their *saker* falcons to hunt bustard. In Indian and Pakistan Punjab and in the Northwest Frontier region of Pakistan falconers fly their falcons at duck and their goshawks at partridge. Much-prized Indian hawk bells are made at Lahore and Amritsar. A few falconers survive in Japan, flying their Japanese hawk eagles at hares and their goshawks at pheasants.

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FALERII: *see* Civita Castellana.

FALERIO (mod. ***Falerone***), an ancient town of Picenum, Italy, about 10 mi. S.E. of Urbs Salvia, which, from the remains of its buildings, appears to have been of some importance. It was probably founded as a colony by Augustus after his victory at Actium.

Considerable remains of a theatre in concrete faced with brickwork, erected, according to an inscription, in 43 B.C., and 161 ft. in diameter, were excavated in 1838 and are still visible; an amphitheatre, less well preserved, also exists, the arena of which measures about 180 by 150 ft.

Between the two is a water reservoir (called Bagno della Regina) connected with remains of baths.

FALGUIÈRE, JEAN ALEXANDRE JOSEPH (1831–1900), French sculptor, whose most significant works were his naturalistic female nudes, was born at Toulouse on Sept. 7, 1831. He won the Prix de Rome in 1859 and became a member of the Institute in 1882. His "Victor of the Cock-Fight" (1864) and "Tarcisus the Christian Boy-Martyr" (1867) are in the Luxembourg. Falguière's more important monuments are those to Admiral Courbet (1890) at Abbeville and the famous "Joan of Arc." His "Triumph of the Republic" (1881–86), a vast quadriga for the Arc de Triomphe, Paris, was perhaps more amazingly full of life than others of his works, all of which revealed this quality of vitality in superlative degree.

To these works should be added his monument to "General de La Fayette" (in Washington), and his statues of "Lamartine" (1876) and "St. Vincent de Paul" (1879). His "Balzac" was executed for the Société des Gens de Lettres on the rejection of that by Rodin. "Diana" and "Woman and Peacock" are examples of his sensual treatment of the human form which aroused accusations of vulgarity from his contemporaries. He died in Paris on April 19, 1900. Falguière was a painter as well as a sculptor, but somewhat inferior in merit.

FALIERI, MARINO (1279–1355), doge of Venice, belonged to one of the oldest and most illustrious Venetian families and had served the republic with distinction in various capacities. In 1346 he commanded the Venetian land forces at the siege of Zara, where he was attacked by the Hungarians under King Louis the Great and totally defeated them; this victory led to the surrender of the city. In Sept. 1354, while absent on a mission to Pope Innocent IV at Avignon, Falieri was elected doge, an honour which apparently he had not sought. His reign began, as it was to end, in disaster, for very soon after his election the Venetian fleet was completely destroyed by the Genoese off the island of Sapienza, while plague and a declining commerce aggravated the situation. Falieri fretted under the constitutional restrictions of the ducal power, and the discontent of the arsenal hands at their treatment by the nobles offered him his opportunity. In concert with a sea-captain named Bertuccio Ixarella (who had received a blow from the noble Giovanni Dandolo), Filippo Calendario, a stonemason, and others, a plot was laid to murder the chief patricians on April 15 and proclaim Falieri prince of Venice. The Council of Ten arrested the ringleaders; several of the conspirators were condemned to death and others to various terms of imprisonment. The doge was himself arrested; at the trial he confessed everything, and was condemned and executed on April 17, 1355.

See Horatio Brown, *Studies in Venetian History* (1907, with bibliography).

FALISCI, a tribe of Sabine origin or connections, but speaking a dialect closely akin to Latin, who inhabited the town of Falerii as well as a considerable tract of the surrounding country, probably as far south as Capena. But at the beginning of the historical period (*i.e.*, from the beginning of the 5th century B.C.), and no doubt earlier, the dominant element in the town was Etruscan; and all through the wars of the following centuries the town was counted a member, and sometimes a leading member, of the Etruscan league (*cf.* Livy iv. 23, v. 17, vii. 17).

The Faliscans show many traces of their Italic origin, above all in their language, which is preserved in some 36 short inscriptions, dating from the 3rd and 2nd centuries B.C., written from right to left in a peculiar alphabet denved from the Etruscan, with some traces of the influence of the Latin alphabet.

The phonetic characteristics of the Faliscan dialect are:—

1. The retention of medial *f* which in Latin became b;

2. The representation of an initial Ind.-Eur. gh by *f* (*foied,* contrast Latin *hodie)*;

3. The palatalization of *d*+consonant *i* into some sound denoted merely by *i*—the central sound of *foied,* from *fo-died;*

4. The loss of final *s,* at all events before certain following sounds (*cra* beside Latin *crds).*

Other characteristics, appearing elsewhere, are:

5. The retention of the velars (Fal. *cuando* = Latin *quando;* contrast Umbrian *pan(n)u*);

6. The assimilation of some final consonants to the initial letter of the next word.

It seems probable that the dialect lasted on, though being gradually permeated with Latin, till at least 150 B.C.

The remains found in the graves, which belong mainly to the period of Etruscan domination, give ample evidence of material prosperity and refinement. The earlier strata have yielded more primitive remains from the Italic epoch. A large number of inscriptions consisting mainly of proper names may be regarded as Etruscan rather than Faliscan.

See W. Deecke, *Die Falisker;* E. Bormann, *in C.I.L.* xi. pp. 465 ff.; and R. S. Conway, *Italic Dialects.*

FALK, ADALBERT (1827–1900), German politician, was born at Matschkau, Silesia, on Aug. 10, 1827. In 1847 he entered the Prussian state service. and in 1853 became public prosecutor at Lyck. From 1872 to 1879 he was minister of education, and in connection with Bismarck's policy of the *Kultur-kampf* he was responsible for the famous May Laws against the Catholics *(see* GERMANY: *The German Empire).* He retained his seat in the reichstag till 1882, when he was made president of the supreme court of justice at Hamm. He died on July 7, 1900.

See H. R. Fischer, *Adalbert Falk* (1901).

FALK, JOHANN DANIEL (1768–1826), German author and philanthropist, was born at Danzig on Oct. 28, 1768. In 1813 he established a philanthropic society (Gesellschaft der Freunde in der Not), one of the earliest of its kind, and about the same time founded an institute for the care and education of neglected and orphan children, which, in 1829, was taken over by the state and still exists as the Falksches Institut. Falk lived at Weimar, and enjoyed the intimate friendship of Goethe; his account of their intercourse was posthumously published under the title *Goethe aus näherein persönlichen Umgange dargestellt* (1832) (English trans. by S. Austin). Falk died on Feb. 14, 1826.

Falk's *Satirische Werke* appeared in 7 vols. (1817 and 1826); his *Auserlesene Schriften (3* vols., 1819). See *Johannes Falk: Erinnerungsblatter aus Briefen und Tagebuchern* edited by his daughter, (1868); Heinzelmann, *Johannes Falk und die Gesellschaft der Freunde in der Not* (1879); S. Schultze, *Falk und Goethe* (1900).

FALK, MAX (1828–1908), Hungarian editor and statesman, was born at Budapest, Oct. 7, 1828. While he was still a young man, he edited in succession three small newspapers. In 1861 he was imprisoned for his part in the Hungarian nationalist movement, but was released in 1867 to become' the teacher of the Empress Elizabeth. In 1868 Falk assumed the editorship of the *Pester Lloyd,* a position he held until 1906. He was elected to the Hungarian parliament in 1869 and joined the liberal faction led by Francis Deak and the elder Count Julius Andrassy. He was the author of a biography of Count Istvan Széchenyi and of a book of reminiscences about the Empress Elizabeth. He died in Budapest, Sept. 10, 1908.

FALKE, GUSTAVE (1853–1916), German lyric poet and novelist, was born in Lubeck, Jan. 11, 1853. After finishing his studies at the Lubeck Catharineum, he became a bookseller. a position he gave up in 1878 when he was made professor of music at Hamburg. In 1903 the Hamburg government gave him a yearly subsidy of 3,000 marks so that he was able to devote the remainder of his life to writing. Falke wrote mainly of homely things such as the country about Hamburg and the simple pleasures of domestic life. In his early years his work was much influenced by that of the poet, Detlev von Liliencron. His poems include *Mynkeer der Tod* (1892), *Frohe Fracht* (1907), an epic poem, *Hohe Sommertage* (1902), and numerous others. His best-known novel is *Der Mann im Nebel* (1899) He died in Hamburg, Feb. 8, 1916.

FALKE, JOHANN FRIEDRICH GOTTLIEB (1823–1876), German historian, was born at Ratzeburg on April 10, 1823. In 1856 he was appointed secretary of the German museum at Nuremberg, and in 1859 keeper of the manuscripts. With the aid of the manuscript collections in the museum he studied economic history, and, with Johann H. Müller, established an historical journal, *Zeitschrift* fur *deutsche Kulturgeschichte* (4 vols., Kuremberg, 1856–59). To this journal he contributed a history of German taxation and commerce. In 1862 he became secretary and, later, keeper of the state archives at Dresden. His works include: *Geschichte des deutschen Handels* (2 vols., 1859–60); *Die Hansa als deutsche See- und Handels-macht* (1862), and *Geschichte des deutscken Zollwesens* (1869). He died at Dresden on March 2, 1876.

FALKENHAYN, ERICH VON (1861–1922), Prussian general, was born on Nov. 11, 1861 at Burg Belchau (Thorn). He took part in the China expedition of 1900 and remained in China with a brigade of occupation until 1903. In 1907 he was appointed chief of staff of the XVI, and in 1912 of the IV army corps. In 1911 he was appointed commander of the 4th guards (infantry) regiment. In 1913 he was made general. and from July 7, 1913, to Jan. 20, 1915, was Prussian war minister. He succeeded General von Moltke on Nov. 3, 1914, as chief of the general staff of the army Although Falkenhayn did not accept the principle that a decision could be obtained in the east, the abandonment of the plan for a break-through on the Albert-Arras front, and the increasing evidence of shortage of material and weakening efficiency on the Russian side made him regard a very heavy blow on the Russian front as necessary and desirable. Eight divisions were brought from the Western front, and Mackensen was made chief of this army (XI), which succeeded in breaking through the Russian lines (Gorlice–Tarnow) on May 2–3, 1915 (*see* WORLD WAR I).

Falkenhayn later helped to plan the summer offensive of 1915 against Russia. At the end of 1915 he became convinced of the necessity of opening a road to Turkey for the transit of munitions and expert personnel, and organized the operations by which. with the co-operation of the Bulgarian army, Serbia was overrun in the winter of 1915–16. At the end of Dec. 191j, Falkenhayn sent the Kaiser a memorandum setting forth his reasons for advocating an attack on Verdun, and he was severely blamed when the attack eventually failed. (*See* also VERDUN, BATTLES OF.)

In July 1916, Falkenhayn, submitting to public opinion, proposed that Field Marshal von Hindenburg should be made supreme commander from Pripet to the Dniester, and a few days later he offered him the command of the whole eastern front from the Baltic to the Carpathians. The desire for the creation of a general supreme command was rapidly growing even in Austria, and on Sept. 16. 1916 the *Oberste Kriegsleitung* was signed by German and Austrian plenipotentiaries; under this agreement the German Kaiser became responsible for the higher leading of operations in general.

This agreement was signed on the part of the Germans by Hindenburg, who had succeeded Falkenhayn as new chief of the general staff on Aug. 29, 1916, the immediate cause of Falkenhayn's dismissal being the Rumanian declaration of war (Aug. 27, 1916). Falkenhayn was then assigned the leadership of the IX army against Rumania and commanded in the fighting at Hermannstadt and on the Targu Jin.

In 1917 he took command of the so-called Asiatic corps, for operations in the Caucasus, and in 1918 and 1919 was at the head of the X army in Lithuania.

He wrote an interesting account of the German conduct of the war during its first two years, entitled *Die oberste Heeresleitzrng in ihren wichtigsten Entschliessungen 1914–16* (1919), and *Der Feldzug der IX Armee gegen die Rumänen und Russen 1916–17*, 2 vol. (1921). He died on April 8, 1922, at the castle of Lindstet, near Wildpark.

See A. Alberte, *General Falkenhayn, die Beziehungen zwischen den Generalstabschefs des Dreibundr* (1924).

FALKIRK, a large and parliamentary burgh of Stirlingshire, Scot., 11 mi. S.E. of Stirling by road and about midway betneen Edinburgh and Glasgow. Pop. (1961) 38,043. Falkirk stands on high ground overlooking the fertile Carse of Falkirk. The Forth and Clyde canal passes through the north of the burgh and the Antonine wall runs through the southern end. The suburb of Camelon is the site of successive Roman forts. Grangemouth (*q.v.*), the port, lies 3 mi. N.E. The Gaelic name, Eaglais Bhreac (1166), the Latin Varia Capella (1166) and the English Faw Kirk (1298) all mean "speckled (or many-colouredj church." The place is mentioned by Simeon of Durham (early 12th century) as Egglesbreth.

The first church was built by Malcolm Canmore, but the present church is of the early 19th century. The town became a burgh of barony in 1600 and of regality in 1646 under the important Livingston family who had held the estate of Callendar (with its *caput* immediately southeast of Falkirk) since the mid-14th century. They were forfeited after the rebellion of 1715 and the regality was canceled.

Control of the town fell eventually into the hands of the stentmasters (a body of men elected by the trades to levy a "stent" to be spent for the common good). who governed its finances until 1857. Falkirk is now under the control of a council with provost and bailies, and combines with Stirling and Grangemouth to return one member to parliament.

The long-important trysts or sales of cattle and sheep, known as the Great Mercat, were transferred to Falkirk from Crieff in about 1750, but only local markets are now held. The district is rich in coal. and fire clay is mined, though iron is no longer worked. Falkirk is the chief seat of the light-casting trade in Scotland; other industries include aluminum rolling. precast concrete, chemicals and hosiery manufacture, and brewing and bookbinding are also carried on.

Carron, 2 mi. N.N.W., is well known for the ironworks established in 1759 by John Roebuck for whom John Smeaton and James Watt (*qq.v.*) worked. (X.)

Battles of **Falkirk.**—These were two engagements, one fought in 1298, the other in 1746. The battle of July 22, 1298. was fought between the forces of Edward I of England and those of the Scottish national party under the command of Sir William Wallace. The Scots had taken up a strong position on a hillside south of the town with an impassable marsh to their front, and were formed in four "schiltrouns" or dense circles of spearmen, with archers between the schiltrouns and a small body of mounted men in reserve.

The English first line, under the earl marshal and the earls of Hereford and Lincoln, tried the morass in vain and then rode round its western side. The second line. commanded by the warlike bishop of Durham, Antony Bek, rounded the marsh to the east and then halted to await the arrival of the third line under the king. The bishop's undisciplined and impatient followers, telling him to go back to his Mass and leave warfare to soldiers, charged the nearest schiltroun. The first line under the earls attacked on the other side but Wallace's "forest of spearmen" resolutely repulsed all attacks with heavy loss. The Scottish cavalry fled without striking a blow, except for a few leaders such as Sir John de Graham and Sir John Stewart who remained to die with the archers and spearmen.

Seeing that his cavalry could make no headway, Edward brought up his Welsh archers, who from a safe distance wrought such havoc among the schiltrouns with arrows and stones that the mounted troops were at last able to break the weakened and disorganized Scottish ranks and complete their destruction. It was the first victory of the longbow in a major battle.

At the second battle of Falkirk, fought on Jan. 17, 1746, the Jacobites, under Prince Charles Edward. defeated the government troops under Gen. Henry Hawley. Hawley had formed the opinion that a Highland army could not withstand a charge of cavalry and allowed them to occupy the high ground to the west of Falkirk. The dragoons, attacking uphill against driving rain. broke under the controlled and heavy fire of the Highland right under Lord George Murray. Most of the infantry became involved in the rout and Hawley fell back to Edinburgh with heavy losses in men, guns and stores. (R. L. HR.)

FALKLAND, LUCIUS CARY, 2nd VISCOUNT (*c.* 1610–1643), son of Sir Henry Cary. afterward 1st Viscount Falkland (d. 1633), lord deputy of Ireland from 1622 to 1629, was born either in 1609 or 1610. and was educated at Trinity college, Dublin. In 1625 he inherited from his grandfather the manors of Great Tew and Burford in Oxfordshire; he married Lettice. daughter of Sir Richard Morrison. In 1633 he succeeded his father as Viscount Falkland.

He assembled round him at Great Tew many learned men. He was the friend of Hales and Chiilingworth, was celebrated by Jonson, Suckling, Cowley and Waller in verse. and in prose by Clarendon, who is eloquent in describing the virtues and genius of the "incomparable" Falkland, and draws a delightful picture of his society and hospitality.

Falkland served on the king's side as a volunteer under Essex in the campaign of 1639 against the Scots. In 1640 he was returned for Newport in the Isle of Wight to the Short and Long Parliaments, and took an active part on the side of the opposition. He spoke against the exaction of shipmoney on Dec. 7, 1640, denouncing the servile conduct of Lord Keeper Finch and the judges.

Falkland supported the prosecution of Strafford and he voted for the third reading of the attainder. On the church question he deprecated clerical encroachment in secular matters; on the other hand, though he denied that episcopacy existed *iure divino,* he was opposed to its abolition, fearing the establishment of the Presbyterian system. which in Scotland had proved equally tyrannical. In fact Falkland sought compromise, but a bill simply excluding the clergy from secular offices failed, and on May 27, 1641, the Root and Branch bill, for the total abolition of episcopacy, was introduced in the house of commons. This measure Falkland opposed, as well as the second bill for excluding the bishops, introduced on Oct. 21. In the discussion on the Grand Remonstrance he took the part of the bishops and the Arminians. He was now definitely ranged against the policy of the parliament, and on Jan. 1, 1642. was persuaded by Hyde to accept the secretaryship of state, though he had little influence in the king's councils.

He signed the protestation against making war at York on June 1j, 1642. On Sept. j he carried Charles's overtures for peace to the parliament, when he informed the leaders of the opposition that the king consented to a thorough reformation of religion. The secret correspondence connected with the Waller plot passed through his hands. He was present with the king at Edge Hill and at the siege of Gloucester. By this time the hopelessness of the situation had completely overwhelmed him, and he welcomed death on the battlefield as an escape from the catastrophe which he foresaw but saw no means of avoiding. Riding alone at a gap in a hedge commanded by the enemy's fire in the battle of Iiewbury (Sept. 20. 1643), he was immediately killed. He was succeeded in the title by his eldest son, Lucius, 3rd Viscount Falkland, his male descent becoming extinct in the person of Anthony, jth viscount, in 1694. when the viscounty passed to Lucius Henry (1687–1730), a descendant of the first viscount.

Falkland wrote a *Discourse of Infallibility* (1646); *A Letter . . . 30 Sept. 1642 Concerning the Late Conflict Before Worcester* (1642); and *Poems* (ed. by A. B. Grosart, 1871, in Fuller's Worthies Library) in which he shows himself a follower of Ben Jonson.

See Lady M. T. Lewis, "Life of Falkland," in *Lives of the Friends . . . of Lord Chancellor Clarendon,* vol. i, p. 3 (1852); J. A. R. Marriott. *Life and Times of Lucius Cary, Viscount Falkland* (1907).

FALKLAND, a royal burgh and civil parish of Fifeshire, Scot., at the northern base of the hill of East Lomond (1,471 ft.), 21 mi. N. of Edinburgh as the crow flies and 16 mi. S.E. of Perth by road. Pop. (1961) 1,032. The little town, with its cobbled streets and many old houses, has been connected with Scottish kings since the 12th century. The castle was replaced by Falkland palace which, from the 16th century, became a favourite seat of the Scottish court. It was finished in 1j40 by James V who died there in 1542. Its east wing was partly destroyed by fire in 1654 while Cromwell's forces were in occupation; only the foundations remain of the north wing; the south wing was rebuilt by the 3rd marquess of Bute. who acquired the property in 1887. The gardens have been restored to their original royal plan and at Falkland is the only royal tennis court left in Scotland.

In 1952 the National Trust for Scotland became deputy keeper of the palace.

Falkland became a royal burgh in 1458 and its charter was renewed in 1595. It gives the title of viscount to the Devon family of Cary (granted in 1620). Richard Cameron (*q.v.*) the Covenanter was born at Falkland *c.* 1648 and his thatched house still stands. The chief industries are linen and linoleum.

FALKLAND ISLANDS AND BRITISH ANTARCTIC TERRITORY. The Falkland Islands, a group of islands in the South Atlantic ocean. belonging to Great Britain, lie between latitudes 51° S. and 53° S. and longitudes 57° W. and 62" W., and about 250 mi. E. of the nearest point on the South American mainland. The two principal islands. East Falkland and West Falkland. are separated by the Falkland sound. a narrow strait running northeast to southwest and nowhere more than 25 mi. across. Round them lie about 200 smaller islands. of which about a dozen are inhabited. The total area is 4.618 sq.mi. Pop. (1953) 2,230. Capital. Stanley. *(See* below, *Falkland Islands Dependencies and British Antarctic Territory.)*

Physical Features.—The coast line is deeply indented and affords many secure and sheltered anchorages. In dull weather, which predominates, the general appearance of the islands is uninviting, but under bright sun the scenery takes on colour and beauty. East Falkland is almost bisected by the Choiseul and Brenton sounds. Its hilly northern part is traversed by the Wickham heights, a rugged range running from east to west with its highest point at Mt. Usborne (2,245 ft.). The remainder of the island is mainly low and undulating ground covered with coarse grasses, with small streams feeding the valleys but also with extensive bog and shallow tarns and much stony outcrop. Seen from the air, its appearance is bleak and inhospitable. At the northern extremity are two fine inlets. Berkeley sound and Port William. The early seat of government, Port Louis, lay at the head of the former but it was moved in about 1844 to its present site at Stanley, a landlocked harbour within Port William.

West Falkland enjoys a gentler climate. Its hillier part lies to the east of the island where the Hornby hills, running parallel to the Falkland sound, reach their highest at Mt. Adam (2.290 ft.).

The small town of Stanley is built along the southern slope of Port William inlet, overlooking the harbour, and on a fine day presents an attractive picture with its cluster of clapboard houses with their painted roofs and their porches gay with flowers. It is dominated at one end by the red brick Anglican cathedral and at the other by Government house.

With the exception of Lafonia (the southern part of East Falkland). which is Permocarboniferous. the islands consist of the older Paleozoic rocks, Lower Devonian or Upper Silurian, slightly metamorphosed and a good deal crumpled and distorted. In the low grounds are clay. slate and soft sandstone and on the ridges hard sandstone passing into white quartzite. There are no minerals of value. Many valleys in the islands are characterized by the presence of "stone runs" of varying length which upon examination are revealed as extensive accumulations of quartzite boulders. from 2 ft. to 20 ft. long and half as wide and with a depth corresponding to the quartzite ridges of the hills above. These blocks or boulders, angular in form and resting irregularly. though close packed, one upon another. give an unmistakable impression of a river of stone flowing down toward the sea.

The Falkland Islands correspond in latitude in the southern hemisphere with London in the northern, and the temperature is equable with an annual mean of 43° F. The climate is not unlike that of the Outer Hebrides though somewhat colder. Its most trying feature is a persistent wind that blows at an average strength of 15 knots throughout the year and often with great force. The average annual rainfall (27 in.) is rather more than that of London. but the hours of sunshine. though fitful, are much the same. The strong winds and tempestuous seas have accounted for more than 130 wrecks around the islands and the hazards of navigation have been enhanced by the lack of beacons. There is only one lighthouse, at Cape Pembroke. but automatic lights have been placed at a number of danger points.

There is no evidence of human occupation before the establishment of the first settlement at Port Louis, in 1764, by L. A. de Bougainville. The land fauna is scanty. A small wolf or wild dog—the *loup-renard* of De Bougainville—is extinct, having last been seen in 1875. There are introduced hares and rabbits and, on two of the islands. Patagonian foxes, which have become a menace to young lambs. The herds of cattle that ran wild after the departure of the first settlers and bred prolifically have almost died out. and sheep. which were first raised on East Falkland in 1835, provide the sole economy of the islands. The whole colony is divided into sheep farms varying in size from 3.600 ac. to 400,000 ac. These carry a total in excess of 600.000 head with an average production of about 5,000,000 lb. of wool annually. The mortality. especially among lambs. is very high. Hair seal (sea lion and elephant seal) abound but attempts to exploit them commercially in the 20th century have failed. The southern fur seal, which was almost exterminated by wholesale killing in the 19th century. is re-establishing itself as the result of close protection. There are a few species of land birds. some of which, including the white-rumped sandpiper of North America, the Paraguayan snipe and the military starling, are migratory. There is a great wealth of sea birds and the islands possess large colonies of penguins. petrels and albatross. The only insect pest is the bluebottle.

As the islands are connected with subantarctic South America by an elevated submarine plateau, the island flora much resembles that found on the mainland except that the trees, of which there are such dense forests in southern Patagonia, are wholly absent. Attempts at tree planting have not met with success. The greater part of the land is formed of peat which is in some places of considerable age and depth and, at the bottom of the beds, dense and bituminous. It differs in character from the peat of northern Europe. for the lower plants enter but little into its composition and it is formed almost entirely of the roots and stems of *Empetrum nigrum* variety *rubrum,* a kind of crowberry bearing the local name of diddle-dee; of *Myrtus nummularia,* a small creeping myrtle known as teaberry; and of sedges and sedgelike plants. It is in general use as fuel. Two vegetable products. balsam bog *(Azorella caespitosa)* and tussock grass *(Poa flabellata),* have long been objects of interest. The first is a boulder-shaped, bright green mass which when dead becomes gray and stony in appearance. When cut open it reveals an infinity of minute leaf buds and stems from which, at intervals, exudes an aromatic resin. The second is not unlike an African sword grass but has broader leaves and grows in tufts that rise about six to ten feet high. The leaves are cut and fed to dairy cattle and horses and, having a high protein content, make admirable fodder. With the introduction of sheep, which eat the heart of the plant, the tussock grass was threatened with extinction on the main islands. Where it survives it is fenced in. On many of the smaller islands, where it is prolific. cattle and horses are put out to winter and. as they feed only on the leaves, do the plant no harm.

History. — The Falklands were discovered by the English navigator John Davis (Davys) in the "Desire" in 1592 and two years later Sir Richard Hawkins sailed along their northern shore. In 1598 Sebald van Weerdt appears to have visited some of the northern islands of the group (probably the Jasons). which were for long named the Sebaldine Islands. The Falklands derive their present name from Capt. John Strong, who, in 1690, sailed down the sound separating the eastern and western islands and called them after Lucius Carey, Viscount Falkland, then treasurer of the navy. Their existence had long been known to French mariners sailing out of St. Malo for the Rio de la Plata who called them Les Îles Malouines, which the Spaniards on the mainland converted to Las Islas Malvinas.

Recorded history begins with the establishment by De Bougainville of a party of settlers on East Falkland in 1764. In the following year Capt. John Byron, who had been sent out on a survey expedition, claimed the islands for Great Britain and left a small party at Port Egmont on Saunders Island. In 1766 the French settlement was withdrawn under pressure from Spain, which later (17'70) ejected the British party — an action that brought the two countries to the brink of war. Port Egmont was restored to Britain in 1771 but voluntarily abandoned three years later. In 1829 the Republic of Buenos Aires, which claimed to have inherited the rights of Spain, sent Louis Vernet to develop a colony in its name; he made some progress but in 1831 was rash enough to seize three U.S. sealing vessels and this brought down a U.S. corvette, the "Lexington," which "laid waste the Settlement and proclaimed the islands free of all governance." In 1833 Great Britain, which had never renounced its claims to sovereignty, resumed official occupation. The colony was under the charge of successive naval officers engaged on hydrographic work until 1841 when a civil administration was set up at Port Louis and continued from that time. In 1914 the adjacent waters were the scene of the battle of the Falkland Islands (*q.v.*), and during World War II Stanley was an important naval base and radiotelegraphy station.

Claims are outstanding by Argentina to the Falkland Islands and their dependencies and to the antarctic continental shelf opposite Argentina, and by Chile to territories lying between longitudes 53° W. and 90° W., including the South Shetlands. The claims of the two countries overlap and are contested by Great Britain. Bases were set up by both claimants in the territories claimed. Great Britain sought the arbitration of the International Court of Justice, but the court refused arbitration in March 1947 because Argentina and Chile had rejected its competence to adjudicate. A truce between the three countries, agreeing not to move warships south of 60° S. latitude, was renewed from time to time, and the 12-nation agreement of Dec. 1959 on the peaceful use of the antarctic continent, involving a moratorium on territorial claims, served to relax tension.

Administration and Population. — The administration follows the normal crown colony pattern under a governor who is appointed by the crown and is himself advised by an executive council of four official and three unofficial members. The lawmaking body is the legislative council comprising five official and six unofficial members, of whom four are popularly elected. There is thus an unofficialmajority. There is no public debt and the colony is self-supporting. The revenue is derived mainly from income tax and from duty levied on imports of malt, wine, spirits and tobacco and upon the exports of hides and skins, tallow and wool. In the case of wool the duty is assessed on the average price for the season's clip. The islands have no other resources and apart from meat, fish and vegetables are dependent on external supply. The biggest single landowner is the Falkland Islands company. which obtained a royal charter in 1851. This company is responsible for the shipment and delivery to the London market of the annual wool clip. It acts as general agent for the farms and owns a large retail store and workshops at Stanley.

About half the population live in Stanley and the remainder on the farms. Most are of British descent but there are some Scandinavian strains. Family allowances are paid by the government, provided there are two or more children, and there is a contributory old-age pension scheme for male workers. Education is the responsibility of the government, which maintains two schools in Stanley where attendance is obligatory between the ages of 5 and 14 and voluntary up to 16 years. There is a flourishing boarding school at Darwin on East Falkland and a smaller school on West Falkland. Elsewhere on the farms education is largely dependent on traveling teachers. There is a well-equipped hospital and dental surgery and, in addition, medical officers are stationed on East and West Falkland. The colony has an efficient mdiotelegraphy station, which is its link with the outside world, and a substation at Fox Bay on West Falkland. All farms and outlying islands are provided with two-way radiotelephone sets that keep them in daily touch with Stanley. Physical communications with the mainland and with the farms are maintained by the company's steamer, supplemented in the latter case by privately owned cutters, by a small government motor vessel and by an internal air service operating float planes. This air service, with the number of natural harbours available and the close proximity of the farms to them, provides the ideal medium. It is extremely popular and along with the provision of radiotelephone sets has revolutionized life in the islands.

Falkland Islands Dependencies and British Antarctic Territory. — By an order in council effective from March 3, 1962, the separate colony of British Antarctic Territory was established, comprising part of the former territory of the Falkland Islands dependencies. The dependencies now consist of the islands lying between longitudes 20° W. and 50° W. and latitudes 50" S. and 60° S., and those between longitudes 50° W. and 80" W. and latitudes 58° S. and 60° S. These are principally South Georgia and the South Sandwich group.

British Antarctic Territory comprises all land and islands between longitudes 20° W. and 80° W. and south of latitude 60° S.: namely the South Orkney and South Shetland island groups, and the wedge-shaped sector of the antarctic continent from Palmer peninsula (including Graham Coast) to the south pole. It is administered by the Falkland Islands' governor acting as high commissioner.

The above territories, until 1962 all part of the Falkland Islands dependencies, were annexed to the British crown in 1908. The area of the dependencies is 1.570 sq.mi., and their population about 1,300 in summer and 100 in winter. The area of British Antarctic Territory is about 475,000 sq.mi., and its population 150 in summer and 90 in winter. South Georgia is the site of an important land-based whaling industry. A chain of meteorological and scientific bases is maintained on British Antarctic Territory, stretching from Signy Island in the South Orkneys to Stonington Island off the west coast of Palmer peninsula, and manned by the British Antarctic survey (formerly the Falkland Islands Dependencies survey). This organization has been responsible for the topographical and geological survey of the greater part of British Antarctica. A meteorological office at Stanley receives reports from the bases and issues a daily weather forecast of which wide use is made. A scientific bureau in London serves as a clearinghouse for the distribution of this material and the publication of reports. Revenue is derived mainly from income tax, customs duties and an export tax on whale oil, and is supplemented by a substantial grant from the U.K. Most of the revenue is spent on the maintenance of the scientific bases.

While the bases, generally, are icebound throughout the winter months. South Georgia remains open. The South Sandwich group and Deception Island in the South Shetlands are volcanic and there are hot springs at the latter. The scenery in Antarctica as a whole is magnificent on a fine day in the summer, and this is especially true of South Georgia.

The island is closely associated with the memory of the explorer Sir Ernest Shackleton, who is buried there, and of his heroic journey during 1915–16.

South Georgia and the South Sandwich Islands were discovered in 1775 by Capt. James Cook, the navigator, who took possession for the crown. His reports of the abundance of whales and seals in those waters led to the discovery of the antarctic continent by the whalers and sealers who followed in his wake, for some of the shipowners were interested in discovery for its own sake and encouraged their captains to push even farther afield. Outstanding among the latter were George Powell (South Orkneys. 1821–22). William Smith (South Shetlands, 1819), James Weddell, Edward Bransfield (antarctic mainland. 1820) and John Biscoe (Graham Land. 1832); these in turn led to the expeditions of A. de Gerlache (Belgian), Otto Nordenskjöld (Swedish), W. S. Bruce. (Scottish); J. B. Charcot (French), Shackleton (British) and W. Filchner (German), the continuing work of the Discovery committee and the British Graham Land expedition, and so to the establishment of the Falkland Islands Dependencies survey in 1943.

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FALKLAND ISLANDS, BATTLE OF. One of the principal actions of World War I, known as the battle of the Falklands, was fought on Dec. 8, 1914, to the southeastward of the Falkland Islands, between a British squadron under Vice-Adm. Sir Doveton Sturdee and a German squadron under Vice-Adm. Graf von Spee. This battle was a counterstroke to the battle of Coronel (*q.v.*). With the utmost secrecy the two battle cruisers "Invincible" and "Inflexible" had been detached from the grand fleet in the North sea and sent, with all dispatch, to reinforce the British squadron in the South Atlantic. Admiral Sturdee's orders, on leaving England in the "Invincible," were to "Seek out and destroy the enemy." The following table shows the details of the rival forces:

Armament and Speed of Rival Forces

Type of ship	Name	Guns	Nominal speed
British			
Battle cruisers .	"Invincible"	8 12-in.	26 knots
	"Inflexible"	8 12-in.	26 ,,
Armoured cruisers	"Carnarvon"	4 7.j-in., 6 6-in.	22 ,,
	'all"	14 6-in.	23.5 ,,
	"Rent"	14 6-in.	23.5 ,,
Light cruisers .	"Glasgow"	2 6-in., 10 4-in.	25 ,,
	"Bristol"	2 6-in., 10 4-in.	24 ,,
Armed merchant cruiser . .	"Rfacedonia"	...	
German			
Armoured cruisers	"Scharnhorst"	8 8.2-in. 6 5.9-in.	23 knots
	"Gneisenau"	8 8.2-in. 6 5.9-in.	23 ,,
Light cruisers .	"Leipzig"	10 4.1-in.	23 ,,
	"Nürnberg"	10 4.1-in.	23.5 ,,
	"Dresden"	10 4.1-in.	24 ,,
Supply ships .	"Seydlitz"	...	
	"Baden"	...	
	"Santa Isabel"	...	

Fleet at Port William.—After the defeat of Admiral Cradock's squadron at Coronel, the old battleship "Canopus" had returned to the Falklands and was berthed on the mud in Port Stanley, the inner harbour. Her light guns had been erected on shore and the entrance to the harbour mined with electric mines constructed out of old oil drums. A signal station had been erected and the local volunteers organized as a defense force. Thus being sturdily prepared for eventualities, the little colony had waited.

On his arrival at Port William on Dec. 7, Admiral Sturdee ordered the "Macedonia" to patrol outside the harbour; the "Inflexible" and "Kent" to be ready for 14 knots at half an hour's notice and the other ships of his squadron to keep steam for 12 knots at two hours' notice. Only three colliers were available, so all ships could not coal at once. By 6 A.M. on Dec. 8. the "Carnarvon" and "Glasgow" had finished coaling. The "Invincible" and "Inflexible" then began. The "Bristol" had her fires out to remedy defects and the "Cornwall" had one engine opened up at six hours' notice; the "Glasgow" was also repairing machinery and could not be ready for two hours. Such was the situation when, at 7.50 A.M.. the observation post on Sapper's hill reported two strange ships in sight. At 7.56 A.M. the "Glasgow" fired a gun to draw attention to a signal flying in the "Canopus," making known this report.

German Squadron in Sight.—A scene of activity ensued; colliers were cast off and preparations made for leaving harbour. The "Kent," having just taken over guard duty, was ordered to weigh and observe the enemy. The general signal to weigh was made at 8.14 A.M.; at 8.30 "action" was sounded off and all ships were striving to raise steam at the earliest possible moment.

The two ships which had been sighted were the "Gneisenau" and "Nürnberg," which Spee had sent on ahead to reconnoitre; they were not visible from the "Canopus" but, with the aid of an extemporized observation hut which had been established on the hill, she opened fire on them at 9.15 A.M. with her 12 in. guns. The range, however, was too great and the shots fell short; nevertheless, the firing made the two German ships turn away to the southeast.

Von Spee, in the "Scharnhorst" was some 15 miles distant from the harbour, but the clouds of smoke visible over the intervening land made him suspicious. The "Gneisenau" was near enough to make out the masts and funnels of six ships in the harbour, and, worse still, some observers thought they could distinguish the tripod masts of battle-cruisers. The report from the "Gneisenau" confirmed von Spee in his misgivings and he immediately ordered the advanced ships not to accept action. This order was followed by a general signal to his squadron to raise steam in all boilers and steer east.

Von Spee's Intentions. — It is impossible to be sure with what intention Admiral von Spee made for the Falkland Islands. By one account he expected to find there a British squadron weaker than his own; he hoped to draw them to sea, destroy them, and then occupy the Islands. Some colour is lent to this by the report of British officers at the observation post on shore that they could distinguish, through telescopes, men on board the "Gneisenau" dressed and equipped ready for landing. Von Spee was certainly unaware that the Admiralty had despatched two battle-cruisers to these waters. Their arrival just in time was a stroke of luck which the latter fully dcservcd; but Admiral Sturdee was momentarily at a distinct disadvantage owing to his ships being at anchor with colliers alongside.

Von Spee's position if the British squadron brought him to action in the open was hopeless; but if the Germans had pressed home an attack at the entrance to the harbour, the prospects would have been far from pleasant for the British forces within.

Pursuit of the German Squadron. — By 10.15 A.M. all ships, excepting the "Bristol," had steam up, and 1j minutes later they had cleared the harbour; the enemy was hull-down to the south-east, some 12 or 13 miles distant; so Admiral Sturdee made the signal for "general chase," an order for each ship to steam at her utmost speed in pursuit. The sea was calm, the sky clear, and a light north-westerly breeze was blowing. At 10 50 A M. it became evident that the British ships were gaining and Sturdee ordered the "Glasgow" to keep three miles ahead, and the "Inflexible" to keep on the port quarter, of the "Invincible." This annulled the "general chase." By 11 A.M. the German ships were clearly visible and the battle-cruisers reduced speed to 24 knots. The "Carnarvon" and "Cornwall" were now lagging behind, their best speed being 20 knots and 22 knots respectively, and, to avoid his ships becoming too widely scattered, Sturdee reduced the speed of the squadron to 19 knots and ordered the crews to be piped to dinner. The German squadron was then doing little more than 1j knots.

Meanwhile, the German auxiliaries had been sighted from the Islands, and the "Bristol," which by extraordinary exertions had managed to raise steam and was just leaving harbour, was ordered to take "Macedonia" under her orders and "destroy the transports." Unfortunately, it was not known then that these ships were colliers.

At 12.20 P.M. Sturdee decided to press the chase and speed was increased to 22 knots; by 12.50 P.M. the British battle-cruisers were steaming 25 knots and were rapidly overhauling the enemy. At 12.55 P.M. fire was opened by the "Inflexible" on the "Leipzig" at a range of 16,000 yards. To save his light cruisers, von Spee ordered them to scatter and make for the South American coast; they turned away to the southward at about 1.20 P M. Such a contingency had been provided for, and, without further orders, the British cruisers turned off in pursuit.

The Battle-Cruiser Action. — As his light cruisers left him, von Spee turned to the eastward to accept action; and Sturdee's battle-cruisers turned into line ahead on a nearly parallel course to the enemy. Fire was now opened on both sides, but the range —about 14,000yd.—was too great, and the shots from the German ships fell short. The range closed to 12,500yd. and about 1.45 P.M. "Invincible" was hit; whereupon Sturdee turned away to open the range and obtain full advantage from his heavier armament. His object was to annihilate the enemy, but in doing so to receive as little damage as possible. By 2 P.M. the range had increased to 16,000 yd. and firing ceased for a time.

In order to renew the action, the British battle-cruisers altered course to starboard, and gradually reduced the range to 15,000 yd. Fire was then reopened and von Spee again accepted action, manoeuvring his ships to reduce the range sufficiently for his secondary armament to be brought into action. Sturdee allowed the range to fall to about 12,500 yd. and then, as the Germans began to fire with their 5.9-in. guns, he sheered off again. With his superior speed Sturdee was able to keep the range as he wished and the British guns now began to inflict severe damage on the enemy ships.

By 3 10 P M. the Germans showed signs of damage; the "Scharnhorst" being on fire. The smother of smoke made spotting the fall of shot a matter of some difficulty, so, at 3 1j P M., Sturdee turned the battle-cruisers round to port; von Spee replied by also turning his ships, and the action now ran to the south-westward.

End of the **"Scharnhorst."**—By 4 P.M. the "Scharnhorst" was suffering terribly; she was on fire from stem to stern; her superstructure was in ruins and she had a heavy list to port, but she continued to lire gamely with her remaining guns. Her end came at 4.17 P.M., when she turned completely over and sank with flag flying. No one was saved.

The "Gneisenau" Sunk. — After the "Scharnhorst" sank, both battle-cruisers engaged the "Gneisenau," and, to prevent being blinded by smoke, steered on independent courses. The "Carnarvon" had now been able to close sufficiently to open fire, and the doomed German cruiser became a target for a concentrated fire from three directions. Her fire slackened; she was on fire fore and aft and her speed rapidly dropped. Her one remaining gun continued to fire at intervals; but at 5.40 P.M. her splendid fight against hopeless odds was at an end and she heeled slowly over and sank at about 6 P.M. The British ships closed, lowered their boats and succeeded in rescuing 187 survivors from the icy water.

The Light Cruisers. — When the German light cruisers broke away, they had about 11 miles' start on their pursuers. The British ships had nominally no superiority in speed, but, owing to their recent continuous cruising, the boilers in the German ships were in no condition to withstand severe pressure. At first the enemy kept together. The "Glasgow" was the fastest of the pursuers and soon forged ahead of her consorts, the "Kent" and "Cornwall," and, having crossed ahead of them, she headed for the "Dresden," the fastest of the pursued. It was, however, soon evident that the only chance of bringing the enemy to action before the light failed. waa to attack the rearmost ship, in the hopes that this would bring the others back to her assistance.

"Glasgow" and **"Cornwall"** versus **"Leipzig."**—At 2.53 P.M. the "Glasgow" opened fire on the "Leipzig" and by 4.15 P.M. the "Cornwall" had closed the range sufficiently to bring her guns into action. The "Leipzig" suffered considerably under the cross-fire from the two British cruisers; her speed too was falling so rapidly that her attackers were in the fortunate position of being able to keep the range as they desired. By 7 P.M. the "Leipzig's" stern was enveloped in flames and she was in sorry plight, but she made no sign of surrender. At about 8.10 P.M. she made signals of distress and the British ships closed and lowered boats to rescue survivors. At 9.23 P.M. there was an explosion and the "Leipzig" disappeared.

"Kent" versus **"Nürnberg."**—The "Kent" meanwhile had been pursuing the "Niirnberg" and, by extraordinary efforts on the part of her engine-room department, succeeded in exceeding her designed speed. At 5 P.M. the "Niirnberg" opened fire, but the 6-in. guns of the "Kent" were not yet within range. The weather was becoming thick, owing to a fine drizzle having set in, when fortune favoured the pursuer; the "Nürnberg's" boiler tubes gave out and her speed sank rapidly, which enabled the "Kent" to close to effective range. By 6.25 P.M. the "Niirnberg" was a blazing wreck and about 7.30 P.M. she turned over and sank. The boats from the "Kent" searched the sea until g P.M. but rescued only seven survivors.

German Colliers Destroyed. — Meanwhile two of the German colliers had been overhauled by the "Bristol" and "Macedonia." They were captured at about 4 P.M. The signalled order to the "Bristol" to "destroy the transports" was literally obeyed in spite of these ships not being transports, but ships full of valuable coal. The "Dresden" escaped and was not hunted down and destroyed until March 14, 1915.

Casualties. — The following table shows the casualties of the British and German forces.

Ship	Hits Received	Casualties	Rounds fired
British:			
"Invincible" . . .	22	0 k., 1 w.	573 12-in.
"Inflexible" . . .	3	1 k., 2 w.	661 12-in.
"Glasgow" . . .	2	1 k., 4 w.	316 6-in.
"Cornwall" . . .	18	0 k., 0 w.	1,000 6-in.
"Kent"	36	4 k., 12 w.	646 6-in.
"Carnarvon" . .	0	0 k., 0 w.	...
German:			
"Scharnhorst" . .	Sunk	All	...
"Gneisenau" . .	Sunk	187 saved	...
"Leipzig"	Sunk	18 "	...
"Nürnberg" . . .	Sunk	7 "	...
"Dresden" . . .	Escaped	...	...

*k=killed, w=wounded. (J. E. T. H.)

FALKNER, WILLIAM: *see* FAULKNER, WILLIAM.

FALL, ALBERT BACON (1861–1944), U.S. politician, was born on Nov. 26, 1861, at Frankfort, Ky. He served in the U.S. senate from 1912 to 1921, when he became secretary of the interior. Following a senate investigation of his action in leasing to private oil interests certain tracts in the Teapot Dome reserve in Wyoming and other reserves in California, Fall was convicted of accepting a $100.000 bribe and served a year and a day in prison. Fall died in El Paso, Tex., Nov. 30, 1944.

FALLA, MANUEL DE (1876–1946), the most distinguished Spanish composer of the early 20th century. was born at Cádiz on Nov. 23, 1876. and took piano lessons from his mother, aho encouraged his early musical ambitions. Later he went to Madrid to continue his piano studies and to study composition with Felipe Pedrell, who inspired him with his own enthusiasm for 16th-century Spanish church music, folk music and native opera. He had already written two *zarzuelas* (the distinctively Spanish type of operetta), though without recognition.

In 1905 Falla won two prizes, one for piano playing, which led to his teaching the piano in Madrid for two years, and the other for a national opera aith *La vida breve,* which despite lyrical passages influenced by the works of Jules Massenet evoked a truly Andalusian background. Disappointingly. it was not performed until 1913. In 1907 Falla moved to Paris, where he associated with Claude Debussy (who had an intuitive sympathy for Andalusian music), Paul Dukas and Maurice Ravel (whose orchestration influenced his own), and there he published his first piano pieces and songs.

At the outbreak of World War I he returned to Madrid, where the success of *La vida breve* led to his being invited to write the music for a ballet, *El amor brujo* (Madrid, 1915), which aroused enthusiasm only after the original chamber scoring had been expanded. The work is remarkable for its distillation of Andalusian folk music, though. as in all his works, save occasionally for the purposes of allusion, there is no actual quotation of folk melodies. Falla, followed this with a mime version of a folk tale, *El corregidor y la molinera* (Madrid, 1917), which had an immediate success and attracted the attention of Diaghilev, who persuaded him to reshape and rescore it for a ballet by Leonide Massine; under the title *El sombrero de tres picos* (*The Three-Cornered Hut;* London, 1919) its vitality and wit scored a triumph. *Nqches en los jardines de España (Nights in the Gardens of Spain),* a suite of three impressions for piano and orchestra (the piano being treated not as a concerto instrument but as *primus inter pares)* (Madrid, 1916), was a poetic evocation in the most subtle instrumental colouring of Andalusian atmosphere, though by suggestion rather than by illustration. All these works established Falla internationally as the leading Spanish composer.

Having always been interested in *cante jondo,* the traditional folk song of southern Spain, the flavour of which he had captured in *La vida breve,* Falla retired to Granada, where in 1922 he organized a *cante jondo* festival and composed a puppet opera, *El retablo de Maese Pedro* (*Master Peter's Puppet Show),* based on an episode in *Don Quixote.* Like the subsequent *Harpsichord Concerto* (1926), containing echoes of a Corpus Christi procession and of Domenico Scarlatti, the *Retablo* shows Falla in a new idiom, much influenced by Igor Stravinsky; his style was now neoclassical instead of romantic. It was nonetheless quintessentially Spanish, but Castilian rather than Andalusian.

After 1926 he wrote little, living in semiretirement first in Mallorca and, from 1939, in Argentina, where he worked fitfully on a cantata, *L'Atlántida,* which was, however, left unfinished at his death and was completed by his pupil Ernesto Halffter. Contemplative and scholarly by nature and a perfectionist in his ideas, Falla sought to lead Spanish' music out of facile and false "Hispanicisms," and in his own work achieved a fusion of poetry, asceticism and ardour that represents the spirit of Spain at its purest. He died at Alta Gracia, Arg., on Nov. 14, 1946.

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FALLACY, the term given generally to any mistaken statement used in argument; in logic, technically, any violation of the conditions of valid inference (Lat. *jallax,* "deceptive"). An argument may be fallacious in matter *(i e.,* misstatement of facts), in wording (*i.e.,* wrong use of words) or in the process of inference. Fallacies have, therefore, been classified as material, verbal and logical (or formal). The two latter kinds are often included under the general description logical and in scholastic phraseology, following Aristotle, are called fallacies *in dictione* or *in voce,* as opposed to material fallacies *in re* or *extra dictionem.*

Material.— The classification widely adopted by modern logicians and based on that of Aristotle's *Organon (Sophistici elenchi*) is as follows. (1) *Fallacy of accident; i.e.,* confusing what is accidental with what is essential. (2) *Secundum quid; i.e.,* arguing erroneously from a general rule to a particular case, without proper regard to special circumstances which vitiate the application of the general rule: *e.g.,* if manhood suffrage be the law, arguing that a criminal or a lunatic must, therefore, have a vote; or the converse fallacy of arguing from a special case to a general rule. (3) *Irrelevant conclusion,* or *ignoratio elenchi,* wherein, instead of proving the fact in dispute, the arguer seeks to gain his point by diverting attention to some extraneous fact (as in the legal story of "No case. Abuse the plaintiff's attorney"). Under this head come the so-called *argumentum (a) ad hominem, (b) ad populum,* (*c*) *ad baculum, (d) ad verecundiam,* common in platform oratory, in which the speaker obscures the real issue by appealing to his audience on the grounds of *(a)* purely personal considerations, *(b)* popular sentiment, *(c)* fear, (d) conventional propriety. This fallacy has been illustrated by ethical or theological arguments wherein the fear of punishment is subtly substituted for abstract right as the sanction of moral obligation. (4) *Petitio principii* (begging the question) or *circulus in probando* (arguing in a circle), which consists in demonstrating a conclusion by means of premisses which presuppose that conclusion. Jeremy Bentham points out that this fallacy may lurk in a single word, especially in an epithet; *e.g.,* if a measure were condemned simply on the ground that it is alleged to be "un-English." (5) *Fallacy of the consequent,* arguing from *a* consequent to its condition; *e g,* if a man is a drunkard he becomes destitute; therefore, if he is destitute, he is a drunkard. (6) *Fallacy of false cause,* or *non sequitur* ("it does not follow"), bases a conclusion on an insufficient or erroneous reason. This is often confused with (7) *Post hoc ergo propter hoc* ("after this, therefore. because of this"), wherein one thing is incorrectly assumed as the *cause* of another, as when the ancients attributed a public calamity to a meteorological phenomenon. (8) *Fallacy of many questions* (*plurium interrogationum*), wherein several questions are improperly grouped in the form of one, and a direct categorical answer is demanded; *e.g.,* if a prosecuting counsel asked the prisoner, "What time was it uhen you met this man?" with the intention of eliciting the tacit admission that such a meeting had taken place.

Verbal.— These fallacies are those in which a false conclusion is obtained by improper or ambiguous use of words. They are generally classified as follows. (1) *Equivocation* consists in employing the same word in two or more senses; *e.g.,* in a syllogism, the middle term being used in one sense in the major and another in the minor premiss, so that in fact there are four not three terms ("All fair things are honourable; This woman is fair; therefore this woman is honourable," the second "fair" being in reference to complexion). (2) *Amphibology* is the result of ambiguity of grammatical structure; *e.g.*, of the position of the adverb "only" in careless writings ("He only said that," in which sentence, as experience shows, the adverb has been intended to qualify any one of the other three words). (3) *Composition,* a species of (1) which results from the confused use of collective terms ("The angles of a triangle are less than two right angles" might refer to the angles separately or added together). (4) *Division,* the converse of the preceding, which consists in employing the middle term distributively in the minor and collectively in the major premiss. (5) *Accent,* which occurs only in speaking and consists of emphasizing the wrong word in a sentence ("He is a fairly good pianist," according to the emphasis on the words, may imply praise of a beginner's progress, or an expert's depreciation of a popular hero, or it may imply that the person in question is a deplorable violinist). (6) *Figure of speech,* misinterpretation of a form of expression or an inflection; *e.g.,* taking "desirable" to mean what can be desired (instead of what ought to be desired) because "visible" means what can be seen.

Logical.—The purely logical or formal fallacies consist in the violation of the formal rules of the syllogism (*q.v.*). They are: (1) fallacy of four terms (*quaternio terminorum*); (2) of undistributed middle; (3) of illicit process of the major or the minor term; (4) of negative premises.

Of other classifications of fallacies in general the most famous are those of Francis Bacon and J. S. Mill. Bacon (*Novum organum,* Aph. i, 33, 38 *et seq.*) divided fallacies into four *idola* (idols; *i.e.,* false appearances), which summarize the various kinds of mistakes to which the human intellect is prone (*see* BACON, FRANCIS). With these should be compared the *offendicula* of Roger Bacon, explained in the *Opus maius,* pt. i. Mill discussed the subject in book v of his *Logic,* and Jeremy Bentham's *Book of Fallacies* (1824) contains valuable remarks.

See A. Sidgwick, *Fallacies* (London, 1883); H. W. B. Joseph, *An Introduction to Logic,* 2nd ed. (Oxford, 1916).

FALLIÈRES, CLÉMENT ARMAND (1841–1931), president of the French republic, was born on Nov. 6. 1841 at Mezin, Lot-et-Garonne, where his father was clerk of the peace. He studied law and became an advocate at Nérac, beginning his public career there as municipal councillor (1868), afterward mayor (1871), and as councillor general of the department of Lot-et-Garonne (1871). He lost his position in May 1873 upon the fall of Thiers, but in Feb. 1876 was elected deputy for Nérac. In the chamber he sat with the Republican left, signed the protestation of May 18, 1877, and was re-elected in October by his constituency. He held at first a minor part (1880–81) in the Jules Ferry ministry, was then minister of the interior (1882–83) and for a month (Feb. 1883) premier. His ministry had to face the question of the expulsion of the pretenders to the throne of France, because of the proclamation by Prince Jérome Napoleon (Jan. 1883), and Fallieres, who was ill at the time, resigned when the senate rejected his project. He became minister of public instruction (Nov. 1883–March 1885), then minister of the interior in the M. Rouvier cabinet in May 1887, and exchanged his portfolio in December for that of justice. He returned to the ministry of the interior in Feb. 1889, and was minister of justice from 1890 to 1892. In June 1890 his department (Lot-et-Garonne) elected him to the senate by 417 votes to 23. In March 1899 he was elected president of the senate, and retained that position until Jan. 1906, when he was chosen by a union of the groups of the left in both chambers as candidate for the presidency of the republic. He was elected on the first ballot by 449 votes against 371 for his opponent, Paul Doumer. He held office until Jan. 7, 1913, when he was succeeded by R. Poincaré. He died June 22, 1931. For the events of his presidency *see* FRANCE: *History.*

FALLING STARS: *see* **METEOR.**

FALL LINE, in U.S. geology, a line marking the junction between the hard rocks of the Appalachians and the softer deposits of the coastal plain. The Pre-Cambrian and metamorphic rocks of the mountain mass form a continuous ledge parallel to the east coast, where they form a series of "falls" and rapids in the river courses all along this line. The relief of the land below the falls is very slight, and this low, level country, the tidewater region of Virginia, for example, rarely rises to a height of 200 ft., so that the rivers are navigable up to the falls, while the falls themselves are a valuable source of power. A line of cities may be traced upon the map whose position will thus be readily understood in relation to the economic importance of the fall line. They are Trenton on the Delaware, Philadelphia on the Schuylkill, Georgetown on the Potomac, Richmond on the James and Augusta on the Savannah. It will be understood that the softer and more recent rocks of the coastal plane have been more easily washed away, while the harder rocks of the mountains, because of differential denudation, are left standing high above them, and that the trend of the edge of this great lenticular mass of ancient rock is roughly parallel to that of the Appalachian system.

FALLMERAYER, JAKOB PHILIPP (1790–1861), German traveler and Byzantinist, who propounded the theory that the inhabitants of Greece are descended not from the ancient Greeks but from the Slavs and Albanians who later overran the country (*see* GREECE: *Postclassical and Medieval History*), was born of a peasant family at Tschötsch (now Scesse), near Bressanone, in the Tirol. He studied theology and classics at Salzburg. law at Landshut and modern Greek. Turkish and Persian while on garrison duty during the latter part of his five years' military service (1813–18). During 1818–1830 he taught at Augsburg and at Landshut. and in 1827 he made his name with his first book, *Geschichte des Kaiserthums von Trapezunt.* After producing the first volume of *Geschichte drr Halbinsel Morea* (1830; 2nd vol.. 1836) in which he enunciated his ethnological theories, he set out on a series of lengthy journeys which took him all over Greece and the Levant, as well as round Europe. He acted as foreign correspondent for an Augsburg newspaper, and published a number of political. historical and critical pieces. In 1848 he became professor of history at Munich. but had to resign in the following year when as a member of the national congress he accompanied the rump parliament to Stuttgart. The amnesty of 18jo permitted him to return to Munich, where he died on April 26. 1861.

Fallmerayer was one of the first to discuss the ethnological problems of the Byzantine empire, which are difficult to solve as the racial terminology of most Byzantine writers is far from precise. His extreme position on the Greek question, which caused much controversy among scholars, is now generally discarded, but the subject is still a living issue.

BIBLIOGRAPHY.—*Gesammelte Werke von J. P. Fallmerayer,* ed. by G. M. Thomas, 3 vol. (1861), contains political, critical and travel works only. Some of his historical works are collected under the title *Byzanz und das Abendland* (1943). *See* also the full list of his writings in H. Seidler, J. P. *Fallmerayers geistige Entwicklung* (1947). For criticism of his ethnological views *see* H. O. Eberl, J. *P. Fallmerayers Schriften in ihrer Bedeutung für die historische Erkenntnis des gräkoslavischen Kulturkreise* (1930).

FALLOPIUS, GABRIEL (GABRIELLO FALLOPIO or FALLOPIA) (1523–1562), Italian anatomist, was born at Modena, where he became a canon of the cathedral. He studied medicine at Ferrara and became teacher of anatomy in that city and later at Pisa and Padua, where he worked with Andreas Vesalius (*q.v.*). He died on Oct. 9, 1562.

Fallopius discovered or described the chorda tympani. the sphenoid sinus, the opening of the uterine tubes of the human female into the abdominal cavity, the trigeminal, auditory and glossopharyngeal nerves. He named the ovarian tubes. the vagina. the placenta, the muscles of the forehead, occiput and tongue. He boldly attacked the teaching of Galen. Only one treatise by Fallopius appeared during his lifetime, the *Observationes anatomicae* (Venice, 1561).

FALL-OUT. The phenomenon of deposition of radioactive materials on the earth from the atmosphere is known as radioactive fall-out or more commonly fall-out. Strictly speaking, fall-out refers only to deposition during nonprecipitant weather. with such terms as rain-out and snow-out used to describe the deposition during precipitant weather. However, in the broader sense and when discussing long-time effects, fall-out can include deposition during all types of weather.

This radioactivity in the atmosphere may arise from (1) natural causes; (2) atomic bomb or thermonuclear bomb explosions; and (3) induced radioactivities and fission products from atomic reactor operations.

Most of the natural radioactivity in the atmosphere is a result of cosmic rays and the gaseous diffusion of radon and thoron from natural uranium and thorium found in the earth's crust. The local concentrations of these gases in the atmosphere depend to a great extent on the concentrations of uranium and thorium in the earth, as well as on meteorological conditions. Cosmic rays produce, among other isotopes, radioactive forms of carbon and hydrogen. Radioactive carbon has a sufficiently long half-life to be useful in the dating of archeological objects. This interesting technique arises from the fact that the isotope is absorbed into a plant only during its growth and remains there after the death of the plant, slowly dissipating in the course of time. Knowledge of the initial amount. present amount and the half-life of the isotope leads to the age of the object. Radioactive hydrogen is similarly used, but for the dating of much more recent objects.

Concerning the explosion of nuclear bombs which release radioactivity, there are three separate types of fall-out: local. tropospheric and stratospheric. The local fall-out is due to the deposition of the larger radioactive particles near the site of the explosion. This is quite intense but relatively short-lived. Tropospheric fall-out occurs when the finer particles become trapped in the troposphere and are deposited at a later time and over a larger area—both factors being determined by the local meteorological conditions. In general tropospheric fall-out occurs in the month following the explosion. and takes place in the general latitude of the explosion site. Stratospheric fall-out. due to extremely fine particles in the stratosphere. may continue years after the explosion and the distribution is nearly world-wide. Generally only very large bombs (*i.e.*, thermonuclear) produce stratospheric fall-out. While many different radioisotopes are formed during a nuclear explosion, only the long-lived isotopes are concerned in stratospheric fall-out. Particularly involved are cesium-137 and strontium-go which have 27 and 28 year half-lives. The latter presents the greater hazard to humans since it is chemically similar to calcium and. in calcium deficient areas, it may replace the calcium in certain foods and ultimately become deposited in the body. The radioactive material in the stratosphere ultimately mixes with the troposphere where it then deposits out on to the earth through electrical attraction, gravity or by attachment to larger particles such as water droplets. Since the latter is the largest effect it is obvious that the rate of fall-out will be larger during precipitant conditions where the droplets are not only coming down, but scrubbing the atmosphere at the same time.

The final sources of the radioactivity which might be dispersed in the atmosphere are emanations from reactor operations. The normal radioactive products associated nith reactors can be quite successfully controlled and contained; however, should a reactor accidentally explode, the net result would be little different from that of a small nuclear bomb explosion and would produce large local fall-out but mould not penetrate the stratosphere.

Concerning the levels of radioactivity. it has been estimated that by the end of the 1950s, the world-wide stratospheric and tropospheric fall-out from nuclear bomb tests, reactors and other man-made radioactivity was very small—about $\frac{1}{100}$ of the radioactivity resulting from natural causes.

See also ATOMIC ENERGY; ISOTOPE; LIGHT AND RADIATION IN RELATION TO HEALTH. (E. C. G.)

FALLOUX, FRÉDÉRIC ALFRED PIERRE, COMTE DE (1811–1886), French politician and author, was born at Angers on May 11. 1811. His father had been ennobled by Charles X, and Falloux began his career as a legitimist and clerical journalist under the influence of Rfme. Swetchine. In 1846 he entered the legislature as deputy for Maine-et-Loire, and with many other ultra-Catholics he gave real or pretended support t~ the revolution of 1848. Louis Napoleon made him minister of education in 1849, but disagreements with the president led to his resignation within a year. He had nevertheless secured the passage of the Loi *Falloux* (March 1j, 1850) for the organization of primary and secondary education. This law provided that the clergy and members of ecclesiastical orders, male and female, might exercise the profession of teaching without producing any further qualification. This exemption was extended even to priests who taught in secondary schools. where a university degree was exacted from lay teachers. The primary schools were put under the management of the curés. Falloux was elected to the French academy in 1856. His failure to secure re-election to the legislature in 1866, 1869. 1870 and 1871 was a result of the opposition of the stricter legitimists, who viewed with suspicion his attempts to reconcile the Orléans princes with Henri, comte de Chambord. In spite of his failure to enter the national assembly his influence was very great. and was increased by the intimacy of his personal relations with Thiers. But in 1872 he offended both sections of the monarchical party at a conference arranged in the hope of effecting a fusion between the partisans of the comte de Chambord and of the Orléans princes, divided on the vexed question of the flag. He suggested that the comte de Chambord might recede from his position with dignity at the desire of the national assembly, and he insinuated the possibility of a transitional stage with the duc d'Aumale as president of the republic. His disgrace with the Catholic party was so complete that he was excommunicated by the bishop of Angers in 1876.

Falloux died on Jan. 16, 1886.

Of his numerous works the best known are his *Histoire de Louis XVI* (1840); *Histoire de Saint Pie* (1845); *De la contre-révolution* (1876); and the posthumous *Mémoires d'un royaliste,* 2 vol. (1888).

FALLOW. Fallow is land normally under cultivation that is allowed to be idle for a season (sometimes longer) with or without cultivation. In dry-land areas the term applies specifically to land that is clean cultivated for a season to store water or release plant food for a crop the next year. Fallowing is a standard practice in many dry-land areas where the annual rainfall is not sufficient to produce paying crops regularly unless supplemented by stored moisture. Where the surface litter is plowed under it is called "black fallow" or "bare fallow" and where crop residues are left on the surface it may be called "trashy fallow."

In humid or subhumid areas fallow may be land lying idle without cultivation, but more often it is land plowed during the summer to destroy needs or to improve the next year's crop prospects. Although true fallow is land without a crop, there are modified forms such as "green manure fallow" where a growing crop, usually a legume, is turned under; "bastard fallow" where a fall-planted crop is pastured off or harvested in an immature state in the spring and the land then cultivated; and "green fallow," a term used in some countries to indicate an intertilled crop such as turnips or potatoes. Fallow is not properly used to describe land cultivated for only part of a season after a mature crop has been harvested.

FALLOW DEER (*Dama dama*), a medium-sized representative of the family Cervidae, characterized by its palmated antlers, rather long tail (black above and white below) and a coat spotted with white in summer but uniformly coloured in winter. The shoulder height is about three feet. The species is semidomesticated in British parks and occurs wild in western Asia, north Africa, south Europe and Sardinia. In prehistoric times it occurred throughout northern and central Europe. Bucks and does live apart except during the pairing season, and the doe produces one or two and sometimes three fawns at a birth. The Persian fallow deer (*D. mesopotamica*) is larger and has a brighter

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EUROPEAN FALLOW DEER (DAMA DAMA)

coat differing in some details of colouring. An allied genus, the gigantic fossil deer commonly known as the Irish elk (*Megaceros giganteus*), had horns of the fallow-deer type This deer inhabited Ireland Great Britain, central and northern Europe and western Asia in Pleistocene and prehistoric times, and stood 6 ft. high at the shoulder The antlers were greatly palmated and of enormous size, fine specimens measuring 11 ft. betueen the tips. See also DEER.

FALL RIVER, a city of Bristol county in southeastern Massachusetts, U.S , on the east shore of Mount Hope bay at the mouth of the Taunton river, about 50 mi S. of Boston. Atop a sharply rising granite ledge, the city faces west overlooking its large harbour. Pop (1960) city, 99,942; standard metropolitan statistical area (Fall River city and Somerset, Swansea and Westport tonns in Bristol county, Tiverton town in Neuport county. Rhode Island), 138,156. (For comparative population figures see table in MASSACHUSETTS : *Population*)

French and English legends on monuments and French language newspapers testify to the considerable number of residents who are of French-Canadian origin.

'(Freeman's Purchase," or Freetown, including the present city of Fall river, was bought from the Indians by a group of settlers who came from Plymouth in 1656 In 1803 "Fallriver" was incorporated as a separate toun. The name was changed to Troy a year later, but in 1834 it was changed back to Fall River, after the Quequechan (or Fall) river which flows through the city from the Watuppa lakes about 200 ft. above the city, and 2 mi. E. It was incorporated as a city in 1854.

Until the American Revolution, agricultural interests predominated, but the city developed some industry thereafter and by 1871 had established itself as the cotton textile centre of the nation. Despite a disastrous fire in 1843 Fall River's natural advantages — water power, a mild moist climate and a good sea harbour — provided a basis for continuing booms in the cotton industry, and attracted new residents throughout the 19th century. The population grew from 14,026 in 1860 to 104,863 in 1900.

Although the Fall River cotton millworkers lost two of three important strikes in 1870 and 1875, textile craft unions nevertheless obtained recognition. Cotton workers predominated in the United Textile Workers of America, formed in 1901, and Fall River was its backbone. One of the first big walkouts after the union's organization occurred in Fall River in 1904, when about 27.000 workers stayed out for six months in protest against a general wage cut. The outcome was important because Fall River wage rates generally governed the rest of the industry. The strike ended by state intervention, and the workers accepted a unique sliding scale arrangement which actually meant a reduction. The industry, and the city as a whole, were seriously affected by the depression of 1920–21, competition of southern cotton mills and the hnancial crash of 1929. The apparel and textile industries, however, continued in the second half of the 20th century to be the largest source of employment; the manufacture of rubber products is the next industry of importance.

Fall River was the scene of the celebrated unsolved mystery in which Lizzie Andrew Borden (1860–1927) was acquitted of the ax-murder of her wealthy father and step-mother Aug. 4, 1892.

(L. G. BA)

FALMOUTH, a seaport, holiday resort and municipal borough in the Falmouth and Camborne parliamentary division of Cornwall, Eng., 36 mi. E.N.E. of Land's End and 11 mi. S. of Truro by road. Pop. (1951) 16,975. Area 2.9 sq.mi. Falmouth stands on the uest shore of Carrick roads, the largest of the estuaries which open on the south coast of Cornuall. Several rivers empty into the estuary, opening it to inland navigation by river steamer; the largest is the Fal, at the head of the estuary on the east shore; the Penryn river and creek join Falmouth with Penryn on the west, and the picturesque inlet of the Percuil (Porthcuel) river opens out from St. Mawes, near the entrance opposite Falmouth. Carrick roads forms one of the best refuges for shipping on the south coast, being accessible at all times by the largest vessels. The shores are beautifully nooded and slope sharply up to about 250 ft The entrance from Falmouth bay on the channel is about 1 mi. across betneen St. Anthony's point, with its lighthouse, and Zone point, on the east, and Pendennis point, the promontory of Falmouth, on the west. Pendennis and St. Mawes castles are Tudor fortresses; the former is celebrated for its gallant defense in the Civil War, when Cornwall was a centre of the royalist cause, another memorial being the Restoration church of King Charles the Martyr, built about 1662. Standing on a peninsula, Falmouth faces the water on both sides, and the old part of the town, with narrow streets, overlooks the inner harbour, while the newer residential area with the hotels faces the bay. There is an extensive marine drive, a concert hall, three sheltered beaches and approximately 100 ac. of public walks and pleasure grounds. Among the chief buildings are the town hall and municipal buildings. Because of its especially line yachting harbour, the Royal Cornwall Yacht club has its headquarters in Falmouth; the principal prize in the annual regatta, held in August, is a cup usually given by the prince of Wales as duke of Cornwall.

Falmouth (*Falemuth* in 1235) as a haven, port and mail-packet station, has had a place in the maritime history of Cornwall from early times. The site of the town, formerly known as Smithick and Pennycomequick, formed part of the manor of Arwenack held by the Killigrew family, the last of whom died in the 18th century. Arwenack house still stands. In 1652 the Commonwealth parliament granted a market to Smithick. This market was confirmed to Sir Peter Killigrew in 1660, together with two fairs and a ferry, which still runs. between Smithick and Flushing, on the opposite shore of Penryn creek. By the charter of incorporation granted in the following year the name was changed to Falmouth. In 1664 an act creating the borough a separate ecclesiastical parish empowered the mayor and aldermen to assess all buildings within the town for the support of the rector, but this rector's rate later occasioned some ill feeling and by act of parliament (1896) it was taken over by the corporation and finally abolished. By the Redistribution act, 188j, 'the number of members returned to parliament by the united boroughs of Penryn and Falmouth was reduced from two to one. The municipal borough is under a mayor, four aldermen and 12 councillors, and has a separate commission of the peace.

With its sandy beaches and equable climate, Falmouth is a favoured holiday town all the year round. Engineering and ship repairing are undertaken, and there are oyster fisheries in Falmouth harbour and Helford river. The ever-increasing importance of the town as a ship-repairing centre was being met in 1956 by increased wharfage and the extension of dry-dock facilities to accommodate the world's largest oil tankers and other ships. The area of the tidal harbour within the docks is about 42 ac.

Across the bay to the east is the Roseland peninsula with the parishes of St. Anthony in Roseland and St. Just in Roseland. The church of St. Anthony has a Norman doorway, that of St. Just is Perpendicular and stands by a creek of Carrick roads with an exceptionally beautiful wooded churchyard sloping down toward the water. Both villages are well known for their beauty. In 1956 part of the Trelissick estate on the estuary of the Fal was made over to the National Trust. It includes Trelissick house, which existed as a farm in the reign of Elizabeth I.

FALSE IMPRISONMENT is the total restraint upon the liberty of another person for however short a time without legal justification. Imprisonment may be justified either at common law or under statute, but justification for interference with 'the liberty of the subject must be strictly proved. (See also ARREST; HABEAS CORPUS.)

FALSE PRETENCE: see FRAUD.

FALSETTO, a forced form of sound production employed to obtain notes above the natural range of the voice. The notes of this register are of poor and peculiar quality owing to the vocal cords being only partially set in vibration.

FALSTAFF, SIR JOHN: see OLDCASTLE, SIR JOHN; FASTOLF, SIR JOHN.

FALTICENI, a town in the region of Suceava, Rumania, on a tributary of the Sereth, on the fall line between the Transylvanian Alps and the Bessarabian plain. The population in 1956 was 13,085. A branch railway runs for 15 mi. to join the main line between Czernowitz (Cernauti) and Galatz

(Galati). The Suceava department (named after Suceava or Suciava, its former capital) is densely forested; its considerable timber trade centres in Falticeni. It has a summer fair.

FALUN, a town of Sweden, capital of the district (*län*) of Kopparberg, 153 mi. N.W. of Stockholm by rail. Pop. (1950) 14,741. It is situated in difficult country near the northern shore of Lake Runn. Its famous copper mines have been worked since the 13th century. Their produce gradually decreased after the 17th century, and is now unimportant, but various secondary products are still obtained. The mines belong to the Kopparberg Mining company, the oldest industrial corporation in Sweden, established before 1347. It has various industrial interests besides copper mining. Falun has railway rolling-stock factories and there are museums of mineralogy and geology and a school of mining.

FAMA, in classical mythology, the personification of rumour (Gr. Φήμη, Ὄσσα). The Homeric equivalent Ossa (Iliad, ii, 93) is represented as the messenger of Zeus. who spreads reports with the rapidity of a conflagration. Homer does not personify Pheme, which is merely a presage drawn from human utterances, whereas Ossa (until later times) is associated with the idea of divine origin. A more definite character is given to Pheme by Hesiod (*Works* and Days, 764), who calls her a goddess; in Sophocles (Oed. Tyr., 158) she is the daughter of Hope. According to Aeschines the orator (c. Timarch., 128, de falsa leg. 145) and Pausanias (i, 17, I) there was a temple of Pheme at Athens, but apart from this, she is a figure of mythical and poetical imagination rather than cult.

In Rome, Fama is purely a poetical figure (*e.g.,* Virgil, Aen., iv, 173). The Φήμη καὶ κληδὼν of Plutarch (*Camillus,* 30. de fert. Roman., 319 A) is simply Aius *Locutius,* misunderstood, *cp.* Livy, v, 50, 5.

FAMAGUSTA, a town and harbour on the east coast of Cyprus (Gr. Ammochostos). 2½ mi. S. of the ruins of Salamis (*q.v.*). When Salamis (Roman Constantia) was destroyed by the Arabs in A.D. 647, its Christian inhabitants settled at the neighbouring Arsinoe (Ammochostos "choked with sand") which had been built by Ptolemy Philadelphus in 274 B.C., and now became the seat of the orthodox archbishopric.

Famagusta received many refugees at the fall of Acre in 1291; was annexed by the Genoese in 1376; reunited to the throne of Cyprus in 1464; and surrendered to the Turks in 1571 after a year's siege. The fortifications, remodelled by the Venetians after 1489, the castle, the grand Gothic cathedral of St. Nicolas (now the mosque St. Sophia), the Palazzo del Proveditore and the remains of many churches testify to the mediaeval splendour of Famagusta. Acts ii and v of Shakespeare's Othello pass there, and the "Moor's tower" is still shown. Much was done to develop the natural harbour, which is connected by railway with Nicosia (*q.v.*).

Population (1946 census) 16,194. Most of the Christians have migrated to the near-by suburb of Varosha.

FAMILIARITY, in psychology, is defined as a feeling upon which recognition follows so immediately that its complex nature is hidden. This recognition is based upon subliminal association and there is consequently no need for the presence of mental images.

Familiarity is therefore a developed "new" process of the mind, resulting from a fusion or combination of mental processes no longer individually felt. See ASSOCIATION. MENTAL.

FAMILISTS, a term of English origin (later adopted in other languages) to denote the members of the "Family of Love." founded by Hendrik Niclaes who died probably in 1580. His calling was that of a merchant, in which he and his son Franz prospered, ultimately becoming wealthy. Not till 1540 did he appear in the character of one divinely endowed with "the spirit of the true love of Jesus Christ." For 20 years (1540–60) Emden was the headquarters at once of his merchandise and of his propaganda, but he travelled in both interests to various countries, visiting England in 1552 or 1553. Niclaes claimed to hold an impartial attitude towards all existing religious parties, and his mysticism. derived from David Joris, was undogmatic. Yet he admitted his followers by the rite of adult baptism, and set up a hierarchy among them on the Roman model (see his *Evangelium* Regni, in English A *Joyfull Message* of the **Kingdom,** 1574?; reprinted, 1652).

His pantheism had an antinomian drift; for himself and his officials he claimed impeccability; but whatever truth there may be in the charge that among his followers were those who interpreted "love" as licence, no such charge can be sustained against the morals of Niclaes and the other leaders of the sect. The society spread in the eastern counties, in spite of repressive measures; it revived under the Commonwealth, and lingered into the early years of the 18th century.

The leading idea of the society's "service of love" was a reliance on sympathy and tenderness for the moral and spiritual edification of its members. Thus, in an age of strife and polemics, it seemed to afford a refuge for quiet, gentle spirits and meditative temperaments.

See W. T. Whitley, article "Enthusiasts, Religious" in Hastings, *Encyclopaedia of Religion* and *Ethics;* F. Loofs, article "Familisten" in Herzog-Hauck, *Realencyklopaedie;* F. Nippold, "H. Niclaes und das Haus der Liebe" in *Zeitschrift* fur *die hist. Theol. (1862).*

FAMILY. Viewed abstractly, the most familiar of social institutions seems the most stable, enduring and universal. It appears to have arisen earlier in human prehistory and occurred more ubiquitously than church or state or any of the other persistent forms of relationship by which men organize their activities. Viewed individually and concretely, however, each family is endangered by multiple threats of dissolution at every phase along its typical cycle of existence. The dependence of human beings almost exclusively upon their families for the satisfaction of certain of their most important wants makes the continued working of this institution a perennial concern.

For the sake of analysis, many anthropologists assert that the family functions to satisfy certain universal needs nhich persist among all men in all times The forms of relationship assumed by actual families, however. are not given in nature; they arise as artifacts of human ingenuity. Thus, patterns of family life are extremely variable.

In any particular time and place, the favoured form of the institution is believed by such theorists to be that which has proven most workable in meeting the universal needs under the existing specific conditions. And in the career of any single family, its unique variation upon the traditional design of its society is the adaptation it has made to the conditions and crises confronting it. Moreover, if the imputed underlying needs are granted to change, then still further diversity and uncertainty of outcomes must be expected. The kinds of classifications and generalizations and predictions which can be made about the family, therefore, must always remain somewhat loose and controversial.

Many late 19th-century scholars sought to establish an evolutionary sequence in the development of the forms of the family. The most advanced outcome of human progress was taken to be the form reached in western Europe during that period — a form much altered in the half-century since. Notable controversies arose over the inferred origin of the family — from a promiscuous horde, a polygamous patriarchy, a matriarchy or a nuclear family of father, mother and children, with variations added.

Although continuing among a few specialists, these controversies began to die down unresolved uith World War I, along with theological interest in primitive origins and popular faith in the idea of progress. Investigations among living primitive peoples, moreover, had brought to light the immense range of variation existing in familial forms. The distribution of these customs around the globe could be accounted for better by specific histories of cultural invention and diffusion than by some supposedly biological process.

Celibacy, contraception, infidelity. illegitimacy, incest, infanticide and neglect and desertion are found among all peoples, as are also kinship systems, marriage, adoption, incest tabus and rules of morality. Only a wide range of capacities can be regarded as innate and universal, capacities which make any concrete form of family behaviour possible for each individual.

Despite the occurrence of what looks like the nuclear human family among primates and some lower species, it is now recognized that there is no instinctual basis universally compelling human beings to form families or to rear their young. The long period of dependency of the human infant is now regarded as a necessary condition of its uniquely extreme malleability. The characteristic patterns of behaviour it acquires are learned rather than instinctual; their identity depends upon the local version of human culture to which it is exposed. That each society appears to have instituted some kind of family to care for and instruct its young has never insured that this will be done without exception. Each society has devised distinctive myths to explain the origins and uphold the duties of families, but this does not permit the reading of some innate purpose into sexual complementariness and infant helplessness.

Classifications of Forms of Family Organization. — Certain analytical terms derived from ethnological studies are useful in classifying existent forms of family organization and in sketching a broad historical movement away from joint families and extended kin groups (combining several generations and degrees of relationship) toward the nuclear form as the most characteristic of mobile, industrial communities and societies.

Consanguineal families have been more prominent in the past and in peasant countries. Here the family is defined primarily in terms of blood relationship and descent, with family functions concentrated in the unit so constituted. Ralph Linton speaks of the consanguineal family as consisting of parents, children and grandchildren, surrounded by a fringe of spouses. He contrasts it with the conjugal family, consisting of husband, wife and their offspring, surrounded by a fringe of loosely attached and intermittently operative relatives. The nuclear family structure which can be detected underlying all other forms is identical with the conjugal family as to form, but this analytical observation is not to be confused with the matter of social recognition and emphasis; until recently consanguineal obligations have generally received prominence and precedence over conjugal. Another way of clarifying the distinction is from the standpoint of an individual adult: he normally belongs to two families, his family of orientation (parents, siblings, relatives) and his family of procreation (spouse and children). Universal tabus upon incest have persisted to prevent any accepted merger of consanguineal and conjugal types of families in any known society. The ruling Pharaohs of ancient Egypt were expected to marry their sisters to conserve the royal lineage, but the practice was forbidden to commoners, so this does not constitute a valid exception.

The conjugal family is knit primarily by the marriage bond rather than by descent, but conjugal family practices tend to show some impress of the pattern of descent. If descent — of name and relationship, but usually including appended attributes, such as ownership and residence — is traced through the father, the family is called patrilineal; if through the mother, which is less common, matrilineal; if through both, which is common in western countries but less common elsewhere, bilineal. Least meaningful for English-speaking societies is the corresponding distinction into patrilocal and matrilocal, according to whether the custom is for the wife to live with her husband's family or, less commonly, the husband to live with his wife's. This distinction is very meaningful for those societies where a family's occupation is agriculture and its settled residence is the land it farms, although migratory grazing and hunting tribes often exhibit the pattern when they travel in groups. It is significant that among peoples like the Eskimo, who migrate continually in minimal family units, the conjugal form almost necessarily predominates because of the dispersion of the food supply. Economic advantage, whether conceived in terms of industrial plenty or agrarian scarcity, appears to be a major influence affecting the forms of descent in families and a powerful sanction in enforcing authority.

Distinctions like patriarchal and matriarchal continue to have meaning in all societies, with fathers far more commonly ruling their families. In English-speaking countries. however, paternal authority tends to decline wherever the father's occupation removes him from his home and wife and children much of the time, or where their employment away from their home reduces their dependency upon him. Frequent and substantial changes of job and residence likewise reduce the control which can be exerted by relatives, while industrial changes which reward skill and learning rather than property ownership reduce the economic advantages of loyalty to the consanguineal family. Thus, with the spread of industrialization and urbanization, the further attrition of consanguineal family types can be predicted. From the scientific standpoint, this trend can be adjudged neither progress nor retrogression, but numerous partisans uphold each view.

Between World War I and World War II, previous emphases by scholars upon biological and historical origins were replaced by attention to the dependence of the forms of institutions upon the functions they are intended to perform. This latter outlook led increasingly toward psychological and sociological interpretations of change in family forms. The transfer of production from homes to industrial and commercial institutions was pointed out as reducing the economic functions of the family to serving only as a consuming unit. The reduced differentiation of men's work from women's work in the home tended to transform marriage from interdependence into companionship, especially among urban couples above the lowest income levels. Children ceased to be valued as economic assets in a family enterprise and became in a sense wanted "items of consumption," with each family deciding how many it could afford. Maintenance of health, protection from enemies, education of the young, religious and recreational functions likewise were transferred in large part to specialized institutions.

Family **Stability.**—Despite certain retransfers and the emergence of various new functions, as in hygiene and recreation, the net effect of these changes has been generally appraised as reducing the importance of families to their members, thereby posing an additional threat to family stability. On the other hand, certain traditional functions have remained the recognized responsibility and offering of families; indeed, comparison might indicate that families show more attention than in the past to the giving and receiving of affection, the care and enjoyment of children. Such transformations as these can no longer be usefully conceived as the natural unfolding of an independent entity; instead, the family is now seen as both a reaction to and an influence upon other institutions of the whole society.

Thus the family is studied and served professionally from the standpoint of each of its functions — as a biological unit (demography, medicine), as a producing and consuming unit (home economics), as a unit of social organization (sociology, law), as a personality-forming agency (psychology, social work), as a culture-transmitting agency (education) and as a centre for the formation of values and identities (recreation, religion).

The popular and conservative outlook tends to construe certain forms of family life in each culture and subculture as sacred, given, ideal and not subject to purposeful modification .or legitimate deviation therefrom. While all societies exhibit actual deviations in behaviour from the ideal forms upheld in their recognized moralities, all known societies employ a variety of means to stabilize and enforce conformity to the forms they honour. Indeed, a large share of what is known as morality in every society is devoted to specifying the proper behaviour of family members toward each other.

The sociologist Charles Horton Cooley stated the influential proposition that moralization of communities at large, and ultimately of world society, consists of extending to secondary groups the relations characteristic of primary (face-to-face) groups. In view of the frequency of hatred and violence within families. his notion that family relations may be extended to less personal group relationships was probably more realistic than he supposed. Like Cooley, virtually all religions tend to conceive the proper relationships of mankind in family terms. Because of the interdependence of institutions, the growth of love within families and of brotherhood among nations is now thought more likely to proceed in step than apart.

The devices which have traditionally been employed to strengthen observance of family rules and enforce moral obligations include ritual advertisement of changes in family status; ascription of sacramental significance to wedding and name-giving ceremonies; cultivation of fears of supernatural sanctions; ridicule and ostracism of violators: withdrawal of economic support or co-operation; and, of course, the sanctions of law, courts and the state. Only recently in western European countries have there been tendencies to construe marriage as simply a matter-of-fact civil contract. Despite widespread decline of these religious and moral fortifications of marriage and the family, many spokesmen maintain strong misgivings as to whether families can remain sufficiently united without them to perform the functions for which the family is still deemed indispensable.

Commitment to certain moral norms ultimately furnishes the structure of any society, without which its members cannot organize and successfully conduct their various interdependent activities. Yet moral commitment based solely upon individual self-interest is a contradiction in terms. This modern dilemma is causing both social scientists and philosophers to scrutinize deeply the conditions upon which marriage and parenthood may be freely contracted yet may effectively commit the partners to the discharge of their family obligations.

In the representative conjugal family, it is the quality of the marriage between husband and wife which principally guarantees successful performance by the family of its functions. On this account, although marriage and the family are quite distinguishable, they are almost merged as concepts in popular thought among English-speaking people. Apart from the death or physical or mental breakdown of members, the major threat to any family is dissolution of the marriage which launched it. Correspondingly, the frequency of divorce is widely taken as the most significant index of family instability. Yet many unseparated families are quite unsuccessful in rendering to members the satisfactions they expect. Professional scholars are therefore engaged in research to find more precise and valid indexes of family success than the raw divorce rate: measures of welfare; happiness, solidarity, adjustment, development and competence.

Modern societies tend to require every person to achieve independence from his parents at adulthood. Asserting emancipation from parents often generates a stormy period of reorganization of family relationships during adolescence. which may overlap with the period of courtship. mate selection and marriage. Marriage in a society holding to the conjugal type of family ordinarily marks the transition of a person's primary loyalty from his family of orientation to his family of procreation. To the extent that he does not so transfer his loyalty, he endangers the stability of his marriage. Such readjustments require insight, skills and resources for handling problematic life situations. An important recent development which may contribute to increased family success is the belief that these insights, skills and resources may be improved through training and professional assistance. It may be debated whether in eras of large, consanguineal-type families and closely knit neighbourhoods such preparation for marriage and parenthood nas more available or less needed; in either event. consciousness of the value of adequate preparation has been growing. It is giving rise to a diffuse movement for family-life education in schools and colleges. Family failures in recent decades account for a vast array of remedial agencies, both public and private, in all the English-speaking countries. Some of the remedial agencies are likeaise turning their interest toward measures to prevent breakdowns, through programs of education, recreation and community planning.

Where the consanguineal family system predominates, mate selection is usually not left to the two individuals who marry, but is arranged by parents, brokers or community functionaries. It is paradoxical that as successful marriage becomes more basic to stability of the family, it is less and less entrusted to experienced persons to arrange. Contemporary insistence by young people upon making free choice of mates introduces new hazards of unwise selection, especially as the average age at marriage has tended to drop. The uncertainties of making a wise choice have given rise to an impressive growth of both magical and scientific devices for predicting success in marriage before it is contracted. The scientific procedures are still in their infancy, though the magical procedures are very old (see MARRIAGE).

The scientific method may have raised unjustified hopes that it could allay some of the perennial risks inherent in launching and conducting a family. There is, however, logically no direct appeal which can be made to science. as to religion, to strengthen the bond of marriage. On the other hand, it may be justifiable at least to hope that research and experiment mill progressively become able to state the conditions under which an optimum outcome is attainable. A description of these conditions may resemble no existing form of family life. Since the scientific approach is to evaluate such forms comparatively and experimentally, they would probably be conceived as tested organizational procedures rather than as sacred dogmas. Equipped nith such a basis for predicting and controlling outcomes, however. human beings might as readily employ it in venturing upon new explorations as in eliminating the hazards to family solidarity. Were all the striving to stabilize this errant institution ever to succeed. human life would lose its familiar likeness to a game of chance and skill. Only a glance at a daily newspaper is required to confirm the observation that not all persons place the same value upon successful marriage and stable families.

Values. — At the risk of oversimplification, changes in the family may be further analyzed in terms of a contrast between two general sets of values, familism and the pursuit of individual happiness. Some influential scholars, pointing to the trend from the large, patriarchal, consanguineal type of family to the small, equalitarian, conjugal type, ascribe this development to wider acceptance of the values of freedom, equality, participation in decision-making and the development of personality. At the same time, spokesmen who deplore this change are inclined to blame it upon the weakening of certain traditional values: obedience to legitimate authority, loyalty to parents and kin, respect for ancestors and the past and the virtues of the large-sized family. Despite their important disagreements, it may be noted that partisans of each type of family assume that the values they hold will influence further developments. Moreover. each party claims that its favoured form of organization is more conducive to the optimal development of children—whose rearing both groups agree upon as the principal end served by families. It is quite conceivable that the family as an institution could be dispensed with altogether and society would survive, since theoretically all family functions could be transferred to other institutions. But no influential theorists at present would hold with Plato that, for the best development of the children who are to become the guardians of society, they should be taken at birth from their parents and reared expertly by the state. A few tendencies in this direction in the early Soviet Cnion were soon reversed.

It is upon general commitment to the value of some kind of family, despite differences as to exact kind, that continuation of the institution depends. Thus it becomes useful to specify more closely the values sought in family life, and to regard these as diverse, variable. problematic. It is not valid to dispute one type of family over another simply in terms of their relative efficiency in satisfying imputed fixed needs. The functionalist approach uhich characterized professional thinking during the period between World Wars I and II is making way for a more procedural analysis of family functioning. The latter approach stresses periodic appraisal of the forms and functioning of family life in relation to specified, desired outcomes, these in turn being concrete versions of general values. Thus nepotism and the inheritance of wealth are family practices highly honoured according to certain traditional family values; but where emphasis is upon equality of opportunity for the children of all families, they are viewed as unethical advantages. The sovereignty of parents over children, as against public intervention, is a dispute over values. expressed in the contrasting practices of child labour and compulsory education. The privacy of the home may be regarded as sacred in one country but an invitation to conspiracy against the state in another. Financial responsibility for aged parents has become controversial.

To the extent that the forms and functions of family life come to be devised and deliberately revised according to conscious value judgments, the character of family living is seen as the product of specific social policies. In the modern world this definition has been given to many social institutions, and the family is apparently not to be excepted.

Public Programs. — Even an outcome ostensibly so much a matter of biology, of hope and fate, as the number of children a family will have is now increasingly thought of as subject to influence by the population policy of governments. Thus through several decades countries such as Sweden and France attempted to encourage the birth rate through such devices as child welfare programs and family allowances. Other governments give tax exemptions for dependents as an indirect form of assistance to families who raise children. Conversely, some countries which deemed themselves overpopulated ventured to conduct broad programs for discouraging birth rates.

Policies are in process of formulation in all modern countries affecting other major aspects of family life — health, standard of living, legal obligation and personal development. These programs go considerably beyond mere remedial measures designed to correct cases of deviation from norms; they include definition of new norms as goals of concerted social effort, and thus constitute positive planning as distinguished from either therapy or philanthropy.

Since their outcome prior to trial is uncertain. programs of reconstruction often arouse anxiety. The security of a dynamic society, however, appears to rest more in becoming able to make reliable predictions of outcomes than in attempting to restore a state of affairs in which change would cease. 'The growth of population, invention, mobility, knowledge and diversity of outlook make it improbable that any *status quo* ante could be restored and maintained. Yet, among the many instabilities of contemporary life, people may turn hopefully to their homes for the security they miss outside. Some theorists go on from this observation to declare that only well-prepared families can successfully foster the kind of balanced and competent personality which in turn can weather the strains of urban, industrial existence. If their belief is correct, then public policy may become still further oriented to facilitating the optimal personality development of children and the mental health of families. Such an orientation of policy was the theme of the Midcentury White House Conference on Children and Youth, held in 1950. Similar trends in policy-making have been observed outside the U.S.

Influence of the Family on Individual Personality. — Psydhiatrists, contemplating the incidence of personality instability and breakdown, have turned intent scrutiny upon the family experiences of individuals from infancy onward. Until the post-World War II period, however, this scrutiny proceeded largely upon the assumption of some natural pattern of development. Distortions of this pattern, which could be diagnosed and dealt with remedially, were taken as the origins of maladjustment. Since then the view that personality development within the family is a continuous process of construction or fabrication of some complex identity as an expression of the family's values has gained renewed recognition. This perspective implies a heightened degree of responsibility of the family for the kind of child personality it turns out as its product.

In the English-speaking countries, particularly, this outlook gained wide acceptance and led to formation of child study groups, courses for prospective parents, media for dispensing expert knowledge, child development research and professional counselling. At their outset, these activities involved mothers almost exclusively, but a trend toward participation by fathers gradually developed. Self-conscious improvement of competence as parents by these means is related to a general social movement toward professionalization in industrial countries. In countries of high birth rates and low standards of living, however, the main aim in child rearing remains physical survival.

The popularity of existentialist philosophies in the years after World War II may be traced largely to the sense of personal isolation and loneliness which became common with the decline of family and neighbourhood solidarity. Psychoanalytic thought has likewise concentrated upon the effects of isolation and the processes of identification of children with their parents. Immense quantities of popular literature are devoted to the hazards and tragedies which befall the pursuit of romantic love in mobile, competitive settings. Much professional thought goes into attempts to intensify the sense of intimacy and trust in quasi-family groups. Whether this strenuous intellectual ferment a-ill produce a fresh synthesis or will eventually turn back toward restoration of classical family life will probably depend upon whether it can find new supports for individual identity.

The traditional family conferred upon each member an unquestioned sense of identity and even the illusion of being part of an immortal chain. It did this through associating him in a virtually permanent way with a definite physical place — an abode if not a piece of land, with a trade or enterprise which descended by inheritance and domestic instruction through successive generations and with a closely associated body of kin (as in the "place-work-people" formula of the early French sociologist. Pierre Guillaume Frédéric Le Play). So much was personal identity established by these three modes of placement in the social order that most surnames are derived from these sources. Only individuals of the most talented or heroic distinction ever achieved surnames based upon personal traits.

The small, modern family of industrial countries, however, has neither fixed place of abode, family transmission of occupation nor more than a tenuous connection with kindred. A steadily growing practice among persons in professional ranks may therefore be prophetic. The changing of names by individuals to foster or to distinguish their public careers is a phenomenon which could spread to other strata. Some women in business and the professions keep their maiden names after marriage — though their children continue to take the father's name, at least until they choose their own professional names. If the changing of names at adolescence or at entry into a professional career were to increase, and the chosen identity could be satisfactorily established. then it could be asserted that the identity-conferring function of the family had been transferred to the career as a social institution. This possibility accords with a tendency in sociological circles to redefine marriage as a mutually contingent pair of careers; in this light, the ancient division of labour between man and wife, which has everywhere given function and solidarity to the family, receives a new definition.

On the other hand, the immense increase of leisure in the industrial countries has worked a curious reversal upon the earlier separation of work from residence. Though many mothers hold jobs which absent them more and more from their families, the reduction of hours of work has made it possible for fathers to spend more time with their families than was formerly the case. The possibility of using this leisure in forms of recreation conducive to optimal personal development is being grasped and employed by increasing numbers of families and family agencies.

Utilization of the opportunities presented may suffice not only to correct the previously disproportionate influence of the mother in rearing children, but may accentuate optimal child development as a principal value and goal of family functioning. As parenthood has become more voluntary, children are coming to be wanted more consciously as expressions of the creative and affection-giving potentialities of their parents. This trend may help to account for the decline of such institutions as orphanages. Among industrial countries the demand for children for adoption outruns the supply of children made available by illegitimacy, desertion or death of the parents. Demand has significantly become greatest for infants, rather than for children of working age, as used to be true for children taken from orphanages. Some observers professed to see the emergence of a child-centred family and ultimately of a child-centred society.

Future. — Despite the hazards imposed by mobility and migration, the breakup of traditional supports and controls. the perils in readjusting authority and dependency roles, the greater ease of divorce and remarriage, there are probably as many grounds for hope as for anxiety regarding the future of the family. No doubt the outlines of the conjugal form will persist indefinitely, but the family is likely to be conceived increasingly as constituted by interpersonal values, to which concrete forms function instrumentally. Family policy for the future. both public and private, may thus come to crystallize around a dynamic conception of personality development, dramatized by identities self-chosen at adolescence. As ever, the principal function of the family will remain the rearing of children, but for their own sake. Assuming an increasing sense of competence through scientific research and experiment, the people of industrial countries may view the developing drama of family life with mounting enjoyment rather than anxiety or dread.

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(N. N. F.)

FAMINE. The story of famine goes far back in history. The Bible relates how a young Jewish administrator named Joseph advised the Pharaohs on famine relief measures in ancient Egypt. Thereafter a long list of famines links up with famines of the 20th century.

B.C. 436	Famine at Rome, when thousands of starving people threw themselves into the Tiber.
A.D. 42	Great famine in Egypt.
879	Universal famine.
1005	Famine in England.
1016	Famine throughout Europe.
1064–72	Seven years' famine in Egypt.
1148–59	Eleven years' famine in India.
1162	Universal famine.
1344–45	Great famine in India, when the Mogul emperor was unable to obtain the necessities for his household.
1396–1407	The Durga Devi famine in India, lasting 12 years.
1586	Famine in England giving rise to Poor Law system.
1661	Famine in India. No rain fell for two years.
1769–70	Great famine in Bengal; a third of the population (10,000,000 persons) perished.
1783	The Chalisa famine in India extending from eastern edge of the Benares province to Lahore and Jammu.
1790–92	The Doji Bara, or skull famine, in India, so called because the dead were too numerous to be buried. Relief works first opened during this famine in Madras.
1838	Intense famine in North-Western Provinces (Uttar Pradesh), India; 800,000 perished.
1846–47	Famine in Ireland, resulting from the failure of the potato crop. Parliamentary grants up to £10,000,000.
1861	Famine in northwest India.
1866	Famine in Bengal and Orissa; 1,000,000 perished.
1869	Intense famine in Rajputana; 1,500,000 perished.
1874	Famine in Behar, India. Government relief in excess of the needs of the people.
1876–78	Famine in Bombay, Madras and Mysore; 5,000,000 perished. Relief insufficient.
1877–78	Famine in north China; 9,500,000 said to have perished.
1887–89	Famine in China.
1891–92	Famine in Russia.
1897	Famine in India. Government policy successful. Mansion house fund £550,000.
1899–1901	Famine in India; 1,000,000 perished. The government spent £10,000,000 on relief, and at one time there were 4,500,000 people on the relief works.
1905	Famine in Russia.
1916	Famine in China.
1921	Famine in Russia.
1932–33	Famine in Russia.
1943	Famine in Bengal; about 1,500,000 perished.

In the decade 1940–50, there was famine in the ghettos of Warsaw, in prison camps in central Europe, in the Setherlands. Greece and in besieged Leningrad. A major famine occurred in Bengal. In the far east, many in the Japanese prison camps lived under famine conditions and also some of the peoples of the Netherlands East Indies during the Japanese occupation. Only a blind optimist can think this tale complete. Half the population of the world consists of peasants struggling to produce food against the uncertainties of primitive agriculture. In the industrial cities, the social and economic factors that poise the delicate balance between the outflow of manufactured goods and services to the countryside in return for a supply of food are uncertain and readily upset. Then hunger and perhaps famine must follow.

Causes of Famine.—The primary causes of famine are four:

1. *Widespread* Failure of Crops Because of Lack of *Water.*—Vast numbers of people in tropical and subtropical countries have died in famines arising from drought. Irrigation schemes have enabled man to preserve and, in a relatively small way, to control the rain after it has fallen. Millions of acres of land are now partially independent of direct rainfalls. Yet there were no signs at mid-20th century that science would soon be able to insure a regular rainfall over all the cultivated areas of the world, and so danger of famine from this cause will continue to arise.

2. War and Civil Disturbance.—Europe, North America and most other temperate regions enjoy such a regular rainfall that natural famines caused by catastrophic failures of the crops from lack of water are rare. European famines have been characteristically man-made. War is a potent cause. Armies fighting over a countryside may cause famine by destruction and, more especially, by requisition or looting of crops. In this way, many famines arose, especially in the religious wars of the 16th and 17th centuries. In the 20th century, fighting in Europe has seldom been so widespread or prolonged as to cause major destruction of the crops except in relatively local areas, nor did the armies. in the west at least. generally live off the land.

Famine conditions have arisen in the great industrial cities more frequently than in the countrysides. The disruption of large transport systems and of the economic structure of society necessary for the feeding of urban populations has in many cases led to famine (*e.g.*, in Vienna in 1919). Finally, in some cases famine conditions have been deliberately produced for the purpose of exterminating large masses of people. This happened in the ghettos of Warsaw in 1942 and in the nazi concentration camps.

3. Destruction of Crops by Diseases and Pests.—The great Irish famine of the 19th century was caused by the destruction of the potato crops by the blight, a fungus infection. In these famines 2,000,000 to 3,000,000 persons died, and large numbers emigrated. Wherever one single crop dominates agriculture there is always a risk that the crop may perish from a plant disease. In those large areas of the world subject to plagues of locusts, safety from famine can only be purchased by constant vigilance.

4. Great *Natural Disturbances.*—Earthquakes and floods are a constant threat in many parts of the world. Great destruction of crops, food stores and communications may result.

Famine Relief.—A sound agriculture with the best possible use of available water supplies is the best provision against famines in the tropics. Political and economic stability will usually prevent famine in temperate regions. A reasonable agricultural surplus to carry over from the last harvest is essential. This necessitates adequate storage accommodation.

Successive Indian governments acquired much experience in the handling of famines. Nearly all famines are relatively local and the main problem is the bringing of food from neighbouring areas. Transport is a key to the problem. The building of the Indian railways in the middle of the 19th century thus led indirectly to a great saving of life. A principle of British famine administration in India was that gratuitous relief should not be given. If money could be got into the famine area, then food would follow automatically through the normal trade channels. The organization of large emergency public works was the means adopted to overcome the shortage of money. Elaborate plans were drawn up in all areas where famine was possible and works opened as soon as signs of scarcity arose. There are criticisms in detail of this method (for instance manual labour increases food requirements), but on the whole the measures prevented major disasters.

Almost every year famine conditions arise in India, but only rarely do people die of starvation. In Bengal in 1943 at least

1,500,000 people died when relief measures were not introduced until several weeks after famine had begun. Adequate information about the scarcity in the villages was not available in Calcutta until too late.

The United Nations Relief and Rehabilitation administration (USRRX) took effective relief measures against famine in Europe following World War II. As early as Nov. 1943, representatives of 44 nations met in Washington. D.C., at the invitation of Pres. Franklin D. Roosevelt. The countries that had not been invaded agreed to contribute 2% of their income to the resources of the administration. UNRRA poured vital supplies into Albania, Austria, Byelorussia, China, Czechoslovakia, Ethiopia, Greece. Italy, Poland, the Ukraine and Yugoslavia. Limited aid was also given to six other countries. Goods included locomotives, trucks and freight cars for the transport of food to centres of population, farm animals, tractors and plows and seed grains necessary for the restarting of agriculture, besides fully equipped hospitals and medical supplies. The most vital and immediate part of UNRRA's work was, however, the provision of food of every kind. The result was that at least three famines that might have involved 15,000,000 people in Europe were prevented; misery, hardship and underfeeding among many more millions were alleviated. The general assembly of the UN has given the Food and Agriculture organization the responsibility of keeping watch on threatening famine and reporting without delay.

Effects of Famine. — If a group of persons are forced to live on a limited diet yielding only about 1,600 calories daily (equivalent to about one pound of cereals), at first they will lose weight rapidly. After a few meeks this process will slow down and after two to three months. when about 25% of their initial weight has been lost. they will be in equilibrium again and may continue to exist for many months on such a diet Provided medical and good sanitary services are available. the death rate should be little above normal. If the calorie content of the diet is lowered still further, neight losses will increase rapidly, deaths from starvation will soon occur and become increasingly numerous. For women, children and persons of small build, slightly lower food intakes could be tolerated If hard labour is forced upon the group, then deterioration will be more rapid and equilibrium cannot be reached. Some persons resist famine better than others. But deaths become frequent in any group in which, on an average, the weight has fallen more than 25% of the weight in health. The body is able to make remarkable adjustments to conserve energy. The reduction in weight reduces the active tissues. nhich use energy, and there is also a decreased rate of utilization of energy (metabolism) in the tissues which remain. There is in addition a great economy of movement. A marked lethargy prevents any unnecessary muscular effort. Psychologically the mind is dominated by a desire for food. Other emotions are dulled and there is a mental apathy, but the intellect can function normally if necessary. Moral standards fall and this may be aggravated by social circumstances. Murder and cannibalism have frequently been reported in famines.

Dropsy is often found in famine victims and in severe starvation there is a constant and very distressing diarrhea which is often the immediate cause of death. The pulse rate is slowed, the blood pressure falls and the heart is atrophied. This atrophy may be irreversible and resist all rehabilitation. Vitamin deficiencies are not common in simple starvation. Anemia is usual, but seldom severe. Amenorrhea usually soon sets in, and in both sexes the libido is markedly reduced. (See EDEMA.)

Epidemics of infectious diseases such as cholera, malaria, louse-born typhus, influenza and tuberculosis add greatly to the death toll in famines.

A very important aspect of famine in a peasant community has been the disruption of family and village life. Whole villages may migrate and wander in search of food. Children may be separated forever from their parents, hordes of such children may roam the countryside capable of any crime in their search for food.

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FAN, in its usually restricted sense denotes a light instrument held in the hand and used for raising a current of air to cool the face. Among the ancients the fan was also known as a winnower, as a bellows for fire and as a fly whisk. Modern usage also applies the word to an instrument for winnowing grain (winnowing fan) and to various appliances in systems of ventilation. (See FAN [MECHANICAL].)

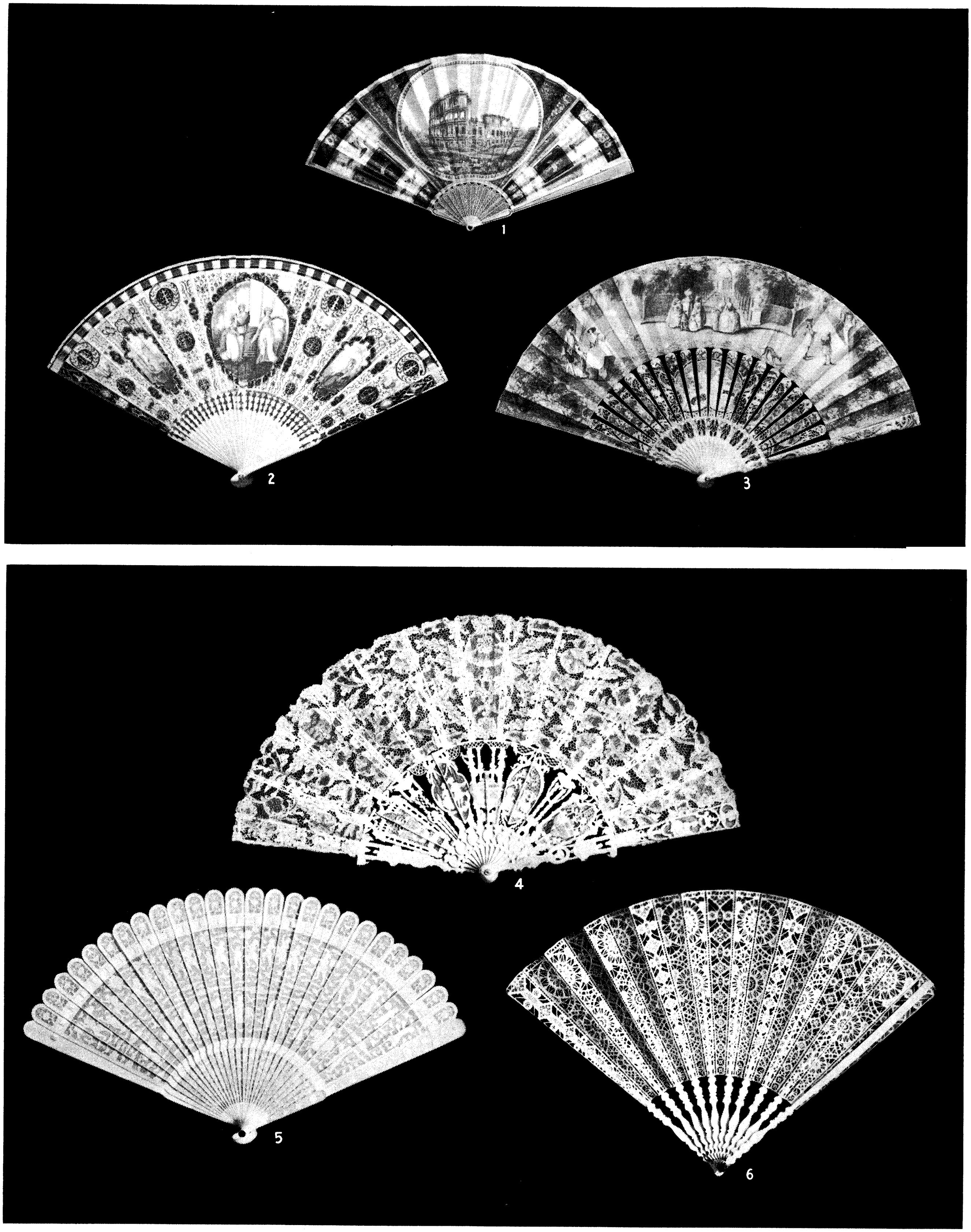
In the more familiar sense the forms of the fan may be divided into two main groups — the screen fan and the folding fan. In general the former consists of a handle to which is attached a rigid mount; except feather fans, which may be included in this class, the usual mount is made of straw, cane, silk, parchment, etc., and is square, circular, pear or leaf-shaped. In some cases the mount is placed at one side, producing a flaglike form, such as the Venetian type of the 16th century, which was also known to the Copts of the early Christian era. The so-called cockade fan, which, as its name implies, has a circular pleated mount that may be folded flat, also belongs to this group. Types of the screen fan are to be found throughout the world in all periods, among both primitive and highly civilized peoples. The folding fan, although the better-known form, has a more circumscribed history. It is said to have been invented in Japan about A.D. 670. It was introduced into China in the 10th century and thence into Europe in the late 15th or early 16th century, probably at the time when the Portuguese under Vasco da Gama established themselves as the supreme trading power in the East. The folding fan is composed of sticks and a mount. The sticks are a number of blades, the one at each end being a guard; they may be ivory, mother-of-pearl or various woods, pierced, carved and often ornamented with inlay and gilding; all are fastened at the handle end by a pin or rivet. The mount (or leaf), is pleated and stretched over the blades at the top, it may be made of paper, parchment, silk, lace and "chicken-skin" (an especially prepared kidskin) or other materials, and is usually decorated with painting. A variant of the folding fan, popular in France in the 18th century, is the cabriolet, which will be described later. The distinguishing feature of the *brisé* fan is that it has no mount but is composed of a number of blades fastened at the handle end by a rivet and radiating toward the top where they are connected by a ribbon; the delicately carved ivory fans of China are exquisite examples of this type.

China. — The fan of the Far East is the most ancient known to us and is a separate chapter in the history of the instrument. Some authorities testify that in China fans have been known since about 3000 B.C. The earliest form was of dyed pheasant or peacock feathers mounted on a handle. Cockade fans and large ceremonial screens are also of ancient origin while the small handscreens of various shapes, made of palm, bamboo and silk stretched on a frame, have been in use from ancient to modern times. Ivory fans seem to have come into being shortly after the folding fan was introduced into China. The Imperial ivory works within the palace at Pekin were founded in the 17th century and became the centre of the best productions. The delicacy of carving in ivory *brisé* fans can hardly be overestimated. Sometimes the decoration is made up of pierced, flat, open work, sometimes of elaborately carved figure or floral subjects with a background formed by ribbing of exquisite quality. Tortoise-shell was used in a similar way, also sandalwood and mother-of-pearl. Filigree fans of silver or silver gilt frequently inlaid with enamel form another variation. A class of Chinese folding fan often seen is the mandarin fan with sticks of carved ivory and the leaf painted with

BY COURTESY OF (6) THE METROPOLITAN MUSEUM OF ART, NEW YORK, FROM (1, 2) THE COLLECTION OF ESTHER OLDHAM, WELLESLEY HILLS, (3, 4) THE COLLECTION OF DE WITT CLINTON COHEN, NEW YORK

FANS OF THE 18TH CENTURL

1. Cabriolet fan, with three strips of painted skin, sticks and guards of painted ivory. This type of folding fan was in vogue about 1755 when the cabriolet, a light two-wheeled carriage, which is often represented in the scenes or engraved on the fan leaves, became popular in France
2. Mask fan, popular in Spain during the second quarter of the 18th century. The leaf is of paper
3. Fan of painted skin with ivory sticks and guards, used in France during the third quarter of the 18th century
4. Vernis-Martin fan. This variety is one of the rarest and most sought after by collectors. Ine name is derived from tne transrucent varnisn accidentally discovered by the brothers Martin, French coach painters, while they were attempting to imitate Japanese lacquer. The painting on the fan reproduced is attributed to Boucher
5. Elaborate French fan of the 18th century. On the parchment leaf are painted the figures of Louis XVI., Marie Antoinette, the princess royal and the dauphin. This fan, a product of the period when the most extravagant and luxurlous ornament was in vogue, has sticks and guerds made of carved and gilded mother-of-pearl



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FANS OF THE SIXTEENTH, EIGHTEENTH AND NINETEENTH CENTURIES

1. Itaiian fan, early 19th century. Leaf of skin painted in ***gouache*** with view of the Colosseum; sticks and guards of pierced mother-of-pearl. 2. Ivory brisé fan with painted medallion in style of Cosway. English, late 18th century. 3. Fan with mount of painted skin, sticks and guards of carved and painted ivory. English, middle of the 18th century. 4. French fan, mount of Argentan lace, sticks and guards of carved ivory. Third quarter of the 18th century. 5. Carved ivory brisé fan. Chinese, 18th century. 6. Late 16th century Itaiian fan with mount of parchment cut out in a geometric design. The sticks are of ivory

innumerable minute figures with ivory heads and silk costumes applied. Almost every city or district in China has its characteristic fan distinguishable by its colour and ornament and made to suit every class from mandarin to peasant.

Japan. — In Japan also the use of the fan is very closely linked with the life and customs of the people. In Rhead's *History of the Fan* the author says that it is regarded as an emblem of life, widening and expanding as the sticks radiate from the rivet. It plays a part in almost every aspect of their existence: it is presented to the youth on the attainment of his majority; it is used by jugglers in feats of skill; the condemned man marches to the scaffold fan in hand. The earliest examples were made of palm leaves or feathers while the rigid screen fans were introduced from China in the 6th century A.D. Large screens were used tor religious and civil ceremonial and as war standards. Most interesting of all the rigid fans is the Gumbai Uchuia, a type of battle fan of iron first kno n in the 11th century. It is, however, the folding fan, invented by the Japanese in the 7th century, that has played such an important role in their history and art. There are innumerable variations of its form each designed for a particular use and possessing individual characteristics. The Akomé Ogi is the earliest form of court fan having come into use in the 7th century; it is composed of 38 blades fastened with a rivet. formed of a bird or butterfly, and ornamented at the corners with artificial flowers and 12 long streamers of coloured silks; it was the type used by court ladies until 1868. The Gun Sen is the folding battle fan with sticks of wrought iron and the mount of thick paper painted with the sun, moon or star in red or gold on a black or coloured ground; its initial purpose in battle was as a signal. The Mai-Ogi or dancing fan dates from the 17th century; it has 10 sticks and a mount of thick paper usually decorated with a family crest. The Rikin-Ogi or tea fan, used in tea ceremonies celebrated in each province on the first day of every month, has only three sticks and the paper mount is simply decorated, the fan itself being used for handing around little cakes, fanning being prohibited during this dignified ceremony. Many early fans were designed with the infinite artistry of the great painters of Japan but these are rarely seen to-day. Those most often found in collections are the modern brisd of ivory or tortoise-shell decorated with lacquer and inlay and often made for exportation to Europe. *(See* DRESS: *Far Eastern.)*

Ancient. — In the cultures of ancient Egypt, Assyria and India, the fan achieved considerable importance both as a civil and religious emblem. Especially in Egypt fans played an important part in royal ceremony; the office of fan-bearer to the king was a highly prized honour; their fans, made of feathers arranged in a half-circle and mounted on long handles, may be seen in Egyptian wall paintings and reliefs. Two actual examples now in the museum at Cairo, were found in the tomb of Tut-ankh-amen (14th century B.C.); the gold mounts with embossed and incised decorations were fitted with brown and white ostrich plumes and the handles were made in one case of gold and in the other of ebony overlaid with gold and lapis-lazuli In India both the fan and umbrella were held in reverence; the punkah or large screen fans are still hung in rooms and manipulated by servants detailed for the purpose. In Greece peacock feather hand fans were known about 500 B C. and may be seen in contemporary vase paintings while the rigid palm leaf shaped fan is frequently depicted in the terracotta figurines from Tanagra. As for ancient Italy, an Etruscan cinerary urn in the hfetropolitan hfuseum of Art shows the deceased in the customary reclining posture holding in her hand a feather fan; and in Rome tablet fans of precious woods or finely cut ivory were carried by the exquisites on the Via Sacra for their ladies, while another type was always part of the bridal outfit of a Roman woman.

Mediaeval. — In the Middle Ages the Christian Church perceived the usefulness of the fan in religious ceremonials The *flabellum*, as it was called, a disc sometimes of silver or silver gilt mounted on a long handle, was held by deacons and used to drive away flies and insects from the sacramental vessels. Accounts of the *flabellum* occur repeatedly in the old inventories of church and abbey property but except for two, whose use was probably secular. no fans of the period exist to-day. With the exception of the large feather fan carried in state processions for the pope, the fan is no longer used in the Western Church, but it still appears in the rites of the Eastern Church. The two famous specimens mentioned above, of the mediaeval period, are of the cockade type with mount of vellum and handle of carved bone. One of these dating from the 11th century from the abbey church of Tournus is now in the National museum at Florence while the other, said to be the oldest existing Christian fan and identified with Theodolinda, queen of the Lombards, is now preserved as a sacred relic in the cathedral of Monza near hfilan, where superstition has invested it with magic powers.

Modern European. — The vogue of the folding fan in Europe dates from its introduction through Portuguese trade connections with India and the Far East in the 16th century. Although it may have been known earlier, the impetus supplied by oriental importations produced a new era in its evolution. In popularity it soon supplanted the feather fan mounted on a carved ivory handle and the Venetian flag-like instrument. The type of folding fan found in late 16th century portraits is about a quarter circle in shape with sticks of ivory and a mount composed of alternate strips of vellum and mica, or of vellum cut out in a geometrical pattern of circles and lozenges similar to the designs of reticello lace of the period. Of this kind, called *découpé* from the perforated vellum mount, there is a beautiful example in the Cluny museum and one almost identical in a private collection in New York. It was at this time that the vogue for fans, already general in Italy and Spain, spread to France and England. Although not then confined to the use of ladies, special conventions were developed and gestures in handling them grew into code signals of amorous import.

In the 17th century Paris became the centre for the manufacture of fans. Louis XIV. issued edicts at various times for the regulation of the industry and in 1678 the Fanmakers' Guild was formed. The revocation of the Edict of Nantes (1685) drove many fanmakers to England and Holland. In consequence a fan trade was established in England where, after the formation of the Fanmakers' Company (1709), the importation of foreign fans, especially from India and China, was for a time prohibited. During this period the shape of the fan gradually grew to a full semi-circle with sticks of ivory or mother-of-pearl pierced or carved. The mounts of paper, vellum, parchment and specially prepared kidskin were painted or engraved, often from designs of such artists as Lebrun, Romanelli, Abraham Bosse and Callot.

It was, however, in the 18th century that the most extravagant and luxurious ornament was expended upon the decoration of the fan. The delicately carved sticks of ivory and mother-of-pearl, sometimes the product of Chinese workmen in Europe, were further enriched with incrustations of gold, silver, enamel and jewels. The mounts were made not only of skin but of silk, lace and paper perforated in imitation of lace, while the suave and gracious designs with which they were painted followed the fashion set by the chief artists and decorators of the day. As it was an age of considerable decorative invention, it is not surprising that new forms of the folding fan should appear. One of the rarest and most sought after by collectors is the so-called Vernis Martin. In form this type of fan is an ivory *brisé*, the blades of which are painted in thin oils and then varnished. It is from the particular translucent varnish that the name is derived, for in attempting to imitate Japanese lacquer, the brothers Martin, coach painters by trade, accidentally developed a method suitable for this decoration. Vernis Martin fans are smaller in size than the usual type of the period and because of their interest to collectors many imitations have been made. About the middle of the reign of Louis XV. another type of folding fan, the cabriolet, became the vogue. This was a reflection of the immense popularity achieved by a light two-wheeled carriage introduced to Paris by Josiah Child in 1755. For such fans, the mount instead of being one broad strip, was composed of two or sometimes three narrow strips with an intervening space between them. The strips were then painted or engraved with small scenes which usually included representations of people driving about in the fantastically popular carriage itself.

Toward the end of the reign of Louis XV. the fan industry suffered from a vogue for cheap printed fans. The sticks were thin and often undecorated, the printed paper mounts frequently depicted incidents and personages connected with contemporary political events. Some of the most interesting of these fans commemorate the balloon ascensions of 1784 and 1785 and the meeting of the Estates General in 1789. Other more pretentious fans of the period were much ornamented with spangles and tinsel, often with cheap effect. In England at this time there developed a particular type of ivory *brisé* fan—the ivory pierced and decorated with medallions painted in miniature in the style of Cosway or Angelica Kaufman.

During the period of the First Empire fans retrieved very little of their past elegance. They were small, delicate instruments often with mounts of spangled gauze and sticks of pierced ivory. The lorgnette fan, a variant of the cockade form, was made of pierced horn or ivory and had a little glass inserted at the rivet. As the century advanced the romantic and antiquarian tastes of the Victorian era were reflected in the style and decoration of fans There was much lifeless imitation of the Louis XV. types, and there were many large fans with mounts of lace or, frequently, paper with coloured lithographic prints of romantic scenes. The sticks of mother-of-pearl were pierced and gilded and, except in rare cases, were coarse in both design and execution. The invention of Alphonse Baude in 1859 for carving sticks by machinery reveals the lack of taste and discriminating quality of the time, for no mechanical contrivance can duplicate the verve of hand-carving. Somewhat later, however, certain fan-makers attempted to revive the old distinction of design and workmanship. Exhibitions were held in Paris and at South Kensington (1870) and painters of repute made designs for fan mounts, among whom may be cited Gavarni, Diaz, Couture, Solde, Jacquemart and Charles Conder (1868–1909).

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FAN (MECHANICAL), a device for moving air or other gases or vapours. (For the light hand instrument, *see* FAN.) Mechanical fans are used in systems for ventilating, heating and air conditioning buildings; for cooling and drying different materials and products; for cooling internal-combustion engines; for dust exhaust; for conveying light materials; and for induced and forced draft for steam boilers. In a fan the change in fluid density is so small that the gas is regarded as incompressible. A fan develops a relatively low pressure difference, of the order of a few inches of water to less than one pound per square inch. As a contrast, in an air or gas compressor the density change is appreciable; the pressure developed by the compressor is measured in pounds per square inch instead of inches of water.

Sometimes various qualifying terms are applied to a fan. In a so-called exhaust fan, piping may be connected only to the inlet of the fan, and the fan discharges directly into the atmosphere. In a blower fan, piping may be connected only to the outlet of the fan, and the fan inlet is open directly to the atmosphere. A desk fan is a relatively small portable unit used to circulate air within the room in which it operates; fans also may be fixed to a wall or a ceiling to circulate air in a room.

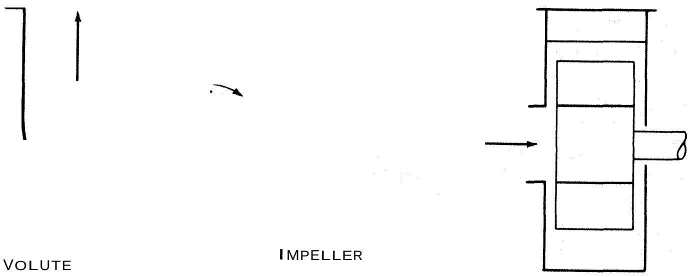

FIG. 1.—SCHEMATIC DIAGRAMS OF CENTRIFUGAL FAN (*see* TEXT FOR FURTHER EXPLANATION)

Fans are frequently classified according to the motion of the fluid through the rotating member; this rotating member may be called an impeller, rotor or a runner. Fig. 1 illustrates a centrifugal fan. Air is led through the inlet pipe to the centre or eye of the impeller. The impeller throws the fluid into the volute or spiral casing or scroll, where it is led to the discharge piping. If the flow through the impeller is primarily in a radial direction, the impeller could be classed as a radial-flow runner.

Fig. 2 illustrates an axial-flow fan, with the runner and guide vanes in a cylindrical casing or housing. The air passes through the runner essentially without changing its distance from the axis of rotation. In a centrifugal fan, air moves from one inner radius to another outer radius; there is a centrifugal force effect which increases the air pressure. In an axial-flow fan, however, this centrifugal force effect is not present. In a mixed-flow runner, the air flows through the runner partly in an axial direction and partly in a radial direction. Fig. 2 shows an axial-flow fan with fixed inlet guide vanes and fixed exit guide vanes; these vanes are sometimes called stator vanes. Guide vanes serve to modify performance and improve efficiency. The phrase "vane-axial" is sometimes used to designate a fan with a runner and a set of inlet or exit guide vanes in a cylindrical casing; the term "tube-axial." to designate a fan which has only a runner in a cylindrical casing and no guide vanes. A propeller type of fan is one with a propeller or disk within a mounting plate or ring.

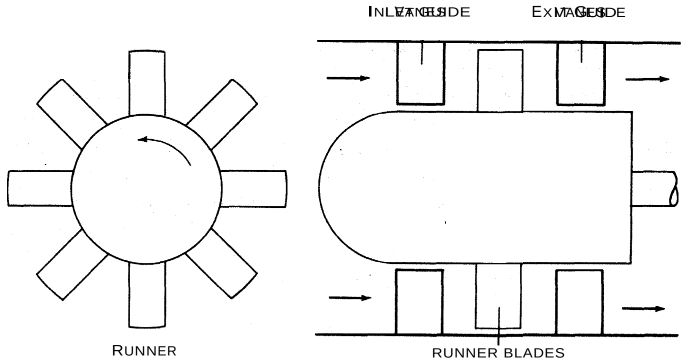

FIG. 2.—SCHEMATIC DIAGRAMS OF AN AXIAL-FLOW FAN

The fan housing or casing may be constructed of sheet metal or cast metals with or without protective coatings, as rubber, lead or enamel. Fan wheels may be constructed of sheet metal or cast metals. The sheet metal may be steel or an aluminum alloy. In centrifugal fans the number of blades may range from 5 to 66; in axial-flow fans, from 3 to 26. A fan runner may be driven by a high-speed electric motor, an internal-combustion engine, a steam turbine or a gas turbine. Belt drives and direct connections between driver and fan wheel are used.

Various factors or parameters are used in correlating data on performance and design. One useful factor is the specific speed N_s which is defined as

$$N_s = \frac{N\sqrt{C.F.M.}}{H^{\frac{3}{4}}}$$

where N is the angular speed of the runner in revolutions per minute, C.F.M. is the flow through the fan in cubic feet per minute and H is the fan head in feet of the fluid flowing. For narrow straight-blade centrifugal fans, N_s varies from about 140 to goo; for curved-blade centrifugal fans, from about 1,000 to 3,000; and for axial-flow fans, from about 4.000 to 8,000. Generally speaking, an axial-flow fan is suitable for a relatively large rate of flow with a relatively small pressure boost and a centrifugal fan for a small rate of flow and a large pressure boost. In some cases it is desired to obtain a relatively high pressure boost with a relatively large capacity. Two or more axial-flow fans can be staged. When staged, several fans are essentially connected in series, so that the same capacity goes through each fan, but each fan adds to the pressure boost.

The capacities of fans may range from 100 to 500,000 cu.ft. per minute. That of small kitchen fans may range from 300 to 800 and the capacities of attic window fans from 3.000 to 8,000. Exhaust fans for use in a central system may have capacities ranging from 2.000 to 100,000.

In selecting a fan it is frequently necessary to consider performance characteristics. It is customary to test a fan at constant speed of the runner. Measurements are made of the head or pressure rise across the runner, the capacity or volume rate of flow through the fan and the power input to the runner. Fig. 3 illustrates a plot of head versus capacity and a plot of power versus capacity. The head characteristic is important in matching a fan to a system, in order to maintain the proper flow through the system. The power characteristic is important in deciding the size of the motor or engine needed to drive the fan. Different fans have different performance characteristics. By examining the performance characteristics one can match a fan to a particular system over a range of flow rates.

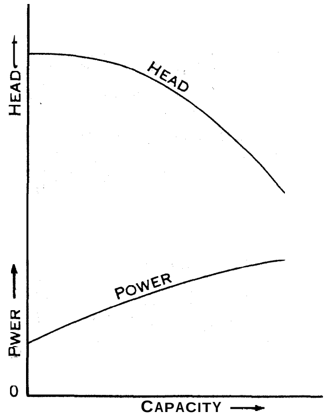

FIG. 3.—PERFORMANCE CHARACTERISTICS OF A FAN AT CONSTANT RUNNER SPEED

As an example, consider a centrifugal fan with blade tips which are forward-curved, that is, the blade tips are curved in the direction of rotation. In general, such a fan has a head characteristic which is flat; it does not change much with change in capacity. In some applications a flat characteristic is desirable. On the other hand! a backward-curved blade tip has a steep head versus capacity curve: that is, there is a marked change in head with capacity. Some cases require a steep characteristic. A radial-blade centrifugal fan (illustrated in fig. 1) has a head characteristic between that of the forward-curved fan and the backward-curved fan. The forward-curved fan is slower, and the backward-curved fan is faster than the radial-blade fan in developing the same pressure boost and capacity.

The efficiency of a fan is the ratio of the useful power added to the fluid divided by the power input to the runner shaft. The nominal or design rating of a fan at a certain speed is the head and capacity at the point of maximum efficiency. Consider a fan operating at different speeds, but with essentially the same efficiency. Certain approximate relations are used for estimating performance. These relations are: the capacity varies directly as the runner speed N; and the pressure boost across the fan varies directly as N^2. Consider a series of geometrically similar fans of different sizes but having similar flow patterns and operating at the same shaft speed and same efficiency. Let D represent the outside diameter of the runner. Some useful approximate relations are: the ian head varies directly as D^2; and the capacity varies directly as D^3. The flow is steady, or practically so, in many installations of a fan and connected system. In some cases, however, there is a marked periodic fluctuation superposed on the main steady flow; this fluctuation is usually called surging. Surging may become dangerous and may limit the useful range of operation of a fan. Surging occurs at low-volume rates of flow, when operation is in a region in which the fan characteristic shows an increase in head or pressure with an increase in capacity. Surging does not occur when the fan characteristic shows a decrease in pressure with an increase in capacity. Surging can be avoided sometimes by bypassing some of the flow from the fan before it enters a particular system in which a lower rate of flow is desired.

Fan noise is an important factor in various applications. A fan may be mechanically efficient but not suitable if it is considered noisy. Noise is a particularly important factor in domestic applications. Fan noise may be reduced by proper blade design. operating conditions, proper balancing and mounting. Fans can be installed in ducts so arranged that the noise is absorbed before it leaves the duct. In general, noise from an air stream is proportional to some mathematical power of the air velocity. Reducing the air velocity reduces the noise. Generally speaking, the lowest fan noise is developed at the point of highest efficiency.

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FANCY, display, showing forth, as a philosophical term, the representative power of the mind. "Fancy" is a shortened form of the older "phantasy" and dates from the 15th century. The older form "fantasy," which is now chiefly used poetically, was in its early application synonymous with imagination.

In music, Fancy is the name of an important kind of instrumental composition much favoured in England in the seventeenth century. It had no definite form, its interest depending on the free development, on polyphonic lines, of a single "ayre" or theme. Byrd and Orlando Gibbons, among others, left fine examples. In recent times the name was revived by Mr. W. W. Cobbett to denote a new type of short single-movement chamber work, to encourage the writing of which he offered substantial prizes.

FANE, JULIAN HENRY CHARLES (1827–1870), British diplomat, was born at Florence, Italy, in Oct. 1827, the fifth son of the 11th earl of Westmorland. He was a member of the Apostles club at Trinity college, Cambridge; he had already been attached to his father's legation at Berlin. In 1852 he published some lyric *Poems,* and in 1854 some translations from Heinrich Heine. His lively wit, vigorous pen and quite exceptional charm made him an ideal recruit to the diplomatic service, in which he spent a career as brilliant as it was brief. He was at the Paris congress in 1856, and served two years in St. Petersburg and seven at Vienna. In 186j he became first secretary at Paris, sometimes acting, with skill and judgment, as chargé d'affaires. He retired in June 1868 because of ill health. Fane had married Lady Adine Cowper (b. 1843j in 1866, and was prostrated by her death in Oct. 1868. He died in London on April 19, 1870. (M. R. D. F.)

FANFARE, in music: a short phrase or passage of a bold and rousing character played unaccompanied by a brass instrument or instruments, usually the trumpet, more especially on festive or ceremonial occasions.

FANG, an African tribe occupying the district north of the Ogooué river in the Gabon Republic. The name means "men." They call themselves *Paⁿwe, Faⁿwe* and *Faⁿ* with highly nasalized *n*. They are a finely made race of chocolate colour; some few are very dark, but these are of slave origin. They have bright expressive oval faces with prominent cheekbones. Many of them file their teeth to points. Their hair, which is woolly, is worn by the women long, reaching below the nape of the neck. The men wear it in a variety of shapes, often building it up over a wooden base. The growth of the hair appears abundant, but that on the face is usually removed. Little clothing is worn; the men wear a bark waistcloth, the women a plantain girdle, sometimes with a bustle of dried grass. A chief wears a leopard's skin around the shoulders. Both sexes tattoo and paint the body, and delight in ornaments of every kind. The men fight and hunt, carry muskets, spears for throwing and stabbing and throwing knives with blades broader than they are long. They use crossbows made of ebony to hunt apes and birds. In battle the Fang used elephant hide shields; now apparently discarded.

In 1815 the Fang were an inland people inhabiting the hilly plateaus north of the Ogooué affluents, now south of the Gabon they have reached the sea at several points. Their language is of the Bantu family. The Fang were noted cannibals. Among certain tribes the aged alone were permitted to eat human flesh, which was tabu for all others. The Fang are skilful workers in iron and have a curious coinage called *bikĕi,* little iron imitation axeheads tied up in bundles called *ntet,* ten to a bundle; these are used chiefly in the purchase of wives. They are energetic traders and are skilled in pottery and in gardening. Their religion appears to be a combination of primitive animism and ancestor worship, with a belief in sympathetic magic.

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FANGLOMERATE is a poorly sorted, coarse fragmental rock that is the product of the partial or complete consolidation of material deposited on an alluvial fan, usually in an arid or semi-arid region. The biggest fragments in the rock must be larger than sand size; they may be blocks many feet in diameter. Few of the larger fragments are well rounded as they are in a conglomerate (*q.v.*), and so the rock may be considered one variety of breccia (*q.v.*). The rock fragments are commonly of considerable variety. They reflect more or less faithfully the range of rock types represented in the region of erosion. The interstices between the larger fragments are filled with smaller ones, down to sand, silt or even clay size. The cementing material is usually clay or calcium carbonate.

Fanglomerates form near the heads (apices) of alluvial fans and grade downslope into sandstone or siltstone. The recognition of a fanglomerate, after the characteristic shape of the fan's surface has been obscured by overlying sediments, partial erosion or deformation, is facilitated by the discovery of lateral gradation into sandstone and then siltstone. Rocks called fanglomerates have been found in many parts of the world and in most parts of the geologic column, but especially in the Mesozoic and Cenozoic successions of western North America. (A. O. W.; X.)

FANO, a coast town and episcopal see of the Marches, It. (anc. Fanum Fortunae), province of Pesaro and Urbino, 8 mi. S.E. of Pesaro by rail and 46 ft. above sea level. Pop. (1951), 20,459. S. Croce and S. Maria Nuova contain pictures by Giovanni Santi, the father of Raphael. S. Agostino contains a painting of the Angelo Custode ("the Guardian Angel") by Guercino which is the subject of a poem by Robert Browning. The fine Gothic Palazzo della Ragione (1299) has been converted into a theatre. The palace of the Malatesta has fine porticos and Gothic windows, and there is also an imposing citadel built by them. S. Michele, built against the arch of Augustus, is an early Renaissance building (1475–90), probably by Matteo Nuzio of Fano, with an ornate portal.

Mediaeval Fano had a chequered story and in the 14th century became subject to the Malatesta. In 1463 Pius II added it to the states of the church. Julius II established there in 1514 the first printing press with movable Arabic type. The harbour was restored by Paul V; Fano is a favourite sea-bathing resort.

FANSHAWE, SIR RICHARD, BART. (1608–1666), English poet, translator and diplomat whose version of Cambes' *Lusiad* is a major achievement of English verse translation, was born at Ware Park, Hertfordshire, in June 1608. Educated at Jesus college, Cambridge, in 1635, he was appointed secretary to the English embassy at Madrid. At the outbreak of the Great Rebellion he joined the king. In 1644 he married Anne Harrison, whose *Memoirs* contain an admirable account of her husband's career. In 1648 he became treasurer to the navy, and in 1650 was dispatched by Charles II to obtain help from Spain. Although this was refused, Fanshawe was created a baronet; he rejoined Charles in Scotland and was taken prisoner at the battle of Worcester. On Cromwell's death he re-entered the king's service in Paris, and after the Restoration was appointed ambassador to Portugal and later to Spain. He died at Madrid on June 26, 1666.

Fanshawe published a translation of *Il Pastor Fido* by Baptista Guarini in 1647. A second edition "with divers other poems" (1648) included his version of the fourth book of Vergil's *Aeneid*. His *Selected Parts of Horace* appeared in 1652. The great work of his retirement during the Protectorate was his translation of the *Lusiad* of Cambes (1655). His other works include a version of a comedy by Antonio de Mendoza (1654) and a Latin translation of John Fletcher's *Faithful Shepherdess* (1658). Fanshawe's version of the *Lusiad* is at once a faithful rendering in the original metre and a lively, picturesque English poem. His translation of *Il Pastor Fido* is equally distinguished.

His *Fourth Book of the Aeneid* is in the Spenserian stanza and few translations of Vergil have so well conveyed the nobility and delicacy of the original.

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(V. DE S. P.)

FAN-TAN, a Chinese gambling game and also the name of a card game. In the gambling game, a square is laid out in the centre of a table, its sides being marked 1, 2, 3 and 4. The banker empties onto the table a double handful of small coins—in China "cash"—beans, or similar articles, which he covers with a metal bowl. The players bet as to what will be the remainder when the pile is divided by four by setting their stakes on the side of the square which bears the number each favours. When all have staked, the bowl is lifted and the banker, with a small stick, removes coins (or beans, etc.) from the heap, four at a time. When the final batch is reached, the number of coins it contains determines the winning number; if four coins, the backer of no. 4 wins; if three, the backer of no. 3 wins, and so on. The banker deducts 25% from each winner's stake; then he pays each winner five times the amount of his stake thus reduced, which is to say, 2.75 to 1 when the true odds are 3 to 1.

The card game fan-tan, may be played by any number of players up to eight. The full pack of 52 cards is dealt out, one card at a time. Thus some hands may contain one more card than others. All players ante to a pool; in some games, players dealt fewer cards than others are required to ante an extra counter.

Only one card is played at a turn. Beginning with eldest hand (the player to the left of the dealer), each in turn must play a card if able; whenever unable to play, he must pay one counter to the pool

The first card played must be a seven. The next player may add a card next in rank and of the same suit—*i.e.*, the eight or the six—or he may play another seven. Thereafter, each must play a card of the same suit and in unbroken sequence with one already on the table, or may play a seven. Sequences build up to the king; down to the ace. The player who first gets rid of all his cards wins the pool, to which each of the others must add one counter for each card remaining in his hand. A player who passes when able to play must pay three counters to the pool as an additional penalty. (R. L. FY.)

FANTASIA, a name in music for a composition possessing little structural form, and having the general style of an improvisation; also for a combination or medley of familiar airs connected together with original passages of more or less brilliance. The word, however, was originally applied to more formal compositions, based on the madrigal, for several instruments. Fantasias appear as compositions of a distinctive type in Bach's works, in the case of which they frequently serve as preludes to fugues, *e.g.*, the "Chromatic Fantasia and Fugue." Brahms used the term for some of his shorter piano pieces, and it was applied on occasion to much larger and more elaborately organized works, alike for the piano and for the orchestra, such as Schubert's "Wanderer" fantasia, Schumann's Op. 17 and Tchaikovski's symphonic fantasia *Francesca da Rimini*. The Italian word is still used in Tunis, Algeria and Morocco with the meaning of "showing off" for an acrobatic exhibition of horsemanship by the Arabs.

FANTI, MANFREDO (1806–1865), Italian general, was born at Carpi on Feb. 24, 1806, and educated at the military college of Modena. In 1831 he was implicated in the revolutionary movement organized by Ciro Menotti (*see* FRANCIS IV, of Modena), and was condemned to death and hanged in effigy, but escaped to France, where he was given an appointment in the French corps of engineers. In 1833 he took part in Mazzini's abortive attempt to invade Savoy, and in 1835 he went to Spain to serve in Queen Christina's army against the Carlists. There he remained for 13 years, rising to a high staff appointment. But on the outbreak of the war between Piedmont and Austria in

1848 he hurried back to Italy, and although at first his services were rejected both by the Piedmontese government and the Lombard provisional government, he was afterwards given the command of a Lombard brigade. In the general confusion following on Charles Albert's defeat on the Mincio and his retreat to Milan. where the people rose against the unhappy king, Fanti's courage and tact saved the situation. He was elected member of the Piedmontese chamber in 1849, and on the renewal of the campaign he again commanded a Lombard brigade under General Ramorino. After the Piedmontese defeat at Novara (March 23) peace was made, but a rising broke out at Genoa, and Fanti with great difficulty restrained the Lombards from taking part in it. But he was suspected as a Mazzinian and a soldier of fortune by the higher Piedmontese officers. He was court-martialled, and, though acquitted. he was not employed again until the Crimean expedition of 1855. In the second Austrian War in 1859 Fanti commanded the second division, and contributed to the victories of Palestro, Magenta and San Martino. After the peace of Villafranca he converted the army of the Central Italian league (composed of the provisional governments of Tuscany, Modena, Parma and Romagna), into a well-drilled body of 45,000 men. He steered a clear course between the exaggerated prudence of Baron Ricasoli, who wished to recall the troops from the frontier, and the impetuosity of Garibaldi, his second-in-command, who was anxious to invade Romagna prematurely, even at the risk of Austrian intervention. Fanti's firmness led to Garibaldi's resignation. In Jan. 1860 Fanti became minister of war and marine under Cavour, and incorporated the league's army in that of Piedmont. In the meanwhile Garibaldi had invaded Sicily with his Thousand, and the king of Sardinia, Victor Emmanuel, decided at last that he too must intervene; Fanti was given the chief command of a strong Italian force which invaded the papal states, seized Ancona and other fortresses, and defeated the papal army at Castelfidardo, where the enemy's commander, General Lamoricière, was captured. In three weeks Fanti had conquered the Marche and Umbria and taken 28,000 prisoners. When the army entered Neapolitan territory the king took the chief command, with Fanti as chief of the staff. After defeating a large Neapolitan force at Mola and organieing the siege operations round Gaeta, Fanti returned to the war office at Turin to carry out important army reforms. His attitude in opposing the admission of Garibaldi's 7,000 officers into the regular army with their own grades made him unpopular, and led to a severe reprimand from Cavour. In 1861 he resigned office and took command of the VII army corps. He died in Florence on April 5, 1865. (L. V.; X.)

FANTI, a Ghanaian people living on the Cape Coast—Elmina-Secondi littoral and hinterland, and speaking a language closely related to Ashanti (*q.v.*). They have an organization similar to that of the Xshanti, and though less warlike in temperament, probably derive from the same stock.

FANTIN-LATOUR, IGNACE HENRI JOSEPH THÉODORE (1836–1904), French artist noted for his paintings of flowers, still life and portraits, was born at Grenoble on Jan. 14, 1836. He studied first with his father, a pastel painter, and then at the drawing school of Lecoq de Boisbaudran. He was the friend of Ingres, Delacroix, Corot, Courbet and others. He exhibited in the Salon of 1861 and many of his more important canvases appeared on its walls in later years, though 1863 found him with Harpignies, Manet, Legros and Whistler in the Salon des Refusés. His style remained independent and academic, however. His portrait groups, arranged somewhat after the manner of the Dutch masters. are as interesting for their subjects as they are from the artistic point of view. "Hommage à Delacroix" showed portraits of Whistler and Legros. Baudelaire, Champfleury and himself; "Un Atelier à Batignolles" gave portraits of Monet, Manet, Zola and Renoir, and is now in the Luxembourg; "Un Coin de table" presented Verlaine, Rimbaud, Camille Péladan and others; and "Autour du Piano" contained portraits of Chabrier. D'Indy and other musicians. His paintings of flowers are perfect examples of the art. In his later years he devoted much attention to lithography. After "L'Anniversaire" in honour of Berlioz in the Salon of 1876, he regularly exhibited lithographs, some of which were examples of delicate portraiture, others being elusive and imaginative drawings illustrative of the music of Wagner, Berlioz, Brahms and other composers. He illustrated Adolphe Jullien's *Wagner* (1886) and *Berlioz* (1888). There are excellent collections of his lithographic work at Dresden, Ger., the British museum and the Louvre. He died on Aug. 25, 1904.

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STILL LIFE BY HENRI FANTIN-LATOUR

FARABI, AL- (MOHAMMED IBN MOHAMMED IBN TARKHAN ABU-NASR AL-FARABI; Lat. ALFARABIUS) (*c.* 870–950), Arabic-writing Moslem philosopher of Turkish origin. was born c. 870 in Transoxiana (the central Asian province north of the Oxus river). Having studied first in Khurasan and then in Baghdad, where he lived for a considerable time, he eventually transferred himself to the court of the Shi'ite ruler of Aleppo, Saif al-Daula. He died near Damascus in 950.

Al-Farabi's teachers, the Christian Arabic philosophers of Baghdad, were late descendants of the 6th-century Christianized school of Alexandria, and his writings show everywhere the influence of this blend of Aristotelian and Neoplatonic thought. Most later Arabic philosophers depend on his achievement. He believed in the essential identity of Plato's and Aristotle's views, following Plato in politics and Aristotle in logic and physics; his metaphysics combine Aristotelian and Neoplatonic thought. His renowned commentaries on the Aristotelian treatises are lost; and his *Paraphrase of Plato's Laws* is written in support of special political theories of his own and is not meant to give an accurate account of the work in all its detail. We have, however, three comprehensive works on the whole of his philosophy. The earliest comprises three books, book i being a discourse on the attainment of happiness, book ii being a survey of Plato's philosophy and book iii dealing with Aristotle. The other two are the *Views of the Citizens of the Perfect State,* which is perhaps the most accomplished of his works, and the *Book of the Government of the State.* The *Aphorisms of the Statesman* is a short work intermediate between the *Views* and the *Book of the Government.* Whereas these books remained unknown to the Latin schoolmen, al-Farabi's *De divisione scientiarum,* a survey of the entire body of philosophical knowledge, including specific Islamic sciences, was translated by Gerard of Cremona and extensively used by Dominicus Gundisalvi in his *De divisione philosophiae.* There were also medieval Latin versions of his treatise *De intellectu* and of some of his writings on music.

The *Book of Gems,* formerly attributed to al-Farabi, is by Avicenna. For an account of al-Farabi's thought, *see* ARABIC PHILOSOPHY.

For the writings on Plato see *Plato arabus,* vol. ii, ed. by F. Rosenthal and R. Walzer (1943), and iii, ed. by F. Gabrieli (1952); for the *Views of the Citizens,* the text ed. by F. Dieterici (1895) and the Fr. trans. by R. P. Janssen *et al.*, *Idées des habitants de la cite' vertueuse* (1949); for the *Book of the Government*, the Ger. trans. by F. Dieterici, *Die Staatsleitung von Alfarabi*, ed. by P. Bronnle (1904); for the *Aphorisms*, the Eng. trans. by D. M. Dunlop in *Iraq*, xiv (1952); for the *De divisione scientiarum*, the text ed. with Lat. and Sp. trans. by A. Gonzalez Palencia, 2 parts (1932); for the *De intellectu*, the text ed. by E. Gilson in *Archives d'histoire doctrinale et littéraire du moyen âge*, iv (1930); for the musical writings, H. G. Farmer, *Al-Farabi's Arabic-Latin Writings on Music* (1934); for other works, F. Dieterici, *Alfarabi's philosophische Abhandlungen*, Ger. trans. (1892), and D. M. Dunlop, articles in *Islamic Quarterly* (1955 ff.).

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FARAD. A unit of electric capacity, named for Michael Faraday (*q.v.*). The capacity of a conductor or condenser is one farad when a quantity of electricity, equal to one coulomb increases its potential by one volt. *See* CAPACITOR; ELECTRICITY: *Condensers: Capacitance;* PHYSICAL UNITS.

FARADAY, MICHAEL (1791–1867), English physicist, chemist and physical-chemist or, as he himself would have said. natural philosopher, was the discoverer of electromagnetic induction, of the laws of electrolysis and of fundamental relations between light and magnetism, as well as being the originator of the conceptions that underlie the modern theory of the electromagnetic field. Faraday was born on Sept. 22, 1791, at Newington, Surrey, nhich later became part of the borough of Southwark in south London, but was then in the country. His father was a blacksmith who had migrated from Yorkshire. The family having moved to north London Michael, at the age of 14, was apprenticed to a bookseller and bookbinder, in whose shop he read with keen interest books on science which came into his hands. Having heard Humphrey Davy lecture at the Royal institution and conceived an eager desire to "enter into the service of science," to use his own words, he applied to Davy for employment, sending him, as evidence of his interest, the notes which he had made of the lectures. As a result he was, at the age of 21, appointed assistant to Davy, to help with both lecture experiments and research. He accompanied Davy on a tour in Europe, where he had many menial duties to perform, but also saw much of active scientific research and. in general, expanded his view. As J. H. Gladstone, who knew him well, wrote, "His University was Europe; his professors the master whom he served, and those illustrious men to whom the renown of Davy introduced the travellers."

His first published paper, which appeared in 1816, was of no importance. In 1820 he was devoting much attention to steel, the preparation of a rustless steel being one of his objects, and this work continued for some years, but beyond the finding that small quantities of added metals had a pronounced effect on the properties, no result of importance was obtained. In 1820 Faraday discovered two unknown chlorides of carbon and a new compound of carbon, iodine and hydrogen. It was in this year that the Danish physicist, H. C. Oersted, announced his discovery that a wire conveying an electric current deflected a pivoted magnetic needle to which it ran parallel, a discovery which aroused great interest but was imperfectly understood. Faraday grasped that the force w-as a circular one round the wire and on this basis made in 1821 the first of his great electrical discoveries, that of electromagnetic rotation. A rigid mire, so mounted that it could turn about the point of suspension, hung with its lower end in a pool of mercury. A vertical magnet was fixed with one pole beneath the point of suspension. When a current was passed through the wire it rotated rapidly. This discovery brought Faraday widespread fame, but also some trouble with W. H. Wollaston (*q.v.*), who had been unsuccessfully attempting something similar. In the same year Faraday married Sarah Barnard. The union was a happy one, but childless.

In 1823 Faraday liquefied chlorine, ahich aroused the jealousy of Davy, who considered that he had initiated the work and was entitled to the credit. In consequence he opposed Faraday's election to the Royal society, which nevertheless took place in 1824. The next year Faraday made a chemical discovery of the first importance by isolating benzene or, as he termed it. bicarburet of hydrogen, from a liquid obtained in the production of oil gas. About the same time he was concerned mith a research. to become prolonged, on optical glass, to which he devoted much labour without great immediate result. The "heavy glass" which was one of the products played. however, an essential part in his great discovery of the rotation of the plane of polarization of light in a magnetic field. It was in 1825 that Faraday's position at the Royal institution was improved by his promotion to the post of director of the laboratory. The next year he began to give formal lectures for the members of the institution on Friday evenings, which have continued, as Friday evening discourses. ever since. He also initiated the Christmas lectures for young people, known formally as Christmas Courses of Lectures Adapted to a Juvenile Auditory, of which he himself gave 19 courses. As an inspiring lecturer and as a deviser of effective lecture experiments Faraday was supreme and there are many contemporary accounts of the interest and enthusiasm which his discourses aroused.

The second period of Faraday's researches may be said to have begun in 1831. His mind was governed by the conviction that the various forces of nature with which physics, always termed by him natural philosophy, was concerned were intimately interconnected. The electric current produced magnetic force, and the magnet acted. as he had shown, on the electric current. He was sure that it should be possible to make magnetism produce electricity: in fact as early as 1822 his note book contains the words "Convert magnetism into electricity." From time to time he had tried to produce currents by stationary dispositions of magnets with respect to wires or coils of wire, without success. In ten days in 1831 he carried out a series of experiments convincingly demonstrating the discovery of electromagnetic induction. experiments of such importance that in 1931 the centenary was celebrated at a conference, to which came delegates from all parts of the world, organized by the Institution of Electrical Engineers in London. The most famous experiment was that of the induction ring, a ring of soft iron on which were two different windings of insulated wire, one of ahich mas connected to a simple galvanometer. When the two ends of the other winding were permanently connected to a battery there was no effect, but when the circuit was made or broken the galvanometer indicated a current. A similar effect was obtained with an iron cylinder with a helix wound on it. When, by means of magnets, the magnetic flux in the cylinder was changed, there was a momentary current in the helix. A variation of this experiment was to introduce a magnet into a helix, or to withdraw it. In general, what Faraday showed was that change of magnetic flux through a circuit produced a current in the circuit.

He also rotated a copper disk between the poles of a large electromagnet and showed that a current could be obtained from contacts with the axis and with the edge of the disk—the first dynamo. He soon followed these experiments with others demonstrating the inductive effect of a current circuit on another circuit, without the presence of iron. In discussing these fundamental discoveries Faraday employed the conception of magnetic lines of force to make his ideas clear, for he was no mathematician. Somewhat later, in the course of his researches on static electricity, he developed the analogous conception of lines of electric force, whose course and concentration expressed the various effects. It is in acknowledgment of his fundamental discoveries concerning the functions of dielectrics that the unit of capacity is named the farad (microfarad in more general use). In this mork he discovered the significance of what he termed "specific inductive capacity," later called dielectric constant.

Faraday's conceptions of electric and magnetic force and their interrelations, expressed in terms of his lines of force, were fundamental. It was from them that James Clerk Maxwell (*q.v.*) developed his equations, which lie at the base of all modern theories of electromagnetic phenomena.

It was shortly after his nork on electromagnetic induction that Faraday, once more in search of unity, showed that the five kinds of electricity then distinguished—frictional, galvanic, voltaic, magnetic (induced current) and thermal—were fundamentally the same. "Electricity, nhatever may be its source is identical in its nature." In the same period of his researches he arrived at the basic laws of electrolysis which bear his name. and introduced the terms that are universally used, "anode," "cathode," "anion," "cation" and "electrode."

After this succession of epoch-making discoveries ensued a period of exhaustion, reminiscent of Sir Isaac Newton's nervous breakdown. from which Faraday gradually recovered. The third and last period of his researches began about 1844 and includes as the main discovery that of the rotation of the plane of polarization of light in a magnetic field, in which his heavy glass played an essential part. This, again, was the outcome of a fixed idea that light and magnetism must be in some way connected. In 1850 he tried to establish experimentally a relation between gravity and electricity, concluding his paper with "Here end my trials for the present. The results are negative; they do not shake my strong feeling of the existence of a relation between gravity and electricity, though they give no proof that it exists."

In 1858 he retired to live in a comfortable house near Hampton Court, Surrey, provided by Queen Victoria. At that time he still retained a lively interest in science, but his health and his powers gradually waned and there he died peacefully on Aug. 25, 1867.

Faraday nas possibly the greatest experimental genius the world has known. "He smells the truth," said the German professor F W. Kohlrausch, speaking to John Tyndall. Something incessantly prompted him that certain fundamental relations were waiting to be found and he was not dismayed by dozens of fruitless experiments from persisting until basic discoveries, of the type described here, were finally established. In theoretical physics he provided the fundamental conception, expressed by his lines of force, that the medium was the seat of electromagnetic action, which at the hands of Clerk Maxwell led to the conception of electromagnetic waves. To all his other gifts he added that of being able to express his experimental results and his thoughts concerning them in clear and simple language.

His published works were *Chemical Manipulation* (1827); *Experimental Researches in Electricity* (1839–5j); *Experimental Researches in Chemistry and Physics* (1859); *A Course of Six Lectures on the Clzemical History of a Candle,* ed. by W. Crookes (1861); *On the Various Forces in Nature,* ed. by W. Crookes (1873). His *Diary,* edited by T. Martin, was published in 8 vol. (1932–36).

See also ELECTRICITY: *Direct-Current Circuits: Batteries: Faraday's Law of Electrolysis;* ELECTROMAGNETIC WAVES: *Origin of Electric Wave Concept.*

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FARADAY'S LAW: *see* ELECTRICITY: *Faraday's Law of Electrolysis.*

FARAH, a town of Afghanistan, on the river that bears its name on the main road betu-een Herat and Kandahar, 160 mi. S. of Herat and 225 mi. W. of Kandahar. It commands the approaches to India and Seistan from Herat. The town (2,460 ft. above sea level) is a square walled enclosure in the middle of the plain. Because of its unhealthiness it is only occupied by the Afghan regiment quartered there. It is probably the Phra mentioned by Isidore of Charax in the 1st century A.D.

FARAH, a river of Afghanistan. It rises in the southern slopes of Siah-Koh, which forms the southern wall of the valley of Herat, and after a southwest course of about 200 mi. falls into the Seistan Hamun. At the tonn of Farah it is 1jo yd. wide in the dry season with 2 ft of water and a clear, swift stream. It is liable to floods, when it becomes impassable for weeks. The lower valley of the Farah Rud is fertile and well cultivated.

FARAZDAQ, AL- (AL-FERAZDAQ; originally HAMMAM) (*c.* 641–*c.* 728), Arab poet, famous chiefly for his satires, was born at Basra. and at the age of 15 was already known as a poet. He devoted his talent to attacks on the tribes of bani Nahshal and bani Fuqaim. When Ziyad. a member of the latter tribe, became governor of Basra, the poet fled, first to Kufa, and then to Medina. He remained there about ten years, writing political satires on the Bedouin tribes, but taking no other part in political life. He lived a prodigal life, and his amorous verses (in which, as in his life, he indulged in unbridled licence) led to his expulsion by the caliph Marwan I. On the death of Ziyad he returned to Basra, where he secured the favour of Ziyad's successor, 'Obaidallah ibn Ziyad. Much of his verse during this period is concerned with his dispute with his wife, his cousin Nawar, whom he married against her will. Another subject which occasioned a long series of verses was his feud with his rival Jarir (*q.v.*) and his tribe the bani Kulaib. Al-Farazdaq was prevented by fear from taking an important part in political life. He seems, however, to have been attached to the house of 'Ali. During the reign of Muawiya I he entirely avoided politics, but later gave his allegiance to Abdallah ibn Zobair. He died at Basra about 728.

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FAR EAST is a regional term commonly used to cover east and southeast Asia. East Asia refers primarily to China, Korea, Formosa and Japan; it usually includes Mongolia as well and on occasion the Pacific littoral of the U.S.S.R. Southeast Asia, sometimes called farther India (*Chinese*: Nan-yang; *Japanese*: Nan-yo), refers to the region between India and China, including Burma, Thailand, Laos, Cambodia, Vietnam, Malaya, Singapore, Indonesia, British Borneo, Portuguese Timor and the Philippines. Although at times India, Pakistan and adjacent territories have been subsumed within the far east concept, they are correctly excluded from it and belong more appropriately within the area known as south Asia (India, Pakistan, Ceylon. Nepal, Bhutan, Afghanistan). In its most restricted sense, the term far east often is equated with east Asia alone.

Historically, the far east described those portions of the Eurasian land mass and archipelagoes farthest from and of greatest interest to the maritime powers of western Europe. It was one of a trichotomy of regional expressions of which the other two were the middle east (south Asia plus Iran and on occasion portions of Soviet central Asia) and the near east (the Levant and northern Africa). The orient is a term popularly connoting all countries of the east (including middle and near East) or of Asia generally.

From the standpoint of North Americans, far east is a cultural and geographical archaism since the term may in fact be regarded as the American farther west and potentially may become the farther north as air communications over the arctic region continue to be expanded. *See* also SOUTHEAST ASIA; and countries referred to above. (N. S. G.)

FAR EAST: RELATIONS WITH THE WEST. The term "far east," as used in this article, applies to Japan, China, eastern Siberia and adjacent portions of eastern Asia. Not until the 16th century, with the opening of the sea routes to India and the far east, did Europeans begin to change the face of Asia. When the Portuguese admiral Vasco da Gama rounded southern Africa and sailed, in 1497–98, to Calicut on the southwestern coast of India, a war to the death began between the Portuguese and the Arabs for control of the Indian ocean and the trade of the Indies. The Arab hold was broken in 1511 with the Portuguese capture of Malacca, entrepôt of trade by sea between the middle and far east. On arriving there the Portuguese came into direct touch with the peoples, cultures, riches and power of the extreme eastern world.

Early European Relations.—The handful of Portuguese who invaded the far east in the 16th century owed their success to their superior arms and ships, their crusading determination, their wisdom in limiting their objectives to relatively isolated places and the haughty confidence of the Chinese court in its ability to deal with the alien intruders at its own convenience. Despite wars between the invading Europeans and China's vassals in Malaysia, relations between Portugal and China might possibly have been established in a mutually satisfactory manner had it not been for the outrages and piratical activities of the Portuguese along the coast of southern China.

The first Portuguese ambassador, Tomé Pires, who arrived in southern China in Aug. 1517, was not permitted to reach Peking until approximately three years later. Moreover, when the letter from the king of Portugal was opened its tone was judged to he lacking in respect. The Portuguese embassy was rejected and Pires was ordered back to Canton where he was imprisoned. Although diplomatic relations were not permitted, trade relations were continued illegally after 1521 at the wish of mercantile elements of both peoples and with the purchased connivance of the Chinese official hierarchy. By 1557 the Portuguese had established a settlement at Macao by consent of local officials. 'Ground rent, symbol of sovereignty, was paid to China until 1849. Only in 1887 did China by treaty confirm Portugal's right of government with perpetual occupation—while Portugal agreed never to alienate the territory and its dependencies without China's consent.

The conquest of Malacca was followed during the autumn of 1511 by the dispatch of a Portuguese expedition to the Moluccas and other islands of the Malay archipelago. Some of the leaders, shipwrecked on the return voyage, are said to have landed on Mindanao. Not to Portugal, however, but to Spain fell the ownership for more than three centuries of the archipelago named, in 1561, in honour of Philip II. In 1521, about nine years after these initial landings, Ferdinand Magellan arrived in these islands after a voyage across the Pacific ocean. In so doing he opened to the country of his adoption the western route to the far east, via the Atlantic and Pacific oceans, and thenceforward the Spanish used Mexico as a base for conquest, trade and religious propaganda in the east. Manila was captured by Miguel López de Legazpi in 1571, and shortly became capital of the colony.

The Portuguese and Spanish were amazed by the numbers and wealth of the Chinese people, their philosophical pacifism and military and naval ineptitude. In 1598, 18 years after the union of the crowns of Spain and Portugal, the Spanish obtained permission to trade at Canton. But Portuguese opposition, in conjunction with the preference of the Chinese for trade at Manila where they could more easily obtain goods from Spain and Mexico, prevented relations of the two peoples on the mainland from developing to any considerable extent along either religious or economic lines. Thus Manila became the clearinghouse for Sino-Spanish trade as Canton had become for Sino-Portuguese. The Chinese in the Philippines increased in numbers and wealth; they, rather than the Spanish, profited from the trade with Mexico.

From 1432 to 1549 Japan was officially in vassalage to China. Meanwhile, in about 1542, shipwrecked Portuguese reached a tiny island off the southern extremity of Kyushu. In this manner were opened Portuguese-Japanese relations which lasted 98 years. For two generations no other Europeans appeared in Japan. With the arrival of the Spaniards, however, toward the end of the 16th century, European relations with Japan—as well as with China—became increasingly complicated. This was a result of national and religious rivalries, carried on between the westerners and the Asians and between the westerners themselves.

As early as 1577, within a generation after the breaking of Japan's vassalage, Toyotomi Hideyoshi was planning the unification of China and Korea with Japan. Before long he was envisaging annexation of Formosa, the Philippines and India as well. On July 25, 1591, he warned the Portuguese viceroy at Goa of his intention to invade India as soon as his "heavenly mission of conquering China" had been completed. On Sept. 15 following he sent a letter to the Spanish governor of the Philippines making similar threats. During the following two years and in 1597–98 two great campaigns were fought in Korea and its waters to force that kingdom to serve as a roadway to China. This effort was defeated when China came to the aid of its Korean vassal.

Out of Hideyoshi's expressed intentions with respect to the Philippines arose the opportunity for Spanish priests to poach upon the Jesuit-Portuguese preserve of Japan. Through Macao, and under the aegis of Portugal, the Jesuits had entered both China and Japan during the latter half of the 16th century. By intelligently directed zeal. subtle diplomacy and scholarship they made their conquests in both countries, hut approximately a generation earlier in Japan than in China. Although anti-Christian decrees had been issued in Japan during 1565, 1568 and 1587, there were in Japan by 1595, an estimated 300,000 converts and 137 Jesuits. In 1593 Governor de Marinas sent an embassy with a reply to Hideyoshi's demand of 1591 that he should travel to Kyushu "to make submission to us." Circumventing a bull of Gregory XIII and a Spanish-Portuguese agreement, four Franciscans now entered upon rival religious propaganda. The Franciscan-Jesuit, Spanish-Portuguese quarrels which ensued strengthened the position of the enemies of the groups concerned, native and alien, especially that of the Protestant Dutch. The Dutch, arriving in Japan in 1600, hated the Catholic Portuguese and Spanish, against whose rule they were rebelling in Europe. Weakened by Hideyoshi's continental wars and fearful of attempts by Spain to conquer the country, Japan attempted the extirpation of Christianity and, around 1640, closed its doors to Europeans (with the exception of a handful of Dutch) for the next three centuries and more.

Even before this Japanese-European drama had reached its climax, other aspects of the far eastern problem, religious and secular, were developing in China. During the period c. 1635–1742 there occurred a cultural-political-religious struggle, generally referred to as the rites controversy, between the Jesuits and their Catholic critics and rivals, chiefly the Dominicans and Franciscans. This centred in the relative values of Chinese and European-Christian culture and the spiritual authority of Manchu emperors and Roman popes. Although no approximate parallel to this problem occurred in Japan, the results in both countries were the same: Christianity and western influence suffered a serious setback.

Contemporaneously with this essentially spiritual and intellectual struggle between China and the west, other difficulties more material in nature were occurring. The Dutch, who had contributed to the collapse of Portuguese influence in Japan, themselves suffered in China at the hands of the Portuguese. Attempts of the Dutch East India company to trade at Canton in 1604, 1607 and 1653 were blocked from Macao; the Dutch attack on that Portuguese stronghold in 1622 was disastrously repulsed; the company's missions to Peking of 1655, 1665 and 1795 effected little of value. Consequent upon their repulse from Macao, the Dutch established themselves (1624) on the primitive island of Formosa whence they were expelled (1662) by Koxinga (Cheng Ch'eng-kung), an adherent of the recently conquered Ming dynasty. Against Koxinga the Hollanders aided the Manchu (Ch'ing) K'ang Hsi emperor (1662–1722), in return for which they were rewarded by having their country listed among the vassals of Peking and by little else.

The western Europeans of the 16th and following centuries approached the far east from the west and south by way of the sea. The Russians approached overland from the west and north. Russia was the first European power to fight—and lose—a war with the Manchu empire and the first to enter into treaty relations with it. In two generations, approximately 1581–1639, the Muscovites pushed across northern Asia, thereby becoming an important factor in the far east. The northern frontiers of the Manchu-Chinese empire not being precisely defined, hostilities were caused by the encroachments and aggressions of the Russians in the Amur river valley. The treaty of Nerchinsk was negotiated in 1689. Russia withdrew from its outposts behind the Argun river and the watershed of the Amur. Transfrontier trade was arranged, and extraterritoriality in part was to be administered by both parties. The form, as well as the content, of the treaty implied equality of the contracting states. Except for provisions in art. v of the Kyakhta treaty of 1727, relations between Russia and China remained essentially unchanged from 1689 to 1858–60—although during the years 1789–91 plans were formulated for the seizure of the Amur valley and possibly Japan as a means of aiding Kamchatka and developing the fur trade. But by the Nerchinsk treaty the Russians were cut off from convenient entrance to the Pacific and from easy access to the marts of eastern Asia. This made it extremely difficult for Russia to establish permanent settlements in its easternmost provinces and to participate readily in the trade and conquest of the far east until after the middle of the 19th century.

The 19th Century.--Although the Portuguese were the first Europeans in modern times to have relations with China and Japan, it was not they but the English and the Americans who, mainly in the 19th century, opened those states respectively to world intercourse. During the middle and later years of this period the far eastern problem became increasingly acute, largely as a result of political and military weaknesses and confusion which prevailed in eastern Asia and of the effects upon western Europe, particularly Great Britain, and later upon the United States, of the Industrial Revolution. Britain's need for raw materials at home and markets for manufactured goods and investments abroad induced that country to take the lead in "opening" China. This was accomplished ultimately by war, in and after 1839, consequent upon more than two centuries of peaceful relations.

From 1635 various diplomatic attempts were made by England to establish intercourse with China on a basis of equality between nations with prevention or removal of irritating exactions upon westerners and extreme limitations upon their trading and religious activities. The mandates from the Ch'ien Lung emperor (1736–96) to King George III, in connection with the embassy of Earl Macartney, 1793, indicate the conflicting aims and viewpoints of the governments concerned at that time and later. The English ruler was commended for his "respectful humility" in sending a "memorial and tribute." The request that an English envoy be permitted to reside in Peking was refused, it being disclosed that China itself had no desire to be represented abroad. "Swaying the wide world, I have but one aim in view, namely to maintain a perfect governance . . . Our dynasty's majestic virtue has penetrated into every country under Heaven and Kings of all nations have offered their costly tribute by land and sea. As your Ambassador can see for himself, we possess all things. I set no value on objects strange or ingenious, and have no use for your country's manufactures." China's goods, however, "are absolute necessities to European nations"; therefore, "as a signal mark of favour" trade might be carried on at Canton — but not, as the English had asked, at "Ningpo, Chusan, Tientsin and other places . . . ," including storage of goods at Peking. As to the propagation of Christianity: "The distinction between Chinese and barbarian is most strict, and your Ambassador's request that barbarians shall be given full liberty to disseminate their religion is utterly unreasonable." Arrogant in tone as the Ch'ien Lung mandates might appear, they no more than manifested the indisputably unique position of the ruler of the Manchu empire and of that vast area's civilization and self-sufficiency.

Another aspect is worthy of note: throughout the documents is indicated the emperor's complete. if intuitive, comprehension of the principle of western international law embodied in the most-favoured-nation clause. For example, "Consider, moreover, that England is not the only barbarian land which wishes to establish relations with our civilization and trade with our Empire: supposing that other nations were all to imitate your evil example and beseech me to present them each and all with a site for trading purposes, how could I possibly comply?"

Having dispatched to China an envoy whose conveyances inland bore flags marked "Ambassador bearing tribute from the country of England," and who presented gifts ("tribute") to the imperial court even though he did not perform the kowtow. Britain was now definitely rated a vassal kingdom. Lord Macartney, however, equally well informed of his own country's strength and of China's weakness in defense forces, was fearful that war would not only upset for an indefinite time the trade in tea and woolens but would also bring Russia into the fray. He therefore concluded that peaceful relations with China were best. For almost half a century longer, despite increasing friction over impositions and limitations upon its trade, England maintained peace with the Manchus and their subjects — as, in general, did the United States from the beginning of its intercourse with them in 1784 to the dissolution of the empire in 1911–12.

During 1839–42 and 1856–60 London took the lead in challenging Manchu-Chinese pretensions to "sway the ten thousand kingdoms," and in insisting upon recognition by Peking of the western state-equality concept. Notwithstanding, London came increasingly to fear collapse of the Manchu empire with inevitable wide-scale confusion and tended fundamentally, almost as definitely as did Washington, to aid the Manchus to maintain their dynasty.

To the previously indicated causes for friction lying back of the first (1839–42) and second (1856–60) Anglo-Chinese wars— in the latter of which France participated — the opium trade must be added. From the 10th century at least the Chinese were acquainted with the medicinal value of opium poppy seeds; from the 15th century opium itself was manufactured in China. Foreign, in contrast to native, opium was imported into China first by the Portuguese, later by other westerners including English and Americans. Until April 22, 1834. the English East India company held a monopoly on English trade with China. Following a precedent established by the Mogul rulers of India, the company began farming out opium in Bengal in 1773, in which year the drug was first imported from Calcutta into Canton. Seven years later the company assumed a monopoly of the Anglo-Chinese trade in the commodity. Determination of the west to have Chinese teas and other products; light demand by the Chinese for western products including English woolens; unwillingness of westerners to drain their lands of and load their ships with silver bullion and specie to pay for Chinese goods; the high value of opium in small bulk and its popularity for purposes of smoking; these explain the phenomenal growth of the opium trade despite the issuance of Manchu imperial antiopium edicts from 1729 on, edicts which were ordinarily disregarded by native officials and nonofficials and aliens alike. Important, however, as was opium in contributing to the outbreak of hostilities in 1839, the war itself, as with that of 1856–60, was basically one between two worlds and two differing conceptions of international relations.

The treaty of Nanking, signed Aug. 29, 1842, between China and Britain opened 100 years of relations between the west and the extreme east based on written agreements. This was followed within a few years by treaties and other types of agreement between China and the United States, France, the kingdom of Norway and Sweden, the German confederation, Russia, Japan and other states. Among the developments of outstanding importance from the wars, ensuing negotiations and the treaties and agreements were: (1) the cession of Hong Kong to Great Britain; (2) the opening first of Canton, Amoy, Foochow, Ningpo and Shanghai, and after 1860 of other coastal and interior cities, as treaty ports for residence and trade; (3) the right of foreign nations to appoint consuls at treaty ports; (4) uniform tariffs of about 5% on most imports and exports; (5) equality of foreign with native officials of corresponding ranks; (6) most-favoured-nation treatment (*q.v.*); (7) extraterritoriality; (8) toleration of both Roman Catholic and Protestant forms of Christianity; (9) legalization, by the provincial and the imperial governments of China, of the opium trade both before and by the treaties of 1858; (10) the residence in Peking after 1860 of foreign envoys; (11) the right of aliens to travel with passports — but not to reside — and of missionaries to hold property, reside and carry on their activities in the interior, *i.e.,* outside of treaty ports, after 1860; (12) the formation of the imperial maritime customs service under western (predominantly British) administration; (13) the legalization of study of the Chinese language by foreigners.

Advance of British power northward in eastern Asia contributed immediately to a renewal of Russian pressure southward. Anglo-Russian rivalry in the far east was but a projection of that in Europe, the near east and the middle east. If the British were to control the deltas — and possibly more — of the chief rivers of China proper why should they not advance to the Amur? In 1847 Tsar Nicholas I appointed Nicholas Muraviev to the office of governor general of eastern Siberia. Three years later Muraviev transferred the Russian naval base from Okhotsk to Petropavlovsk on Kamchatka. On an exploratory voyage, by order of Governor General Muraviev, G I Nevelskoi, a naval officer. discovered that Sakhalin is an island and that therefore the Amur is accessible from the south and not alone from the north as the Russians had previously supposed. Advancing about 20 mi. up the Amur, Nevelskoi raised his flag and established, in 1850, the port of Nikolayevsk. In 1853 he claimed Sakhalin. Meanwhile, he pushed south, establishing posts on the coast of the mainland practically to the border of Korea. Events taking place at this time in Europe foreshadowed the Crimean War and in Jan. 1854 the tsar gave Muraviev complete freedom of action in eastern Siberia. Fearing attack upon Petropavlovsk, the governor general, disregarding Chinese protests, immediately established steamers on the Amur to connect with Kamchatka. This was the first occasion on which the Amur had been traversed by Russians since 1644.

In 1854 an Anglo-French fleet twice attacked Petropavlovsk and was repulsed with severe losses. These victories strengthened Muraviev's hand in his negotiations with Manchu-Chinese officials, as did the transfer of the naval base from Petropavlovsk to Nikolayevsk and the transport down the Amur of several thousand Russian subjects for colonization of the coast. He was not, however, able to obtain the signing (May 1858) of the treaty of Aigun until after the defeats to China administered by the Anglo-French allies (1856–58), and then only by the double persuasion of having on the Amur sufficient force to advance to Peking and of pointing to the danger of England's seizure of that river. By this agreement Russia's sovereignty over the northern left bank of the Amur nas recognized, as was China's over the south bank as far as the Ussuri. The territory between the Ussuri and the sea was to be jointly held for the time. Navigation of the two rivers and the Sungari was to be limited to vessels of the tao empires. In June 1858, by the treaty of Tientsin. which contained the most-favoured-nation clause, Russia obtained through diplomacy all that England and France had won through war. particularly treaty-port rights, including that to trade with China by way of the sea and not as hitherto, merely overland by way of Kyakhta. Following the Anglo-French march on Peking in the autumn of 1860, Russia by additional diplomacy and again without use of arms, obtained on Nov. 14 a convention ceding the territory between the Ussuri and the sea. This became the maritime province of Siberia. In the preceding July (1860) Muraviev had ordered the occupation of the site which was named Vladivostok. To the further annoyance of Japan, Russia's far eastern naval base was moved in 1872 to Vladivostok from Nikolayevsk.

Not alone in farthest Asia did Russia consolidate its position in 1860. By the Peking convention of Nov. 14 Russia was permitted to trade and open consulates in Outer Mongolia and Sinkiang at Urga (Ulan Bator) and Kashgar (Shufu). Continued pressure from the north and northwest upon China, Korea and the kingdom of Japan followed. Rebellions against Chinese rule in Sinkiang in 1864 and 1866 offered opportunity to Russia, in 1871, to occupy Ili. Ten years later, as a result of China's readiness and ability to fight Russia if necessary, the treaty of St. Petersburg was ratified. By this treaty the greater part of the occupied territory, including the most strategic passes, was returned to China in exchange for an indemnity and permission for Russia to open consulates and trade and for Russians to reside in certain cities of Sinkiang and Mongolia. Expansion of Russian trade in the vast territories as far as the Great Wall was also permitted.

In its relations with France regarding the old Xnnamite empire, China was less fortunate. From 1787 a degree of interest in Annam was from time to time evinced by France. Between 1843 and 1857 several expeditions were sent to avenge the deaths of Roman Catholic missionaries. From 1858 to 1862, France and Spain waged war upon Annam which resulted in the cession to France of Saigon, three of six Cochin Chinese provinces and the island of Poulo-Condore (Pulo-Condor) ; a promise in perpetuity by the Annamite emperor to cede territory to no poner other than France; and the payment to France and Spain (which had sent a squadron from Manila) of an indemnity. In 1863 France supplanted Siam and Annam as protector of Cambodia. Four years later the remainder of Cochin China was swallowed to give France control over the outlets of the Mekong river.

France's determination to penetrate the southwestern provinces of China by way of the Red river route led to negotiation of the Franco-Annamite treaty of Saigon in March 1874. Ignoring the vassalage of Annam to China, France recognized the complete independence of Annam and promised protection against external aggression and internal disorder. China, however, continued to assert its suzerainty over Annam, and Franco-Chinese relations steadily deteriorated. By the treaty of Hué, Aug. 25, 1883, Annam was forced to recognize and accept the status of a French protectorate and to agree that all foreign relations, including those with China, should be controlled by France; territory was ceded to French Cochin China; Tongking was put under the administration of French residents; the customs and public works of Annam were brought under French control; French military posts were for an indefinite period to control the course of the Red river. Hostilities between the rival suzerains began in Dec. 1883; after alternating with desultory resorts to diplomacy, they ended in April 1885. When finally, after an expenditure by France of 344,000,000 fr., the treaty of Tientsin was signed on June 9, 1885, the suzerainty of China over Annam was surrendered; the frontier between China and Tongking was delimited in favour of France; and trade over the frontier. which Peking had previously forbidden, was granted.

The results of the Franco-Annamite-Chinese imbroglio of 1858–85 served as a lesson to Japan, which was then being reopened to international intercourse. During the period of Japan's closure, of Russia's overland approach to China and the Pacific and of the western European-American maritime approach. the Pacific ocean routes to Asia had been of minor importance. Transcontinental expansion of the United States; sustained American interest in the present and future markets of China and the potential markets of Japan; application of steam to ocean-going vessels with consequent need for coaling stations; rebuffs and insults to American civilians and naval officials who had called at Japanese ports; mistreatment of shipwrecked Americans cast up on the shores of the archipelago; all these lay back of the Matthew C. Perry expedition of 1853–54.

Long before Perry's arrival, a few Japanese modernists had advocated the reopening of their country. Russians, Dutch, English, French and Americans had also attempted in a variety of ways to persuade the Tokugama officials to change their policy on closure. Had the Fillmore administration made no attempt, or had it failed, Japan would still have been opened. voluntarily or involuntarily, within a comparatively short time. The factor of outstanding significance was. accordingly, not the time but the agent. The United States desired friendship and trade with Japan as it did with China, and it had no more desire to witness the disintegration of the one than of the other. Furthermore. the United States, unlike the western European powers and Russia, was not considered powerful enough to threaten the sovereignty of the independent states of eastern Asia. Japanese-American relations in their first half century were characterized by friendliness.

The Perry treaty of Kanagawa, March 31, 1854, laid the groundwork for the superstructure of foreign rights and interests—essentially paralleling that in China—which limited the sovereignty of Japan for two generations and more. The reactions of Japan to the westerners and their treaties were notably different from those of China Japan was motivated by no deeper admiration and affection for the interests and actions of aliens within its borders than was China, but it set to work in 1868 to construct a powerful government able to meet the requirements of the west without further sacrifices of sovereignty. Japan simultaneously safeguarded the ages-old spiritual core of its life while at the same time modernizing its institutions and working for revision of the treaties that infringed upon its rights as a sovereign nation. At the same time its leaders began to outline a national policy of expansion that was calculated to make Japan the leading nation of the far east.

In Japan the year 1871 marked the passing—in law if not in national thought—of feudalism. The ministry of education was also reorganized and diplomatic missions were dispatched to China and the west. The mission of Lord Tomomi Iwakura to the United

States and Europe (1871–73) was primarily "to study the institutions of the civilized nations, adopt those most suited to Japan, and gradually reform our government and manners, so as to attain the status equal to that of the civilized nations." Little or nothing was accomplished by this mission in obtaining the revision of treaties, but much was gained from the knowledge of conditions in the west which its members carried home. Shortly thereafter, Tokyo took the step, unprecedented for an eastern Asiatic government, of establishing permanent legations in five western countries. This move helped to break down the co-operative policy of European diplomats in the Japanese capital, as Japan's problems were brought directly to the attention of the western governments.

On Sept. 13, 1871, Japan signed at Tientsin a treaty which—since the western powers had treaties with the Manchu empire—was, from the viewpoint of Tokyo, better than no treaty, but which was nevertheless disappointing. Formulated on the assumption of equality of the contracting parties, it was no more satisfactory to China, longtime suzerain of Japan, than to the former vassal intent on "standing with European countries" on a plane superior to that occupied by China. The terms were meticulously reciprocal—and the most-favoured-nation clause was not included. To the momentary consternation of those European adventurers and statesmen who were as assiduous as most of the Japanese, and for the nonce more experienced, in "protecting" the Manchu empire. art. ii of the treaty of 1871 declared it to be "the duty of each [of the contracting parties] to sympathize with the other, and in the event of any other nation acting unjustly or treating either of the two Powers with contempt, on notice being given [by the one to the other], mutual assistance shall be rendered or mediation offered for the arrangement of the difficulty, in fulfillment of the duty imposed by relations of friendship." Instead of following a policy in consonance with this sentiment, Japan set out immediately to wrest leadership in the far east from China, to seek a dominating position in China's foreign relations and to limit as much as possible the influence of the western nations in the affairs of eastern Asia.

While China resorted first to passive, and then. at the turn of the century, to madly active resistance to aliens and the unilateral treaties, Japan patiently used diplomacy through the years 1871–94. In London, on July 16, 1894, one week before the outbreak of war with China, Tokyo succeeded in signing with Great Britain what served as the master treaty of a series providing for gradual removal of limitations upon Japanese sovereignty which went into force simultaneously in 1899. Consular jurisdiction ended in 1899. The conventional tariff remained in force until July 1911; and in March 1937 the powers finally relinquished perpetual leases in the former foreign settlements.

Europeans sought control of eastern Asiatic shores by seizure first of delta areas and river ports, and the Japanese did likewise with the archipelagos and islands controlling the sea approaches to the eastern coast of Asia. From 1868 they officially manifested what they themselves termed a "peculiar" interest in Korea. the mainland territory nearest them. Fear and anger were aroused by the Russian invasion of Sakhalin. but not until after the "restoration" of the tennō (emperor) and the organization of a new government after 1867–68 was Japan able to focus attention upon the complicated Russian problem. Finally, a treaty was signed on May 7, 1875, by which Japan and Russia relinquished their respective claims to Sakhalin and the Kuril Islands. Tokyo rejoiced in an agreement signed on the basis of equality with a power which was considered European, and for 30 years the problem of Sakhalin was shelved.

The Luchu (Ryukyu) Islands between Japan and Formosa had for centuries been vassals of both China and Japan. In 1871, according to Japanese charges, shipwrecked Luchuans were killed by Formosan aborigines. This "incident" offered an opportunity to Tokyo to break Luchuan vassalage to China, to foreshadow a claim to Formosa and to create a precedent followed later in Korea. The king of the archipelago was "invited" to Tokyo and given a Japanese peerage and a pension. Members of the diplomatic corps in Tokyo were informed that henceforth Luchuan foreign relations would be controlled, and obligations met, by Japan. Peking protested, made a feint at military action and, following an ultimatum, signed in Oct. 1874 an agreement of an unprecedented type. The justice of Japan's actions was admitted. and the Manchu empire paid an indemnity. Many of the methods used time and again thereafter were applied by Japan during these years, but to westerners these appeared less meaningful than the unveiling of China's weakness.

While they were attempting to bring the islands off the mainland under their control as rapidly as possible, Japan's leaders were aiming at the same objective in the Korean peninsula. There the deeds of 16th-century Japanese invaders had by no means been forgotten. Korea was, moreover, scornful of its small neighbour's attempts at modernization, desirous of maintaining closed-door policy as regards both east and west, but satisfied to remain vassal to China, and it treated with contumely Tokyo's overtures in 1868 and the following years. Except for fear of Russian or British intervention. war between the two countries would probably have begun in 1873. As a substitute for hostilities. Japan imposed independence upon Korea by the treaty of Kianghwa, Feb. 26, 1876, thereby following French precedent established in Annam approximately two years earlier. Little attention was paid by the west to this indication of Tokyo's determination to upset the balance of power in the far east. Henceforth until its annexation by Japan in 1910 Korea was a paralytic upon the international highway.

In part incidental to the buffeting of Korea; in part as a result of Japan's broader aims; in part because of ancient differences, nonmaterial as well as material, between Chinese and Japanese. war broke out between China and Japan in 1894–95. Japan's easily won victory led to the treaties of April 17, 1895, and July 21. 1896. Japan. by virtue of the most-favoured-nation clause plus rights not hitherto granted to aliens, obtained a position vis-à-vis China stronger than any hitherto held by a western power. Formosa and the neighbouring Pescadores were ceded to Japan; thus the maritime approaches to China were brought under Japanese control and Japan obtained an important base from which to advance indefinitely southward and westward. Likewise ceded—temporarily—was a considerable section of southern Manchuria including mainly the Liaotung peninsula. Indemnity was paid which strengthened Japan's preparation for its second challenge to the west.

Defeat of China and annexation by Japan of territory on the mainland upset the diplomatic equilibrium. Great Britain, having found it impossible to persuade the continental European powers and the United States to intervene in the struggle against Japan, concluded that the friendship of Nippon would be valuable in obstructing Russia's advance. The foundations were laid for the Anglo-Japanese alliance of 1902; and China was conditioned for the secret defensive alliance with Russia of 1896. This alliance, helpful to Russia during the next eight years in its expansion into Manchuria, did China no more good than had art. ii of its treaty of 1871 with Japan. Russia and Germany were determined that Japan must not advance onto the continent, especially in the quarter earmarked as their own preserve, and, with France, they intervened to prevent Japan taking over Manchurian territory. Wounded and furious, Tokyo permitted Peking to pay an additional indemnity and relinquished, temporarily, its hold on Liaotung.

The Early 20th Century.— That nature abhors a vacuum has rarely been more clearly illustrated than during the years 1895–1903 in the scramble for concessions in China and the ensuing Boxer tragedy. Among the concessions made by the Manchu government were the leases, with additional rights, during 1898 of Kiaochow in Shantung to Germany; of Port Arthur (Lii-shun) and Dairen (Ta-lien) on the Liaotung peninsula in southern Manchuria to Russia; of Kwangchowwan in Kwangtung to France; of Weihai-wei in Shantung and the Kowloon peninsula close to Hong Kong to Great Britain. The Manchu empire would almost certainly have been divided by the continental European powers had they been able to agree among themselves and nith Great Britain and the Cnited States. This being impossible. the form of empire and part of its content were preserved, largely through the operation of the power balance. Japan was not yet in condition "to put meddling poners in or [out of] their places" and to attempt to control all of China. Great Britain and the United States had more to gain from trade with the empire as a whole than from exploitation of one annexed part, while at the same time being excluded from the parts annexed by other powers.

The year 1898 marked the flood tide of concession bagging in China and also the transformation of the United States into a Pacific and Asiatic power by the annexation of the Hawaiian and the Philippine islands. In September and November of 1899, partially at the instigation of London, the more than century-old U.S., and English, policy in China of most-favoured-nation treatment (meaning equality of opportunity — but in practice not solely — with reference to trade and commerce) was re-enunciated. Henceforth it was known as that of the open door. The corollary policies of territorial integrity and administrative entity were laid down officially by Secretary of State John Hay on July 3, 1900, during the course of the Boxer outbreak. These policies were formulated primarily in defense of United States (and British) interests; incidentally they were favourable to China and were formally recognized by that state in the nine-power Washington treaty of 1922.

The struggle over China south of the Great Wall was one open to all. The simultaneous struggle for Manchuria and Korea was a relatively more exclusive affair waged between Russia and Japan. Back of the latter, but not very far back, was Great Britain, an ally after Jan. 30, 1902. Great Britain stood by when Japan, having been unsuccessful in persuading Russia to divide Manchuria and Korea with it, struck without declaration of war on Feb. 8, 1904. By the war of 1894–95 China had been eliminated from Korea; by that of 1904–05 Russia was likewise eliminated. Moreover, it was thrust from southern back to northern Manchuria and required to cede to Japan the southern half of Sakhalin. As it had after 1871 so after 1905 Japan made clear its decision to "stand with European countries" in exploiting China rather than, in co-operation with the United States, to aid China to modern nationhood. By this choice Japan came increasingly to look upon China. Europe and the United States as basically its enemies instead of its friends, actual or potential.

Throughout the course of the Russo-Japanese War the neutrality of the United States was friendly to Japan. In April 1905, consequent upon Tokyo's intimation that the U.S. president's good offices were desired to end the war, Theodore Roosevelt stipulated that Japan should maintain the open door in Manchuria and restore that area to China. To this Jutaro Komura, minister for foreign affairs, agreed. Both provisions mere incorporated into the Portsmouth treaty. On Aug. 12, before the signing of the treaty on Sept. 5, the Anglo-Japanese alliance was renewed. By the secretly negotiated Taft-Katsura executive agreement of July 29, 1905, which was based perhaps on President Roosevelt's fear that Japan might attack the Philippine Islands and Japan's desire that the Washington government should maintain a complaisant attitude with respect to Japanese-Korean relations, the United States became a silent partner in the Anglo-Japanese alliance until the Roosevelt administration came to an end on March 4, 1909. The second Anglo-Japanese alliance and the U.S.-Japanese agreement contributed directly to the annexation of Korea.

In 1907, two years after Portsmouth, Japan signed agreements with France and Russia providing for continuance of "sphere-of-influence" and "special-interest" policies in China, a practical nullification of the open-door policy. Successive agreements between Russia and Japan foreshadowing their ultimate absorption of Manchuria and Inner and Outer Mongolia were signed in 1910, 1912 and 1916, the last a secret treaty of alliance which related to "China" and not merely to its dependencies. The 1917 revolution in Russia rendered this secret alliance valueless.

From the ending of the Russo-Japanese War to the outbreak of World War I in 1914, Russia. France, Great Britain and Japan dominated China in almost complete disregard of the United States and its open-door policy. Abdication of the Manchu dynasty (1912) and the establishment of a republic in place of the monarchy considerably aided occidental — including U.S.—and oriental imperialists of all types; *e.g.,* the land-hungry British in Tibet as well as the French. Russians and Japanese elsewhere, the railway concessionaires, exploiters of mines and other sources of raw materials, investment bankers and others.

World War I and After. — Japan took advantage of Europe's absorption in World War I to try to "become the chief nation of the orient" and the western Pacific. The Germans were expelled from Kiaochow following a declaration of war, but Japan consistently refused to send military forces to Europe; the German islands in the Pacific north of the equator were seized; Japanese and British fleets eliminated German naval forces from the Pacific and the Indian oceans; the Japanese naval forces performed valuable services in the Mediterranean in exchange for Britain's promise to support Tokyo's claims to become Germany's heir in the far east.

Tokyo wanted more than Germany's possessions in China and the South seas. In the autumn of 1914 there appeared another of the revelatory documents which so often marked Japan's advances to empire. Known as the Black Dragon memorandum, this one called on the government to "decide upon a course of action towards China which shall be practical in execution." The means was to be "a defensive alliance with [China] under secret terms" by which political, financial and military control of the sometime suzerain would fall to the sometime vassal. With characteristic abruptness Japan presented to Pres. Yuan Shih-k'ai, on the night of Jan. 18, 1915, 21 demands in five groups making clear, among other things, Japan's will with respect to: Shantung, South Manchuria and eastern Inner Mongolia; the future joint control of the Han-yeh-p'ing (iron-mining and iron-smelting) company; the nonalienation of Chinese coastal territory or waters to a "third power"; Japanese Buddhist "missionary propaganda in China"; the employment of Japanese political, military and financial advisers; Japanese railway construction; purchase of munitions from Japan; and Japanese priority in the lending of funds to China.

Of the powers, the United States was the only one in a position to challenge the Japanese actions. Following the dispatch of an ultimatum by Tokyo to Peking, both governments were informed by Washington that it could not "recognize any agreement or undertaking ... impairing the treaty rights of the United States and its citizens in China, the political or territorial integrity of the Republic of China, or the international policy relative to China commonly known as the Open Door policy." Here was clearly foreshadowed the American nonrecognition doctrine announced by Secretary of State Henry L. Stimson on Jan. 7, 1932, as a result of Japan's later aggressions in Manchuria. Nevertheless, Secretary of State William Jennings Bryan had earlier declared that with respect to "Shantung, South Manchuria and east Mongolia, the Cnited States frankly recognizes that territorial contiguity creates special relations between Japan and these districts."

Two Sino-Japanese treaties, with accompanying exchanges of notes, were signed on May 25, 1915, by which Peking acceded to part of the demands, others having been postponed for later consideration. The position of Japan in regard to South Manchuria, eastern Inner Mongolia, Fukien and the Han-yeh-p'ing company was strengthened. Although Japan did not obtain all it had demanded. its aims had been made abundantly clear; these aims, and more, were held as goals during the next quarter century. Not ratified by the Chinese parliament, as constitutionally required, the treaties of 1915 were never considered valid in China by either government or people. Despite Tokyo's objections China entered World War I in Aug. 1917. Thereby it obtained membership in the Paris peace conference and ultimately in the League of Nations.

The peace conference of 1919 (see PARIS, CONFERENCE OF) proved as rich a seedbed for war as any in world history, the east equaling the west in the gravity of issues involved. However, many of the factors contributing to renewal of hostilities long antedated the meeting in Paris; *e.g.,* Sino-Japanese antagonism and the demand for racial equality advanced by the Japanese. In general they were successful in their claims as heir to Germany in Shantung and the northern Pacific islands. The mandating of these archipelagos to Japan constituted another advance southward by water to balance land extension westward. On the racial question the Japanese and the other "coloured" peoples of the earth were defeated.

The rebuffs sustained by China at Paris brought to the fore a strong feeling of resentment against the west. Elsewhere in eastern Asia frustrated national feelings also were powerfully stimulated by Wilson's promise of "self-determination." Many thousands of Koreans made clear their attitude toward their Japanese overlords by a wide-scale peaceful demonstration in 1919 in favour of freedom. The relations of the Indochinese and their French masters improved despite the general attitude of Paris that liberty, equality and fraternity were better suited to French citizens than to Asian subjects. In 1927 the government council for Indochina was reorganized on a membership basis of 25 natives to 35 aliens. In Siam significant steps toward sovereignty were taken when new bilateral treaties were negotiated between 1920 and 1926 to replace the former unilateral treaties.

The Bolshevik revolution of Nov. 1917 caused confusion throughout the Russian empire, dissolved the Russo-Japanese alliance of 1916 and gave the expansionists of Japan an opportunity for the invasion of Siberia. In May and September 1918 the largely Japanese-controlled Peking government signed military and naval pacts with Tokyo for joint operations in Siberia. In July Vladivostok was seized by the allied and associated powers. Japan, France. Great Britain and Belgium desired intervention and at length the Wilson administration proposed to Tokyo a joint Siberian expedition. Contrary to preliminary agreement, Japanese forces greatly outnumbered those of any other intervening power and friction between the United States and Japan appeared for a time before the Armistice in Europe to threaten hostilities. Early in 1920 all intervening troops except those of Japan were withdrawn; the Japanese forces were increased to strengthen their hold on the Transbaikal and maritime provinces and to enable them to seize the northern half of Sakhalin. which they held until the spring of 1925. Intervention, particularly the actions of the Japanese, directly contributed to reunification of Russia under the Bolsheviks. Japanese forces were finally withdrawn from continental Siberia in the autumn of 1922.

Relations between the United States and Japan were not improved by their co-operation in Siberian intervention but were later somewhat brightened by the treaties and agreements negotiated as a result of the Washington conference (*q.v.*). This meeting of the representatives of nine states in or having important interests connected with the far east—but excluding the Russians—was convened in the hope of solving problems threatening the peace of east and west alike. Outstanding among the questions considered were those of U.S.-British-Japanese naval rivalries, renewal of the Anglo-Japanese alliance of 1911 and Sino-Japanese-occidental relations. From the sessions, held Nov. 1921 to Feb. 1922, emerged 7 treaties and 12 resolutions (*see* WASHINGTON, TREATIES OF). Two other treaties were signed outside but during the period of the conference. These mere the Sino-Japanese Shantung agreement and the U.S.-Japanese settlement of the issue over Yap, an important cable station in the Pacific.

The Anglo-Japanese alliance. as unpopular in parts of the British empire as it was in the U.S. (now that Japan rather than Russia appeared to threaten the balance of power in eastern Asia), was superseded by the four-power Pacific treaty. Great Britain, Japan, France and the United States each agreed for a period of ten years to respect the others' position in the Pacific. Japan was considerably strengthened by this agreement, but naval rivalries were temporarily allayed by it and by the five-power naval treaty which fixed a capital-ship ratio of 5–5–3–1.67–1.67 for the United States, Great Britain, Japan, France and Italy respectively, and restricted fortifications in the Pacific.

China participated in the Washington conference in the hope of solving its external problems, particularly those related to limitations on its sovereignty imposed by the unilateral treaties and the treaty-port system. But the position of the foreign powers in China was little affected. The continued confusion in China and the limited evidence offered by the governments and people of that country of their ability to meet the obligations of a sovereign state led the western nations to maintain their special privileges.

By the Sino-Japanese Shantung treaty earlier mentioned, the former German-leased territory of Kiaochow was returned to China—Japan retaining large commercial interests therein and otherwise safeguarding its financial interests in Manchuria. Japan's position was further enhanced inasmuch as the 191 j treaties were fruitlessly protested by the Chinese representatives.

A nine-power "treaty regarding principles and policies to be followed in matters concerning China" was signed on Feb. 6, 1922. The contracting governments, other than the Chinese, bound themselves to respect the sovereignty, independence and territorial and administrative integrity of China and to afford that distracted country opportunity to establish effective rule; also to use their influence toward maintenance therein of the open-door principle. In turn, China undertook for the first time to be guided by this principle. Noble in conception, the nine-power treaty lacked two requisites for a solution of the problems with which it dealt: ability and willingness on the part of the cosignatories, including China, to carry into effect its promises and provisions.

The Washington settlement of 1922 was based primarily upon U.S.-British policies. To a considerable degree it was favourable to China, although the safeguarding there of most of the foreign rights and interests made it clear that that country had failed to attain a majority of its declared objectives. Japan's short-run position was felt to be strengthened but potentially it was weakened —from Japan's viewpoint at least—since an actually independent and strong China must divert Japanese expansion into other channels.

Maintenance of the status quo as desired by Washington and London was unlikely to be long tolerated by Tokyo or Peking or Nanking, and assuredly not by Bolshevik Moscow. Russia's urge to the east and its influence there were about equally marked under tsars and commissars—to the increasing wrath and fear of Japan. No less fear stimulating and wrath inspiring were the development of nationalist-militarist-industrialist-capitalist Kuomintang China and nationalist-militarist-agrarian soviet China, inspired respectively by the U.S. and Britain and by the U.S.S.R. By war and diplomacy Japan attacked both Kuomintang-nationalist and soviet-nationalist China. The Chinese, disunited but determined to recover unity, along with lost sovereignty, territories and national dignities, continued in the third and fourth decades of the 20th century, as they had in times of weakness through the ages, to play off one power or group of powers against another. In the 15 years preceding the outbreak of war in the Pacific in 1937, they made marked progress in removing some of the causes of domestic weakness that had forced them to fall back on such uncertain means of nrotection.

Time after time during the preceding four centuries the far eastern problem had reflected the power struggles of Europe. This was the case with Russo-Chinese relations after 1920, when, having failed to bolshevize Europe, Lenin and his co-workers attacked the western nations through their Asiatic possessions. In China south of the Wall. in Manchuria, in Outer Mongolia and in Sinkiang, the impact of Bolshevism was felt by the Chinese. Tsarist privileges and concessions were largely renounced mhile revolutionary ideology was widely disseminated, and wherever possible the nationalist aspirations of colonial and semicolonial Asia were encouraged. Outer Mongolia was sovietized despite Moscow's recognition of China's sovereignty therein. Throughout the first third of the century the political and social confusion prevailing in China aided both native and foreign predatory elements.

Sun Uat-sen, leading anti-Manchu revolutionary, for a few weeks in 1912 provisional president of the Chinese republic and for 13 years thereafter chief southern opponent of northern Chinese militarists and their Peking governments, strove, while alternately in and out of office in successive revolutionary governments at Canton, to obtain help from the western powers in the implementation of his social. economic and political policies. Disappointed and embittered he turned to Russia early in 1923, and that country, through the third international, sent him political and military advisers and other aid. Reorganized and revivified, the Kuomintang within five years brought most of China under its control, split with and expelled the Russian advisers and established a national government at Nanking. The break between the Kuomintang and the Muscovites in the summer of 1927 marked the failure of the third international's offensive in Asia but it did not end soviet influence in China. This was demonstrated by the sporadic struggles between the Kuomintang and the Chinese soviets during 1927–41, and by the inability of Nanking to eradicate the communist movement as a political and military threat.

Consequent upon Stalin's three five-year plans (1928–42), Siberia — western, northern and eastern — was developed as a potential base of military action. Before these plans could be fully realized, however, Japan's seizure of all Manchuria (1931–32) threatened eastern Siberia, especially rail communications between Moscow and Vladivostok. The Chinese Eastern railway, a product in part of the Sino-Russian secret alliance of 1896, which soviet diplomats had maintained a firm hold on hitherto, was sold in 1935 as a matter of expediency to the Japanese puppet state of Manchoukuo.

Offsetting Japan's advance into northern Manchuria and Inner Mongolia were soviet construction of the Baikal-Amur railway; development of new towns, ports, engineering and industrial projects — conspicuously that of the Angara-Yenisei riverine area — in eastern Siberia; opening in 1932 of the Eurasiatic sea route via the Arctic ocean; double-tracking of parts of the Trans-Siberian railroad; and continued manifestation of Russian interest and influence in Sinkiang, bordering which, not far to the west, the Turkistan-Siberian railway had been completed in 1930.

In 1935 the government of the new commonwealth of the Philippines (preliminary to the attainment of independence by those islands on July 4, 1946) was inaugurated. In that same year, the popular front was adopted by the seventh congress of the third international (*q.v.*). Repercussions of this policy were felt both within China and between China and Japan. Sino-Japanese hostilities were renewed on July 7, 1937. In partial reply to the popular front, and as a precursor to the outbreak of hostilities, the anti-Comintern pact between Nazi Germany and Japan was signed on Nov. 25, 1936. Shortly thereafter adhered to by Italy, this agreement led directly to the triple military alliance of Sept. 27, 1940.

Other events and conditions also made apparent the determination of Japan's militarists to build a new far east consonant with their national mythology and political philosophy. On April 17, 1934, the so-called Amau declaration (after Amau Eiji, a foreign ministry spokesman) was issued. In direct defiance of the open-door doctrine, this declaration enunciated Tokyo's claim to act alone as guardian of "peace and order in eastern Asia," definitely discouraged joint operations by foreign powers in aid of China and expressed determined opposition to their "supplying China with war planes, building airdromes . . . and detailing military instructors or military advisers . . . or contracting a loan to provide funds for political uses." On Dec. 29 of the same year, Tokyo notified of its intention to withdraw from the naval limitation treaty of Washington as of Dec. 31, 1936. A naval race, hitherto avoided, was now begun — immediately by Japan, tardily by the United States — and in less than one year from the expiration of the treaty the U.S.S. "Panay" and three United States merchant vessels were bombed on the Yangtze (Dec. 12, 1937) by Japanese airmen.

Acceptance by Washington of Tokyo's hasty assurance of regret, accompanied by indemnity, contributed to a delay of almost four years before full-dress war broke out between the two chief rivals in the Pacific. This delay permitted U.S. citizens to sell limited quantities of goods on a cash and carry basis to China, and practically unlimited quantities to Japan. The sales to Japan made possible not only that country's sustained attack on China but the destruction, in China, of U.S. lives, property and moral reputation.

World War II and After. — During the years 1938–40 Washington indicated disapproval of Japanese actions in China by loans to China to be repaid in wood oil and tin; by announcing, in Dec. 1938, as if in rebuttal of the Xmau presumption: "This government does not admit . . . that there is need or warrant for any one power to take upon itself to prescribe what shall be the terms or conditions of a 'new order' in areas not under its sovereignty and to constitute itself the repository of authority and the agent of destiny in regard thereto"; by gradually limiting, practically to the point of elimination, exports of commodities needed by Japan's air forces; and by abrogating as of Jan. 1940 the U.S.-Japanese trade treaty of 1911. In China itself the war ground on. Both the nationalists and communists pursued a policy of exchanging territory for time: persevering against Japan through a period of stalemate, exhausting that country while strengthening China and finally counterattacking. Japan, frustrated in China after 1938, decided to seize upon the confusion of western Europe and concluded (April 13, 1941) a five-year nonaggression pact with the U.S.S.R. Despite the opposition of the United States, Japan also decided to effectuate at last its long-meditated policy of advancing into southeastern Asia and the southwestern Pacific. All this brought about increased tension. U.S. Ambassador Joseph C. Grew warned from Tokyo in Jan. 1941 that a surprise attack might be expected. But no agency of government or military authority in the United States was prepared for the Pearl Harbor attack of Dec. 7, 1941. Bitter efforts were made to determine the responsibility for America's unpreparedness, but to little avail.

(H. F. MacN.; D. F. L.)

From 1937 to 1945 China lived in a state of siege. The united front between nationalists and communists permitted both Chinese groups to battle the Japanese while maintaining a truce with each other. After 1941, as the major western powers gradually began to take the lead in the war against Japan, the nationalists and communists became determined to resume their civil war for control of China. Pres. Franklin D. Roosevelt sought by all means to keep China actively engaged in the war against Japan, and continuously worked for the elevation of China to a position of international leadership and heir to Japan as the leading power in the far east. In this policy Roosevelt had neither the wholehearted support of his European allies nor of the Russians, even though all of the antifascist powers recognized and nominally, at least, supported the national government of Chiang Kai-shek.

Chiang (Soviet *Russia* in China, 1957) asserted that "once the war was over, Moscow immediately unleashed its comprehensive plan to conquer China from without and subvert her from within." Though it was not all this simple, Russia certainly took a greater interest in the future of Chinese communism at the end of the war than at the beginning. At the Yalta conference of Feb. 1945, President Roosevelt, under pressure to obtain Russian participation in the war against Japan at the earliest possible date, acceded to a number of Stalin's demands in the far east and promised to secure Chiang's assent. In return for U.S. co-operation, Stalin agreed to conclude a pact of friendship and alliance with the national government of China.

While Russian forces prepared to move against the Japanese in northeastern Asia, a Sino-Soviet treaty was being worked out in Moscow in July 1945. By its terms Russia reaffirmed its formal recognition of the Kuomintang government, its respect for China's full sovereignty over Manchuria and its determination not "to interfere with China's internal affairs." On their side the Chinese agreed to joint ownership of the Manchurian railways, joint use of Port Arthur as a naval base and the opening of Dairen to all nations as a free port. It was also agreed to hold a plebiscite in Outer Mongolia on the question of independence, the result of which was the declaration of Mongolian independence in the fall of 1945.

The final decisions in northeastern Asia, however, were not to be made at the conference table or by voting, but rather by force of arms. While Japan writhed in military defeat, Russian forces carried out an extensive occupation of Manchuria. The surrender of Japan in 1945 was the signal for the opposing forces in China to advance their respective causes. Each side was particularly anxious to gain control over Manchuria, the strategically and economically vital nexus of northeastern Asia. But for the nonce the Russians occupied Manchuria and their inclination was to allow the Chinese communists gradually to take over strategic points and key cities. While the nationalists protested, seconded by dispatches from Washington, no military pressure of consequence could be brought to bear on the firmly entrenched Russians. By the time the Russians carried out a formal withdrawal in the spring of 1946, the Chinese communists had acquired arms, a firm foothold and a staging ground for their subsequent advances into China south of the Wall, where other communist units were already in operation. While Russia gradually moved to the support of the Chinese communists, the United States until 1947 promoted the nationalist cause in international agencies, continuing to give military and technical advice and aid to the Kuomintang armies, and to seek a peaceful solution to the Chinese civil war. The United States also tried to perpetuate the united front by urging both sides to compromise to the point where a coalition government might become viable. To this end Gen. George C. Marshall arrived in China in Dec. 1945 as head of a mediation mission. After a year of frustrating efforts, Marshall gave up his task in despair, concluding that "extremist elements of both sides" made compromise impossible to realize. While Marshall contemplated withdrawal, the United States signed on Nov. 4, 1946, a bilateral commercial agreement with the national government.

The failure of mediation was followed shortly by the withdrawal of U.S. military forces from China. Washington decided to postpone further activities there to concentrate on the containment of communism in Europe. As "the dust settled" in China, it became ever more obvious that time favoured the communists. The Kuomintang government, which had had its chance since 1928, appeared 20 years later to have lost its popular appeal and revolutionary fervour. The communists, attributing most of China's ills to western capitalist exploitation, seemed to offer an opportunity for a fresh start on the road to internal stability, security and independence. Fighting alone, the forces of Chiang Kai-shek were unable to stem the communist advance that was clearly receiving encouragement and stimulation from Russia.

While it may be argued that no amount of U.S. support could have maintained the Kuomintang in power, it is clear that the withdrawal of troops and diplomatic support by the United States in 1947 hastened the collapse of nationalist China. By the autumn of 1949 the communists had taken over intramural China, and the remnants of the Kuomintang forces (numbering about 2,000,000) sought refuge on the island of Taiwan (Formosa), 90 mi. E. of Fukien province.

The proclamation of the People's Republic of China on Oct. 1, 1949, was followed by a complete repudiation of the old treaty structure and the inauguration of a Marxist foreign policy centred on the promotion of world revolution. The United States was clearly identified in Peking's pronouncements as the major "imperialist" enemy and the new regime committed itself to the side of socialism and to co-operation with the U.S.S.R. Peking let it be known that foreign relations in the future would be conducted on its own terms and without reference to China's past commitments. Foreign nationals in China were put under close surveillance, arrested or forced to leave. Diplomatic installations and other foreign properties were seized and strict limitations were imposed on western missionary and educational activities. As a precondition for normal diplomatic relations, Peking demanded from the other nations immediate recognition, severance of ties with the nationalists and China's seat on the Security council of the United Nations.

The first nation to conclude a treaty with the new Peking regime was Russia. On Feb. 14, 1950, the cornerstone in their relations was laid in a bilateral treaty and two subsidiary agreements concluded in Moscow, and notes were exchanged to render null and void Russia's treaty of 1945 with nationalist China. By the terms of these agreements Russia retained a place in the border states, control over which had long been in dispute between the two nations, though the Manchurian railways were to revert to China by 1952. Nominally the treaty was a military agreement against Japan, but in reality it was aimed at "any other state that may collaborate with Japan in acts of aggression." Clearly the prime target was the United States, the country mainly responsible for the occupation and rehabilitation of Japan after 1945. Russia also agreed to advance credits to China, and provisions were made for economic and cultural interchange. Meanwhile, Peking began military action against Tibet to bring that ancient theocracy under its sway before serious interference could come from the outside world.

The future of relations with communist China was hotly debated after 1949 in the UN and among the foreign ministers of the various western countries. In the early months of 1950 Washington pursued a policy of watchful waiting, while Britain and several other western European countries extended legal recognition to the new Peking regime. Russia, in the same period, began to call for the unseating of nationalist China in the UN and for the immediate seating of communist China on the Security council as the government exercising "effective authority" on the China mainland. Any possible success of such efforts was checked by the outbreak of the Korean war on June 25, 1950.

The end of Japanese control over Korea in 1945 brought with it a "temporary" division of the peninsula at the 38th parallel for the purpose of accepting the Japanese surrender. North of this arbitrary line Russian troops carried out the occupation. and south of it U.S. forces disarmed the Japanese and operated under an interim military government. Meanwhile the fires of Korean nationalism, which had been relighted by the spark of hope contained in the Cairo declaration of Dec. 1943 that Korea "in due course shall become free and independent," began to spread both north and south of the parallel. As nationalist leaders jockeyed for position in the ensuing political scramble, the problems of the occupying forces increased. While Koreans tried to stake out their own future, the decision was being taken out of their hands by international arrangements. At the Moscow council of foreign ministers in Dec. 1945 a four-power (United States. U.S.S.R., Great Britain and China) trusteeship mas agreed upon "to prepare Korea for its independence within five years." But this was about all on which Russia and the United States could agree, and after 1945 their military commands went ahead with separate and differing programs designed to lay the foundations for Korea's independent future.

In northern Korea the Russians quickly carried forward a swift economic and social revolution in conjunction with native communist leaders. In the U.S. zone a more gradual program of reorientation was instituted, without much advice or co-operation from native groups. In 1947 the United Nations sent a team to Korea to help in the reunification of the peninsula and to seek ways for bringing an end to the occupation. Despite protests from the Soviet Gnion that it had no jurisdiction in Korea. elections were held in Korea on May 10, 1948, under the supervision of the GN commission. Syngman Rhee and his cohorts emerged victorious from this election, which was conducted mainly south of the parallel, and thereafter went ahead with the organization of a permanent government which claimed jurisdiction over the whole of the country. In the north the communist-sponsored government set itself up on a permanent basis and also claimed to be the legitimate government of the entire peninsula.

The proclamation of the two permanent governments, each claiming the other to be illegal, brought about a local and international stalemate in Korea. Russia recognized and supported the northern government at Pyongyang, and the U.S., supported by the UN. recognized and aided Rhee's government at Seoul. All the parties were dissatisfied by this impasse, and the northern regime sought by propaganda and subversion to undermine Rhee's power. The victory of the communists in China in 1949 encouraged North Korea to even more overt attacks upon its southern rival, culminating in the outbreak of civil war in June 1950.

The armed invasion of South Korea by North Korea was immediately denounced by the Security council of the UN as a breach of the peace. Shortly thereafter C.S. sea and air forces were dispatched from Japan to aid the fleeing South Koreans, and the Security council invoked military sanctions against North Korea. Such a decision was possible because the Soviet Union had temporarily withdrawn from the Security council in an effort to push the UN into recognition of communist China. Officially the communists took the position that no international frontier had been transgressed and that the Korean civil war was legitimately only of concern to the Korean people. Meanwhile U.S. ground forces and British and Australian fleet units were rushed to the scene. Gen. Douglas MacArthur took command of the UN forces nhich fought desperately in the summer of 1950 to retain a toehold in Korea, and which launched a counteroffensive in the autumn that moved swiftly northward.

On the first anniversary of its inauguration, the Peking government warned on Oct. 1, 1950, that it would not stand idly by should "the imperialists wantonly invade the territory of North Korea." MacArthur's forces, nevertheless, continued their northward drive and in mid-October took Pyongyang. By Nov. 1 Chinese "volunteers" in constantly increasing numbers began to appear in North Korea. MacArthur soon proclaimed to the Security council that a "new war," clearly of international magnitude and of greater potential danger to the peace of the rest of the world, was in the process of breaking out in Korea.

The first UN attempt to negotiate the Korean war took the form of an invitation to Peking to send representatives to Lake Success in Nov.-Dec. 1950. While the battle raged in Korea, the Peking delegation charged the United States with aggression in Asia. It was alleged that the United States was the only outside force that persisted in intervening in eastern Asia, that it occupied Japan, that it led the intervention in the Korean civil war and that Washington had resumed its policy of interfering in the Chinese civil war by its decision of June 27, 1950, to seal off the island of Formosa from the mainland. On its side the United States took retaliatory measures in Dec. 1950 by seizing Chinese communists' assets in the United States, by proclaiming an embargo on trade with the China mainland and by advancing additional credits and support to Chiang Kai-shek. On Jan. 20, 1951, the United States introduced a resolution in the UN asking that communist China be branded an aggressor in Korea. Though the Arab-Asian bloc called for compromise, the general assembly on Feb. 1 approved the U.S. resolution, thereby declaring Peking the aggressor in Korea. At this point it seemed as if the war in Korea must settle down to a war of attrition that might at any time precipitate a general war.

In the spring of 1951 the "great debate" over possible future action raged in the U S. MacArthur and a highly vocal minority wanted to bring the stalemate to a quick end by an attack on China directly. The Truman administration, acutely aware that U.S. policies were not winning approval in western Europe or with the Arab-Asian nations, preferred to follow a less drastic policy. The climax in the "great debate" came with the dismissal of MacArthur on April 11, 1951. Though the military stalemate in Korea continued, both sides agreed in the summer of 1951 to inaugurate negotiations for a truce. After repeated deadlocks over a demarcation line, truce teams and exchange of prisoners, a truce agreement was finally arrived at on July 27 (Korean time), 1953.

The Korean war lasted more than three years; the truce talks dragged on for the last two years while the fight continued. Casualties were high for all the parties, especially the Koreans. Over 1,000,000 persons were killed, 2,500,000 found themselves homeless and property damage was estimated at more than $1,000,000,000. Korea remained disunited, devastated and hungry. Perhaps the greatest positive accomplishment of the war was the UN's success, costly as it was, in halting defiant aggression and proving to the Peking regime that it could not act unilaterally and arbitrarily without fear of military retaliation.

While waging war in Korea, the United States was also occupied with bringing the occupation of Japan to an end and preparing Japan for reinstatement in the family of nations. The occupation that had begun with the surrender of Japan in Aug. 1945 went through two phases. Originally it was the objective of MacArthur and the SCXP (supreme commander Allied powers) organization to demilitarize, democratize and re-educate Japan. Beginning in 1948, as conditions in Europe and China became more favourable to the spread of communism, the major objective of the occupation came to be the economic rehabilitation of the country. Though Australia, the Philippines and others protested, the U.S. concern with the spread of communism led MacArthur to adopt policies which aimed at making the Japanese economy viable in an effort to keep Japan from following China down the road to communism.

The United States also took the lead in negotiating a peace treaty with Japan as a cornerstone for future relations. MacArthur proclaimed in March 1947 that Japan was ready for a peace treaty. Immediately a conflict developed between the Cnited States and Russia over procedure, and so for about two years little was accomplished. The spread of communism in eastern Asia led the United States in 1949–50 to press for a Japanese peace treaty, whether or not the communist states were agreeable. Though the Japanese socialists opposed a "one-sided treaty" from the beginning, Washington in the spring of 1950 inaugurated diplomatic conversations and written exchanges with those noncommunist nations which had waged war against Japan. The outbreak of the Korean war in the summer of 1950 highlighted for even some of the most skeptical countries the importance of working out a clear-cut peace formula with Japan. Over the course of the following year a treaty was worked out that was found acceptable by most of the noncommunist nations.

From Sept. 4 to 8, 1951, Japan and its former enemies met in San Francisco to sign the treaty and accompanying agreements. The Russians attended the conference to register their protests, but they refused to sign the treaty. Forty-nine nations, including Japan and a protesting Indonesia, finally signed the document that formally brought to an end the state of war. The treaty acknowledged the return to Japan of full sovereignty over its four main islands and their territorial waters. But Japan was required to recognize the independence of Korea and to renounce all rights to Formosa, the Pescadores, the Kurils, south Sakhalin, the former mandated islands, Spratly and the Paracels. About the Luchu (Kyukyu) Islands and the Bonins, Japan was required to "concur in any proposal of the United States to place them under its trusteeship system." In China, Japan was forced to give up all "special rights and interests." Finally, Japan was obligated to negotiate reparations claims made by countries that had suffered from Japan's wartime depredations. A separate treaty was signed with the United States on Sept. 8 permitting the establishment of American "land, air, and sea forces in and about Japan" with an accompanying promise that similar rights should not be granted "to any third power" without Washington's consent.

The peace treaty and the accompanying security pact did not go into effect until April 28, 1952, and shortly thereafter the occupation of Japan formally ended. Japan's subsequent foreign policy centred upon the problem of increasing exports, maintaining security in a bipolarized world, re-establishing economic and political ties in eastern Asia and in winning admission to the United Nations. For over four years the U.S.S.R. vetoed Japan's admission to the United Nations. But finally in Oct. 1956 a Japanese-Soviet joint declaration was signed in bloscow to restore normal relations between the two countries. Two months later Japan's application for admission to the United Nations was approved, thus enabling Japan for the first time since the war to have an independent voice in the decisions of the nations.

Divisions of opinion over the Korean war and the Japanese peace treaty brought about tensions between the United States and its western European allies. But the issue of Taiwan (Formosa) provoked even more division in policy. Beginning in June 1950 the United States again lent its support to the nationalist cause and in so doing was accused in Europe, Africa and Asia of meddling in the Chinese civil war. Peking persisted in claiming legal jurisdiction over Taiwan and its claims were supported by the communist nations and by the 15 noncommunist states that recognized the government of Mao Tse-tung. In spite of the denunciations of the communists and the protests of other less interested states, the United States after 19jo consistently championed the nationalist cause through military, technical and psychological aid. This policy was based on the belief that Taiwan in the hands of the communists would endanger Japan, Okinawa, the Philippines and southeast Asia. It was also based on the hope that the continued existence of a noncommunist China would give the Chinese, both inside China and in the overseas world, an alternative to communism.

On Formosa itself the direct support from the U.S. made the island of over 10,000,000 people into a heavily armed fortress. Nonmilitary aid helped to strengthen the island's economy which had always been rich in rice. While the Kuomintang government rectified many of its past errors, it continued to maintain tight political control over the island. Its position was strengthened by

U.S. support, and particularly by the conclusion in 1954 of a mutual defense pact. By its terms the United States guaranteed to protect Taiwan and the Pescadores from "armed attack and communist subversive activity directed from without against their territorial integrity and political stability." Meanwhile. Chiang and his cohorts continued to prepare for the day when they would return to the mainland. The communists on the mainland continued to inveigh against the American "imperialists" and promised that they would never relinquish their claim to Taiwan.

Though the United States successfully helped Taiwan remain free of communist control, Peking won a degree of success in Indochina after the conclusion of the Korean truce in 1953. French authority in this peninsula had been seriously undermined during the war, and after 1945 the Indochinese national movement fell increasingly under the influence of the communists. The United States and Great Britain, while fearing the spread of communism into Indochina, urged their French ally to follow the path of negotiation rather than war. For even after seven years of bitter war few permanent successes had been won by French arms. Finally, it was agreed to convene a conference of the four major powers to which Korean and Indochinese representatives might present their conflicting views.

The conference opened at Geneva on April 26, 1954. After three months of parley, the Korean phase of the discussions ended in a deadlock. On July 21, just one year after the initialing of the Korean truce, an agreement on Indochina was concluded despite the fact that the United States was not pleased with some of its conditions. France agreed to withdraw its military forces from the Red river delta, Hanoi and Haiphong, and the Vietminh (League for Independence) agreed to evacuate southern Vietnam and southern Laos and to respect the territorial and political integrity of Cambodia. A neutral commission made up of representatives from Canada, India and Poland was set up to supervise the truce. These agreements in effect permitted the communist-dominated Vietminh to control the northern half of the peninsula and its 12,000,000 persons. The southern half of Vietnam was to remain, temporarily as it turned out, in the hands of the French-approved ruler, Bao Dai. After 1954 few overt changes took place, but communist influence steadily mounted.

Fear of the spread of communism into southern Indochina and the other independent countries of southeastern Asia prompted the western powers under the leadership of the United States to lay foundations for a regional security program. The war and its aftermath had brought colonial control to an end in the Philippines (1946), Burma (1948), Indonesia (1950) and Malaya (1957). Thailand had always managed, though under great difficulty, to retain its independence. With the experiences of China, Korea and Indochina behind them, the leaders of the noncommunist nations, in conjunction with their colleagues in some of the newly independent states, began around 1950 to design a program for stopping the growth of communism in southeastern Asia.

The trend toward collective defense efforts began after it became clear that economic aid would not be enough to keep communism in check. In 1951 the United States, Australia and New Zealand concluded a Pacific defense treaty (known as Anzus), and in the following year organized a Pacific Defense council. At the Asian and Pacific peace conference held at Peking in 1952, the communists characterized the new defense operation as the old imperialism in a new dress.

Communists throughout the world were encouraged to do their utmost to sabotage the economic aid programs, such as Point Four and the Colombo plan.

After the debacle in Indochina, a conference of western and Asian nations was called at Manila for Sept. 1954. The result of this conference was the conclusion of the southeast Asia collective defense treaty and the publication of a Pacific charter. Eight nations took membership in SEATO (Southeast Asia Treaty organization; *q.v.*): Australia. France, New Zealand, Pakistan, the Philippines, Thailand, the United Kingdom and the United States. The object of the charter was to try to reassure the new nations of the benevolent intentions of the western powers and of their desire to see orderly political, economic and social progress in the new states. The treaty pledged the member states "to maintain and develop" their individual and collective capacities to resist armed attack and subversion directed against "the territorial integrity and political stability" of the countries of southeastern Asia, and the southwestern Pacific regions. The participants also agreed to collaborate on economic and technical programs and to establish a council for the co-ordination of their military programs. Conferences on problems of mutual concern were held at Bangkok (1955), Karachi (1956) and Canberra (1957).

Despite many such efforts to bring the other new nations of eastern Asia into alliance with the western powers, neutralism in Asia continued after World War II to grow as an international political factor of significance. After independence it was adopted as the official policy of the governments of India, Burma and Indonesia. And it was an attitude shared by many intellectuals within all the Asian countries. Its proponents asserted that their governments must limit their involvement with both of the great power blocs to preserve their national independence and to give themselves the opportunity to act as a third force in world affairs. Shortly after the end of World War II Prime Minister Jawaharlal Nehru of India sought through a series of conferences to develop regional solidarity, regional co-operation and even a permanent organization for the promotion of Asian unity. These efforts, based as they were primarily upon geographical ties, common problems and general hostility toward colonialism, achieved only a limited success. Nevertheless, the neutralist governments of Asia in combination with the Arab nations were able to throw their collective weight into international negotiations with considerable success. But, as in the case of Indonesia, it appeared that the cost of pursuing a neutralist foreign policy might come high and might have to be paid for in terms of economic dislocations, social unrest and even civil war.

Throughout the history of modern far eastern international relations, China has stood at the centre of affairs, with the possible exception of the period from 1905 to 1945. The major problem after 1949 was that of dealing with a China dominated by communism and closely tied. politically and economically, to the Soviet Union. The United States took the leadership in constructing a defense perimeter to halt the spread of communism through its program of mutual security treaties with Japan, Korea, nationalist China and the Philippines, through its part in the creation of SEATO and by its economic and technical aid programs. By the late 1950s no general far eastern settlement had been agreed to and as a result many issues remained unresolved in the area. At best it might be said that in the bipolarized world of the second half of the 20th century an uneasy truce had been established in the far east.

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FAR EASTERN AREA, an administrative unit of Asiatic Russia, created in 1922, upon the fall of the independent Far Eastern People's republic; it occupies 1,072,817 sq.mi., but its population in 1939 was only about 2,338,095. On Oct. 20, 1938, the Far Eastern Area was subdivided into the following two regions:

(1) Maritime (Primorskaia) *Kray*, 64,788 sq.mi., including Ussuri region. Population (1956) 1,305,000; urban 861,000; rural 444,000.

(2) Khabarovsk *Kray*, 315,521 sq.mi., including the Jewish Autonomous *oblast*. Population (1956 est.) 1,140,000; urban, 811,000; rural 329,000.

Eastward from Chaun bay the Arctic ocean forms its northern boundary, and the Bering sea, the Okhotsk sea and the Gulf of Tartary wash its eastern shores. The Yakutsk and Buriat-Mongol Soviet republics lie to the west, the boundary running for the most part along the crests of the Anadyr, Stanovoi and Yablonoi mountains.

Mongolia, Manchuria and Korea lie to the south; the Peking convention of 1860 defined the boundary between Russia and Manchuria as following the Argun, Amur, Ussuri and Sungacha rivers to Lake Khanka, thence crossing the lake westward to the Pai-ling river, thence along a mountain range to the junction of the Hu-pu-tu (Khubtu) with the Suifen river, and thence along the Hunchun river, and along the range of mountains between that river and the sea, up to the Tumen river 6 mi. inland from its mouth. However, most maps show the boundary as running along the whole course of the Hu-pu-tu river. 'The ocean boundary lies along the Bering strait, separating Russia from Alaska and Lawrence island, and passes south of Cape Lopatka separating the Kurile isles from Kamchatka. The Commander islands, off the east of Kamchatka peninsula, and the part of Sakhalin island north of lat. 50°, form part of the Far Eastern area. Much of the area is unproductive, and difficulties of position, structure and climate combine to retard its development.

A great part of Kamchatka has not yet been topographically or geologically surveyed, and uncertainty exists as to the continuity of the Yablonoi and Stanovoi mountains, and as to the northeastern termination of the latter. The relation of the Great Khingan to the Stanovoi is also not yet worked out. Much of Kamchatka, both peninsular and continental, is occupied by mountains, and in the Amur region a range of granitic and schistose mountains, called the Little Khingan, or Bureya or Dousse Alin, runs parallel to the Great Khingan from the north bank of the Amur river, while still further east is the Sikhota Alin range, occupying most of the Maritime territory. The only volcanic activity is in Kamchatka peninsula, where a series of partly active and partly extinct volcanoes runs along the east coast. Kluchevskaya, 16,130 ft., is probably the highest active volcano in Asia.

The Trans-Baikal region, with the Selenga, Vitim and Aldan plateaus, forms part of a terrace rising 3,000 to 5,000 ft. above the general 1,200 to 1,500 ft. level of the high eastern plateau of Asia. Tundra occupies one-third of the Far Eastern area, and in addition part of north Sakhalin is tundra. If these tundra regions are excluded, 64% of the remaining land is forest clad.

The forests may be divided roughly into the following three groups:

(1) the Daurian type stretching from the west of Transbaikal to the Zeya river, consisting mainly of larch and birch, with open prairies which in spring become grassy seas, where the peony, aconite and similar blooms reach a height of 4 to 5 ft.;

(2) the Manchurian type, extending eastward from the Bureya river and southward along the western slopes of the Sikhota Alin range. The prevailing trees are fir, silver fir and Manchurian cedar, amongst which are sprinkled broad-leaved Manchurian varieties, *e.g.*, velvet tree, Greek nut, Manchurian ash, Mongolian oak and a few species of maple;

(3) the Okhotsk-Kamchatka flora occupying Okhotsk and Kamchatka, the eastern slopes of the Sikhota Alin, the northern parts of the Amur region and Maritime territory and the island of Sakhalin. It consists mainly of the Siberian fir and cedar, with a few birch, aspen, alder and poplar trees.

In spite of this wealth, the timber industry is little developed, partly because of the lack of road communication and sea tonnage and partly because of the lack of suitable port facilities; the capital to provide these is lacking. The Amur river forms an excellent summer waterway for timber, but Nikolaevsk at its mouth has no facilities for timber haulage and embarkation. The river is frozen from November to May and at Nikolaevsk to June. Therefore, Vladivostok is the main timber port, but the fact that timber must be carried by rail to it increases the cost and hence puts Russian timber at a disadvantage on the world market. Vladivostok also is the natural outlet for Manchurian timber, and with better dock facilities could double its trade. Oak, cedar, fir and planks of aspen for match manufacture are chiefly exported, while Imperatorskaya bay (now Soviet bay) exports soft woods to Australia, and Olga bay exports pit props. Attempts are being made to replace the export of raw timber by local industries dependent on timber, and match, veneer and plywood factories have been established in the Ussuri valley, while in Transbaikalia, the Amur region and the Maritime territory there are now more than 30 timber mills, those round Vladivostok manufacturing barrels for the fishing industry. At Spasskaya (Yevgenevka) on the Ussuri railway, is a factory producing turpentine, tar, wood alcohol, vinegar, resin and potash.

In spite of destructive exploitation in the past, hunting and trapping still form the chief occupation of the native tribes, and a supplementary source of income for the Russian settlers. The Arctic fox and white bear are found only north of lat. 60°, and the former is not so abundant as in western Siberia. The blue, the red and the black or silver fox are trapped in quantity, especially by the Koryaks. The raccoon dog, a native of China and Japan, is found in the Amur basin and valued for its skin in winter and its flesh in summer. The polar bear is found where there are seals, but the brown or Kamchatkan bear is common in the forests and yields both fur and food; the black or Tibetan bear is found in the south. The Gilyak tribes are specially skilled in bear hunting, and the bear has religious significance for many native tribes. The marten and sable are decreasing; the best sable comes from the Nerchinsk, Amgun and Zeya districts and the poorest quality from Sakhalin. Ermine, glutton, skunk and otter are also decreasing. The hare is trapped for local use, though many tribes will not eat its flesh. Squirrels are not found in Kamchatka, but in the south they are common, and their skin is in great demand for gloves, hoods and carriage aprons. The reindeer is widespread in the tundra region, the Koryaks and Chukchee often owning herds of two to five thousand head, which provide them with meat, leather and means of locomotion. War conditions of 1914–22 had a disastrous effect, and it has been calculated that of 1,622,000 reindeer, only 687,000 survived. The elk is also found, and the wapiti and maral deer are valued for their horns. From the horns of the maral deer a powder called *panty* is obtained which is in great request amongst Chinese physicians. The musk deer is hunted in the Amur region and Sakhalin; its flesh is eaten, its skin used for clothing and its thin leg bones made into arrowheads. The roebuck, stag, rock deer and spotted deer are found, and in the island of Askold near Vladivostok, the siku. The musk ox is extinct, except possibly in Sakhalin.

The Commander islands were at one time famous for the fur seal, but promiscuous killing has greatly diminished its numbers. Near Chita and in the jungles of the Maritime territory, tigers are much dreaded; the snow leopard, lynx and two varieties of wild cat are also found. Fish is abundant and varied, both in the rivers and the sea; many native tribes rely on fish for food in much the same way as we rely on bread. It is salted or frozen for winter use, and towards the end of winter is often eaten in an advanced state of decomposition. The best market for exported fish is Japan. Attempts are being made to foster a tinned fish industry, and Kamchatkan tinned salmon, mainly put up under Japanese direction, finds an increasing market. The scarcity of salt greatly hampers the fish preserving industry, and the government was financing the Yakutsk salt mines on Vilyui river, a tributary of the Lena, to meet the need. Herrings are abundant in Peter the Great gulf and could find a ready market in Siberia if better transport and refrigerator facilities were provided. The Keta or dog salmon is common except in south Kamchatka, and from its skin the natives make sails, clothes and boots. For a detailed account of the numerous kinds of fish see *A Handbook of Siberia and Arctic Russia,* I.D. 1207, London 1920, in which there is also a detailed account of the various native tribes.

Climate.—The climate varies much, since the region extends from 70° N. to 42° N. The northeast corner, including the

Anadyr mountains, lies within the frozen Arctic tundra zone, where summer is very short, with a temperature never rising above 60° F, and winter is long and cold, with a January mean of —10° F to —40° F. Precipitation is slight. Three factors influence the climate of the remaining area, (1) the cold current of the Okhotsk sea considerably lowers the temperature; thus the centre of the frozen Kamchatka desert lies in about the same latitude as Moscow; (2) the south-east monsoon brings rain, especially in July and August, to all the Pacific coastal areas, thus making summer stormy, wet and cool and unfavourable to agriculture; (3) the continental situation and high elevation of Transbaikalia and part of the Amur region cause severe winters, often lasting seven months, though in the remaining five summer months the heat is sufficient to allow sub-tropical plants, *e.g.*, rice, to be grown. The slight snowfall exposes the ground to the severe winter frosts and prevents the cultivation of winter wheat. The range of temperature here may be 70° F, and even at Vladivostok is 64.6' F. The annual rainfall in Transbaikal and the west of the Amur region is 300 to 500 mm.; in the eastern Amur regions and the Maritime territory 500 to 700 mm. and towards the south 700 mm. Dense fogs are common on the coast in summer. Sakhalin and Kamchatka have less severe extremes of climate and heavier rainfall all the year round; in east Kamchatka precipitation is about 1,000 mm. per annum. Ayan, on the south coast of the Okhotsk sea, gets the same heavy rainfall, but the north coast of this sea is completely dry.

Agriculture **and** Industry. — Rumours of rich black earths in the southern parts attracted the first settlers, but black earth exists only in the Transbaikal, where it is of poor quality and rapidly degenerates; climatic conditions here are unfavourable for agriculture. The soils in the Amur region and Maritime territory, formerly accepted as black earths, prove to be dark coloured bog, semi-bog and ash coloured soils; when capital for draining becomes available, they should prove productive. On the narrow coastal fringe, the impenetrable clayey and stony rocks led to bogging and flooding during the semi-tropical summer rains. Agriculture is therefore most favourably carried on in the light, easily worked, muddy alluvial soils of the Amur, Ussuri, Zeya and Bureya valleys. The most densely sown area is round Blagoveshchensk, from which district sown land thins out in every direction; the chief crops are wheat 52·2%, oats 39·3%, grasses 2·2%, potatoes 1·4%, rye 1·3%, other crops being buckwheat, millet, sunflower seed, barley, flax and hemp. Melons are also grown. The Ussuri valley and the district near Vladivostok, especially from Lake Khanka to the Suifen river are well cultivated. Of late years rice has been introduced so successfully that its northern limit is now 49" N., instead of 42" N. Experiments are being carried out with a view to establishing the cultivation of tobacco, sugar-beet and silk; the chief crops at present are oats, wheat and buckwheat. Soya beans are increasingly grown and carrots, potatoes, tomatoes, cabbages and fruits, especially the apple, ripen well in the short summer. Hay in this district is so rank and coarse that cattle sometimes refuse it, Wild grapes are found in the southern Ussuri region. Beekeeping, since its introduction in 1871, forms a valuable supplement to agriculture, except where the opium poppy is grown. The only other cultivated region is in Transbaikal, along the valleys of the Ingoda, Onon and Argun rivers, where irrigation of a primitive kind is practised, rye, oats, wheat and buckwheat forming 92.4% of the harvest. The northern limit of agriculture in the Maritime territory is 43° N., as against 65° N. in the Yakutsk Republic, but a small patch of land near the Tym and Poronaya rivers in Sakhalin, another near the mouth of the Uda river, and a third in the Kamchatka peninsula form tiny islands of possible cultivation much to the north of the general limit. War and civil war diminished the size of the sown area, and the quality of the harvest, which is still (1928) much below the 1913 level. Even then, however, sufficient grain for the needs of the population was not grown. Most imported grain is floated down the Sungari river from Manchuria; the remainder either comes from North America via Vladivostok or from western Russia via the Siberian railway. The home meat supply is also deficient, and fat cattle from Mongolia form a staple import. Dairying and cattle breeding of a fairly intensive type are carried on in the Ussuri region to supply the towns of Khabarovsk and Vladivostok, but are much hampered by insect pests. In Transbaikal an extensive nomad form of cattle-breeding is carried on, the herdsmen often taking their flocks into Manchuria for the winter. Horses are bred and used as working animals in the summer and for posting routes in the winter. The rearing of sheep and goats wherever possible was emphasized by war conditions, which cut off the supply of imported cloth and made the country dependent on homespun. Strong and hardy camels are bred in Transbaikal. Pigs in this region are of poor quality, but in the Ussuri district they are better bred and a bacon industry is developing.

The mineral wealth is as yet not completely surveyed. Gold output has diminished markedly since 1917 and will probably need to be put on a machine using basis in place of the old hand methods; it is mainly obtained from alluvial washings. The rich quartz deposits could not be profitably exploited under present conditions. Climatic conditions make work possible only in summer, and most of the gold is found in places where the ground never really thaws; if the summer is dry, water for washing is deficient; if wet, flooding is troublesome. Population is scanty, roads almost non-existent and the cost of bringing machinery and food supplies is exceedingly heavy. The chief regions are the Nerchinsk, the Zeya and its tributaries, the Bureya, and especially its tributary, the Niman; Blagoveshchensk and Zeya-Pristan have government gold laboratories. The Amgun mines near Kerbinski have proved too costly to exploit, but the Orsk mines on Lake Chlya, near Nikolaevsk, are more successful. The more accessible mines in the Ussuri district are worked out, but a new source has been opened on the Iman river. Quartz gold was extracted formerly from Askold island near Vladivostok. The silver mines of Nerchinsk, in Transbaikal, which were worked as early as 1704 and reached their maximum output in 1774, are no longer worked, since the easily reached layers are exhausted and the Kirghiz silver mines are more productive. Zinc and silver-lead mines are worked near Tyutikha bay and Soviet bay. Wolfram, bismuth, asbestos, platinum, molybdenum, osmiridium and tin are found and many precious stones, unworked for lack of demand. Antimony occurs in quantity in the Amur region. Brown coal of a low calorific value has been mined in the Transbaikal and Amur region since the coming of the railway. In the Maritime territory both brown coal and a better variety are mined for the Ussuri railway, but the best coal is obtained from Sakhalin; the Japanese markedly developed the mines during their occupation. The eastern shores of Sakhalin also produce good quality naphtha, and this and the coal are worked by a Japanese concession. Iron was worked in the Transbaikal in the 18th century and an iron foundry existed at Petrovsk on the Balaga river; it declined after the opening of the trans-Siberian railway, but revived temporarily in 1914–22. Chinese competition, with better fuel and ore conditions, is now reducing its prosperity. The Olga bay iron industry is more prosperous North-east Kamchatka has undeveloped resources of gold. platinum, silver-lead ore, iron, coal, granite, marble and naphtha. In 1925 concessions were granted to the following British firms, (1) "Lena Goldfields" for 30 years. (2) "The Priamur Mines" for 36 years to develop the iron, zinc, lead and silver at present unworked in the Olga bay district. (3) "The Tetukhe Mining Corporation" for 36 years to develop the zinc, silver, lead and sulphate near the Tetukhe river. (4) "The Ayan Corporation" for 36 years to work the gold mines in Kamchatka. The industries of the Far Eastern Area are at present mainly restricted to peasant products for local needs, homespun, sewn leather footwear, flour-milling, etc. Leather is distinctly a peasant industry, except in Vladivostok and the Transbaikal. Vladivostok and Blagoveshchensk are important flour-millirg centres, and a macaroni industry was established at the former town in 1923. Both towns have shipbuilding and repairing industries; the latter for the Amur river fleet. The former Khabarovsk arsenal now produces agricultural implements. The damage to the railway bridges and rolling stock and to the river fleet during 1914–1922 is still felt. Roads are lacking in many places and are often impassable in the rainy season. The opening of the final railway link between Khabarovsk and the Transbaikal in 1914–15, has not yet had time to make its influence felt. Coastal transport is difficult owing to the uncharted seas and the summer fogs and winter ice. The Far Eastern Area thus presents itself as an area of potential wealth as yet undeveloped. Its present exports of timber, fish, furs, coal, oats, beans, rice, hempseed and bran hardly cover its imports of grain, fats, tea, sugar, meat, cattle, agricultural and other implements, machinery and small necessities such as paper, soap and chemicals. The seasonal nature of its industries and the difficulties of agriculture, combined with transport difficulties are a check on colonization, and yet intensive colonization is the only means of creating a demand for'manufactures of a non-seasonal character. Its chief towns are Vladivostok, Khabarovsk, Chita, Nerchinsk (*qq.v.*) and Blagoveshchensk.

Native Tribes.—Many native tribes still survive. Until recently the Palaeo-Siberian races, akin to the North American Indians, occupied all eastern Siberia and some Japanese islands. They have been pressed out by invaders towards the north-east, and of the present 35,000 population of Kamchatka, about 30,000 are natives. The Chukchee are the most important. Their original territory was mainly from east of Chaun bay to the north of the Anadyr region. but the increase of their reindeer herds has caused them to expand, at the expense of the Yukaghirs. They inhabit the tundra and its taiga fringe, seeking the latter for shelter in the autumn and camping in summer near a glacier or in the open tundra. They were probably originally a maritime people who later developed reindeer breeding and they are today divided into the Reindeer and the Maritime Chukchee. The latter live mainly by seal and walrus hunting and their boats are made from walrus hide. The Reindeer Chukchee hunt wild reindeer, wolves, bears and foxes to supplement their reindeer breeding. The Koryak tribe, closely related to the Chukchee, extends from the Stanovoi mountains to the sea, and along the west coast of Kamchatka to lat. 55° N. They are also divided into a Maritime and a Reindeer section, the latter intermarrying with the Chukchee and the former with the Kamchadals. They fish, hunt and breed reindeer, and have developed much artistic skill in carving wood, ivory, whalebone and horn and in basketwork and rug-making. Kamchadal is a name applied to the principal tribe of the Kamchatkan peninsula; pure aborigines are rare, much intermixture between them and escaped convicts having occurred. Their chief occupation is salmon fishing, though some are hunters and trappers. They train sledge dogs and are expert sledge drivers. The Gilyaks of the coastal region on either side of the Amur present an ethnological problem, one type approximating to the Ainu, another to the Tungus and a third being distinct from either. Hunting, fishing and trading are their chief occupations and till recently they carried on a slave trade with the Ainu and Goldi. The bear is their sacred animal, and there is a bear cage near each of their villages. A few Eskimo are found in the north and a few Aleuts in the Commander islands.

Of the Neo-Siberian tribes, sometimes called the Ural-Altaic, the Tungus are the most important in this region; they are a branch of the same Mongolic tribe as the Manchu. They stretch from the Taimir peninsula along the Yenisei valley across the Vitim plateau to the sea coast almost from Korea to Kamchatka; the Amur and Ussuri are Tungus streams. The Lamuts and Olennye of the Chukchee peninsula are a branch of the Tungus. The southern Tungus fall into two linguistic groups, one including the Orochon, Manegir, Birar and Kile, the other the Olcha, Oroke, Negda and Samagir. Physical and linguistic divisions do not, however, correspond, *e.g.*, the Olcha resemble the Gilyaks physically, and the Samagir resemble the Goldi of the Amur, Ussuri and Sungari region. In Transbaikal many Tungus have become sedentary and intermingled with the Russian settlers, but the nomadic cattle-breeding Tungus, forming about 45% of the whole, have preserved their nationality and language and are demanding recognition of an autonomous area The Buriats of Transbaikal are the principal Mongol tribe in Siberia; the eastern branch is known as the Aga-Buriat, as distinct from the Buriat Mongol (*see* BURYAT).

In 1925 the first congress of native peoples of the Transbaikal Amur region and Maritime territory was held. It laid down a broad basis for preserving native cultures and suggested plans, (1) for combating shamanism (*q.v.*), the sale of women, and the spread of such diseases as syphilis, leprosy, etc., (2) for establishing cooperation among the natives to prevent their exploitation, (3) for enabling the natives to adapt themselves gradually to timber and other industries, in view of the fall in the value of hunting and fishing. The congress was significant of a new outlook on problems of the relations of native tribes and incoming settlers and traders. In 1926 a station providing veterinary aid to native reindeer breeders and medical help for the natives was established in St. Lawrence bay near Bering strait.

Colonization.—The history of the opening up of the Far Eastern Area is full of romantic interest, and the hardships suffered in its wild country and Inhospitable climate were perhaps greater than in opening up any other region. The wealth of fur attracted traders from early times. The Cossack Dezhnev in 1648, after whom East Cape has been re-christened Dezhneva, sailed through Bering strait eighty years before Bering, and discovered the Anadyr, where he was joined by other Cossacks who had come by land from the Kolyma river along the Anyui and over the watershed. In 1647 Okhotsk fortress was built and by 1697 Kamchatka was explored and a fortress built at Verkhne-Kamchatsk. In 1643 Poyarkov sailed dbwn the Zeya and the Amur to the Pacific and returned via Okhotsk. In 1649–50 Khabarov, a merchant of Olekminsk sailed down the Amur and wintered at the place which now bears his name. He also selected the future Blagoveshchensk as a suitable site. About this time Verkhne-Udinsk and Nerchinsk were founded, but the Amur was ceded to China in 1689. The final occupation of the Amur is mainly due to Count Muraviev-Amurski, who, in 1849, sent Nevelski to explore the mouth of the river, and Nikolaevsk was founded by him. Two years later de Castries bay and Mariinsk were occupied and outposts established in Sakhalin. The journeys of Middendorf, 1844–45; Akhte and Schwarz, 1852, and in 1854–57 of the Siberian expedition increased the knowledge of and interest in the district. At the same time the Siberian branch of the Russian Geographical Society was formed in Irkutsk as a centre for Siberian research. During the Crimean War, Petropavlovsk in Kamchatka was successfully held against the English and French, and later a flotilla was sent down the Amur to help the Pacific fleet. The settlement of peasants along the left bank began in 1856 with colonies at the mouth of the Kumara, the Zeya and the Sungari, and at the entrance to the Little Khingan gorge. In 1858, by the treaty of Aigun, China ceded to Russia the left bank of the Amur from the Argun to the sea, and the Peking Convention of 1860 confirmed the cession to Russia of the Ussuri region. For some years a zone of free trade existed along the frontier, but this was discontinued in 1912 and much smuggling now goes on. In 1872 Vladivostok was made the Russian Pacific Naval base. In 1896 Russia abandoned the longer and more difficult railway route along the Amur in Russian territory in favour of a joint Chinese-Russian railway through Manchuria to link the Transbaikalia railway with Vladivostok, and in 1898 obtained the lease of Port Arthur, and after the Boxer rebellion of 1900 established herself in Manchuria and Korea. But by the Treaty of Portsmouth 1905, at the end of the Russo-Japanese war, Russia recognized Japan's right to Korea, ceded her rights to Port Arthur and retired from Manchuria. Sakhalin was divided between Russia and Japan at lat. 50° and Japan gained fishing rights in the Bering and Okhotsk seas. Russia was then compelled to build the Amur railway which was completed in 1915. Following on the 1917 revolution, a rising took place in Vladivostok in 1918, and Japanese and British naval forces occupied the town. Much confused fighting took place, Semenov's troops, the retreating Czecho-Slovak army, the White Guards, Allied troops and especially Japanese troops and Bolshevist forces all taking part. From 1920 to 1922 an independent Far Eastern Republic existed, but in November 1922 the Soviet power finally established itself and the Far Eastern Area was incorporated in the R.S.F.S.R., though the Japanese did not evacuate northern Sakhalin until May 1925. Colonization in the area was attended in early days with great difficulties and casualties were heavy. The region of oldest settlement is the Transbaikalia, where Cossacks were established in the middle of the 17th century; thence they were progressively moved eastwards, settling on the Amur river in 1857. In 1869 peasant colonization of the Amur district began and the opening of the Odessa to Vladivostok sea route in 1878, which lessened the transit time from two years of difficult land travel to a few weeks' sea voyage, gave a great impetus to the settlement of the Maritime and Ussuri districts. Besides Cossacks and peasants, political and religious refugees and exiles also settled in the district and have formed a valuable element in the population. Some, notably Bogoras in his studies of the peoples of the Chukchee region, have added considerably to the scientific exploration of the district. Criminal exiles, on the other hand, have been a great source of disorder; many convicts escaped and they and the ex-convicts whose term of imprisonment was completed, frequently terrorized the native tribes and settlers. In 1907 the custom of sending criminals to Sakhalin island was discontinued. After 1925 the Soviet government was offering special facilities to settlers in the far east, especially to those intending to work in the lumbering and fishing industries.

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FAREHAM, a market town, seaport and urban district in the Gosport and Fareham parliamentary division of Hampshire, Eng., 13 mi. E.S.E. of Southampton by road and bridge, at the head of a creek opening into the northwestern corner of Portsmouth harbour. Pop. (1951) 45,520. Area 28.7 sq.mi. The ancient church of SS. Peter and Paul belonged to an Augustinian priory founded by Henry I; it has been several times rebuilt.

The fact that Fareham (Fernham in Domesday Book) formed part of the original endowment of the see of Winchester fixes its existence certainly as early as the 9th century. There is evidence to show that Fareham had become a borough before 1261; it is mentioned in Domesday Book as subject to a reduced assessment on account of its exposed position and liability to Danish attacks. It was a mesne borough held by the bishop of Winchester, but by 1835 it had lost this status. It became an urban district in 1894. Fareham was represented in the parliament of 1306, but two years later it petitioned against representation on the ground of expense. A fair was held under grant of Henry III, and in the 18th century was mainly important for the sale of toys; it was abolished in 1871. The modern Monday market developed from the ancient street market.

Fareham in mediaeval times was a free port and had a considerable trade in wool and wine. Its modern trade is in corn, timber and coal, the creek being accessible to vessels of 300 tons. There is a large public abattoir, built in 1949. The principal industries are boatbuilding, light engineering and the manufacture of bricks, coarse earthenware, terra cotta and leather. Among the localities comprising the urban district are Portchester, Wallington! Stubbington. Hill Head, Titchfield, Warsash, Locks Heath, Park Gate, Sarisbury Green, Swanwick and Burridge.

About 3 mi. W. is Titchfield, with a partly Saxon church and the remains of a Premonstratensian abbey of the 13th century, incorporated in a now ruined mansion after the Dissolution. The ruins of Portchester castle? on Portsmouth harbour (3 mi. E. of Fareham), consist of an extensive walled enclosure retaining its Norman keep and showing considerable evidence of Roman workmanship in its outer walls. The castle walls enclose the church of St. Mary, and the grounds are open to the public.

FAREL, GUILLAUME (1489–1565), French reformer, was born of a noble family near Gap, Dauphiné. He studied in Paris under Jacobus Faber (Stapulensis), on whose recommendation he was appointed professor in the college of Cardinal Lemoine.

In 1521, on the invitation of Bishop Briçonnet, he went to Meaux, and took part in efforts of reform within the Roman communion. The persecuting measures of 1523, from which Faber found a refuge at Meaux, determined Farel to leave France. Oecolampadius welcomed him to Basel, where in 1524 he put forth 13 theses sharply antagonizing Roman doctrine, and defended them with so much heat that Erasmus joined in demanding his expulsion from the city.

Farel then thought of going to Wittenberg, but his first halt was at Strassburg, where Bucer and Capito received him kindly. At the call of Duke Ulrich of Württemberg he went in the capacity of preacher to Montbéliard, but was forced to leave early in 1525.

Retracing his steps to Strassburg and Basel, at the end of 1526 he obtained a preacher's post at Aigle, then a dependency of Bern, and, with reference to his protection by that city, adopted the pseudonym Ursinus. He obtained in 1528 a licence from the authorities to preach anywhere within the canton of Bern, but extended his labours to the cantons of Neuchâtel and Vaud, in Oct. 1530 breaking into the church of Neuchâtel with an iconoclastic mob. In 1532 he visited the Waldenses and on the return journey halted at Geneva, then at a crisis of political and religious strife. On June 30, 1532, the Council of Two Hundred had ordained that in every church and cloister of the city "the pure Gospel" should be preached; against this order the bishop's vicar led the opposition. Reaching Geneva in Oct. 1532, Farel at once began to preach at his lodging, and soon attracted crowds. Summoned before the bishop's vicar, he was violently thrust from the court and bidden to leave the city within three hours. He escaped with difficulty to Orbe by boat. Through the intervention of the government of Bern, liberty of worship was granted on March 28, 1533 to the Reformation party in Geneva. Farel, returning, achieved in a couple of years a complete supremacy for his followers. On New Year's Day 1534 the bishop interdicted all preaching unauthorized by himself, and ordered the burning of all Protestant Bibles. This was the signal for public disputations in which Farel took the leading part on the Reformation side, with the result that by decree of Aug. 27, 1535 the mass was suppressed and the reformed religion established. Calvin, on his way to Basel for a life of study, touched at Geneva, and by the importunity of Farel was there detained to become the leader of the Genevan Reformation. The severity of the disciplinary measures which followed procured a reaction under which Farel and Calvin were banished the city in 1538. Farel was called to Neuchâtel in July 1538, but his position there was made untenable, though he remained at his post during a visitation of the plague. When (1541) Calvin was recalled to Geneva, Farel also returned; but in 1542 he went to Metz to support the Reformation there. In 1544 he returned to Neuchâtel. No one was more frequently and confidentially consulted by Calvin. When the trial of Servetus was in progress (1553), Calvin was anxious for Farel's presence, but he did not arrive till sentence had been passed. He accompanied Servetus to the stake, vainly urging him to a recantation at the last moment. Calvin's death, in 1564, affected Farel deeply. He died at Metz on Sept. 13, 1565.

See C. Ancillon, *Vie de G. Farel* (1691); the article in Bayle; M. Kirchhofer, *Das Leben W. Farels* (1831–1833); Ch. Schmidt, *Etudes sur Farel* (1834); F. Bevan, *W. Farel* (1893); J. J. Herzog, in Herzog-Hauck's *Realencyklopädie* (1898).

FARGO, WILLIAM GEORGE (1818–ISXI), pioneer U.S. expressman, was born in Pompey, N.Y., on May 20, 1818. He became a freight agent for the Auburn and Syracuse Railway Co. in 1841, and express messenger between Albany and Buffalo a year later, and in 1843 a resident agent in Buffalo. In 1844 he organized, with Henry Wells (1805–78) and Daniel Dunning, the first express company to engage in the carrying business west of Buffalo. The lines of this company were rapidly extended to Chicago, St. Louis and other western points. In March 1850, when the American Express Co. was organized, Fargo became secretary; in 1852, with Henry Wells, he organized Wells, Fargo and Co. to conduct an express business between New York and San

Francisco by way of the Isthmus of Panamá. In 1861 Wells, Fargo and Co. bought the Overland Mail Co., of which Fargo had been one of the original promoters. From 1862 to 1866 he was mayor of Buffalo, and from 1868 to his death, in Buffalo, on Aug. 3, 1881, he was president of the American Express Co.

FARGO, the largest city of North Dakota, U.S., and the seat of Cass county, lies at the state's eastern boundary on the fertile bottom soils of ancient glacial Lake Agassiz, on the Red River of the North opposite Moorhead, Minn. The population in 1960 was 46,662 by federal census. (For comparative population figures see table in NORTH DAKOTA: Population.)

Founded by the Northern Pacific railway in 1871 in advance of settlement and named for William George Fargo (of Wells, Fargo and company), pioneer American expressman, its early prominence was due to its rail, steamboat and stagecoach facilities at the head of navigation, where it served as an outfitting point for the first settlers. Wheat planting in the mid-1870s disclosed the soil's productivity and attracted emigrants from Europe, especially Scandinavians. The development of wheat growing confirmed Fargo's role as a transportation, marketing and distribution centre. Railroad expansion ended stagecoaching and steamboating but the Red river's water supply became important to industry. The manufacture of farm machinery and food products engage many factories and furnish work for 12% of the city's labour force. One-third of the labour force is employed in wholesale and retail activities. Significantly identified with the city is the North Dakota State University of Agriculture and Applied Science, which was provided for by the state constitution (1889) and established in 1890 by the first legislative assembly. The agricultural experiment station maintains branches at Casselton, Langdon, Edgeley, Minot, Dickinson, Hettinger and Williston.

There are ice rinks and toboggan slides throughout the city in winter. Summer recreation centres in parks, playgrounds, the municipal swimming pools and at the Fargo-Moorhead Symphony orchestra's "Music under the Stars" concerts. (R. R. J.)

FARIDPUR, a municipality and district in the Dacca division of East Pakistan. The town stands on an old channel which debouches southward at the Titulia mouth of the Ganges. It takes its name from a Moslem saint, Farid Shah. Pop. (1951) 25,287.

FARIDPUR DISTRICT has an area of 2,584 sq.mi.; pop. (1951) 2,719,638. In the north the land is comparatively high, with a light sandy soil. From the town of Faridpur the ground slopes until in the south, on the confines of Bakerganj, it becomes one immense swamp, never entirely dry.

The plains between the rivers are almost invariably more or less depressed toward the centre, where usually a marsh or lagoon is found. The Padma (Ganges) flows along the district's northern boundary as far as Goalundo, where it receives the main stream of the Brahmaputra; thence the united stream turns southeastward and forms the eastern boundary. Rice and jute are the chief crops. The subdivisional town of Madaripur (pop,. [1951] 21,005), in the south of the district, is a centre of the jute-baling industry.

FARID UD-DIN 'ATTAR (c. 1150–*c.* 1230), Persian poet and Moslem mystic, whose most famous work, the Mantiq ut-Tair ("Language of the Birds"), describes, allegorically, the religious experience of the Sufis (see SUFIISM). Born in Nishapur, northeast Persia, toward the middle of the 12th century, he was a forerunner of the great Jalal ud-din Rumi (1207–73). He died *c.* 1230, or in any case after 1221, the year in which the Mongols sacked and destroyed his native city; there is therefore no truth in the story that he lost his life in that catastrophe. It seems probable that he ended his days in Mecca, where, in extreme old age, he wrote his last poem, the *Lisan ul-Ghaib* ("Tongue of the Unseen"). His personal name was Abu Talib (or Abu Hamid), Farid ud-din being his title and 'Attar his pen name, chosen because he followed the profession of pharmacist ('attar) or, rather, physician, having a sort of dispensary to which patients came daily for treatment.

As a young man Farid ud-din had traveled widely, visiting Egypt, Syria, Arabia, India and central Asia; he then settled down in his native town, where for 39 years he mas occupied in collecting the verses and sayings of the Sufi saints.

The *Mantiq ut-Tair* is an allegorical poem describing the quest of the birds (*i.e.,* the Sufis) for their king, the mythical Simurgh or Phoenix (*i.e.,* God). As their leader in the search they elect the hoopoe, who had guided King Solomon across the desert to the queen of Sheba, and who describes the long and hazardous journey they must undertake through seven valleys (representing the seven stages of Sufiism). Many excuse themselves and draw back; and of those who finally set out, only 30 birds (si murgh) succeed in entering the presence of the Simurgh, to discover that in so doing they have lost their identity, that they are he and he is they. In this way the poet allegorizes the final stage in the Sufi's progress, "annihilation in God."

The text of the *Mantiq ut-Tair* was published by Garcin de Tassy in 1857, and a French translation followed in 1863. An English version of this translation, The Conference of the Birds, by S. C. Nott, appeared in 1955. Farid ud-din was a prolific writer, and among his other works may be mentioned the *Pand-Nama* ("Book of Counsels"), translated by Silvestre de Sacy (1819); and the prose *Tadhkirat ul-Auliya* ("Memoirs of the Saints"), a series of biographies of the early Sufis (ed. by R. A. Nicholson in *Persian Historical Texts,* 2 vol., 1905–07).

See E. G. Browne, *A Literary History of Persia,* vol. ii (1906–24); H. Ritter, Das *Meer der Seele:* Mensch, Welt und Gott in den Geschichten des Fariduddin 'Attar (1955). (J. A. BL.)

FARINACCI, ROBERTO (1892–1945), Italian politician, was born Oct. 16, 1892, at Isernia in the province of Campobasso. While a young man, he took part in the Italian Socialist movement as a follower of the reformist leader Bissolati. After the armistice of 1918 he changed sides and was one of the first to join Mussolini's Fasci di Combattimento. He founded the Fascist daily paper *Cremona Nuova* and was one of the leaders of the Fascist armed squads (*squadre* d'azione) in southern Lombardy.

When Mussolini came into power, Farinacci became powerful in the new regime. In 1925 (Feb. 12) Mussolini appointed him general secretary of the Fascist party. Under his impulse, the party and the "fascistized" police suppressed the activities of the opposition. In 1926 (March 31) Farinacci was superseded as general secretary by Augusto Turati. In the following years, Farinacci practised law. He became a member of the Fascist grand council in 1935 and was appointed minister of state in 1938. He played an important part in bringing Italy into World War II. After Mussolini's resignation in 1943, Farinacci fled Rome. Late in April 1945 he was executed by Italian partisans. (M. W. S.)

FARINATO (FARINATI), **PAOLO** (c. 1524–1606), Italian painter, engraver and architect, one of the leading painters at Verona of his day, was born at Verona; the year is not recorded but on a picture dated 1603 he claimed to be 79 years old. His father, Giovanni Battista, was also a painter and may have been his first master; later he probably worked under Nicolò Giolfino. Farinato was active almost entirely in Verona. According to Carlo Ridolfi, a Madonna painted by him attracted the attention of Philip II of Spain when passing through Villafranca on Jan. 17, 1549. The first certain date is 1553, for by March of that year his St. Martin altarpiece for the cathedral at Mantua (still in *situ*) is recorded as finished in a joint letter from Farinato, Domenico Brusasorci, Paolo Veronese and Battista del Moro to Cardinal Gonzaga. All these artists had received commissions for Mantua in 1552. Some dated pictures occur at intervals, the last in 1603 ("Miracle of the Loaves and Fishes" in S. Giorgio in Braida, Verona) where Farinato adds his age of 79 to the signature and date. From 1573 onward he kept a diary of commissions with details of some of his work. His last years were divided between domestic squabbles with his sons and furtherance of his belief that he was related to the noble Florentine family of Farinati degli Uberti. His last will is dated July 23, 1606, and he is assumed to have died shortly after. He was buried in S. Paolo at Verona, where he had had his tomb constructed in 1594. Most of his vast output of paintings was for churches in Verona and its environs, where much of it has survived. He was strongly influenced by his younger contemporary Veronese, and also by Parmigianino among others. He also executed a few engravings, some architectural projects which apparently included work on the Castello S. Felice at Verona and very many drawings. It is by his drawings that he is most widely known and represented; an important series of them is in the royal collection at Windsor. Farinato often signed his work with the device of a snail, sometimes accompanied by his initials.

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FARINELLI (1705–1782), whose real name was CARLO BROSCHI, and who was one of the most extraordinary male soprano singers that ever lived, was born on Jan. 24, 1705, at Naples. In 1722 he made his first appearance at Rome in *Eumene.* He sang at Bologna in 1727, where he first met and acknowledged himself vanquished by the singer Antonio Bernacchi (b. 1700). Farinelli appeared in nearly all the great cities of Italy; in 1731 he returned to Vienna after two previous appearances there. He then modified his style from mere bravura to one of pathos and simplicity. He visited London in 1734 and appeared at the Lincoln's Inn Fields theatre in *Artaserse.* After spending three years in England, Farinelli set out for Spain; he remained there for nearly a j years. His voice. employed by the queen to cure Philip V of his melancholy madness, acquired for him an influence with that prince which gave him eventually the power, if not the title, of prime minister. Under Ferdinand VI he held a similar position, and persuaded him to establish an Italian opera. After the accession of Charles III, Farinelli was asked to leave Spain. He died at Bologna on July 15, 1782.

FARINI, LUIGI CARLO (1812–1866), Italian statesman and historian, was born at Russi, near Ravenna, on Oct. 22, 1812. After completing a brilliant university course at Bologna, which he interrupted to take part in the revolution of 1831 (*see* CARBONARI), he practised as a physician at Russi and at Ravenna. In 1843 he was expelled from the Papal States. He resided successively in Florence and Paris, and traveled about Europe as private physician to Prince Jerome Bonaparte, but when Pius IX was elected pope and began his reign with apparently liberal and nationalist tendencies, Farini returned to Italy and was appointed secretary-general to G. Recchi, the minister of the interior (March 1848). However, he resigned with the rest of the ministry on April 29. Pius now sent Farini to Charles Albert, king of Sardinia, to hand over the command of the papal contingent to him. He was again secretary to the ministry of the interior in the Mamiani cabinet, and later director-general of the public health department. He resigned on the proclamation of the republic after the flight of the pope to Gaeta in 1849, resumed it for a while when Pius returned to Rome with the protection of French arms. but when a reactionary policy was instituted, he went into exile at Turin. There he contributed to Count Cavour's paper *Il Risorgimento,* in *La Frusta* and *Il Piemonte,* of which latter he was at one time editor. He also wrote his chief historical work, Lo *Stato Romano dal 1815 al 1850,* in four volumes (1850). In 1851 he was appointed minister of public instruction in the D'Azeglio cabinet, an office which he held till May 1852. In the Sardinian parliament and in the press Farini was a staunch supporter of Cavour (*q.v.*), and urged that Piedmont participate in the Crimean War. When on the outbreak of the war of 1859 Francis V, duke of Modena, was expelled and a provisional government set up, Farini was sent as Piedmontese commissioner to that city; but although recalled after the peace of Villafranca he was determined on the annexation of central Italy to Piedmont and remained behind, becoming a Modenese citizen and dictator of the state. Farini negotiated an alliance with Parma, Romagna and Tuscany when other provisional governments had been established.

Annexation to Piedmont having been voted by plebiscite and the opposition of Napoleon III having been overcome, Farini returned to Turin, when Cavour appointed him minister of the interior (June 1860) and subsequently viceroy of Naples; but he soon resigned on the score of ill-health. Cavour died in 1861, and the following year Farini succeeded Urbano Rattazzi as premier. He resigned in 1863 and died on Aug. 1, 1866.

FARLOW, WILLIAM GILSON (1844–1919), U.S. mycologist and plant pathologist who pioneered investigations in plant pathology; his course in this subject was the first taught in the United States. He was born Dec. 17, 1844, in Boston, Mass., and received his A.B. (1866) and M.D. (1870) degrees at Harvard university. Later he studied in Europe. In 1874 Farlow returned to Harvard where he was professor of cryptogamic (flowerless and seedless plants) botany from 1879 until his death on June 3, 1919, in Cambridge, Mass.

Although his publications were mainly on taxonomic and bibliographic phases of mycology, he also wrote articles on algae, lichens and ferns. His extensive library and collections of fungi, algae, lichens and mosses became the nucleus of Harvard university's Farlow library and herbarium. Several of his students became prominent in botanical fields.

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FARM: *see* AGRICULTURE; FARM BUILDINGS; FARM MANAGEMENT; FARM TENANCY; SMALL HOLDINGS.

FARMAN, HENRI (1874–1958), French aviator and aircraft constructor, born in Paris May 26, 1874, was first a painter, later a racing motorist. With his brother Maurice he modified a Voisin pusher biplane and with it won, in Jan. 1908, a £2,000 prize for a circular flight of one mile. In 1909 he set a world's endurance record at the Reims aviation meet. In 1920 he again established a world's endurance record as well as an altitude record. As early as 1908 Henri Farman had a school of aviation and a construction works at Buc, near Versailles. Maurice Farman began to manufacture aircraft at a later date, but in 1912 the brothers merged their interests in the Farman works at Boulogne-sur-Seine, making many planes of their characteristic pusher biplane type for military and training purposes. The 1914 model was extensively used for artillery observation and reconnaissance in World War I.

Farman-type planes derived from the Voisin machine of 1908 which depended on inherent stability for lateral control. The landing gear had wheels. After the Wright brothers' public flights in 1908 first disclosed wing warping for lateral control, Farman machines adopted ailerons, a simpler aerodynamic equivalent. The Wright machines adopted wheels. Subsequently, ailerons and wheeled landing gear came into general use on all planes. He died in Paris on July 18, 1958. (J. C. HR.)

FARM BUILDINGS. The buildings on a farm provide a home for the family and structures needed for farming operations. Ideally the house should afford suitable space and the conveniences, comforts and satisfactions that determine the family's standard of living. The service buildings consist of barns, shelters, storages and working arrangements for animals, crops and products. These buildings should be economical in cost and upkeep, include labour-saving facilities and safeguards against loss or damage, and be readily adaptable to changing needs.

Some types of farming do not require service buildings, nor that the operator live on the farm. In such cases, the operator's dwelling may be located in a town or village or nearby in the open country and animals or crops may be marketed directly from field or pasture. Under some conditions the farmhouse is combined with storerooms, stables, sheds and work areas into one major multipurpose building. Sometimes centralized service buildings are set up to serve a large area.

On general-purpose farms the buildings usually include a dwelling, small structures such as garage, well house, workshop, etc., and whatever service buildings are needed for the particular farm. Needs differ from farm to farm, and between localities, regions and countries. The principal influences that determine choices are type of farming, climate, topography, size of enterprise, income and resources and the habits and customs of people. The buildings are most important on farms that are operated as full-time, profit-making enterprises.

This article deals primarily with farm buildings and their development in relation to the changing needs brought about by the rapidly expanding mechanization of agriculture in the second half of the 20th century, especially in the United States. Problems of investment, construction, materials and planning are discussed briefly in the following paragraphs. Then each major type of building is considered separately.

No one farm has all the buildings described; on the other hand, many types of buildings are not mentioned. Wide differences in kind, size and quality of buildings are found in different climates and on different types of farms. In many parts of the world, especially in underdeveloped areas, farming was still largely on a subsistence basis in the second half of the 20th century and farm dwellings and other buildings were of the most primitive sort. Information about living conditions and agricultural methods and production in various lands will be found in the separate articles on individual countries, and on continents. In addition to the references to related articles given in the sections of this article, *see* FARMSTEAD ARRANGEMENT, U.S. For material on structures designed for processing or storing specific crops the reader is referred to the separate articles on those crops; for example, for information on the construction and design of hop kilns or oast-houses, *see* HOP. The U.S. reader who is interested in a given region or kind of farming may obtain more detailed information from the United States department of agriculture, Washington, D.C., and the college of agriculture in each state. In other countries. the government department or ministry of agriculture should be contacted as the first step in seeking information. In each locality, it is advisable to consult with carpenters, materials dealers and building contractors.

REQUIREMENTS

Constant changes occur in farm-building requirements as new needs appear. Building improvements should take account of field mechanization, electric service. the cost and value of labour and demands for sanitation, disease control and improved products. Industrial development creates new materials and methods, better designs and more efficient equipment. Research brings new knowledge of crop storage, animal housing and product processing.

Building Investment. — Relatively high investments are necessary to provide adequate buildings for major farm enterprises, particularly dairying, poultry raising, tobacco curing and grain conditioning. The farm-building investment in the United States, in the second half of the 20th century, was estimated at $20,000,000,000, which was about one-third of the entire farm real estate value. On many livestock farms the buildings were valued at more than the worth of the land. Spending for repairs, upkeep and new construction was at the rate of $2,000,000,000 a year.

Costs of buildings increased rather steadily in line with the general price level. The cost by the second half of the 20th century was fully double pre-World War II cost and three times that which prevailed before World War I. Building costs consist of about equal proportions for labour and materials.

The building investment on farms went up at a greater-than-average rate as labour-saving devices, sanitation controls and processing equipment were added. But farmers also were in a good position to save by doing some of their own work, remodeling buildings already on the farm and using low-cost, locally available materials.

Construction. — Much on-the-farm construction is done by the farmer, by himself or with the help of neighbours or rural builders. Most farm buildings are constructed on the site, largely by traditional methods, although prefabrication increased greatly after World War II. Small "prefabs" were delivered as complete units while the larger ones were in parts, panels or sections that could be quickly erected on foundations made ready by the owner.

Buildings are set on masonry foundations or built on a framework of treated-wood poles set firmly in the ground. Movable structures and temporary buildings are placed on posts, treated wood or concrete sills, or on concrete floor slabs.

Materials. — Farm-building materials need to be durable, easily worked, resistant to destructive forces and to have special qualities where it is important to obtain insulation, watertightness, smooth surfaces and the like. In the United States, the most widely used materials are softwood planks and board lumber, concrete (both cast-in-place and masonry units), treated poles, plywood, sheet metal (mainly steel and aluminum) and asphalt or asbestos coverings. Common local materials include native lumber, ungraded pit or bank gravel, stone and sometimes bamboo or saplings for framework, thatch for covering and adobe for walls and floors.

Plans. — The ideal building plan provides for the space, shape, arrangement and equipment proven suitable by experience and research. Any one of two or more plans may be equally good and the choice is made according to preference or conditions. Many typical plans have been put into books, bulletins or blueprints, so that excellent designs may be had at little or no cost. Sometimes a building already in use in the community is the best guide to follow.

Each type of building tends to fall into a typical pattern. The combination of plan, materials and typical construction produces the buildings characteristic of a region or type of farming. Examples are the general-purpose barn, silo, corncrib, poultry house and tobacco barn. Many farm needs can also be met by multi-purpose buildings. They should have sturdy frame ork, weather-tight enclosure and unobstructed floor space. They are generally one-story, ground-level structures, often prefabricated. The interior plan and the conditions of temperature, light, air circulation and moisture may be made to suit any one of several needs.

FARMHOUSES

The farm dwelling differs from housing for nonfarming people of comparable tastes and incomes mainly because of its location on and attachment to the farm. Because of obstacles to improvement so often encountered, the condition of farm housing may be less adequate than urban housing on the average. Values are lower, houses are older, more of them are obsolete and the arrangement and equipment are sometimes unsuited to the needs of the present occupants. On the other hand, farmers can contribute labour, supplies and the use of equipment to the improvement of their own houses. Excellent plans and planning aids are available, especially from colleges of agriculture, and modern designs may be used most effectively for the betterment of rural housing.

The farmhouse should first meet the basic requirements for family living, the needs for sleep and rest, sanitation, preparation and serving of food, family group activities and storage of possessions. The unique features of a farmhouse are based largely

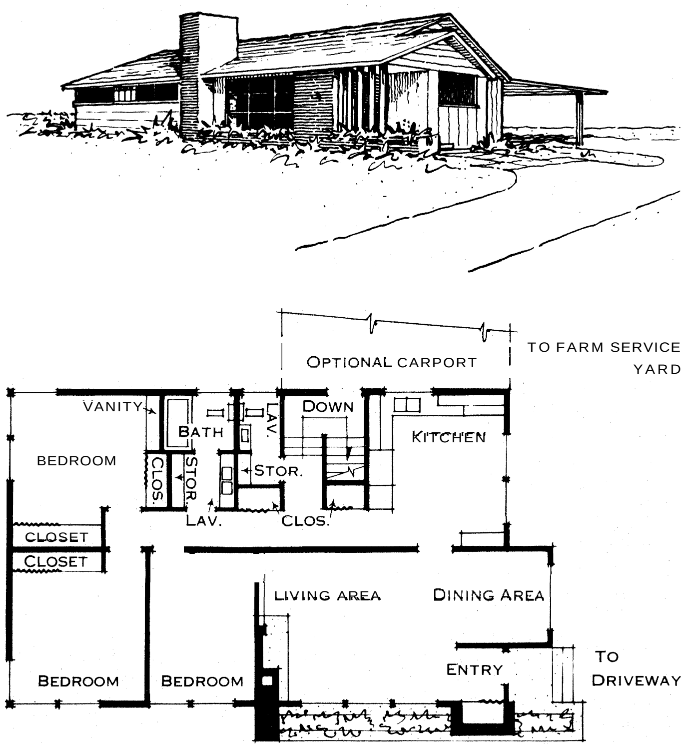
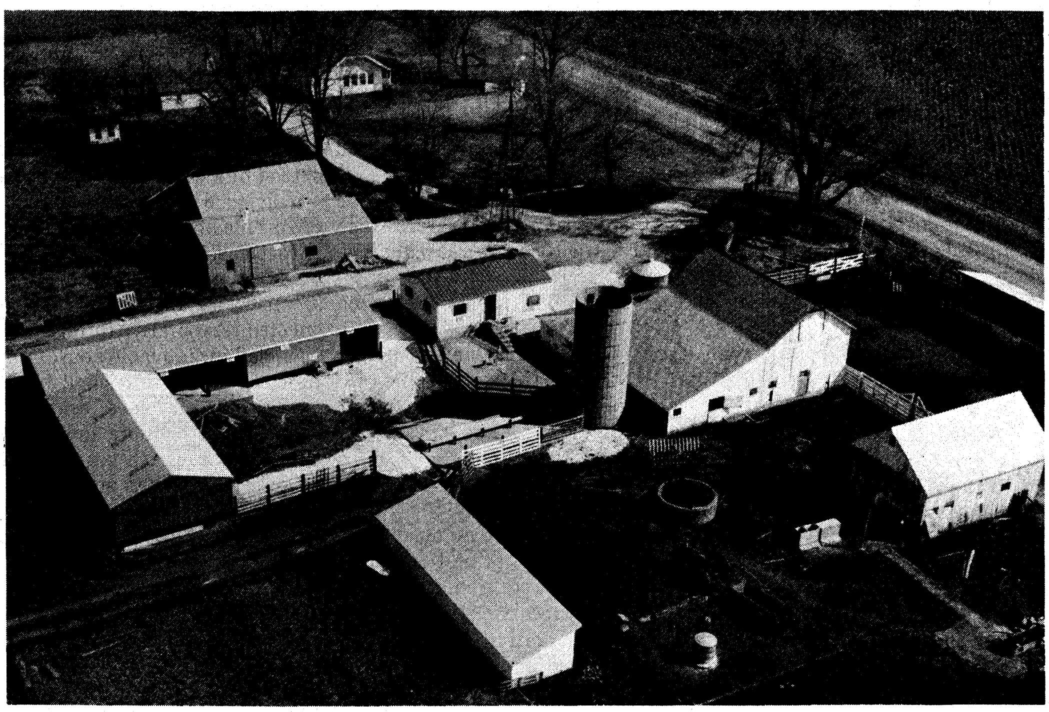


FIG. I. — EXTERIOR VIEW AND PLAN OF ONE-STORY FARMHOUSE OF CONTEMPORARY DESIGN. DESIRABLE FEATURES INCLUDE SIDE ENTRANCE, LARGE KITCHEN. BASEMENT. AMPLE LIVING AREAS AND THREE BEDROOMS upon the nature and pattern of farm life. Farming is a family activity with much traffic in and out of doors and from the back door to barns, fields and gardens. A convenient wash-up space and wrap-storage space are needed, and preferably a toilet and lavatory near the rear entrance. Access to the house is normally from a service yard or drive, so the main entrance should be reached readily from the driveway side. Visitor's parking is needed nearby, and the garage or carport should be attached or adjacent to the house.

Ample storage and workroom space is needed since farm families do most of their own service work—laundering, canning, processing home-grown food—and often prepare produce for market. The house may also serve as a community meeting place, as a business centre for the farm and for activities in which the entire family takes part. Thus ample living, dining and family rooms are desirable. At least three sleeping rooms are needed for the typical farm family.



BY COURTESY OF BUTLER MANUFACTURING CO.

FIG. 2.— MODERNIZATION OF A MIDWESTERN U.S. FARM: THE OLD BUILDINGS (RIGHT) ARE NO LONGER ADEQUATE AND ARE GIVING WAY TO NEW STRUCTURES (CENTRE AND LEFT) THAT INCLUDE HOG SHELTER, CATTLE HOUSING SHED. FEED LOT. MILKING-MILK ROOM COMBINATION. TOWER SILO AND MACHINERY STORAGE

Since the family cannot move to another house as its needs change, and because one farmhouse over a period of years may be occupied by a succession of families, it is desirable that the house be made highly adaptable by multiuse rooms. It should have portions that can be shut off or opened up as needed and otherwise meet the needs of most families rather than one specific family.

Old houses can be made more livable by remodeling and the addition of new finishes, appliances and utilities. The advent of power-line electricity in rural areas enables the farmer to have a water-supply system, plumbing, sewage disposal, heating and air conditioning and other equipment and appliances fully as adequate as those found in urban housing. The farm owner may largely control his own housing, for it is not necessary to conform to building codes and zoning restrictions that apply in many towns and cities and much freedom is possible in planning and design. There is usually a choice of location and there are no limitations as to facing, lot lines, streets and nearby structures.

See also RURAL ELECTRIFICATION.

BARNS

A barn is a building for the accommodation of animals and of feed and other supplies for their use. Barns are named according to the purpose they serve, as hog barns, dairy barns, horse barns, etc. The principal type in the United States is the general-purpose barn, intended mainly for work horses and mules and their feed supply and also for cows, calves, sheep, hay and grain storage, etc. Although the need for the general barn declined with the advent of tractors and electric service, one or more barns are still found on the majority of North American and European farms. Many have been adapted to other uses.

For horses, it is customary to provide a tie stall 5 ft. wide and 9 ft. long for each animal. A feedbox and hay manger are provided in each stall. A feedway 3 ft. wide in front of the manger and a 9- to 10-ft. alley behind the stall are recommended. Horses may be confined in 12 ft. by 12 ft. box stalls. Mules may be kept together in large pens.

QUARTERS FOR ANIMALS

Dairy Housing.—Buildings and equipment for dairying should aid in producing clean milk, saving labour and maintaining healthful conditions in the herd. For grade-A milk, the buildings must meet requirements of space, light, ventilation and cleanliness prescribed by public-health authorities. Housing for dairy cattle includes a barn, shed or shelter for animals, a place for milking, a room for handling milk, storage for silage, grain and feed supplement, a covered area for hay and bedding, an exercise yard or pen, and facilities for the removal of manure. These should be arranged into an organized unit, adapted to herd size and recommended methods of operation.

The requirements for dairying may be met by either of two housing methods known as the stall-barn and the loose-housing systems. In the stall barn each cow is confined in a stall when in the barn for resting, feeding, milking and watering. Stalls are arranged in rows facing on a feedway and aligned along a gutter next to a walkway. A typical plan has two rows of stalls lengthwise with three alleys or service passages. Total barn width is 34 to 36 ft.. and each stall $3\frac{1}{4}$ ft. to 4 ft. wide. One or more maternity pens, calf pens and feed rooms are included. Hay and bedding are stored in adjacent buildings or in an overhead loft; the milk room is generally attached to the barn by means of a short corridor. Stall barns in the colder areas should have insulated walls and ceilings, and power-operated equipment for ventilation, watering, feed distribution and manure removal. In warm-weather areas the barns are partly open, and cows are housed mainly for feeding and milking.

The loose-housing system is much the more flexible for varying herd size, it may be less costly and is well suited for saving labour and maintaining sanitation. The principal structure is a shed or shelter arranged so that the animals may move freely between the shelter and outside yard. Bedded floor area of about 50 sq.ft. is needed for each cow. Hayracks are placed to form a feeding area under shelter. Hay and bedding may be stored within the same open-type structure. Exercise yards should have 75 to 100 sq.ft. of space, usually paved, for each animal. The silo and silage feed trough should be accessible from the yard. Equipment and gates are placed so power manure loaders can be used to advantage.

The milking room or "milking parlour" is adjacent to the shelter area. Two or more milking stalls are elevated 30 in. above the operator's working space. Doors are arranged so cows can be brought in to be milked, held in the stall and sent back to the yard in an orderly manner. The arrangement should enable the operator to do the milking, care for the milk and control the doors all from one small alley with a minimum of walking. The milking room should be insulated, lighted both by windows and electricity, have smooth, washable surfaces and provision for heat in cold weather.

The milk room or milkhouse for market milk must meet code requirements as to surfaces, light, ventilation, hot water, wash vats and cooling equipment. A small room 8 by 10 ft. may qualify, however 12 by 14 ft. is usually more desirable. In the loose-housing system, the milking and milk-handling rooms are often combined in one structure.

Other buildings for dairying may include shelter and feeding areas and separate pens for calves, growing heifers, dry cows and a herd bull. Bull pens or bull barns are less common on farms as artificial-breeding practices are adopted. See also DAIRY INDUSTRY.

Beef-Cattle Housing.—Beef animals do not require warm, enclosed shelters. Complete protection is provided only for young calves, cows at winter calving and young stock just going on full feed. Otherwise, open-front sheds, paved feed lots and facilities for feeding and removing manure are the main requirements. Adjustment may be necessary to give added protection in areas of heavy snowfall and more covered shelter if rainfall is heavy.

Cow herds for producing young stock need enclosed space for about 10% of the herd at one time, also maternity stalls and calf pens. For general livestock raising and cattle feeding, about 32 sq.ft. of shelter and 60 sq.ft. of paved yard are allowed for each full-grown animal. Feed-trough space is allowed at 30 in. per head, but only 10 in. of self-feeder trough and 20 in. of hay-rack space are needed. Labour is saved by self-feeders for grain and hay, continuous feed bunks along fence lines, paved yards, manure removal with power scoops, automatic waterers and well-arranged gates and drives.

Almost any type of semiopen shelter having nine feet or more of headroom will serve for beef cattle. Trussed roofs are desirable to eliminate interior posts and partitions. Hayracks need to be under shelter; however, outside feeders are used for silage, grain and fresh-cut green forage.

Two typical building arrangements are: (1) sheds 20 ft. wide adjacent to one, two or three sides of a hay and feed storage barn; and (2) open-front sheds or multipurpose buildings facing on a barnyard, with ground-level storage for hay and bedding. Construction may be wood frame or metal on a masonry foundation, or a pole frame with lightweight covering. Some have masonry unit walls. In any case the lower walls to a height of from three to five feet should be of masonry or plank to protect against decay and damage.

Shelters for Sheep.—On the open range, structures for sheep include corrals, dipping vats, lambing and shearing sheds, etc. No attempt is made to shelter the flock as a whole. Farm flocks in mild climates need little housing. In moderate climates open sheds are satisfactory but in severe climates buildings are closed during storms. Floor space of 12 to 15 sq.ft., yard space of 30 to 40 sq.ft. and feed-rack space of 15 to 18 in. per ewe are required. At lambing time extra warmth may be obtained by setting up temporary lambing pens inside the building, covering them in case of cold weather. Dryness and ventilation without drafts are essential in buildings for sheep. Movable feed racks, grain troughs, partition and fence panels are used for quickly adjusting pen size to flock needs, setting up temporary lambing pens, temporary feed lots, controlling grazing area, etc. (*See* SHEEP.)

Hog Housing.—The principal hog-housing need is for the sow and litter for about eight weeks from birth to weaning. Young pigs require sanitary surroundings, temperatures above jo° F. for a few days and protection against being crushed by the sow. After weaning, breeding stock requires only reasonably clean, dry shelter and ample yard space, and fattening hogs gain rapidly and thrive with only minimum housing.

The two principal U.S. systems of hog housing are: (1) movable farrowing houses that can be relocated on clean ground each season; and (2) enclosed central-type houses which usually have concrete floors, smooth walls and insulation. A single-unit movable farrowing house may be no larger than 6 by 7 ft. for sow and litter. An A-shaped house is quite common; often the upper portion is made nearly flat to reduce headroom. The house may be built with or without floor, single walled and with burlap sacking instead of a door. Other house shapes are satisfactory if floor space of 42 to 64 sq.ft. is provided, and headroom is 3½ ft. or more. Movable houses are either prefabricated or home built from standard plans.

Multiunit houses with two, three and four pens are quite common. Two three-pen shed roof houses can be paired and connected temporarily to form six-sow units. Among the advantages claimed for movable houses are low cost, ease of handling, mobility and usefulness for small herds.

The fixed-in-place, central farrowing house is used mainly for herds of 12 or more sows; in cases where two or more farrowing seasons occur each year; and if the enterprise justifies a relatively high investment in structures and equipment. The typical house is one-story high, with an insulated ceiling and having a two-row arrangement of pens and a centre work alley in a 20 to 24 ft. width. Pens are 8 to 9 ft. long from wall to alley, and 6 to 8 ft. across. One or more feed and equipment rooms are included in the house. The more elaborate houses may be equipped with unit heaters, underfloor hot-water pipes or heat lamps over each pen and power fans for circulation. Ceiling heights should not exceed 7 or 73 ft. Windows located in side walls or low in the roof should provide about two square feet of glass area for each pen. Each pen should have an individual watering trough, gates opening onto the centre alley and to an outside runway and guardrails on end wall and partitions to protect little pigs from being crushed.

A modern alternative to the pen is the farrowing stall. It confines the sow so that she may stand up or lie down but cannot move about and overlie her young. A space of about 12 to 18 in. on either side of the confinement stall provides room for the pigs to nurse, sleep or exercise. Heat lamps warm the pigs and help keep the space dry. After one or two weeks the farrowing stall may be removed.

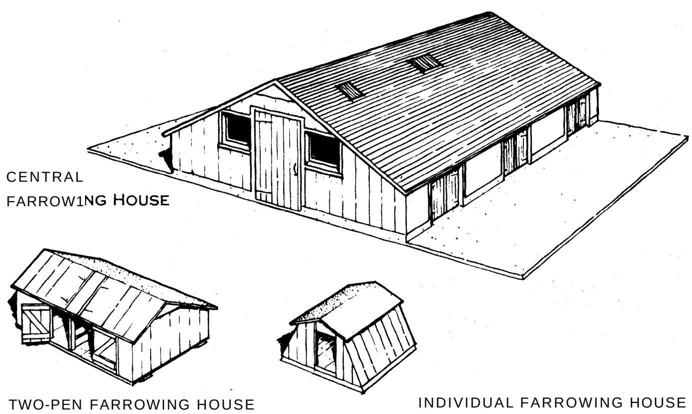


FIG. 3.—PERMANENT AND MOVABLE TYPES OF HOG HOUSES

Minor structures for hog raising include self-feeders, paved feeding floors, summer shades. watering devices, mineral boxes, loading chutes and breeding racks. These are needed with either the movable- or central-house system. Large-scale operators may combine both systems of housing on one farm.

Poultry Brooders and Houses.—Farm poultry houses are used for brooding baby chicks and maintaining laying flocks. A typical brooder house is a 120- to 160-sq.ft., wood-framed, wood-floored, movable structure on skids. Such a house will accommodate 300 chicks for six or eight weeks or until they no longer need heat. An electric or oil-fired brooder stove provides the necessary warmth. Windows in the south wall, insulation in walls and roof and air ducts for ventilation provide the best conditions for growing chicks.

Brooder houses for commercial flocks may be very large—40 by

200 ft. is not uncommon. They differ from small-farm types only in size, construction details and equipment. The larger houses may have several brooder units, underfloor heat or heat lamps, automatic waterers and feeders and fan ventilation. One or more large doors are provided for access by tractor and equipment for removing litter. The houses are used until birds are ready for market or removal to range houses.

Laying houses are similar to brooder or broiler houses in size and construction. A 10 by 12 ft. house is adequate for 30 birds but a 20 by 20 ft. space for 100 hens is a typical unit size. Each 100-hen unit should have 20 nests, 80 linear feet of roost space, one to two waterers, a lighting device and 16 ft. of feed-trough length. Housing for any flock should allow a floor area of $3\frac{1}{2}$ to 4 sq.ft. per bird, and roosts, nests, waterers, lights, etc., in proportion to the requirements for 100 hens. Capacity can be increased and labour reduced by using automatic feeders and waterers and giving close attention to sanitation. For some special conditions, entire houses are equipped with metal cages each accommodating one or two hens.

House sizes range from 20 by 20 ft. up to 24, 30 or 40 ft. wide and 200 ft. or more in length. In the largest establishments, feed storage, egg room and utility space may be in a centre section, with laying-house wings in both directions. If land area is limited, houses may be two or three stories high. Construction varies somewhat with climate, from relatively open shelters to semi-enclosed with partial openings in the leeward wall and fully enclosed, insulated structures. Overhead insulation is often provided by a straw loft, consisting of $1\frac{1}{2}$ to 2 ft. of straw fill over a wood frame, wire-mesh ceiling.

Summer-range shelters are used for growing chicks and replacement pullets. They are built on skids or runners, with light wood or metal framework, raintight roof with wide overhang and wire-netting enclosure. See also POULTRY AND POULTRY FARMING.

CROP STORAGE

Grain Storage.—Wheat, rye, oats, barley, soybeans, grain sorghum and shelled corn must be dried to about $12\frac{1}{2}\%$ moisture content for safe storage in farm-type bins in warm weather. Most grains are dry enough to store when harvested but artificial drying is necessary to reduce moisture in grain crops that are combined or otherwise harvested before they are quite dry.

Drying is accomplished in a few hours by passing the grain through drying machines or drying bins equipped with heating devices and power-driven fans that force warmed air through layers of grain. Moist grain can be kept from spoiling by forcing unheated air through large masses of grain intermittently over periods of weeks or months. However, drying without heat is accomplished only when the air is above 60° F. and the relative humidity is 75% or less.

The most common storages or granaries are: (1) rectangular, wood-framed bins; (2) circular prefabricated metal structures; (3) overhead bins above the driveway in corncribs and feed storages; and (4) flat, ground-level piles on concrete floors in warehouse-type buildings. Capacity of storage is measured in bushels. Each bushel occupies 1.25 cu.ft. of space. A given bin will hold four-fifths as many bushels as there are cubic feet of volume. The heaviest grains weigh 48 lb. per cubic foot, so that bins must be designed to carry heavy loads and pressures.

Typical farm-size bins range from 500 to 2.000 bu. capacity. Several bins within this size range provide more versatile, useful storage than one or two bins having the same total capacity. To maintain acceptable quality, food grains must be stored to safeguard them against dirt, insects and contamination by rodents and birds.

Corn (Maize) Storage.—Shelled corn must be handled and stored in the same way as grain like wheat, barley or soybeans. Since harvesting is most feasible at grain moistures above the safe storage level, field-shelled corn must be dried to near 12% moisture before it is stored. Even when harvested in the ear, the moisture content may be too high for storage in warm weather and drying down to 20% or below may be advisable. Ear-corn drying is generally accomplished by adapting the crib and adding ducts, temporary wall coverings, etc., so that large amounts of air—either cold or heated—may be forced through the crib.

In the principal corn-growing areas much of the crop is stored in the ear; *i.e.,* the kernels are not removed from the cob. Ordinarily the ears are not fully dry when harvested, but because of low winter temperatures little damage occurs until the coming of warm weather; during the intervening months the ears have a chance to dry if well stored. The common type of storage in the United States is a crib sided with wood slats spaced about one inch apart to permit ventilation by the wind; perforated clay or concrete-block walls are also used. The width of crib varies with the climate; in the principal growing areas cribs are 6 to 12 ft. wide with vertical sides 8 to 24 ft. high. A popular type of storage in the corn belt of the United States has a crib on each side of a driveway and grain bins above. A mechanical elevator fills both cribs and bins. A 27 by 40 ft. building with 11-ft. driveway, two cribs 8 ft. wide and 20 ft. deep, will store about 5,000 bu. of ear corn and 2,500 bu. of small grain or shelled corn. Because of the weight of ear corn (28 lb. per cubic foot) and its tendency to arch against walls and over crossbraces, walls must be well tied together with braces that can support safely a large part of the weight above.

Temporary cribs are either circular or rectangular in shape and built of snow fencing or wire mesh or of cribbed poles. Cribs that can be tightly closed are needed in warm regions where it is necessary to fumigate to control insects. For long-time storage it is best to shell the corn from the cobs when dry and store the shelled corn in tight bins. See CORN; CROP DRYING AND PROCESSING; CROP-PROCESSING MACHINERY.

Silos.—A silo is any type of structure or container that affords storage for large masses of high-moisture forage. The most common is the above-ground cylinder or tower silo, made of wood, concrete. masonry staves or blocks.

Tower silos vary from about 10 to 18 ft. in diameter and 30 to 50 ft. in height. Silage must be removed from the top at the rate of about two inches per day to prevent spoilage. For this reason the diameter is made proportional to the amount of silage needed. Height is limited by needed capacity. by the length of the feeding period or by practical considerations of cost and labour. A silo 12 ft. in diameter has 113 cu.ft. in each foot of height. Each foot vertically holds about 2.25 tons of silage weighing 40 lb. per cubic foot. This provides 754 lb. each day if two inches are removed, which is enough for 25 animals fed at the rate of 30 lb. of silage per day. A 12-ft. silo 36 ft. high will hold about 100 tons. (The average weight exceeds 40 lb. per cubic foot at depths greater than 14 ft.)

Silage under the heavy pressures found in upright silos puts a severe strain on the walls. Steel reinforcement is necessary in proportion to the height, as rods in mortar joints, embedded reinforcing in concrete and steel bands on wood or masonry staves. Tower silos have continuous or closely spaced access doors and a ladder.

A silo of unique design is prefabricated with a smooth, noncorroding wall of steel having a porcelain or fused-glass surface. It has an airtight top to reduce spoilage and a power-operated bottom unloader that makes the silage handling operation nearly automatic. This container is also suitable for storing high-moisture grain. shelled corn or ear-corn silage.

The trench silo is most suitable for storing large quantities of green corn or grass at minimum cost. The trench is cut into the ground on a gently sloping site. If made 8 ft. deep. 10 ft. wide at the bottom and 14 ft. at the top, a 60-ft. length gives a capacity of about 100 tons. Earth trenches tend to crumble and cave, so for best results the trench should be floored and the sides lined with four inches of concrete. A variation of the trench is a flat, ground-level bunker silo. It is similar to the trench with concrete floor. vertical or slightly sloping sides of concrete or planks, and open at one or both ends. Flat silos can be adapted for self-feeding by fitting a feeding gate across the end which is moved inward as the silage is consumed. Silage is sometimes stored in circular stacks supported by poles and slat fencing, or in long low ricks. Spoilage is high when temporary methods are used. The history of the development of silos and the use of silage is discussed in the article ENSILAGE.

Hay Storage.--Outdoor stacks, overhead lofts and ground-level roofed-over areas have long been used for loose, uncut, air-dried hay. Weight is about four pounds per cubic ft. and storage space is calculated at 500 cu.ft. per ton. Baling or chopping reduces storage space by one-half, doubles the weight per unit volume and facilitates handling. For these reasons, storage should generally be at ground level, either in low-cost sheds for baled hay or in silolike upright metal hay storages or pole-framed, hire-enclosed structures for chopped hay. For highest quality, legume hay is wilted and only partially dried in the field and air-dried under cover. The barn, loft or other storage then requires a system of air ducts and a power fan to prevent overheating and assure uniform drying. *See* CROP DRYING AND PROCESSING; GRASSLAND.

Storage for Fruits and Vegetables.—The cave or cellar is perhaps the most feasible structure for the home storage of fruit and potatoes and other vegetables. A typical cellar is built partially underground and the upper part is mounded over with earth to prevent freezing and provide fairly uniform conditions of temperature and humidity. Although concrete floor, walls and ceiling are recommended, the floor may be omitted and the ceiling made of logs or timbers treated with preservative. A room 8 ft. wide, 8 ft. high and 12 or more ft. long affords liberal storage and is useful also as a storm shelter. Tile drain, air vent, steps and a doorway are necessary.

Fruits and vegetables are sometimes stored in unheated basement space, insulated ground-level buildings with supplementary heat for cold weather or outdoor pits or mounds covered with straw, stalks, building paper and earth. Under such conditions, only short-time storage of several weeks or a few months is feasible.

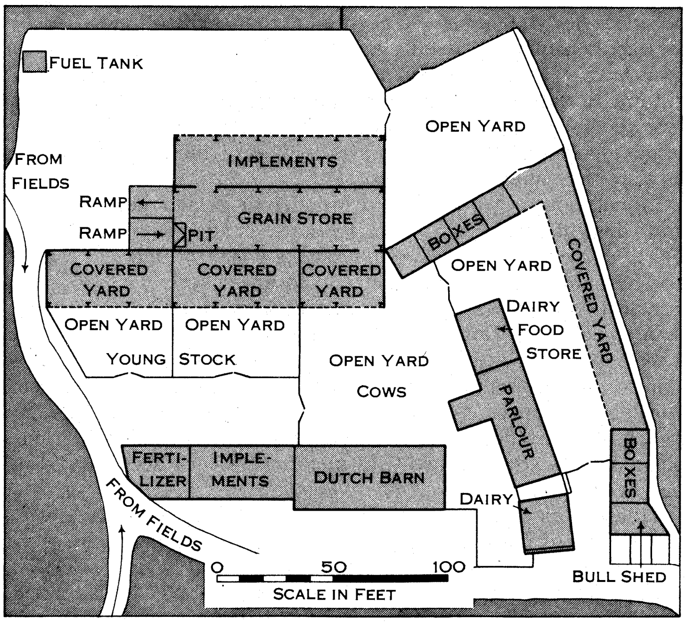
Ideal conditions are obtained only in buildings designed for storage purposes and equipped to maintain control of temperature, relative humidity and air circulation. The cost and labour necessary limit such storages to commercial enterprises or to large specialized farms. The buildings are generally insulated wood-frame structures set on lower walls of masonry. Equipment includes heating systems, refrigeration equipment, electric fans and handling devices such as elevators and conveyers. The buildings are constructed so that humidity in storage rooms can be maintained at about 85% to 90% and temperatures can be kept high enough to prevent freezing and low enough to minimize sprouting and deterioration. White potatoes and most other vegetables should be held at 60° F. for about ten days, then reduced to 50° F. for three-month storage and 40° F. for longer periods. Sweet potatoes (yams) are cured at 85° F., then held at about 55° F., usually in wood-framed, one-story buildings. Apples may be stored at or near 32° F. in well-ventilated storages. *See* FRUIT FARMING: *Harvesting* and *Post Harvest Practices*.

Buildings for Tobacco Curing.—Tobacco "barns" are of two types, for air curing and flue curing respectively. Pole- or post-frame buildings are used for air curing. A barn 32 to 36 ft. wide, 48 or more feet long and having 20-ft. side walls has a capacity for three to four acres of tobacco. Vertical siding is used and about one-third of the wall surface is hinged to allow natural air ventilation in good drying weather. Artificial heat is supplied by coke stoves, oil or gas heaters or a commercial drying unit. Except for a small well-lighted stripping room, the entire space is used for hanging tobacco plants which are strung on four-foot sticks.

For flue curing, the typical building is 17 ft. 8 in. square with 14-ft. side walls. It is tightly built, insulated and fitted with air intakes at the bottom and an adjustable ventilator at the ridge. Because artificial heat is necessary, close attention needs to be given to fire safety, air circulation, humidity control and temperature regulation. Log walls are often used in low-cost barns.

BUILDINGS FOR MACHINERY AND SUPPLIES

Indoor storage of machinery affords protection from weather and animals, makes it easier to maintain a neat, uncluttered farmstead and provides a place for repair and maintenance work. The space is also useful for storing building materials, fertilizers, seeds and other supplies. Machinery-storage buildings should be free from interior posts or other obstructions, have headroom of 10 to 15 ft. over much of the area and doors that will accommodate the largest machines.



ADAPTED FROM A DRAWING IN "FARMER AND STOCKBREEDER"

FIG. 4.— PLANOF A TYPICAL BRITISH FARMSTEAD

Concrete floors are desirable but not necessary. A shed with one side completely open affords fair protection; however, a fully enclosed building is preferable. Post-free construction is obtained by using arches, trusses or heavy beams to support the roof. Walls and roof may be metal or other thin material, or masonry walls with light roof frame and covering may be used. One common design has wood or metal arches spanning the width of the building. The framing members are attached to foundation or floor slab, and covered with any one of several materials.

The minimum practical storage building is about 12 ft. by 24 ft., which is one-car garage size. The two principal farm types are described as follows: (1) the "side-door" building, generally 20 to 32 ft. wide, which has a nearly continuous series of doors in one wall along the length of the building. The narrow width and numerous doors add to the cost if considerable machinery is to be stored. (2) The "end-door" drive-through type, 36 to 48 ft. wide and as long as needed, is best for ample capacity. Doors are located in each end and a centre driveway, kept free of all except wheeled vehicles, gives maximum convenience. Buildings of this type are adaptable to many purposes and are often used for baled hay, grain (with suitable bracing and bulkheads), cattle or sheep. *See* also AGRICULTURE; AGRICULTURE (ARTICLES ON).

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FARM COLONY or GROUP FARM, a joint operation of a large farm and some or all of its related enterprises by a group of individuals or families with common social or economic objectives. Such associations may be defined according to their methods of income distribution, as follows:

1. Joint cultivation association: individual farmers pool some of their productive resources, such as land, machinery, livestock and labour. Proceeds of their joint effort are divided on the basis of each member's investment in, and service to, the association.

2. Co-operative corporation farm: several individuals or families co-operatively own or rent a large farm and operate it as a single unit. Income is distributed on the basis of the value of labour contributed by each member.

3. Communal farm: a large farm operated on the principle that each

member must contribute his labour and other resources according to his ability. He benefits from the enterprise on the basis of what the group considers to be his needs.

4. Institutional farm colony: a large farm employing many people, operated by a government or private welfare institution in charge of determining policy. Wages are paid in the form of subsistence in kind (food, housing and clothing), cash or special grants according to the needs of each individual, as determined by management.

Farm colonies generally have been established to serve purposes beyond the mere production of income. They have been conceived as instruments of moral revival, social reform or national resources planning. Operations have tended to be heavily influenced by an ideology. on the basis of which the farms can be classified into four major types: religio-utopian, secular-utopian, socio-economic and welfare. Each of these types is discussed below.

Religio-Utopian.—Most religio-utopian farm colonies have been established by devout believers seeking moral revival by following, for instance, the example of Jesus and his apostles, who are reported to have lived together and "had all things in common . . . and parted them to all men, as every man had need" (Acts ii, 44–45) Some of the early lay Christians lived on communal farms, as do members of certain contemporary Catholic religious orders, which also emphasize celibacy, frugal living and charity. Communal farms have been operated for many centuries by Taoist and Buddhist monks.

During the 18th and 19th centuries, secular farm colonies with religio-utopian ideology were organized by several fundamentalist Protestant sects in the United States. Many of these groups originated during the late Reformation period in southern Germany. There, under the influence of Anabaptist preachers, small groups of disciples who nished to share a common life gradually formed compact communities. They migrated to North America, where cheap land and religious tolerance presented more favourable circumstances for establishing their "Kingdom of God" than did their native lands. Among these groups were the Ephrata community of German Seventh-Day Baptists, who settled in Pennsylvania (1732–1905); the Harmonist disciples of Father George Rapp. who founded the villages of New Harmony, Ind., and Economy Pa. (1814–1905) (see NEW HARMONY); the Separatists at Zoar in Ohio (1819–1898); and the followers of the mystic William Keil, nho pioneered at Bethel, Mo., and Aurora. Ore. (1844–1881). The Shakers (q *v.*), from England, established more than 20 farm colonies after 1778 in states east of the Mississippi river. They believed in celibacy but replenished their ranks by adopting orphans and converting adults, so that there were a few scattered remnants in the second half of the 20th century.

The Amana society, with a membership of about 2,000 persons after mid-20th century, is established in several villages in eastern Iowa. Their ancestors landed in New York in 1842 as the "Community of True Inspiration," which had been founded in 1714 in Württemberg, Ger. The economically communistic principles of the society were abandoned in 1932, when it was transformed into a co-operative stock company. Members or their children are given preference in employment; all are entitled to free medical and dental service, free burial and, if necessary, support in old age by the society.

The Hutterian Brethren form the largest of the contemporary religious communal sects. About 400 migrated from Russia to South Dakota in 1874–77, to settle in three colonies. In the early 1960s they numbered about 13,000, living in about 11j colonies in western Canada (Alberta, Saskatchewan and Manitoba) and in South Dakota, North Dakota, Montana and Washington. The Hutterites emphasize economic self-sufficiency, supporting themselves through diversified farming and stock-raising, and also engaging in carpentry, building, and electrical and machine-repair work, largely for their own use. There has been much change and mechanization in their income-producing activities, in contrast to the stability of their customs governing personal conduct. family relationships and community life. The latter have changed very slonly since 1528, nhen the early Hutterites were forced to flee Switzerland because of their belief in communal living, pacifism and Anabaptist protestantism. They settled in North America after an odyssey of centuries through temporary havens in Bohemia, Hungary and Russia.

During World Wars I and II, the pacifist convictions of the Hutterites were used as rationalization by some people in Canada and the United States to engage in acts of vandalism or to urge restrictive measures against the sect, which is strongly resistant to all pressures for assimilation. In 1944, the Alberta government passed the Communal Property act, which singled out the Hutterites for restrictions on the purchase of land and prohibited such purchases nithin a radius of forty miles of any existing Hutterite community. Legal obstacles to land purchase were also imposed in South Dakota in 1958. Yet a social and psychiatric study of the group from 1949 to 1954 showed that few Hutterites have ever been institutionalized in mental hospitals or jails, or have required public assistance.

Other religio-utopian farm colonies, like those of the then polygynous Mormons in Utah (1840s) and the Oneida Perfectionists in Vermont and New York (1847–81), who advocated eugenics, were of U.S. origin. Many mushroomed into existence under the influence of revivalist preachers. About 67 other such short-lived farms were organized, mostly in the 19th century. (See LATTER DAY SAINTS. CHURCH OF JESUS CHRIST OF; ONEIDA COMMUNITY.)

Among religious pacifists, group communal farm efforts are not uncommon. Many such colonies had a transitory existence in the United States and Great Britain in the decade before World War II. Foremost among them is the Bruderhof movement. In the late 1950s it had about 1,500 members of 20 nationalities in 11 communities in Paraguay, Uruguay, Germany, England and the United States. Since its founding in 1920 by a German pacifist philosopher, Eberhard Arnold, the movement has grown by attracting intellectuals seeking a sense of identification within an idealistic community. The group shares most of the beliefs and some of the practices of the Hutterites, but does not isolate itself from the larger society in which it lives. It favours higher education. The European and North and South American settlements, while nidely separated geographically, have a common sense of identity and give each other mutual support. The members hope to become the focal point of a new order. They publish a bulletin, the ***Plow,*** in English, German, Spanish and Dutch.

Secular Utopian.—These farm colonies generally had a socialist ideology. Ethical concepts of the virtues of co-operation and neighbourliness also played an important role. Like the religio-utopians, they practised complete economic communism, but it was rationalized on the basis of secular expediency and a humanistic belief in the common good rather than on the basis of religious faith. Most of these colonies had a short life span; many broke up within a fen months because of disagreement concerning their ideology and management. The leaders usually had a detailed theoretical program of action to eradicate what they considered to be the antisocial practices of their capitalist contemporaries. Many of the members, honever, had not joined on the basis of any positive program, but were drawn together by a common protest and the hope of escaping from an imperfect world. Other such colonies experienced great difficulty because their members were largely of urban background—persons who had joined in response to urges to live a "simple" and "creative" life in the country but uho lacked previous experience in agriculture and handicrafts. After the initial enthusiasm there mould follow a gradual disillusionment during which many members left because of inability to do the nork.

The English social philosopher. Robert Owen (*q.v.*), "fathered" 17 such colonies in the 1820s, among which New Lanark in England and New Harmony (*q.v.*) in the United States were the most famous. During the 1840s, some 40 U.S group farms based their system on the nritings of the French utopian socialist, Charles Fourier (*q.v.*). The Brook Farm (*q.v.*) group in Massachusetts (1841–47) had many prominent members including Ralph Waldo Emerson and Nathaniel Hawthorne. Seventy-five others are known to have existed. including the French Icarians, who migrated to the new world during the latter 19th century (see CABET, ETIENNE; NAUVOO); the anarchist New Llano group in Louisiana (1914–36); and the short-lived Sunrise community of urban Jewish workers in Michigan (1933–35).

Socioeconomic. — These colonies developed in response to an interest in economic and social efficiency rather than utopian ideology. They were essentially a 20th-century development, although an illustrious forerunner of this type of group farm was the communal colony of the Plymouth pilgrim fathers. During the 1930s, under the New Deal program of rehabilitating low-income farmers in the United States, joint-cultivation types of farm colonies and family-farm homestead projects were established. About 25 co-operative corporation farms were organized, all but one of which were converted in the early 1940s into individually owned farmsteads.

In England, the commissioner for special areas: in co-operation with local authorities and the ministry of agriculture, experimented with small homestead colonies to assist middle-aged men whose prospects for reabsorption into industry during the 1930s seemed remote. A number of central farms were set up, each with a warden in charge. After a year's training the men were transferred to small individual holdings. Subsistence homesteads, providing house and small garden plots for low-income industrial workers were also tried. By 1949, nearly 700 families had been settled on 19 estates of the land settlement association. A manager provided technical guidance, purchased supplies for the entire group and sold its products.

The American and English group-farming experiments were largely a depression phenomenon. They involved people who had little in common but their poverty and who lacked a philosophical identification with the idea of co-operation. Increased agricultural efficiency and mechanization of agriculture during and after World War II led to the virtual disappearance of government interest in further group-farm experimentation, with one noteworthy exception, in the Canadian province of Saskatchewan, after the Co-operative Commonwealth federation came into power. In 1945 the provincial government established a department of co-operation and co-operative development to encourage rural people in pooling their resources to attain greater economic efficiency and a higher standard of living as well as to facilitate the establishment of villages rather than isolated settlements on formerly virgin territory. The government has an educational program and provides credit. By the late 1950s there were more than a dozen such co-operative farms and about 175 associations owning farm machinery, producing fodder or trapping fur-hearing animals co-operatively. Some had been organized on provincial land by veterans of World War II; others were composed of neighbouring farmers or relatives who decided to pool their land and machinery.

The most spectacular use of farm colonies as an instrument of national reconstruction is found in Israel, where co-operative farm settlements produced 80% of the country's food in 1959. Israel's experiences have been closely studied by representatives of other countries, such as India, Burma, Ghana and Nigeria. Beginning in the late 19th century, Jewish migrants from Europe to Palestine often settled in farm colonies for reasons of economy, efficiency and safety, as well as sociability. Members generally shared a common ideology, such as socialist utopianism, ethical humanism or Jewish orthodoxy.

The main forms of modern co-operative settlements in Israel are:

1. Communal farms, called kibbutz or *kvutzah*. They have from 60 to 2,000 members, who work without pay and are supplied with individual housing, clothing, medical care and other personal needs. There are central dining rooms and kitchens, communal kindergartens and, often, children's dormitories. An increasing number of these settlements have established industrial enterprises. Since the foundation of the first one, Deganya, in 1910, some have become quite prosperous. Many are able to provide a good education for the children, maintain communal libraries and recreation buildings and give their members regular vacations. Especially since the establishment of the Israeli government in 1948, there has been a trend toward more privacy for member families, larger allowances for spending money, and private ownership of clothing and furniture.

2. Joint cultivation associations, called moshav ovdim. These settlements are solely agricultural and range in size from 100 to 1,000 persons. They provide more privacy and individualism than is possible in a kibbutz. Members farm their own land, but use much of their machinery co-operatively and do most of their buying and selling on that basis. No property can be transferred to a new family without approval of the elected village council.

3. Co-operative corporation farms, called moshav *shitufi*. These combine the communal production of the kibbutz with the family ownership of a home and garden of the moshav ovdim. Agricultural and industrial resources are owned in common. Work and pay are adjusted to individual family circumstances. Each family in the moshav *shitufi* takes care of its own children and domestic services, such as food and laundry.

Farm colonies also were used to assist Jewish and other religious refugees outside Israel. At the beginning of the 20th century, the Jewish Colonization association established 19 family homestead projects in Argentina for victims of the Russian pogroms; by 1940 these supported a population of 27,000. Several hundred German refugee families were settled during World War II at Sosúa by the Dominican Republic Settlement association, financed by American philanthropists.

Large-scale voluntary mergers of small peasant holdings into joint cultivation associations and co-operative farms have occurred in Mexico, .particularly during the presidency of Lázaro Cárdenas (1934–40). *Ejidos* (land-owning villages) were provided with liberal credit for the purchase of machinery, and were furnished with free technical advice. In India, the religious Bhoodan movement was reported in 1959 to have transformed parts of 500 villages into co-operative cultivation associations, dedicated to improvement in productivity, rural hygiene, education and social development. This movement was inspired by Vinoba Bhave, a follower of Mahatma Gandhi, who walked from village to village persuading landowners to donate part of their holdings to some of their landless neighbours.

Group farming has also been used as an instrument of Communist economic and social policy. In Russia, a number of peasant joint-cultivation associations (tozes) and communal farms, composed mostly of idealistic urban workers who wished to live together under a system without private property, were set up after the Revolution of 1917. These voluntaristic forms of association were abolished under Stalin's regime. Preference was given to state-managed mergers of private land holdings into large, nominally co-operative corporations, the kolkhozy. Peasants were increasingly pressured into joining. Under Stalin, *kolkhoz* managers had to be approved by the Communist party. Further central control over their operations was exercised at regional, state-owned machine-tractor stations, from which heavy farm machinery was rented and agricultural experts were assigned. Vast tracts of virgin land were also brought under cultivation by group farms under direct state control and ownership in the *sovkhoz* form of settlement.

The haste accompanying the forced collectivization of Russian agriculture resulted at first in a great loss of productivity and was accompanied by much suffering, particularly during the early 1930s. Conditions improved gradually, but peasant resistance to involuntary and total "co-operation" did not entirely disappear. After Stalin's death, the Soviet government gradually increased the degree of autonomy of agricultural producer groups. The kolkhozy were allowed to purchase machinery. Machine-tractor stations mere gradually abolished. Peasants were allowed to cultivate small garden plots and to dispose of their products individually, on the open market.

The spread of Communism during and after World War II to eastern Europe and parts of Asia, especially China, was accompanied by forced collectivization of holdings of individual peasants. In Yugoslavia and Poland, after initial widespread organization of farm producer co-operatives by Communist functionaries, peasants were given some power to decide on the degree and kind of co-operation. As a result, most of the *kolkhoz*-type associations were dissolved. During the rebellipn of October 1956 in Hungary, peasants dissolved about 2,500 of the 3,950 collective farms that had been organized after World War II. Collectivization was pushed in China in the late 1950s to facilitate central economic planning and the mechanization of agriculture.

Welfare Group Farms. — These enterprises are operated by schools, mental hospitals, prisons, poor farms and orphan asylums for educational and rehabilitation purposes. They are under the direct supervision of the institution, with the welfare of the charges rather than farm' production ostensibly being the primary objective of the operations. Before World War I such farm colonies were used on occasion to provide for permanently unemployed persons. However, the unemployment-insurance systems developed in many countries after World Wars I and II proved to be a more satisfactory method of relief, although a few of the older rehabilitation colonies remained in operation.

Farm colonies, irrespective of their structure and ideology, provide a mechanism for reducing the isolation of rural existence and for promoting the mechanization and efficiency of production. They have been the object of considerable social and economic study, since they are generally planned on the basis of an explicit rationale and are small enough to be investigated with resources available to social scientists. Edward A. Norman established a research centre in this field, the Rural Settlement institute, later the Group Farming Research institute (1941–56). An International Council for Research in the Sociology of Cooperation was organized in 1953. It has headquarters in Paris and Milan, Italy, and publishes the *International Archives of Sociology of Cooperation.*

In addition to the references given above, related material will be found under CO-OPERATIVES.

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FARMER-LABOR PARTY, a minor U.S. political party representing the interests of small farmers and urban workers. The Farmer-Labor party of Minnesota—a state with a large Scandinavian population, politically oriented trade unions and a progressive tradition — grew out of the Nonpartisan league (*q.v.*), which had. become active in that state in 1916. Farmer-Labor candidates were nominated as early as 1918, and in 1920 the party placed a ticket in the general elections but withheld active support from the national party (see *National Farmer-Labor Party,* below). In 1922 the Minnesota party elected a U.S. senator and tno representatives. In 1923 the party became the Farmer-Labor federation and won the election of another senator, to fill an unexpired term; in 1930 its candidate Floyd B. Olson was elected governor of the state. He was re-elected in 1932 and 1934, serving until his death in 1936. In that year the federation gained control of all branches of the state government except the state senate, and elected five U.S. representatives and another senator. The federation supported Robert M. La Follette for president in 1924 and Franklin D. Roosevelt in 1932 and 1936.

A political force in one state only, the Farmer-Labor party was an example of a third party that became in fact, for a limited time and in a limited area, one of the major political parties. The election of Harold Stassen, a Republican, in 1938. and his reelection for tno successive terms, marked the beginning of the end for the party. nhich ceased to function as an independent party in 1944 when it joined forces with the Democrats to form the Democratic-Farmer-Labor party. Hubert Humphrey. U.S. senator from Minnesota, first elected in 1948, was instrumental in bringing about this coalition.

National Farmer-Labor Party. — This group was formed from the National Labor party in one of many attempts to unite small farmers, farm workers and urban trade unionists under one banner. In 1920 it nominated Parley P. Christensen for president and Max S. Hayes for vice-president, but, because it lacked finances and organization and failed to win the support of Progressives, Socialists, the Nonpartisan league or the Farmer-Labor party of hlinnesota, it polled few votes. Capture of party control by militant trade unionists at the 1923 convention in Chicago alienated potential supporters, including the Farmer-Labor leaders; and the party disintegrated. The idea, however, persisted, as evidenced by the formation of the La Follette Progressive party in 1924.

The party's platform was antimonopoly; advocated the nationalization of public utilities, basic industries and banks; and protested labour injunctions as usurpation of legislative power by the courts.

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FARMERS UNION, officially the National Farmers union and also known as the Farmers Educational and Cooperative union, was founded by Newt Gresham at Point, Tex., in 1902. Its early leadership and policies justify its being called the natural successor of the farmers' alliances of the 1880s and early 1890s. Initial success in controlling prices by not selling except for specified minimums led to rapid expansion of the union in the cotton states. To bolster this program it was necessary to limit production and ultimately add credit assistance based on crops stored in warehouses. Experience showed the importance of educating the farmers with reference to marketing, credit and tenure; these problems, together with co-operative enterprises, continued to be basic concerns of the union.

In the period from its organization until the mid-1920s the Farmers union was concentrated largely in the south and southwest. Beginning in the early 1920s leaders from the plains states became active and both membership strength and leadership in the Farmers union shifted from the south to the plains states. The union supported legislation to strengthen farmer co-operatives, increase credit available to farmers and increase farm prices. The National Farmers union became badly split in the 1930s on the issue of campaigning for specific office seekers. Those who favoured keeping education and the building of co-operatives as the major task of the union won control of the national offices. During the 1920s and the 1930s there were a number of reorganizations, especially in relation to the business enterprises sponsored.

Following a reorganization in the 1940s the National Farmers union developed a legislative program in support of an expanded program of supervised credit to low-income farmers, increased co-operative marketing, expansion of farm price supports at levels up to 100% of parity and production-control programs as needed to implement price supports.

In the mid-1950s plans were completed to develop potash deposits owned in New Mexico. Although only 24 states had active state Farmers unions, with a membership of about 300,000 farm families, a ten-year expansion program was launched to achieve the goal of an active state Farmers union with affiliated business services in all of the states. Profits from the potash fertilizer business were to be used to finance this expansion program.

The Farmers union from its earliest years differed from the American Farm Bureau federation (*q.v.*) and the Grange (*q.v.*) or National Grange of the Patrons of Husbandry in engaging in more informal co-operative activities with organized labour. in its greater emphasis on the problems of small farmers and in its advocacy of market reforms which often included greater government controls than the other farm organizations were willing to endorse.

Local Farmers unions are formed by ten or more male members.

Often the local unions are organized on township lines. The local unions form and support the county unions which in turn support the state unions. The state Farmers unions sponsor young people's educational and recreational programs. As in the case of the Farm bureau and the Grange, Farmers union locals usually have social and recreational programs for their membership and take an active part in community affairs. *See* also AGRICULTURAL ORGANIZATIONS.

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FARMING THE TAXES. A method of collecting taxes indirectly through contractors instead of directly through officials of the state. The system is best known through the *publicani* of Rome, who formed companies or syndicates to farm not only the indirect taxation of the state, but also sources of the state revenues, such as mines, fisheries, etc. (*see* PUBLICANI).

In monarchical Europe the revenue was almost universally farmed. France from the 16th to the 18th century is the most interesting modern example. Because of the hopeless condition of its revenues, the French government was continually in a state of anticipating its resources, and was thus entirely in the hands of financiers. In 1681 the indirect taxes were farmed collectively to a single company (*ferme générale*).

The rapacity of the farmers-general was proverbial, and the detestation in which they were held culminated in the execution of 32 of them during the French Revolution and the sweeping away of the system.

FARMINGTON, a city of San Juan county in northeastern New Mexico, U.S., at the confluence of the San Juan. Las Animas and La Plata rivers. Farmington was first settled in 1876 when Indian lands were opened to homesteaders, and was incorporated as a city in 1901. The region's first business was cattle ranching, but fruit growing was introduced in 1879 and soon there were flourishing orchards. A small rural town throughout the first half of the 20th century, its population was about 3,500 in 1950. The discovery of natural gas and commercial'oil pools in the 1950s turned the city into an oil and gas centre. Pipelines were built to the Pacific coast. drilling operations were intensified and pumping plants were built. Economic growth also was accelerated by construction of Navajo dam, a bureau of reclamation irrigation project 40 mi. upstream on the San Juan river. By 1960 the population reached 23,786, an increase of 654% over the preceding decade. For comparative population figures *see* table in NEW MEXICO: *Population.* (O. R.)

FARM MACHINERY. Farm machinery includes power machines, tractors and field machines or implements and machinery used for saving labour about the farmstead. Specifically, a machine is a device used to transfer, transform or apply energy to do useful work. While machines include hand tools, such tools are not ordinarily considered in the general classification of farm machinery.

This article deals with the influence of farm machinery on agriculture and discusses developments in the use of power machinery in preparing the soil, planting, cultivating, harvesting and threshing. Additional information on specific kinds of farm machinery will be found in the articles CROP-PROCESSING MACHINERY; DAIRY INDUSTRY: *Dairy Machinery and Manufacturing Processes;* HARVESTING MACHINERY; PLANTING MACHINERY; SPRAYING AND DUSTING MACHINERY; TILLAGE MACHINERY and TRACTORS. See also AGRICULTURE; RURAL ELECTRIFICATION.

The development of farm machinery operated by tractors and electric motors put the modern farmer in the capitalist class. On many modern farms the capital investment per worker is greater than the investment per worker in industry. The investment in machinery on U.S. farms, for example, increased 350% during the 20-year period preceding the second half of the 20th century. While farm machinery was not used as extensively in many parts of the world as in the United States, there developed a growing world-wide recognition that improvement in agricultural production required an increase in the use of machines.

The farmer is a director of both mechanical and electrical power. In the second half of the 20th century each farm worker in the U.S. had an estimated 40 h.p. at his command. In 1933 each worker commanded 33 h.p.; in 1920, 5.3 h.p.; and in 1870 only 1.6 h.p. During World War II the tractor power per acre was greater in England than in the United States.

Aside from speeding the farm work and reducing production costs, the use of tractors instead of animals for power on farms also released millions of acres for the production of food and fibre for humans instead of feed for work animals. Pasture areas so released made possible increased production of beef and other livestock. Timeliness, a most important factor in successful agricultural production, was made possible through the use of modern implements and machines powered by tractors.

During early colonial days in America, 85% to 90% of all workers were required to produce the food and fibre needed, meeting the demand less adequately than did slightly more than 10% of all workers in the second half of the 20th century. Wherever modern machinery was used, the agricultural worker was more efficient, an adequate food supply was assured and fewer workers were needed.

THE USE OF POWER

History. — The history of agricultural development is marked by advance in the efficient use of human labour through the use of machines and equipment designed, developed and improved to utilize animal and mechanical power.

The methods used by the American pioneers in tilling their small fields up to the end of the 18th century were little different from those of farmers in ancient Egypt, Greece and Rome. It was still the age of human power.

While animals had been used during the previous years, it was not until the beginning of the 19th century that the age of animal power began to advance. This resulted from the development of better plows, tillage tools, drills, planters and harvesting equipment designed to be drawn by animals. With the development during the first quarter of the 20th century of "big-team" hitches for pulling plows and combines, the use of animal power in the United States, particularly horses and mules, expanded until after World War I.

With the animal power and implements available, the farm labour required to produce a bushel of wheat was reduced from slightly less than three man-hours in 1830 to slightly less than one-half man-hour in 1896 and to one-fourth man-hour by 1930. This time was cut in half by the second half of the 20th century with tractor-operated equipment. With self-propelled machines, the time required was further reduced.

With the advent of the row-crop or general-purpose tractor, mechanical power had taken the place of horses and mules on most U.S. farms by the second half of the 20th century and was rapidly replacing oxen, horses, mules and water buffalo as power units on farms throughout the world.

Steam Engines. — Steam engines were first used as stationary power units, to take the place of treadmills (animal power) and windmills, to operate stationary machines such as grist and feed mills, wood saws and cotton gins. Later, self-propelled steam engines were used for operating stationary threshing machines that were moved from farm to farm. Many of these units were owned co-operatively by a group of farmers who organized a "threshing ring." Because of the heavy weight, such steam tractors never proved satisfactory as power units for drawing farm machines other than the huge plows of 10-, 12-, 16- or 18-furrow capacity used on the Great Plains.

Tractors. — The internal-combustion-engine tractor had its beginning at the turn of the 20th century. The tractor was first developed as a dual-purpose machine — as a draft machine to take the place of teams of horses and other animals and as a stationary power source for operating shellers. threshers. grinders and other belt-driven machines. By the second half of the 20th century, farm implements and machines were designed as an integral part of the operating unit and were quickly and easily interchanged for the work at hand.

An outstanding contribution of the tractor industry was the development in 1935 of hydraulic-control equipment which literally lifts the implements by fingertip control, the implements being easily and quickly detached from or attached to specially designed hitch bars. An extension of the hydraulic system through a remote or "slave" hydraulic cylinder extended hydraulic control to the raising, lowering and adjusting of drawn equipment as well as integral or tractor-mounted tools.

Modern hydraulic-mechanical devices automatically control working depth of tillage implements, relieving the tractor operator of the need for shifting gears or making adjustments as the implement encounters surface irregularities or changes in soil texture. Tractor speed is maintained, with good uniformity in the tillage job.

PREPARING THE SOIL

Plows.—More power is required in the preparation of the land for planting than in any other farm operation. The plow is the world-wide basic tool of agriculture. Use of oxen or horses to draw it was an outstanding contribution to the advance of agricultural production.

The plow was brought to Britain by the Romans. Some early horse-drawn plows were equipped with wheels and designed to be hitched to the horse's tail. This custom of hitching existed in Ireland as late as 1634, when an anticruelty law was passed prohibiting "plowing by the tayle."

A Dutch plow with a wooden moldboard was improved and patented as the Rotherham plow in England in 1730.

Early American statesmen were greatly concerned with the problems of agriculture. In 1788 Thomas Jefferson presented, as an original mathematical treatise, an account of the principle for constructing a moldboard plow, first to the Institute of France and afterward to the board of agriculture in England. Daniel Webster designed and constructed a large plow to be drawn by 10 or 12 oxen. The cast-iron plow was patented in the U.S. in 1797. It was found to be a good plow for use where the soil was sandy and stony.

As the American settlers moved westward, plowing the black prairie soils, high in organic matter, posed a special problem to the farmers who had cast-iron and iron-patched wooden plows. The ingenuity of John Deere, an Illinois blacksmith and plow maker of the 1830s, resulted in a new kind of plow which was made entirely of steel except for the braces, beam and handles. The one-piece share and moldboard of his first steel plow was cut from a mill-saw blade and shaped over a wooden form. This greatly improved plow not only made possible the effective plowing of the black prairie soils, but according to one writer "it cut by at least one-third the animal power needed to turn the soil."

Improvements of plows followed. Soft-centre steel for the moldboard was introduced in 1868; the three-wheel sulky or riding plows were followed by plows designed to be drawn by tractors, and later plows were mounted on tractors, which made plowing much faster, less laborious and often deeper than it was in the days of animal power.

Disk plows, developed toward the close of the 19th century, are used in hard dry soils, in soils that do not scour readily and where extremely heavy trash must be plowed under.

Harrows.—While the plow is the basic implement used in seedbed preparation, other implements have been devised for final preparation of the land to receive the seed. The branch of a tree was the first harrow. A wooden A frame with wooden teeth, and later iron teeth, was an improvement made during the first half of the 19th century. Steel-frame harrows with steel teeth and also a rotary type of harrow similar to the modern rotary hoe were developed in Norway during that period.

The disk harrow is second only to the plow as an implement for use in preparing a seedbed. It came into use in the late 1860s, but was not patented until 1877.

Other harrows have been developed for special uses in addition to seedbed preparation. Examples are the spring-tooth harrow, used for summer fallowing and weed control.

PLANTING AND CULTIVATING

In the early history of agriculture all the sowing of small grain was done broadcast. The farmers of China, India, Japan and Arabia, however, have drilled in their seeds from earliest recorded history. Information on primitive tools and methods used in planting and cultivating will be found in the article AGRICULTURE, PRIMITIVE.

Seeding Machines.—It is believed that the first seeding machine was developed and used by the Chinese about 2800 B.C. The Chinese drill of the middle of the 19th century resembled a wheelbarrow, nith three small, hollow teeth about 28 in. in length which carried the seed from a box supported above the wheels. The Italians had a two-wheeled seeder around A.D. 1600.

Seed and manure drills were in use in England as early as 1649. Jethro Tull (*q.v.*), an English farmer and writer, perfected a machine drill about 1701 and described a drill for planting turnip seed in his *Horse-Hoeing Husbandry* (1731).

In the United States the first patents on a seeding machine were granted in 1799 but it was not until about 50 years later, in 1851, that the force-feed drill was patented. This drill was equipped with a device which controlled the rate of seeding.

Concurrently with this development, in 1848 drills were equipped with manure and seed colters or blades, acting independently of each other, which deposited manure at one depth and covered it, and deposited the seed at a shallower depth and covered it. Within a hundred years, tractor-drawn machines were developed to place commercial fertilizer in relation to seed for the most effective results. Often hitched in huge squadrons, these drills, drawn by a large tractor, could seed a strip 50 ft. wide.

American machines were available in the second half of the 20th century which in one operation prepared the seedbed, with the mulch on the surface, planted the seed and placed the fertilizer. Drills and seeders accurately planted small grass and legume seed of all kinds along with the grain.

Corn Planters.—Row crops grown in hills of one or more plants are usually planted with a planter. The American Indian and the early settlers used a hoe to open a hole in which three or four kernels of corn were dropped and covered with the same tool.

The first American corn planter patent was issued in 1828. A forward step came in 1860 with the development of the cross-checking two-row planter, tripped by hand for checking as the planter crossed marks previously made in the field. The automatic check rower, tripped by a knotted cord placed across the field, was patented in 1875. The planter wire replaced the cord a few years later.

The first tractor-powered planters were the ordinary horse-drawn type adapted to be pulled by a tractor. They were supplanted with tractor-drawn two- and four-row equipment in the early 1930s. The speed and accuracy of these planters made it possible for the operator to control the time of planting, which played an important part in increasing corn yields.

In the second half of the 20th century equipment was introduced that could plant six, eight or more rous. Also planters could be equipped to do a fourfold operation: (1) plant the seed; (2) distribute fertilizer; (3) sow insecticides to kill ground-born parasites; and (4) apply chemical weed killers to kill weeds upon emergence through the surface.

Cotton Planters.—Cotton planters mere not perfected as rapidly as corn planters. The first U.S. patent on a cotton planter was issued in 182j. and a one-mule improved planter was invented about 50 years later. The modern cotton planter is designed so that the plates which carry the seed in the hopper are interchangeable nith plates designed to plant corn, sorghum and other seed. Multiple-ron cotton planters have been perfected.

Special Planters.—Special planters were developed for planting sugar-beet seed segmented to ensure more nearly the proper stand with minimum thinning. Potato planters. with automatic dropping mechanisms, eliminated the slow, laborious job of hand planting. These mechanical planters were designed to open the furrow, space and drop the seed pieces, properly place fertilizer and cover the fertilizer and seed at the proper depth.

Transplanting Machines.—Commercial gardeners and nurserymen who plant large quantities of plants and seedlings use transplanting machines. The essential parts of such a machine are a furrow opener, a water-supply tank, a hopper for fertilizer and blades for covering the fertilizer and forcing the soil about the plant.

Cultivating and Cultivators.—A crop is cultivated to promote growth of the plants and to destroy weeds which absorb moisture and plant food to the detriment of the crop.

To Jethro Tull, referred to above, is credited the development of what he called "horse-hoe husbandry." Horse-drawn cultivators of different types came into general use early in the 19th century. An improved cultivator equipped with three colters, followed by a harrow, and with a wheel at the end of the beam to regulate the depth and to facilitate turning was invented in Scotland about 1818.

A U.S. patent was issued in 1856 for a straddle-row two-horse cultivator. Later, seats were added, and by 1870 a farmer with two horses could cultivate as much as 15 ac. a day with a riding cultivator.

World War I accelerated the need for and use of multiple-row cultivators. Two-row horse-drawn cultivators were replaced first by two-row, then by four-row tractor-mounted cultivators. Larger multiple-row cultivators appeared in the second half of the 20th century to parallel the capacity of multiple-row planters.

Cultivators for special crops, including beets and beans, and for listed crops (crops planted in ridges) and crops on flat surfaces were developed. Rotary hoes are used for early cultivation of corn, cotton, soybeans, potatoes and small grain. This implement pulverizes the soil crust and destroys small weeds before the crop is large enough to be cultivated with a row-crop cultivator.

Weed and insect control through application of sprays and dusts became important as more was learned about insecticides and weed killers. Much of the loss caused by insect pests, plant diseases and weeds can be prevented through the use of spray material where proper equipment is available and when proved practices are followed. Spraying and dusting are done by custom operators and by individual farmers and orchardists. It became common in the U.S. for custom operators to use both ground machines and airplanes equipped with special sprayers and dusters.

HARVESTING

Sickle and Scythe.—The use of the sickle, a small, curved hand tool, for harvesting small grain dates back to 3000 B.C. The scythe, a larger hand cutting tool, was evolved from the sickle. In the second half of the 20th century both of these tools were still used for harvesting grain and grass in many parts of the world.

The cradle scythe was invented in Europe and was brought to America by the early colonists. The early cradle was a device for gathering the grain stems when cut and laying them in a swath for binding.

The grain stripper—a Gallic invention described by Pliny in the 1st century A.D.—is important as an attempt to lessen drudgery by using animal power. It consisted of a two-wheeled ox-propelled cart with a saw-toothed blade set across the open front to strip the heads, which fell into the cart.

Reapers.—Reaping machines developed gradually and simultaneously on both sides of the Atlantic. In America, where there had always been a labour shortage, development of great wheat-growing areas was impossible without machinery. The U.S. Civil War hastened this development.

In 1786 William Pitt of Pendeford, Eng., failed in his attempt to popularize a header with a revolving cylinder with rows of teeth which caught the heads and dropped them into a box.

The first English patent for a reaper was taken by Joseph Boyce in 1799. Invention followed invention, each adding features. until in 1822 Henry Ogle constructed a reaper that used a straight-edged knife blade as a cutter and employed a reel of revolving bars or arms, resembling the modern form, to push grain back upon a platform. Although Ogle's machine never became popular, his principle of the cutter and reel was adopted in all subsequent successful designs.

In 1826 Patrick Bell, a Scottish minister, invented a reaper with a shear-action cutter—movable blades cutting against stationary blades—a principle still in use.

Although the first U.S. patent was granted in 1803, no machine of importance was patented until 1822, when Jeremiah Bailey brought out a combination mower and reaper. The next invention worthy of mention was that of William Manning in 1831. His cutter bar reciprocated, that is, moved alternately from side to side, over guard teeth, as if anticipating designs used by Obed Hussey and Cyrus H. McCormick. Hussey and McCormick experimented with reapers simultaneously. McCormick had his at work by 1831. but Hussey was the first to secure a patent—on Dec. 31, 1833. Each machine utilized the principle of a reciprocating knife cutting against stationary guards or fingers. McCormick's machine employed a divider between cut and uncut grain and a reel to topple cut grain onto a platform.

Inventors then turned their attention to providing an automatic device to deliver the cut grain in a form suitable for binding. This brought the self-rake and the dropper. The self-raking reaper held the field from 18jo to 1870, when it was replaced by the harvester. A harvester included a special mechanism to handle and bind the cut grain into sheaves or bundles ready to be set up in shocks. C. W. and W. W. Marsh patented the first successful harvester in 1858. A canvas delivered the cut grain over the drive wheel to a box from which it was taken and bound by two men riding on the machine. This design set the pattern for future harvesters. However, a mechanical binding mechanism was still lacking. Because twine was very expensive. the first binders used wire, but damage to cattle resulted, so these binders were never popular. John F. Appleby made a successful twine binder which was put on the market in 1880 when twine was cheap enough to be used economically.

Thus the McCormick cutting principle, the Marsh frame and the Appleby binder were combined to produce the successful modern binder. The result was a grain binder that was still used successfully, though on a limited scale, in the second half of the 20th century.

The header, which merely clipped grain heads and elevated them into a wagon rack, was developed in the United States, Canada and Australia. The headed grain was usually stacked for threshing at a later date. Use of the header, along with the binder on a lesser scale, continued as standard harvest procedure throughout the Great Plains wheat areas of the U.S. and Canada until the grain combine became widespread early in the 20th century.

Windrower.—The header's more modern counterpart was the self-propelled or tractor-drawn windrower which cut the standing grain and laid it in a windrow atop the stubble. Separating and cleaning were done by the combine harvester equipped with an attachment to pick up the windrow in place of the regular cutting platform. The practice of windrowing was followed in the Great Plains of the U.S. and Canada, where the grain was cured in the windrow to protect it from late-season weather and pest damage.

Threshing or Thrashing Machines.—Threshing or thrashing is the separation of grain or other plant seeds from their husks or pods. Until the middle of the 19th century the chief methods were flailing by hand or treading by animals on a threshing floor. The modern methods employ either the drawn-type or self-propelled combine harvester. which harvests the ripened seeds and threshes them in one operation.

The first step in the mechanization of threshing came in the 17th century when fanning mills were developed for winnowing Andrew Meikle, a Scotsman. in 1786 built a threshing machine which combined the blow of the flail (*q.v.*) with the rubbing action of the threshing floor, the prototype of present-day threshers, in which beaters were fastened to a revolving drum forcing the grain against the ribs of a sparred concave sieve placed below the drum.

Probably the best known of the early American machines was developed by Hiram and John Pitts of Winthrop, Me., to combine the threshing, separating and winnowing processes in a single machine.

Eventually, the combine replaced the stationary thresher.

Combines.—The development of a combine (that is, a combination harvester and thresher) was concurrent with the development of the reaper, the binder and the threshing machine. A U.S. patent was issued to Samuel Lane on a combined harvester on Aug. 8, 1828. The first combine to be built was patented by H. Moore and J. Hascall of Michigan in 1836, but its use was abandoned because of climatic conditions. Later it was taken to California and used successfully in 1854.

The first combines were drawn by horses; later by steam and internal-combustion tractors. The self-propelled combine was introduced about 1908. This was a significant advancement because it made the combine more maneuverable and more efficient. The self-propelled model could go into a field without running down part of the crop on the first round. Modern self-propelled combines literally put one man in complete command of his harvest.

The combine, although originally built to harvest wheat and oats, is used to harvest many other crops, including legume and grass seeds, beans, sorghum grains and corn.

Corn Harvesters.—Many types of corn harvesters have been developed. The sled cutter, one of the early attempts, cut the stalks, which were put in shocks by the operator. Corn binders were developed later. Husker-shredders are used to remove the ear from the stalk, husk it and shred the stalk for feed and for bedding. The corn picker was developed for use where the stalks were left in the field By mid-20th century more than 90% of all corn grown in the corn belt of central U.S. was harvested with the picker.

A shelling attachment (introduced in late 1950s) for the two-row corn picker enabled the grower to harvest his crop as shelled corn or ear corn. A corn attachment for the self-propelled combine had entered the corn-harvesting field in 1954. The corn attachment picked the ears and passed them on to be shelled and cleaned in the separator. Because of the high moisture content of the corn when harvested by either of these methods, a drying and storage problem was created, which was solved by installing crop driers either on the farm or at the grain elevator.

Haying Machinery.—Hay has always been an important crop where livestock is raised. The tractor-mounted mower, the tractor-mounted rake and pickup baler have taken the place of the sickle, scythe, hand rake and pitchfork in the modern production of the hay crop.

About 1930 proposals for a hay conditioner or crusher attachment for a mower were developed. The purpose of crushing the green hay was to reduce the time required in curing or drying. Several U.S. manufacturers produce this type of machine. Other hay machinery includes various types of rakes, tedders, loaders, balers and forage harvesters of several types. The latter machine may be used to cut and chop a green crop and deliver it into a wagon or truck to be stored as ensilage, dried artificially for hay or fed (green) to stock in the feed lot. It may be used, also, to pick up and chop windrowed field-cured hay for storage in barn or stack. With a row-crop attachment, it is used to harvest standing row crops, such as corn, for ensilage.

Special machinery and equipment are found on farms that produce large amounts of hay. Sweep rakes and hay stackers eliminate much hard labour during the hay harvest. Automatic pickup balers permit one man to do a job formerly done by several. In the late 1950s an attachment was devised for the automatic baler which would toss small bales directly into a wagon drawn behind the baler, further reducing the labour and time required in harvesting. While the handling of loose hay in barns has been done with forks and slings, the chopped hay and bales are handled with blowers and mechanical elevators and barn conveyers.

Crop Driers.—Much progress was made in the development of farm crop driers during the second quarter of the 20th century. Thtse units are designed to dry grain and hay with heated or unheated air. The various types of driers and their uses are discussed in CROP-PROCESSING MACHINERY.

Cotton Harvesters.—The perfection of mechanical cotton harvesters led to the complete mechanization of cotton production in some areas.

Machines for stripping mature bolls of cotton from the stalks were developed during the last half of the 19th century. These strippers were not used to a great extent until 1940, and largely at that time in Texas and Oklahoma, where stormproof cotton, which is stripped or snapped in a once-over operation, is the principal type grown. With a stripper, one man did the work of 20 men snapping by hand. While a bale of cotton was harvested with a stripper in 30 minutes, it took one man about 40 to 50 hours to harvest a bale by hand.

In open-type cotton, which cannot be stripped, the bolls open wide as they mature to expose the cotton fibre for easiest plucking or pulling. The mechanical cotton picker draws the lint from open bolls and leaves the unopened bolls for a later picking. After many years of field testing, the cotton picker was produced commercially in 1941. As a result, large areas of cotton were mechanized in west Texas, Arizona and in southern California, where open-type cotton is raised.

Other Crops.—Other crops are harvested and handled mechanically. Potato diggers were first available in 1886. Few were used until 50 years later. By 1940 machines were in use that dig, clean, grade and bag the potatoes in one trip across the field. Peanuts, sugar beets, sugar cane and castor beans are harvested with machines designed for the particular crop. These crops were largely mechanized in certain areas by the second half of the 20th century.

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FARM MANAGEMENT. Farm management has been defined as both a science and an art and also as the business side of farming. It is a science in the sense that it deals with the organization and operation of a farm to obtain maximum continuous profits. As a manager a farmer decides what and how much to produce and hom- to produce efficiently. In deciding how to employ his resources most profitably, the farmer applies principles of economics and of physical and biological sciences and uses technical information from various fields. As an artisan he develops and practises the skills necessary to perform a wide variety of tasks in crop and livestock production.

This article is concerned primarily with the management of commercial farms and contract farming. For information on management factors involved in other types of farming *see* FARM COLONY; FARM TENAKCY; LAND TENURE: ECONOMIC AND AGRARIAN ASPECTS; SMALL HOLDINGS. The role of government in farm management is indicated in the articles on the various countries; *e.g.,* RUSSIA. *See* also AGRICULTURE: *Agricultural Economics.* For additional references *see* AGRICULTURE. ARTICLES ON.

Management is less specialized in farming than in nonfarm business, although in this respect farming is similar to other small businesses. Particularly with the increased capital requirements of modern agriculture, the farmer must perform many of the functions of a business manager. A farmer acquires. rents or borrows the needed resources and decides how they will be used. Since he usually provides much of the capital himself, he also bears much of the risk of success or failure of the business. The farmer is, moreover, an organizer and supervisor of labour and of the use of power and machinery. He is also responsible for buying and selling, increasingly important functions in commercial farming.

Profit is the principal objective in farm management but not the only one. Avoidance or reduction of risk is more important sometimes than maximum future profits. The objective of continuous profits also means that the farm should be so managed that its productive capacity will be conserved by maintaining a high level of soil fertility, by controlling erosion and by keeping buildings and other capital assets in good condition.

Most farms in the western world are family operated. and decisions concerning farm business are closely related to matters concerning the family's welfare and level of living. Thus the objective of maximum profits may be modified by the family's goals with respect to living conveniences, education, recreation, health and many other factors. The farmer must make business decisions that are consistent both with his resources and abilities and with the needs and desires of the family.

PRODUCTION RESOURCES

Every farmer uses three basic factors or resources in his business—land, capital and labour. These are his raw materials. He must select and acquire these resources and decide how and in what proportions they are to be used to obtain high returns from the whole iarm as a business unit.

Land.—Agricultural land varies greatly in slope and drainage and in chemical and physical characteristics of the soil (*q.v.*). In a broad sense. land includes the natural climatic factors with which it is associated. Differences in temperature and rainfall. as well as the soil itself, affect the value of particular land areas and the systems of farming to which the areas are best adapted. High value of crop or grass production is important in successful farm management. The farmer should grow crops that are well adapted to his land and he should produce high yields per acre.

Capital.—Many kinds of capital are employed in farming. Some is fixed or overhead capital—assets that are used over many years. Some is semifixed capital—machinery, breeding livestock and other assets that are productive over a shorter period of years. Working or circulating capital includes market livestock. feed, annual fertilizers and annual cash operating expenses.

Adequate capital is a means of increasing the productivity of both land and labour. It is essential in modern commercial farming. Mechanization and other technological advances ahich increase production also greatly increase capital requirements. In managing a farm many decisions are made with respect to the use of capital. How can limited capital be most profitably employed? How much should be invested in buildings, in machinery, in fertilizer and in feed? When should capital be borrowed, and how should borrowed capital be invested so that it can be repaid from increased earnings and without excessive risk? *See* also FARM BUILDINGS; FARM MACHIKERY.

Labour.—Labour is generally the most expensive resource, the chief input (or cost) in farming. It amounts to one-third of the total inputs on commercial farms in the U.S. The proportion of labour that is hired varies a great deal with the size of the farm and the system of farming. It was estimated that the total labour input on commercial farms in the U S in the second half of the 20th century was composed of about 28% hired workers, 23% unpaid family aorkers and 49% operator's labour. Although the percentage of labour hired varied widely between regions. predominance of the family farm was apparent from these estimates. In Great Britain the situation is considerably different. According to data published by the ministry of agriculture and fisheries, *Farm* Incomes *in England* and *Wales, 1952–53,* hired workers performed 76% of all farm labour. family workers 5% and the farmer and his wife 19%. On many British farms. however, the farmer and his family do most of the work.

Management.—In economic discussions management is considered a fourth factor of production along with land. capital and labour. Although it is the central resource around which a farm plan must be built, management is difficult to evaluate in most farm situations, for it is virtually impossible to distinguish between results of the farmer's activities as a worker and as a manager. or to determine at the end of the year how much he has earned for managing and how much for use of the capital, labour and often land that he has supplied to the business. Many studies of farm records, however, indicate high rewards for good management. There is a wide range. for example, in financial returns of farmers in the same area with similar land resources and markets. but with different levels of management.

Combinations of Resources.—There are extreme differences between regions and between individual farms in total resources used per farm and in the proportions in which resources are combined. These differences are the result of variations in productivity and value of land, in types of farming and in the relative availability of land. capital and labour. There is a great diversity in the size of individual farms. According to official censuses 46% of all holdings in England and Wales in the second half of the 20th century were less than 20 ac. in size, and 3.4% were 300 ac. and larger, excluding rough grazing land. However, the holdings 300 ac. and over included 25% of the acreage of crops and grass. In the U.S. in 1935, farms averaged 1jj ac. per farm; 20 years later the average was 242 ac. However, the average was less than 200 ac. in some farming regions in the southeast and more than 6,000 ac. in some other regions in the Great Plains. Increases in size were general throughout the U.S., the result of mechanization making it possible for one man to operate more area, of the need for larger businesses to attain the benefits of the greater amounts of capital being employed. of the desire to maintain higher standards of living and of lorn-income farmers leaving the farm for better economic opportunities. The table shows differences between selected types of farms in the U.S.

Acres in Farm and Capital Investment, U.S. Farms

Type of farm and region	Acres in farm	Capital, including land	
		Per farm	Per worker
Cash grain farms, corn belt . .	232	$92,000	$60,000
Wheat farms, south Great Plains .	720	76,500	54,000
Sheep ranches, north Great Plains . .	6,189	81,800	28,000
Dairy farms, central northeast .	208	30,000	15,000
Cotton farms, south piedmont .	179	16,300	7,000

Source: U.S. Department of Agriculture, "Farm Costs and Returns, 1956; Commercial Family-Operated Farms by Type and Location, *Agriculture Information Bulletin 176* (1957).

Ownership of Resources.—A farmer may own or rent the farm he operates. Proportions of the resources furnished by the tenant and the landowner vary. Young men with limited funds often start farming in the U.S. under a manager-tenant lease requiring the tenant to furnish only his labour and management and the landowner. land and buildings, livestock, machinery and other operating capital. Under a livestock-share lease. the tenant usually owns the machinery and a half interest in livestock. The tenant under a crop-share lease owns all livestock and machinery, and delivers a share of the crop production to the landowner as rent. Under a cash lease a specified sum is paid for rent The proportion of resources furnished by the tenant increases in the order in which the leasing arrangements are listed above. Likewise, his risks increase, but so do his opportunities to gain the rewards of superior management.

The decision to buy or rent a farm is important. A man with limited capital to invest, for example, could rent a farm that is larger or more productive than one he could afford to buy. As a renter he could invest in equipment and other resources necessary for efficient operation. and from which he could expect a higher rate of return than that which usually could be expected from investment in land. The decision to buy or rent, however. is seldom made on strictly economic grounds. For many individuals the satisfaction, independence or security of owning their own farms is an important factor. See also FARM TENANCY; LAND TENURE: ECONOMIC AND AGRARIAN ASPECTS; SMALL HOLDINGS.

PLANNING THE FARM BUSINESS

A complete farm plan includes a budget showing how resources are to be used and the returns expected. In a general farming region where farmers have a relatively wide choice of profitable alternatives from which to choose a system of farming, the following are logical steps in developing a long-time plan.

Inventory of Natural and Economic Resources.—In initial planning, a soils inventory is a major consideration. The soil of the farm should be described in terms of inherent productivity, extent of erosion, present fertility level and adaptation to particular crops. Condition and capacity of buildings should also be inventoried. And finally, it is important that the farmer inventory the capital he has available for land improvements, purchases of livestock, machinery or buildings and operating needs.

Planning the Cropping System.—The long-time cropping plan is largely determined by the inventory of land resources. Acres of the farm that are too rough, rocky or wet for cultivation will be used for forests or permanent grazing. For the tillable land, the crop, or sequence of crops, should usually be the most intensive and the most profitable that the farmer can grow on that land considering his labour and capital limitations and the need to control erosion.

Planning the Livestock Program.—With the land-use program determined. an estimate can be made of average annual production of crops, allowing for increased yields that will result from the use of legumes, fertilizers and erosion-control practices. Estimates of crop production and the proportion of grains and forage will be an important factor in determining the kinds and amounts of livestock. Other important factors are the labour and capital available, markets and the skill and preferences of the farmer. Livestock often offers a practical way to increase the volume of business on small farms.

Transition to the Long-Time Plan.—Having developed a long-time plan for crop and livestock production, it is necessary to plan the steps by which it is put into operation. The transition may take several years. It will be facilitated by plans for each year of the transition, showing crops to be grown in each field, fertilizers to be applied, investments to be made. etc.

Estimating Income and Expenses.—The final test of a farm plan is an estimate of income. expenses and net returns. By this means the farmer can compare alternative plans or modifications of a plan already being followed. To test alternative plans a partial budgeting procedure can be used. including only those expense and income items that would be changed if the present plan were altered.

EFFICIENT FARM OPERATION

A successful farm business depends not only on a sound plan but on the efficient application of the plan. Efficient operation requires many skills and much judgment on the part of the farmer. He must know and carry out crop and livestock production practices that result in high yields and low costs. He decides whether it is profitable to substitute machinery for labour, and to use more or less fertilizer or feed under existing price and cost relationships. Timeliness is important in many operations. If labour is hired, the farmer must be able to direct the work of others and train them in efficient methods.

Farm Records.—Farming is a complex business, and production and financial records contribute much to success. They make possible an analysis of the business for the purpose of determining its strong and ueak points and serve as a basis for improvements in organization or in operating techniques.

Farm records have been studied to determine why some farms earn significantly more than others and to provide farmers with standards to which they can compare the efficiency of their own farms. The relative importance of different efficiency factors varies with systems of farming and, to some extent, in difierent periods. In general farming areas, however, crop yields usually have more effect than any other factor. Other factors that have an important influence on earnings are efficiency in livestock production, prices at which products are sold, the choice of crops and efficiency in the use of labour and machinery.

Professional Management.—In commercial farming regions many farms are owned by persons who do not operate them. Some owners employ a manager to supervise the operation of the farm with hired labour or to plan and supervise a farm operated by a tenant. In both Great Britain and the U.S. there are societies of professional farm managers, which publish journals and sponsor meetings. They have established professional standards and codes of ethics, and have done much to maintain high professional standards in the fields of farm management, rural appraisal and farm credit.

CONTRACT FARMING

In some cases a farmer produces under a contract with business organizations engaged in processing or marketing his product or in providing him with supplies. Canning companies contract with farmers to produce specified acreages of vegetables or fruits. Broilers are produced under contracts with feed companies, hatcheries or broiler processors. Contract systems are practised with many other farm products in the U.S.

Contracts vary a great deal, but have the same general effects on farm management. The farmer gives up some of his independence in making decisions as to how to produce and in marketing. In return he reduces risk by having a guaranteed market and usually a price that is set in advance. For this security he lessens his opportunity for highest returns from superior skill in production and in buying and selling.

The contracting company furnishes or finances a part of the capital for feed and other supplies or livestock. In return it has a controlled source of supply to process or market, or an expanded market for supplies that it sells to the farmer.

Vertical Integration.—Production, processing and marketing are interdependent stages in providing consumers with farm products. Co-ordination of these stages is desirable. Vertical integration refers to the co-ordination of management decisions in, or control over, two or more of the three stages.

Vertical integration may be accomplished by ownership, by contract or by co-operative action. This is illustrated by examples of integration in the meat industry. A meat-packing company that fattens its own cattle is effecting integration by ownership. A farmer who slaughters his own hogs and sells meat is doing the same thing. If the packing company or a feed company contracts with farmers to produce hogs, integration is by contract. In other words. contract farming is one method of integration. If a farmer co-operative provides its members with breeding stock and feed and markets or processes the meat animals, integration is by co-operative action. Farmers, as members of the co-operative. retain control over the integrated system. Co-operatives throughout the world provide many examples of vertical integration.

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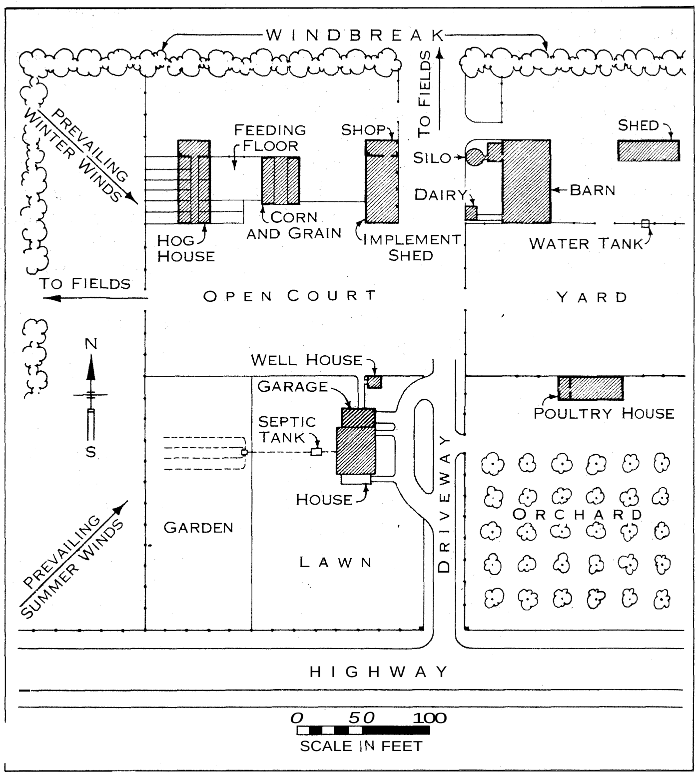
FARMSTEAD ARRANGEMENT, U.S. The farmhouse and farm service buildings along with their associated yards, pens, lots and lanes comprise the typical United States farmstead. Normally the farmstead is located on the land that is being farmed. In pioneer times it was customary to select a site near running water and a stand of timber.

Today the favoured farmstead site is well drained, close to fields and pastures, accessible to power lines and on a good road leading to markets. churches and schools. An area of between five and ten acres which is naturally elevated or sloped gently to the east or southeast is desirable.

The relative position of the various elements comprising a farmstead is influenced by several independent factors. A well-balanced arrangement is a compromise between the limitations inflicted on the site by nature, by the character of the main farm enterprises, by the danger of fire and by the requisites of pleasant farm living.

Natural Influences.—The most unalterable factors in farmstead arrangement are those imposed by nature. They include prevailing winds, sunlight. drainage and natural views.

Prevailing winds are considered in planning the farmstead layout. Feed lots require locations nhere their associated structures can shield workers and livestock from winter winds and where summer air currents will not carry barnyard odours to the farm home. An evergreen windbreak on the north and west sides of the farmstead can shelter the whole area. But it is important not to obstruct air movement immediately around the farmhouse and near structures utilizing natural ventilation for crop drying. To reduce the chances of fire, major structures are placed out of the line of the prevailing winds.



FARMSTEAD LAYOUT IN THE NORTH-CENTRAL UNITED STATES

Sunlight also is a factor in planning farmstead arrangement In addition to giving light, the sun will provide heat and have a sterilizing value in livestock buildings that are oriented to admit a maximum amount of sunlight in the winter. Buildings like corncribs, two-row farrowing houses and stanchion dairy barns need to have the sun on both the east and the west sides. Consequently. they are usually located with the long axis north and south. Poultry houses generally face south with most of their windows on that side.

All areas of the farmstead need good natural surface drainage; the farmhouse occupying the best-drained site. Traffic areas between service buildings and lots also require especially good drainage. A building arrangement that follows the contour of the land will facilitate maintenance. Grading can sometimes redeem a site that would othernise be impractical.

The farmhouse is located where advantage can be taken of views toward naturally attractive features. The best natural view is often of a small lake, a patch of woods or a permanent pasture. Windows in the living portion of the farmhouse are then oriented toward these natural views, and service buildings and lots are kept away from this part of the farmstead.

Major Farm Enterprises. — Farmsteadarrangement is strongly affected by the type of business enterprise for which the farm is suited. While general-purpose farms need a variety of buildings and related lots to accommodate multiple enterprises, more specialized farms need facilities for only one or two.

For efficient chore operations cash-grain farms mainly require storage structures. which are located where they can be conveniently filled and emptied. Shelters for farm machinery are common to most types of farms. They require locations that permit equipment to have ready access to fields by lanes, and where there is ample turning space. A site relatively near the house is suitable, especially if a shop for repairing machinery is incorporated.

Specialized enterprises like dairying require a group of related buildings or integrated units for storing feed and roughage, for housing and exercising livestock. for milking and for preparing milk. Where the major enterprise is feeding cattle and hogs. sheds are arranged about a feed centre which stores roughage, grain and supplements and provides equipment for processing rations.

By the second half of the 20th century many advances had been made in the development and application of automatic equipment for processing feed and distributing it to livestock on the farm. (*See* CROP-PROCESSING MACHINERY.) Electric power assisted by electronic controls have made possible accurate metering, blending. grinding and conveying of feed and roughage with a minimum of hand labour. Mechanical feed-conveying equipment affects farmstead arrangement by allowing wider latitude in locating livestock-feeding areas in relation to the feed-processing centre than do systems depending on gravity for distribution. Later expansion of the enterprise also is easier where mechanical systems have been incorporated.

A farm service yard is an open area that provides access to the principal buildings, lots and lanes to fields. It reduces the need for entry of farm machinery to livestock lots and the open space helps to prevent the spread of fires.

Farm Living Values. — An important but less tangible influence on farmstead arrangement is the value of attractive appearance to the farm family and the community. The farmhouse and the more attractive buildings are placed where they are readily seen from the public road. The, more undesirable views are screened off by buildings and plantings. Deep yards or permanent pastures usually are located next to the public road, keeping the farmhouse 12j ft. or more back.

Unification of the farmstead as a whole helps to improve its appearance. An evergreen windbreak forms a backdrop that gives unity to the over-all setting, as do roof colours and architectural features that are repeated. Ornamental fences and landscape plantings also contribute to the interrelated appearance of buildings and lots.

Trends in Farmstead Arrangement. — In the second half of the 20th century the average size of farms in the United States increased through consolidation of smaller units. Thus the functions of two or more old sets of buildings often have had to be coordinated. On livestock farms one procedure has been to concentrate feed processing at the most centralized set of buildings and use self-unloading wagons to distribute the feed to other centres.

As farms continue to become more specialized, building arrangements reflect this change by further concentrating chore activity centres and by using more automatically controlled equipment. *See* also FARM BUILDINGS; FARM MANAGEMENT.

See Keith H. Hinchcliff et al., *Planning Your Farmstead* (1954); W. A. Foster and Deane G. Carter, *Farm Buildings,* 4th ed. *by* Deane G. Carter, ch. 3 (1954). (K. H. HF.)

FARM TENANCY. Tenancy is one of three major means of organizing agricultural units of production throughout the world. The other two major means are owner operatorship and group or communal tenure: including state ownership. Further discussion of the history and development of the different forms of land tenure and agricultural organization in various lands throughout the world will be found in the article LAND TENURE: ECONOMIC AND AGRARIAN ASPECTS. The article MÉTAYAGE SYSTEM deals with the cultivation of land for a share of the produce. *See* also FARM COLONY; FARM MANAGEMENT; AGRICULTURE: *Agricultural Economics;* LANDLORD AND TENANT; and articles on individual countries and on the continents.

Farm tenancy arises when landowners cannot or do not wish to operate their land and when farm operators cannot afford or do not wish to own the lands they operate. Thus, under tenancy, landowners contribute their lands and various amounts of operating capital and management while tenants contribute their labour and various amounts of operating capital and management. The returns from this pooling of land, labour, capital and management are shared by landlords and tenants in various ways.

In western Europe and North America the usual means of using agricultural lands is through the individual farmer who is either a tenant or an owner-operator. In Africa, in parts of Mexico under the ejido system, parts of the middle east, China and the U.S S.R., various forms of communal and tribal tenures are in practice (see LAND TENCRE, PRIMITIVE).

In areas where land has been alienated to individuals, usually some of these individuals have gained ownership of more land than they could cultivate. Sometimes this occurred as an outgrowth of the feudal structure which characterized the society of Europe in medieval times and of Japan, for example, before the Meiji restoration of 1868. Sometimes it was the result of large Spanish and Portuguese grants of land in newly conquered areas of the new world; grants which still influenced the ownership of land in the second half of the 20th century in Latin America and the southwestern United States. Sometimes it was the result of the appropriation of apparently unoccupied lands in Africa which, in reality, were under some form of tribal tenure and shifting agriculture. In India and Pakistan many landlords originally gained their property as a result of the British delegation of tax-collecting rights, which gave rise to the zamindar and ryotmari systems which were in the process of being eliminated in the second half of the 20th century (see INDIA: Government *and Administration: Finance: Revenue*). In other areas, such as Burma, tenancy has arisen because unstable agricultural prices and low price levels forced many small cultivators to mortgage their lands to moneylenders who eventually gained control when the borrowers defaulted. But in other instances tenancy has arisen because individuals with capital wished to invest in agricultural land and were willing to combine their land with the labour and management ability of some other individual who had little capital.

Regardless of how it arose, farm tenancy in the modern world serves to combine the land resources of the landlord and the labour resources of the tenant into a single operating unit. Under proper conditions this can be economically as efficient as owner-occupancy, as has been demonstrated in the United Kingdom and in the midwestern United States. But when the landlord has too much power — perhaps because of competition for land, credit monopoly or outright intimidation — there may be an arbitrary transfer of income to the disadvantage of the tenant, and there is no incentive for proper cultivation. Under such conditions, poverty ensues, tenants may come to be considered as an inferior social class and many abuses appear.

TENANCY THROUGHOUT THE WORLD

Probably tenants and their families constitute as many as two-fifths of the world's people engaged in agriculture. Thus, around 750,000,000 people live and work on other people's land. There are wide differences in the extent of tenancy throughout the world. In the second half of the 20th century tenancy varied from 65% of all farmers in England and Wales and 77% in Scotland to 5% in Denmark and 5.4% in western Germany. Tenants made up 53% of all farmers in India and 40% of the total in Taiwan. On the other hand, in parts of Thailand tenants were as few as 5% of the total number of farmers. Care should be taken not to associate operator-ownership too closely with a high level of living. Many of the owner-operator farmers in the areas of southeast Asia were heavily in debt and held their land only because moneylenders did not care to take title to the land for themselves.

Within individual countries there were great differences in the extent of tenancy and therefore national averages might be misleading. In the Philippines, for instance, farm tenancy varied from less than 2% of all farmers in the mountain section of Luzon to over two-thirds of all farmers in central Luzon.

Tenancy Improvement. — Governments in both the more advanced and the underdeveloped nations, especially after World War II, showed great interest in improving conditions of tenancy. In the United Kingdom the Agricultural Holdings act of 1948 spelled out tenant rights, giving greater security to tenants. A French law passed in 1946 guaranteed the tenant the right to renew his leases even against the will of the landlord, and provided for compensation if he left. In Brazil the civil code provided that the term of the lease must cover the harvesting of the first crop. In Japan the law of Oct. 1946 provided security for tenants and set maximum levels of rent. In Taiwan rents were limited and minimum conditions of tenancy prescribed by legislation. In India the Bombay Tenancy and Agricultural Lands" act of 1948 provided comprehensive minimum standards for tenancy contracts. Other Indian states, including Hyderabad, Surashtra and West Bengal, passed tenancy legislation.

Properly framed and administered, improved farm-tenancy arrangements in underdeveloped areas offer an important foundation upon which to build a more productive agriculture. Improved tenancy conditions can offer security, fair returns, assurance of future returns for present investments, improved levels of living and the social and political independence of individuals prerequisite to first-class citizenship.

Providing Security. — Paramount in tenure-improvement measures are adjustments favouring security of tenure wherever insecurity is a serious problem. Fortunately, there are several remedial adjustments which are available and which have been used successfully by particular countries. These adjustments include: (1) written lease provisions; (2) a minimum lease term; (3) a minimum termination notice and automatic renewal; (4) restrictions on transfers of leased land; (5) heritability of leases; (6) permanent occupancy and use of rights; and (7) compensation for disturbance.

In an increasing number of nations, tenancy agreements had to be written and meet certain minimum requirements, as mas the case. for instance, in the Netherlands and Sweden. In some of the less developed areas, similar regulations were effectively implemented. In Japan, under the agrarian reform measures following World War II, all tenancy contracts had to be written.

In an effort to lengthen the tenant's planning horizon many nations established a minimum period for an agricultural lease. In the United Kingdom the length of the contract runs for the lifetime of the tenant so long as he practises "good husbandry" and wishes to continue to cultivate his holding. In Belgium the minimum period of lease is nine years. In the Netherlands individual parcels without buildings must be rented for a minimum of 6 years, while farms must be rented for a minimum of 12 years, with, however, provision for adjusting the rent every three years. In the Philippines the tenant has lifetime security of tenure under the Landlord-Tenant Relationships act of 1954, subject to fulfilling statutory requirements. In India the minimum length of time is from five to ten years in different states, and generally the tenant may not be evicted except for default in rent payments, bad cultivation techniques or resumption of the land by the landlord for his own use. In Cuba the minimum period of time is three years. In Mexico the interest of the tenant in any event continues until he harvests standing crops or picks ripening fruit. In Taiwan the minimum period of lease was set at six years, and could be renewed if the tenant desired unless the landlord took back the land for his own cultivation.

Farm and Home Improvements. — Closely allied to the problem of providing security of tenure is the matter of making farm and living improvements on rented lands. Since rented lands are owned by someone other than the operator, and since improvements made on that land usually become the property of the landowner, tenants have little incentive to make improvements which become the property of someone else.

The adjustments usually considered are: (1) compensation for unexhausted vaiue of improvements; (2) compensation for dilapidation~(3) longer-term leases; (4) kind and amount of rental payments.

Perhaps the most highly developed and formal system of compensation is found in the United Kingdom, under the provisions of the Agricultural Holdings act of 1948. Under this act. the tenant has a statutory right to compensation of three general sorts: (1) for long-term improvements; (2) for medium-term improvements; and **(3)** usual improvements necessary for good husbandry (see also LANDLORD AND TENANT).

Provisions for compensation similar to those in the United Kingdom are found in France, the Netherlands and commonly throughout western Europe. But such measures were also being adopted in other countries. In India, for example, several states recognize the right of the tenant to make improvements and claim compensation for them if forced to quit his holding. In Cuba a tenant may claim compensation, upon the expiration of his lease, for improvements made during the first half of the lease. if he can demonstrate that the improvements were necessary to the proper accommodation of his family or his hired labourers, or necessary for proper cultivation of his holding.

Implementing Improvements.—The activities of the Food and Agriculture Organization of the United Nations in providing technical assistance and sponsoring regional land-problem seminars in Campinas. Braz., Bangkok, Thailand, and Salahuddin. Iraq. may be cited as important measures to implement tenancy improvements. Under the leadership of FAO, concerted efforts by the United Nations agencies have been made to assist member governments in their tenancy-improvement efforts. The United States government has contributed to this end by providing land-tenure technicians for various countries such as Japan. the Philippines, South Korea and Vietnam. (See also LAND REFORMS.)

THE UNITED STATES

History.—The history of farm tenancy in the United States begins in the colonial period of the 17th and 18th centuries. Most colonists came to America in search of freedom and land. Settlers in the New England colonies. for the most part, owned the land which they farmed. However, colonies to the south of New England were settled by proprietors with large land grants. Proprietors in the middle Atlantic colonies rented their holdings to tenants and attempted to collect quitrents from the tenants. Terms of the "durable lease" or "incomplete sale" under which these tenants occupied land provided for annual rents in the form of dues and services to the landlord. The landlord retained the option of collecting one-fourth of the sale price or recovering full title to the land at three-fourths of the market price.

The quitrent system hung together for two centuries mainly because few landlords collected the dues and services. Never popular with the occupiers, many of whom came to America to escape European feudal land practices, the system was finally thrown off by the antirent rebellions during the 1840s. Except in the plantation areas of the south, most individual landlords owned only one rented farm after the middle of the 19th century.

With almost unlimited free land to the westward to be had largely for the effort of settling. most colonists refused to tolerate unsavoury tenancy conditions in the colonies and early states. However, some farmers preferred the comforts, safety and improvements of the settled areas over the frontier, and they rented farms in the older areas. As many as one-third of the farms mere rented in a New Jersey county as early as 1843. Although state- and nation-wide statistics on farm tenancy were not obtained until 1880, farm tenancy existed throughout the early development of the nation. At the time of the first nation-wide agricultural census, including detailed farm tenure data, in 1880, 25.6% of all farms were reported being operated by tenants who rented all their land irom landlords. Subsequently. the proportion oi all farms in the U.S. operated by tenants was 28.4% in 1890, steadily increasing to 35.3% in 1900, 37% in 1910, 38.1% in 1920 and 42.4% in 1930. It dropped to 38.7% in 1940, to 26.8% in 1950 and continued to decline in the second half of the 20th century. Tenancy was most prevalent in the midwestern and southern states. For example, in Iowa 38.4% of all farmers were tenants who rented 42.7% of the state's farmland. In addition, 15.9% of the state's farmers rented part and owned part of the land they operated.

Over the years, farm tenancy in the United States arose from a combination of factors. Young farmers without sufficient capital and management experience rented land from owners desiring to retire from active farming. Nonfarmers who acquired land through inheritance or as a hedge against inflation rented their land to farmers without land of their own. During the depressed 1930s many farm owner-operators lost ownership of their farms through foreclosures and excessive debts coupled with low prices for farm products. These farmers became tenants.

A study in Iowa revealed that nine of every ten tenants expected eventually to own the land they operated and these farmers regarded tenancy as a means toward farm ownership (see also FARM MANAGEMENT).

Lease Types.—Farm tenants pay their landlords a share of the products or cash or a combination thereof as rent for the use of land. Of the more than 1,000,000 farm tenants in the U.S. in the second half of the 20th century, 28% paid a share of the crops only, 23% were sharecroppers, 14% paid a share of the crops and in addition some cash rent, 14% paid cash rent only. 9% paid both shares of livestock and crops and the remaining 12% paid various combinations of the above as rent.

Thus, the most prevalent kind of rent was a share of the crops only. These renters are called crop-share tenants. They usually furnish all the labour, machinery and part or all of the operating capital and own the livestock. Crop-share tenants usually pay one-fourth to one-half of the crops as rent to the landlord.

Sharecroppers. the next most prevalent lease type, were most common in cotton- and tobacco-producing areas (see SOUTH, THE). The tenant, or sharecropper, usually furnished the labour only; the landlord furnished machinery. power, seed, fertilizer and other elements of production in addition to the land and improvements. The tenant, or sharecropper, received a share of the crop as a wage for his labour.

Sharecrop-cash tenants are similar to crop-share tenants and differ only by paying some cash in addition to a share of the crops as rent.

Cash tenants pay cash only as rent to the landlord. These tenants pay all operating expenses and receive all returns irom crops and livestock. They hire the land from the landlord for a specified amount of cash as rent. This kind of rent was diminishing in importance in the second half of the 20th century.

Livestock-share tenants pay a share of both the livestock and crops produced as rent. Under the livestock-share lease, the tenant furnishes his labour, the landlord iurnishes his land and everything else is furnished by landlord and tenant jointly. Livestock-share leases. usually on a jo-jo sharing basis. are common among parents and children. This arrangement is an important means whereby parents retire and their children take over operation of the home farm. However, nonrelated tenants and landlords also use this arrangement quite often. The livestock-share lease, most prevalent in the livestock-producing areas of the middle west, was growing rapidly in proportion to other kinds of leases.

Lease Problems and Improvements.—Three major problems plagued leasing arrangements throughout the nation. First, most farm leases were for only one year without automatic renewal. which did not provide the tenant family sufficient certainty of expectations to enable them to become a vital part of the community or to use the farm resources in the most productive manner.

Second. farm leases were influenced largely by past customs and often failed to encourage changing technological improvements in agriculture.

Third, rent payments frequently did not reflect the relative productivity of resources contributed by landlord and tenant, respectively. Changes in prices and costs were not readily reflected in rentals, which lagged behind price and cost changes.

Improvements in farm leases include longer-term leases or annual leases with automatic-renewal provisions unless one party notifies the other four, six or nine months ahead of the end of the lease year. Another improvement is compensation to tenants for unexhausted value of improvements made by the tenant if and when the tenant quits the farm before receiving full benefits from the improvements. The amount of compensation may be determined by the remaining benefits of the improvement at the time the tenant leaves the farm. These remaining benefits may be based upon the original cost of the improvement, replacement cost or productive value. The original cost method is most frequently used. although it fails to reflect price changes and does not necessarily represent productive value. Still another involves making the division of income between landlord and tenant reflect more accurately the productivity of the resources each contributes. Further improvements include provisions for the use of fertilizers, rotation, weed-, insect- and disease-control measures, conservation improvements and other improved farming practices. Finally, leases should be in writing in order to minimize disagreements over their provisions. (J. F. T.)

FARNABY, GILES, English composer, was born in the second half of the 16th century, probably at Truro, where his family lived. He began to study music in 1580, according to his own statement in his *supplicat* when he was taking the degree of bachelor of music at Oxford in 1592. Beyond these facts little is known of his life. His son Richard is one of the composers included in the *Fitzwilliam Virginal Book*. No connection has been traced between Giles and the grammarian and schoolmaster Thomas Farnaby who lived about the same time. The name of Giles Farnaby lives chiefly in his contributions to the *Fitzwilliam Virginal Book*. The fantasia was his favourite form, but his other pieces—bearing such attractive titles as "Giles Farnaby's Dream," "His Rest," "His Humour"; "Up Tails All," "A Maske," "A Toye," "A Gigge"—are full of quaintness and charm. One tiny piece for two virginals is only eight bars long; others, not much longer, are marvelous in their point and precision and intensely musical in feeling.

His *Canzonets to Foure Voices, With a Song of Eight Parts* were published in 1598. Other works are included in Thomas Este's *Whole Booke oj Psalms* (1592) and Ravenscroft's *Psalter* (1621). The madrigal *Come, Charon, Come* is in the Royal College of Music, London; another, *Construe My Meaning*, has been edited by W. Barclay Squire. An autograph volume of *The Psalms of David, to Fower Parts, for Viols and Voyce, the first Booke, Doricke Motets, the Second, Divine Canzonets, Composed by Giles Farnaby, Bachilor of Musicke With a Prelud, Before the Psalmes, Chromaticke* is in a private library in Philadelphia, Pa. *See* the articles "Farnaby," "Virginal Music, Collections of" in Grove's *Dictionary of Music and Musicians.*

FARNBOROUGH, THOMAS ERSKINE MAY, 1st BARON (1815–1886), clerk of the British house of commons, historian and writer on parliamentary procedure, was born in London on Feb. 8, 1815, and was called to the bar at the Middle Temple in 1838. His *Treatise on the Law, Privilege, Proceedings and Usage of Parliament* (1844; 16th ed., 1957) is a standard work on the subject, and has itself influenced parliamentary procedure. Sir Erskine May (he was created knight commander of the bath in 1866) was examiner of petitions for private bills (1846). taxing master of the house of commons (1847), assistant clerk (1856) and clerk of the house of commons (1871–86). His *Constitutional History of England . . . 1760–1860* (1861–63) was revised in later editions by its author. He died in London on May 17. 1886, a few days after his elevation to the peerage.

FARNBOROUGH, an urban district in the Aldershot parliamentary division of the county of Southampton (*i.e.,* Hampshire), Eng., 33 mi. S.W. of London by road. Pop. (1951) 26.271. Area 6.8 sq.mi. It is mainly residential, but is famed as the site of the royal aircraft establishment and has important military and other establishments. A display of civil and military aircraft is held annually by the Society of British Aircraft Constructors. The parish church of St. Peter includes portions of its Norman predecessor and has a wooden belfry at the west end. On the north wall are some 12th–14th century murals.

Above the east side of the main road is Farnborough hill mansion, now a convent but for some time the residence of the former empress Eugénie of France, who built St. Michael's Roman Catholic church in 1887 to receive the remains of Napoleon III and the prince imperial; she too was buried there.

FARNE ISLANDS, a group of 17 main islets with smaller rocks and reefs, about 80 ac. in extent lying $1\frac{1}{2}$ to 6 mi. off the N.E. coast of Northumberland, Eng. They are composed of dolerite, which has resisted the action of the waves, and are a part of the Whin Sill. The largest island, Inner Farne or House, is 16 ac. in extent and has precipitous cliffs up to 80 ft. in height; the other principal islets are Staple, Brownsman, North and South Wamses, Longstone and Big Harcar. The whole group belongs to the National trust and is preserved as a bird sanctuary, for myriads of sea birds breed there. On Inner Farne a small 14th-century chapel stands on the site of the hermitage to which St. Cuthbert (*q.v.*) retired from the priory at Lindisfarne between 676 and 684. He was with difficulty persuaded to leave Farne on his appointment to the bishopric of Lindisfarne and returned to it to die in 687. Longstone lighthouse was the home of the heroic Grace Darling who, with her father, the keeper, rescued survivors of the "Forfarshire" which was wrecked on Sept. 7. 1838, on the Harcars. Also on the group is the powerful Farne lighthouse.

FARNESE, the name of an Italian family which from 1545 to 1731 ruled the duchy of Parma and Piacenza (since 1512 part of the papal states). They appear first as minor feudal lords of Farneto (Farnese) near the lake of Bolsena, tracing their origin perhaps, like so many Italian feudatories, to the reign of the emperor Otto I. From the 12th to the 14th centuries they sustained themselves adroitly in the service of other lords and of various communes, notably Orvieto, where they held office as consuls, *podestà* and bishops. As Guelphs they also served the papacy, first rising to distinction in the person of Ranuccio il Vecchio, who caught the favour of the Colonna and still more of Pope Eugenius IV. Ranuccio received from Eugenius vicariates and fiefs, largely in pledge for his wages as papal *condottiere,* while his sons entered the Roman nobility, one marrying an Orsini, another a Caetani.

Tradition states that Pope Alexander VI was the lover of Giulia Bella, Ranuccio's granddaughter. Certainly it was her brother Alessandro, created cardinal by Alexander VI in 1493 and elected pope as Paul III (*q.v.*) in 1534, who established the family politically. A nepotist like his predecessors, he conferred both titles and lands upon his natural children, the most famous of whom was Pierluigi Farnese (1503–47); it was Pierluigi who in 1545 received from his father the duchy of Parma and Piacenza for an annual *census* of 9,000 ducats. Pierluigi. who had started life as a *condottieve,* proved an able captain but ruthless and dissolute and an insatiable egotist. Nevertheless as a ruler he brought real benefits to his duchy, which had suffered under the listless government of papal legates. He had already improved his ancestral domains as well as the other lands, Castro in the Maremma among them, which Paul had given him; in Parma and Piacenza he showed comparable energy in attacking the privileges and abuses. fiscal and judicial, of the feudal aristocracy and in promoting reforms in agriculture, commerce, industry and the administration of justice: oligarchy gave way to *signoria.* He proceeded. however, with imprudent severity, and a resentful nobility plotted his death, with the support of Ferrante di Gonzaga, the emperor Charles V's governor of Milan, and of Andrea Doria, who sought revenge on Pierluigi for his part in the Fiesco conspiracy (*see* FIESCO). He was murdered on Sept. 10, 1547, and Gonzaga's troops occupied Piacenza.

Pierluigi had several children, for all of whom Paul III generously provided. Alessandro (1520–89), created cardinal at the age of 14, was a man of learning and artistic tastes who attracted the society of scholars and artists, among them Paolo Giovio. Pietro Bembo, Giorgio Vasari *et al.;* it was he who completed the magnificent Farnese palace in Rome, the castle of Caprarola and the church of the Gesù. Orazio, Pierluigi's third son, was made duke of Castro when his father became duke of Parma; he married Diane, the legitimated natural daughter of Henry II of France. Ottavio. the second son (1521–86), married Margaret of Austria (*q.v.*), natural daughter of Charles V. After Pierluigi's death Paul appointed a papal legate to Parma; Ottavio pushed his claims, but did not receive that duchy until the accession of Pope Julius III (1550). This did not end his quarrel with Charles V, for Gonzaga refused to give up Piacenza, and Ottavio was driven into the arms of France (May 1551). Julius, anxious to be on good terms with Charles, ordered Ottavio to surrender Parma to the papal authorities and, on his refusal, deprived him of his Roman fiefs while Charles did the same with those in Lombardy. A French army came to protect Parma, war broke out. and Gonzaga laid siege to the city. But the pope and the French signed a truce (April 1552), and the duke came to an arrangement with his father-in-law whereby his title to Parma was secured; and he eventually regained

Piacenza from Philip II. The rest of his life was spent quietly at home, where he resumed the policy of his father, only with greater moderation, and won the affection of his subjects. At his death in 1586 he was succeeded by his son Alexander Farnese (*q.v.*) (1545–92), the famous general of Philip II of Spain, who spent the whole of his reign in the Flemish wars.

His son and successor, Ranuccio I (1569–1622), issued the constitutions (1594) which gave final form to the ducal administration; he also embellished Parma, building its theatre and reviving its university. But he mismanaged the state finances, borrowed heavily on the Roman market and died in debt. Sombre and suspicious by nature, his reserve was increased by disaffection among the nobility and the discovery of a plot (1611–12), which was violently suppressed. His son Odoardo (1612–46) who succeeded him, was opposite in character to his father; but his failure to pay the interest on the money borrowed in Rome and the desire of Urban VIII to obtain Castro for his relatives, the Barberini (*q.v.*), led to a costly war with the papacy. His son and successor Ranuccio II (1630–94) also had a war with the papacy about Castro, which was eventually razed to the ground. His son Francesco Maria (1678–1727) suffered from the wars between Spain and Austria, the latter's troops devastating his territory. The succession devolved at his death on his brother Antonio (1679–1731), with whom the male line ended. The powers had agreed in the treaty of Seville (1729) that at the death of Antonio the duchy should pass to the *infante* Charles (later Charles III of Spain), son of Philip V of Spain by Elizabeth Farnese (*q.v.*), granddaughter of Ranuccio II; and the treaty of Vienna (1731) confirmed this arrangement. Elizabeth's younger son Philip was recognized as duke by the treaty of Aix-la-Chapelle (1748); meanwhile his brother had become king of Naples and Sicily.

The Palazzo Farnese in Rome, one of the finest specimens of Roman Renaissance architecture: was begun under Paul III, when still cardinal, by Antonio da San Gallo and completed by Cardinal Alessandro under the guidance of Michelangelo (1546). It was inherited by the *infante* Charles, who had most of the pictures removed to Naples when he became king there. It now contains the French embassy and the French school of Rome.

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(P. J. J.)

FARNESE, ALEXANDER (1545–1592), duke of Parma and Piacenza, general and statesman, governor general of the Netherlands under Philip II of Spain, was born at Rome on Aug. 27, 1545, and died at the abbey of St. Waast, near Arras, on Dec. 3, 1592. He was the son of Ottavio Farnese, duke of Parma, and Margaret of Austria, natural daughter of Charles V. He accompanied his mother to Brussels when she was appointed governor of the Netherlands, and in 1565 his marriage with the princess Maria of Portugal mas celebrated in Brussels with great splendour, Alexander Farnese had been brought up in Spain with his cousin, the ill-fated Don Carlos, and his uncle Don John of Austria, and after his marriage lived at the court of Madrid. He fought under the command of Don John in 1571 at Lepanto. In the autumn of 1577 Farnese was sent with reinforcements to Don John, then governor general of the Netherlands, and it was mainly his prompt decision at a critical moment that won the battle of Gembloux (1578). Shortly afterward Don John died, and Farnese was appointed to take his place.

In military ability Farnese was inferior to none of his contemporaries, as a skilful diplomatist he was the match even of William the Silent, and he was untroubled by scruples. He fomented the divisions and jealousies between Catholic and Protestant, Fleming and Walloon, and by the treaty of Arras. May 1579, he secured the support of the "Malcontents," as the Catholic nobles of the south were styled, to the royal cause. The reply to the treaty of Arras was the Union of Utrecht, concluded a few weeks later between the seven northern provinces, who abjured the sovereignty of King Philip and bound themselves to use all their resources to maintain their independence of Spanish rule.

Farnese. as soon as he had obtained a secure basis of operations in Hainaut and Artois, set to work to reconquer Brabant and Flanders. Tournai, Maastricht. Breda, Bruges and Ghent opened their gates, and finally he laid siege (1584) to Antwerp. The town was resolutely defended by the citizens under Philip de Marnix, lord of St. Aldegonde, who was assisted by the engineer Federigo Giambelli. Farnese cut off all access to Antwerp from the sea by constructing a bridge of boats across the Scheldt from Calloo to Oordam. On Aug. 15, 1585, Antwerp was compelled by famine to capitulate. The whole of the southern Netherlands was brought once more to recognize the authority of Philip. But Holland and Zeeland continued to defy Farnese (*see* NETHERLANDS).

In 1586 Alexander became duke of Parma and Piacenza, on his father's death. Philip would not permit him to leave the Netherlands; but neither would he permit him to use his veteran army to reconquer the Northern Provinces, though the moment was opportune. The king's whole energies were directed to the preparation of an Invincible Armada for the conquest of England, and Parma was ordered to collect an enormous flotilla of transports and to keep his army concentrated and trained for the projected invasion of the island realm of Queen Elizabeth I. Thus the critical period passed by unused, and in the interval the Dutch had found in the youthful Maurice of Nassau a military genius. Moreover, the accession to the throne of France of Henry of Navarre had relieved the pressure upon the Dutch and placed Parma and his army between hostile forces. The expenditure upon the Armada had depleted the Spanish treasury, and in 1590 Farnese could get no regular supplies of money from the king for the payment of the soldiery, and he had to pledge his own jewels. A mutiny broke out, but was suppressed. Parma now received orders to raise the siege of Paris, which was blockaded by Henry IV. He left the Netherlands on Aug. 3, 1590, at the head of 15,000 troops. By brilliant generalship he outwitted Henry and succeeded in relieving Paris; but owing to lack of money and supplies he was compelled immediately to retreat to the Netherlands, abandoning on the march many stragglers and wounded.

Again in 1591, in the midst of a campaign against Maurice of Nassau. Parma was obliged to march to relieve Rouen. He succeeded but was wounded before Caudebec, and was finally compelled to withdraw his army. He died near Arras on Dec. 3, 1592. He was honoured by a splendid funeral at Brussels, but his body mas interred at his own capital city of Parma. He left two sons, Ranuccio who succeeded him, and Odoardo, who was created a cardinal in 1591 by Pope Gregory XIV. His daughter Margaret married Vincenzo, duke of Mantua.

See L. P. Gachard, *Correspondance d'Alexandre Farnèse, Prince de Parme, gouverneur général des Pays-Bas, avec Philippe II, 1578–1579* (Brussels, 1853); L. van der Essen, *Alexandre Farnèse,* 5 vol. (Brussels, 1933–37); J. M. Rubio y Esteban, *Alejandro Farnesio* (Saragossa, 1939).

FARNESE, ELIZABETH (1692–1766), queen of Spain, was born on Oct. 25, 1692, the only daughter of Odoardo Farnese (d. 1693), eldest son of Ranuccio II of Parma and Piacenza. On Sept. 16, 1714, she was married by proxy at Parma to the widower Philip V of Spain. This marriage was arranged by Giulio Alberoni (*q.v.*) with the concurrence of 'the Spanish *camarera mayor,* the princesse des Ursins (*q.v.*), who hoped to dominate the new queen. Arrived in Spain and met at Jadraque (now in Guadalajara province) on Dec. 23 by the *camarera,* Elizabeth forthwith dismissed her. She then attained complete ascendancy over Philip, and the control of affairs was shared between her and Alberoni. In 1719 she put herself at the head of a division against the French; but the Quadruple Alliance thwarted her plans, Alberoni was banished and the allies made his remaining in exile a condition of peace (1720). Yet from Philip's frustrated abdication to his death (1724–46) Elizabeth remained supreme, directing the whole of Spanish policy so as to secure Italian thrones for her sons: in fact she saw the poners recognize the accession of the eldest, Charles, first to the duchies of Parma and Piacenza (1731) and then to the kingdom of the Two Sicilies (1738) and that of his brother, Philip, to Parma, Piacenza and Guastalla (1748). Kept from power during the reign of her stepson Ferdinand VI, she returned to it when her son became king as Charles III. Besides Charles and Philip, she bore Philip V two other sons and three daughters. She died on July 11, 1766.

See L. de Taxonera Vivanco, *Isabel de Farnesio* (Barcelona, 1943); Emile Bourgeois, La *Diplomatie secrète au XVIIIe siècle,* vol. 2 (Paris, 1909).

FARNHAM, a market town and urban district in the Farnham parliamentary division of Surrey, Eng., 38 mi. W.S.W. of London by road. Pop. (1951) 23.928. Area 14.1 sq.mi. Farnham lies in the valley of the River Wey, whose northern and southern slopes rise to 600 and 500 ft. respectively above sea level. Aldershot camp is 3 mi. N.E. Farnham castle, on a hill north of the town, was, until the creation of the diocese of Guildford in 1927, the palace of the bishops of Winchester; in that year it became the residence of the bishop of Guildford. The castle was first built by Henry of Blois, bishop of Winchester and brother of King Stephen. It was razed by Henry III but rebuilt by the bishop of Winchester. In 1567 and 1j69 Bishop Horne entertained Queen Elizabeth I there.

Farnham was garrisoned for Charles I, suffered during the Civil War and was demolished in 1648. George Morley, bishop of Winchester, restored the episcopal palace within its walls (1662–84). The park of 300 ac. was acquired by the urban council in 1930. The parish church of St. Andrew is a transitional Norman and Early English building with later additions. It was formerly a chapel of ease to Waverley abbey (2 mi. S.E. of Farnham), the earliest Cistercian house in England, founded in 1128 by William Giffard, bishop of Winchester. William Cobbett (*q.v.*) was born in the parish and is buried in the churchyard. The mansion of Moor park was the residence of Sir William Temple (d. 1699) and his wife, Dorothy Osborne (d. 1695). Here Jonathan Swift worked as Temple's secretary (1689–94). Esther Johnson, Swift's "Stella," also lived in the house, her mother being employed by Lady Giffard, Temple's sister.

By the time of the Domesday survey the manor of the bishop of Winchester at Farnham was as large as most of the king's estates. Farnham's position at the junction of the Pilgrims' way and the road irom Southampton to London was important. In 1205 it had bailiffs, and in 1207 it was definitely a mesne borough under the bishop of Winchester. In 1247 the bishop granted the first charter, giving, among other privileges, a fair on All Saints' day.

Henry Cardinal Beaufort is said to have confirmed the original charter in 1410, and in 1566 Bishop Horne granted a new charter. In the 18th century the corporation, a close body, declined, its duties being performed by the vestry, and in 1789 the one survivor resigned and handed over the town papers to the bishop. Farnham sent representatives to parliament in 1311 and 1460. It early became a market of importance and was famous in the late 17th and early 18th centuries for wheat and oats. Hop-growing has been carried on in the neighbourhood since 1597.

FARNWORTH, a municipal borough in the Farnworth parliamentary division, Lancashire, Eng., on the Irwell, 3 mi. S.S.E. of Bolton. Pop. (1951) 28,616. Area 2.4 sq.mi. Most of the inhabitants work in the collieries, cotton mills, iron foundries and joinery works. The town was incorporated in 1939.

FARO, the capital of a district bearing the same name, in southern Portugal; at the terminus of the Lisbon-Faro railway, and on the Atlantic ocean. Pop. (1950) 17,631. Faro is an episcopal see. Its broad but shallow harbour is protected on the south by the long island of Cães, and a number of sandy islets, which, being constantly enlarged by silt from the small river Fermoso, render the entrance of large vessels impossible. Fish, with nine, fruit, cork. baskets and sumach, are the principalarticles of export. Little has been done to develop the mineral resources of the district, which include tin, lead, antimony and auriferous quartz. Faro was taken from the Moors in 1249. It was sacked by the English in 1596, and nearly destroyed by an earthquake in 17jj.

The administrative district of Faro coincides with the ancient kingdom and province of Algarve (*q.v.*).

FARO, one of the oldest of all gambling games played with cards, supposedly named from the picture of a pharaoh on French playing cards imported into Great Britain. It was enjoined by specific mention in English law as early as 1739. A favourite of highborn gamblers throughout Europe in the late 18th and early 19th centuries, Pharaoh was the game at which the young Count Rostof, in Tolstoy's *War and Peace,* lost a fortune. In the United States a writer in 1894 termed it "unquestionably entitled to be called the national American card game." A commonplace in U.S. gaming rooms, especially in the west, until about 191j, the faro bank (marked traditionally by a picture of a tiger as an advertisement outside the house, whereupon playing faro was known as "bucking the tiger"), by 1925 had all but vanished. Faro later continued to be a fixture at licensed gambling houses in Nevada.

The Layout. — In faro a shuffled 52-card pack of playing cards is placed face up in a dealing box. Bets may be placed only against the house. The 13 cards of the spade suit, representing the ranks of all suits, are enameled on a cloth, or layout, on which the bets are placed. A bet may be placed on any rank to win, or (by coppering the bet, that is, placing a copper counter on the chips) to lose; or, by the manner in which the chips are placed on the layout, may cover several ranks.

The Play. — The dealer takes one card from the box. This card, called soda, is not used. The next card taken from the box loses (the house pays the amount of any coppered bet placed on this rank and takes in bets placed on this rank to win). The next card (left showing in the box) wins, and the house pays the amount of any bet placed on that rank to win. The removal of one card and exposure of the next constitute a turn on which bets are settled. Then the dealer removes the exposed card from the box, puts aside another card, which loses, and leaves exposed another card, which wins. The casekeeper keeps on display a running record of which cards have been played and which are still to come, for reference of all players. The last card in the box (called in hock), like soda, does not count.

When cards of the same rank appear in the same turn, and so both uin and lose. the house takes half of each bet on that rank, whether to win or to lose. This is called a split.

When only three unplayed cards remain in the box, players are invited to call the turn, the house paying 4 to 1 (against odds of 5 to 1) to any player guessing correctly the exact order in which these cards will appear. If the last three cards include a pair (called a cathop) the house pays 2 for 1 to anyone who calls the order.

Stuss is a variant of the game in which the cards are dealt from a pack held face down in the dealer's hand, not from a dealing box, and when a split occurs the house takes all the bets on that rank, instead of only half of them.

See A. H. Morehead *et al.,* The *New Complete Hoyle* (1956).

(A. H. Md.; F. Hs.)

FARQUHAR, GEORGE (1677–1707), British dramatist, son of William Farquhar, a clergyman, was born in Londonderry, Ire., in 1677. He was educated at Trinity college, Dublin. He became an actor on the Dublin stage. but in a fencing scene in Dryden's *Indian Emperor* he forgot to exchange his sword for a foil, with nearly fatal results to a fellow actor, and never acted again.

At the suggestion of Robert Wilks, the comedian. Farquhar wrote his first play, *Love and a Bottle,* which was performed at Drury Lane in 1698. His second comedy, *The Constant Couple* (1699), ridiculing the pilgrimages to Rome in the jubilee year. was enthusiastically received. Wilks as Sir Harry Wildair contributing largely to its success. In 1701 he wrote a sequel, *Sir Harry Wildair,* and in 1702 *The Inconstant,* borrowed from Fletcher's *Wild Goose Chase.* In the same year he published a volume of miscellanies, *Love and Business,* containing a "Discourse on Comedy," defending the English neglect of the dramatic unities. In 1703 he married, in expectation of a fortune which did not materialize. The rest of his life was a constant struggle against poverty. His other plays are *The Stage Coach* (1704), a one-act farce from the French; *The Twin Rivals* (Drury Lane, 1702); *The Recruiting Officer* (Drury Lane, 1706); and *The Beaux'*

Stratagem (Haymarket, 1707). This is the best of his plays, and long kept the stage. Genest notes 19 revivals up to 1808. It was revived again at the Lyric, Hammersmith, in 1927. The plot concerns the adventures of two embarrassed gentlemen who travel as master and servant, in the hope of marrying a fortune. Archer, the supposed valet, was one of Garrick's best parts. Before Farquhar had finished writing the second act of *The Beaux' Stratagem* he was taken mortally ill, but he finished the play, for which he had been paid in advance. It was staged on March 8, shortly before his death, which occurred April 29, 1707.

Farquhar marks the end of the true Restoration tradition. Instead of the intellectual foil play of his predecessors he gives something of the cheerful singlestick of Elizabethan comedy, while his return to the romantic treatment of love, whether regarded as a disastrous lapse into the "luscious" or a breath of purer air, is at any rate fatal to the maintenance of the Restoration atmosphere.

Farquhar's dramatic works were published in 1728, 1742 and 1772, and by Thomas Wilkes with a biography in 1775. *See* also A. C. Ewald, *Dramatic Works of George Farquhar, With Life and Notes,* 2 vol. (1892) ; L. I. Guiney, *A Little English Gallery* (1894) ; *The Beaux' Stratagem,* ed. *by* H. Macauley Fitzgibbon (1898); *The Best Plays of George Farquhar,* ed. *by* William Archer (1906); H. Ten E. Perry, *The Comic Spirit in Restoration Drama* (1925).

FARRAGUT, DAVID GLASGOW (1801–1870), U.S. admiral who won fame as a Union commander during the Civil War, was born on July 5, 1801, near Knoxville, Tenn. At New Orleans he formed a close friendship with Capt. David Porter of the navy, who adopted his young namesake and put him in the navy in 1810. Farragut went to sea the next year on board the U.S.S. "Essex" with Porter, who took every opportunity to throw responsibility on the boy. Farragut commanded a prize with ability when only 12 years old, served with credit in the "Essex's" desperate fight with H.M.S. "Phoebe," and returned to the United States to go to school. The next few years were devoted alternately to service afloat and to school. He learned French, Italian and Arabic. Before he was 20 he was already an accomplished officer. In 1823 the navy department placed Commander Porter in command of a squadron to destroy the pirate strongholds in the West Indies. Farragut accompanied Porter. and active service ashore and afloat may be said to have completed Farragut's education. He had even had practice in handling a steamer and went home in 1824 in command of the U.S.S. "Ferret." Routine service followed for many years.

The Civil War opened in the spring of 1861, and in Dec. 1861 he was assigned to command the West Gulf blockading squadron, with orders to enter the Mississippi river and capture New Orleans. The strategic plan of the administration for the reduction of the seceding states assigned a great role to the navy. While the armies in the field were to oppose the Confederate forces, the task of the navy was to cut the hostile armies from their sources of supply overseas, for which they expected to pay by exporting cotton. The first step of the navy was to establish a blockade of the coast from the Chesapeake to the Rio Grande. By the end of 1861 this blockade was becoming fairly effective, but munitions of war landed in Mexico were finding their way along the Red river and the Mississippi to Confederate armies. The second great strategic operation of the navy was to seize control of the Mississippi and stop the supply of foodstuffs and munitions coming from the southwest. An army in conjunction with a flotilla of river craft undertook this task from the north, while Farragut with the same purpose moved from the open sea against New Orleans, the metropolis of the south, where success would secure him a valuable base for subsequent advance. The war department believed that the forts on the river below the city should be reduced by mortar fire before attempting to thrust wooden ships past them, but Farragut carried out his own bolder plan of running by them in the dark and was completely successful on April 24, 1862. His position above the forts cut them off from the city. Troops from the transports outside could land almost under his protecting batteries and the result was the surrender of the forts and the city. Against Farragut's opinion, the department insisted on his proceeding farther up the river, but the time was inopportune and nothing important was then accomplished. But the following year, when Grant's army was occupied before Vicksburg, Farragut greatly aided him by passing the heavy works at Port Hudson below the Red river and stopping traffic along that stream. Vicksburg fell in July 1863 and the Mississippi was soon in Federal control to the great loss of the Confederate armies fighting in Tennessee and Virginia. Farragut now turned his attention to entering Mobile bay, where he expected an army from the north to meet him and so to cut off another great slice from the Confederacy, but the troops were employed elsewhere. Mobile bay was formed by a long sandspit enclosing a large inlet. It was defended by several forts, of which the strongest was Ft. Morgan at the end of the spit close to the channel. A line of mines obliged ships to pass close to Ft. Morgan, and besides the heavy ironclad "Tennessee" covered the approaches. Farragut had to wait till he had monitors to pit against the "Tennessee" and on Aug. 5, 1864. he entered in two columns, the monitors leading and the wooden frigates following, each with a gunboat lashed to her port side. Farragut in the "Hartford" held the second place in his column. The leading monitor, "Tecumseh," in her anxiety to engage the "Tennessee," crossed the mine field and was blown out of the water. The "Brooklyn," leading the wooden column, stopped: her head fell away; the line drifted in confusion while the tide swept all upon the fort. This was the great moment of Farragut's life. Disaster was imminent. With instant decision he shouted "Damn the torpedoes" to the hesitating "Brooklyn," and swung his own ship clear of her and headed across the mines which had just been fatal to the monitor. The mine cases rattled against the bottom but none exploded and the fleet followed on and anchored triumphantly above the fort. Then the "Tennessee" came out from the shelter of the fort and after a hard fight, in which the wooden ships repeatedly rammed her, she was reduced to impotence and surrendered. The forts were now isolated and surrendered one by one. Ft. Morgan waiting till the troops lying outside in transports had landed their siege guns and brought them into action. Farragut's health now forbade further active service. His work was over. He had been made rear admiral in 1862, vice-admiral in 1864 and admiral in 1866. In 186; he went to Europe and paid a round of ceremonial visits to the seaports of the great powers. He died at Portsmouth, N.H., on Aug. 14, 1870.

(W. L. R.; X.)

FARRANT, RICHARD (*d.* 1580), composer of English church music, became a gentleman of the Chapel Royal in the reign of Edward VI, but resigned his post in 1564 on being appointed master of the children of St. George's chapel, Windsor. It is stated by Hawkins that Farrant was also one of the clerks and organists of St. George's chapel. and that he retained these posts till his death. Many of his compositions are printed in the collections of Barnard and Boyce. Among the most admired of them are a service in G minor, and the anthems "Call to Remembrance" and "Hide Not Thou Thy Face." It is doubtful uhether Farrant is entitled to the credit of the authorship of the beautiful anthem "Lord, for Thy Tender Mercies' Sake." No copy of the music under his name appeared in print till 1800, although it had been earlier attributed to him. Some writers have named John Hilton, and others Thomas Tallis, as the composer. Farrant died on Nov. 30, 1580.

FARRAR, FREDERIC WILLIAM (1831–1903), English theologian, was born on Aug. 7, 1831. in the fort of Bombay, where his father, afterward vicar of Sidcup, Kent, was a missionary. His early education was received in King William's college, Castletown, Isle of Man, a school whose external surroundings are reproduced in his school tale, *Eric; or, Little by Little.* In 1847 he entered King's college, London, and was led by F. D. Maurice to the study of Coleridge, whose writings had a profound influence upon his faith and opinions. He went up in 1851 to Trinity college, Cambridge, where he became a fellow in 18j6.

On leaving the university Farrar became an assistant master, first at Marlborough college and then (1855) at Harrow. In 1871 he was appointed headmaster of Marlborough college, and in the following year chaplain in ordinary to the queen, becoming canon of Westminster and rector of St. Margaret's, Westminster, in 1876. Farrar's first book was his schoolboy story *Eric* (1858), followed by *Julian Home* and *Lyrics of Life* (1859) and by *St. Winifred's; or the World of School* (1862). His Hulsean lectures were published in 1870 under the title of *The Witness of History to Christ. The Life of Christ,* which was published in 1874, passed through a great number of editions. His volume of sermons on *Eternal Hope* (1877)—in which he called in question the dogma of everlasting punishment—caused much controversy but helped to mollify the harsh theology of an earlier age. In 1879 appeared *The Life and Works of St. Paul,* followed by *The Early Days of Christianity* (1882) and other popular works. Farrar was a copious contributor of articles to various magazines, encyclopaedias and theological commentaries. In 1883 he was made archdeacon of Westminster and rural dean; in 1885 he was appointed Bampton lecturer at Oxford and took for his subject "The History of Interpretation." He was appointed dean of Canterbury in 1895. He died at Canterbury on March 22, 1903.

FARRAR, GERALDINE (1882–), U.S. dramatic soprano, was born at Melrose, Mass., on Feb. 28, 1882. Her musical education was received in Paris under Trabedello and in Berlin under Lilli Lehmann. When only 19 she made her debut at the Royal Opera house, Berlin, as Marguerite in *Faust,* Oct. 15, 1901, and continued to sing there each season until 1914. In Nov. 1906 she appeared at the Metropolitan Opera house as Juliette in *Roméo et Juliette* and was a favourite prima donna of the New York stage until her retirement on April 22, 1922. She afterward took her own company on the road and last appeared on the concert stage in 1931.

FARRELL, JAMES AUGUSTINE (1863–1943), U.S. steel executive, was born in New Haven. Conn., Feb. 15, 1863. He began work as a labourer and in a series of rapid promotions became general manager of the Oliver Steel Wire company. When that company was absorbed by the United States Steel corporation in 1901, Farrell became the foreign sales agent for all United States Steel subsidiaries; in 1903 he became head of the subsidiary United States Steel Products Export company. Farrell served as president of United States Steel from 1911 to 1932. He died in New York city on March 28, 1943. (J. R. Lt.)

FARRELL, JAMES THOMAS (1904–), U.S. writer known especially for his detailed fictional explorations of the lower middle class Irish on the south side of Chicago, where he was born, Feb. 27, 1904. Educated in parochial schools and at The University of Chicago, he supported himself at various jobs before becoming established as a writer. In his writing Farrell attempted to present and analyze honestly and painstakingly social groups and what he called "social structures," in a modified version of early 20th-century naturalism. Of more than 30 volumes of fiction he published, the titles are fairly evenly divided between the novel and the short story, though his exhaustive analysis of a section of American urban life required the expanded scope of a linked series of novels. The most famous of these was the first, a trilogy describing the life of "Studs" Lonigan in a deteriorating middle-class section of Chicago (*Young Lonigan,* 1932; *The Young Manhood of Studs Lonigan,* 1934; and *Judgment Day,* 1935). The style followed both social and speech idioms with scrupulous consistency and the work revealed the hero's decline in terms of the decline of the milieu. Subsequently, Farrell drew from one of the lesser figures of his trilogy, Danny O'Neill, for five novels (1936–54); a third hero, Bernard Clare (or Carr), was the subject of another trilogy (1946–1952). These sequences—the first in particular—were likely to stand as Farrell's major achievement.

Of his nonfiction, *A Note on Literary Criticism* (1936) is important for its criticism of the Marxist view of literature; *Reflections at Fifty* (1954) is a volume of reminiscences.

See Joseph Warren Beach, *American Fiction, 1920–1940* (1941); Wilbur Merrill Frohock, *The Novel of Violence in America* (1950); Charles C. Walcutt, *American Literary Naturalism* (1956). (F. J. Hn.)

FARRIER AND FARRIERY, the name given generally either to the professional shoer of horses or in a more extended sense to a practitioner of the veterinary art; farriery is the term for his business. Primarily the art of farriery is identical with that of the blacksmith, insofar as he makes and fixes shoes on horses (*see* HORSE-SHOES); he is liable in law for negligence, as one who holds himself out as skilled; and he has a lien on the animal for his expenses. William the Conqueror is supposed to have introduced horseshoeing into England, and the art had an important place through the middle ages, the days of chivalry and the later developments of equitation. In modern times it has been closely allied with the general progress in veterinary science and in the knowledge of the anatomy and physiology of the horse's foot and hoof.

FARRUKHABAD, a city, tehsil (subdivision) and district in the Allahabad division of Uttar Pradesh, India. The city is near the right bank of the Ganges, 77 mi. N.W. of Kanpur. It forms a joint municipality with Fatehgarh, the civil headquarters and military station of the district. Pop. (1951): Farrukhabad-cum-Fatehgarh city 80,332 (incl. 6,127 in Fatehgarh cantonment); tehsil (485 sq.mi.) 379.806. At Fatehgarh is the government gun-carriage factory; other industries include cotton printing of curtain material and the like, and the manufacture of gold lace, metal vessels and tents.

FARRUKHABAD DISTRICT has an area of 1,645 sq.mi. It is a flat alluvial plain in the middle Doab. The principal rivers are: the Ganges, which has a course of 87 mi. either bordering on or passing through the district; the Kali Nadi or Kalandar (84 mi.) and the Isan (42 mi.), both tributaries of the Ganges; and the Arind which, after a course of 20 mi. in the south of the district, passes into Kanpur. The Kanpur branch of the Ganges canal passes through the south of the district. Principal products are rice, wheat, barley, millets, pulses, cotton, sugar cane and potatoes. Pop. (1951) 1,092,641. Tobacco, potatoes and fruit, cotton prints, scent and saltpetre are among the principal exports.

In the early part of the 18th century Mohammed Khan. governor of Allahabad and later of Malwa, established a considerable state of which the present district of Farrukhabad was the nucleus, founding the city of Farrukhabad in 1714. After his death in 1743 his sons were embroiled by Safdar Jang, the nawab vizier of Oudh, with the Rohillas and afterward with the Marathas, the struggle ending by the country's becoming tributary to Oudh. In 1801 the nawab vizier ceded to the British his lands in this district. In 1804 the Marathas, under Holkar, ravaged this tract, but were utterly routed by Lord Lake at Farrukhabad. During the mutiny the titular nawab was reinstated on the throne. The English military residents took shelter in the fort, which they held until July 4 when, the fort being undermined, they endeavoured to escape by the river. One boat succeeded in reaching Cawnpore, only to fall into the hands of Nana. Its occupants were made prisoners, and perished in the massacre of July 10. The other boat was stopped on its progress down the river, and all those in it were captured or killed except four who escaped. The prisoners were conveyed back to Fatehgarh, and murdered there by the nawab on July 19. The rebels were defeated in several engagements, and on Jan. 3, 1858, the English troops recaptured Fatehgarh fort.

FARS, a province or *Ostan* of Iran, bounded on the north by the *Ostans* of Khuzistan and Isfahan, on the east by Yezd and Kerman and on the south by the Persian gulf. It lies roughly between 50° and 57° E. and 26° and 32° N., with an area of 66,255 sq.mi., and is composed of a great number of districts grouped together into about 20 subprovinces, each under a governor. The coast towns of Bushire, Lingeh, Bandar Abbas, Jask. Chahbar and some other smaller places, though not all geographically within the boundaries of Fars, form a separate administrative district known as the "gulf ports" or "southern ports" under a governor appointed from Tehran.

At Fars, the ancient Parsa or Persis (*q.v.*), remains of early man were found. Flint implements of Paleolithic character, were found northeast of Shiraz and a village of the Chalcolithic period. as the ending Neolithicum is called, with objects of remarkable craftsmanship was unearthed near Persepolis (*q.v.*). A part of Fars belonged to ancient Elam, the seat of a very early Persian civilization, and to the Elamite empire which reached its'peak in the 12th century B.C. While Fars is no longer considered the birthplace of the Achaemenian empire, since the region of Anshan northwest of Fars seems entitled to this claim, on its soil are to be found the most important remnants symbolizing the glory of the Achaemenians, the ruins of Pasargadae built by Cyrus the Great, 559–529 B.C. and those of Persepolis, begun by Darius and continued by his son Xerxes.

Climatically, Fars may be divided into *garmsir* and *sardsir*— the warm and cold regions. The former extends from the coast to the foothills running parallel to it and includes the coastal districts of Liravi, Haiat Daud, Rud Hillah, Angali, Shabankareh, Zira, Dashtistan, Tangistan and Dashti. The *sardsir* embraces the mountainous parts of the province which form a succession of ridges, prolongations of the Zagros chain, running from northwest to southeast and intersected by elevated plains, some of which are fertile and afford good pasture. The highest of these mountains, the Kuh Dina in the northwestern part of the province, has an elevation of 14,029 ft. The rivers are the Rud Hillah and Mund, and a notable feature is the great inland depressions or salt lakes near the middle of the province into which several inland streams drain. The chief town of the province is Shiraz (*q.v.*), 182 mi. N.E. of Bushire, and other populous centres are Niriz, Lar, Abadeh, Darab, Jahrum. Arsinjan. Ardakan, Fasa, Bastak, Kazerun, Firuzabad and Minab (under Bandar Abbas, *q.v*). The population is (1956) 1,494,649. The most important tribes are the Kashgai of Turkic origin and speech, the Khamseh of Arab origin and speech and the Lak, a branch of which gave to Persia one of its most beneficent rulers, Karim Khan Zand (1750–79), founder of the Zand dynasty which preceded that of the Kajars.

Many districts of Fars are comparatively fertile, but some are impoverished by droughts, ravages of locusts and past misgovernment. The products consist principally of cereals, tobacco, fruits and opium, with a little cotton. The wine of Shiraz is highly thought of in Iran and is, on occasions, of excellent quality. Tobacco, of excellent quality, is grown mainly around Fasa, Darab and Jahrum for home consumption, and rosewater is exported from Maimand. Sulfur and lead are found. (P. Z. C.; X.)

FARTHING, the smallest English coin, equal to the fourth of a penny (A. S. *feórtha,* "fourth," +*ing,* "diminutive"). It became a regular part of the coinage from the reign of Edward I, and was, up to the reign of Mary, a silver coin. No farthing was struck in the reign of Elizabeth, but a silver three-farthing piece was issued in that reign, with a profile bust of the queen crowned, with a rose behind her head. and inscribed "E.D.G. Rosa sine spina." The copper farthing mas first introduced in the reign of James I, a patent being given to Lord Harington of Exton in 1613 for the issue of copper tokens of this denomination. It was nominally of six grains weight, but was usually heavier. Properly, the copper farthing dates from the reign of Charles II, in whose reign also was issued a tin farthing, with a small copper plug in the centre, and an inscription on the edge, "Nummorum famulus 1684." No farthings were issued in the reign of Queen Anne, though a number of patterns were prepared. In 1860 the copper farthing was superseded by one of bronze. In 1842 a proclamation was issued giving currency to half farthings, and there were several issues, but they were demonetized in 1869. In 1897 the practice was adopted of darkening farthings before issue, to prevent their being mistaken for half sovereigns. *See* also NUMISMATICS.

FASCES, in Rome, bundles of elm or birch rods from which the head of an ax projected, fastened together by a red strap. As the emblem of official authority, they were carried by the lictors, in the left hand and on the left shoulder, before the higher Roman magistrates, at the funeral of a magistrate, behind the bier. The lictors and the fasces were so inseparably connected that they came to be used as synonymous terms. The fasces represented the power over life and limb possessed by the kings; later, the consuls were preceded by 12 fasces. Within the precincts of the city the ax was removed, in recognition of the right of appeal (*provocatio)* to the people in a matter of life and death; outside Rome, however, each consul retained the ax. Valerius Publicola established the custom that the fasces should be lowered before the people, as the real representatives of sovereignty; lowering the fasces was also the manner in which an inferior saluted a superior magistrate. A dictator had 24 fasces (including the ax, even within the city); other magistrates had fasces varying in number, with the exception of the censors, who, possessing no executive authority, had none. A victorious general, who had been ,saluted "imperator" by his soldiers, had his fasces crowned with laurel. Under the empire, the laurel was regarded as distinctive of the imperial fasces.

In Italy, the fasces were adopted as the emblem of the Fascist party *(see* FASCISM).

FASCISM is the name of a political attitude which puts the nation-state or the race, its power and growth, in the centre of life and history. It disregards the individual and his rights, as well as humanity, in the exclusive interest of the nation. As a political technique it follows the lead of totalitarian bolshevism as a single-party state with strict regimentation of all aspects of national life. The name fascism was first used by the movement started by Benito Mussolini in March 1919. Later on it became the general name for similar movements in other countries, among which German National Socialism (*q.v.*) was the most prominent. The Italian word *fascismo* is derived from the Latin *fasces,* "bundles," denoting in ancient Rome a bundle of rods with an axe, borne before Roman magistrates as a symbol of authority.

Among the intellectual forerunners of fascism were two Frenchmen, Georges Sorel and Charles Maurras, and an Italian, Vilfredo Pareto. Pareto, an economist and sociologist, developed a cyclical theory of social change and of the rise of new elites. Georges Sorel, the theoretician of revolutionary syndicalism, emphasized the creative role of violence in history. His doctrine of direct action mas firmly opposed to mediation and compromise, which he regarded as signs of the decadence of the *bourgeoisie.* Through direct action in the spirit of violence, a new social elite was to lead the proletariat into a new epoch of history and civilization in opposition to plutocracy. His Italian followers applied his theory of a heroic proletariat not to a class but to the Italian nation, which they regarded as a proletarian nation in relation to the western plutocratic democracies. . Charles Maurras was the father of "integral nationalism" in France. He opposed the ideas of the French Revolution, emphasized the precedence of French national self-interest before all other considerations and stressed foreign policy as the foremost field of activity of the state. His newspaper *L'Action française* had little influence in France except under the Pétain regime. Its Italian counterpart, *L'Idea nazionale,* struck much deeper root in Italian soil.

The origins of the fascist movement in Italy are to be found both in the wave of disillusionment and at the same time in the exacerbated nationalism which swept Italy after 1918. Even before World War I Enrico Corradini had propagated a doctrine of extreme and belligerent nationalism, which had fanned enthusiasm for the Libyan war of 1911 and for imperial expansion. The poet Gabriele d'Annunzio had exalted in verse and prose not only the mission of a victorious Italy, but also the love of danger, adventure and war. In the military coup by which he with a legion of black-shirted followers gained possession of Fiume in Sept. 1919, and during the 16 months in which he as *duce* ruled the city, D'Annunzio introduced a constitution foreshadowing the "corporative state" and all the rites, salutes, allocutions and mass shouts which later became characteristic of the fascist movement. Mussolini himself before 1914 had been a leading member and editor of the Italian Social Democratic party, but he had always represented the tendencies of revolutionary syndicalism with their emphasis upon direct action and enthusiastic will. Against the attitude of his party, Mussolini supported Italy's entrance into the war in the fall of 1914; on Nov. 15 he founded his own newspaper, the *Popolo d'Italia,* in Milan, which called itself an organ of combatants and producers and carried the social revolutionary motto by Blanqui, "Who has steel has bread," and Napoleon's saying, "The revolution is an idea which has found bayonets." Mussolini's first famous editorial bore the characteristic title "Audacity."

In the social unrest and moral confusion which followed the war of 1914–18, Mussolini founded the Fasci di Combattimento on March 23, 1919, in Milan. The new group had no definite program; at first Mussolini was still a revolutionary syndicalist who preached the expropriation of the land, the mines and all means of transportation. It was not until the beginning of 1921 that he allied his group openly with the propertied classes, with the landowners and the industrialists. But whatever his sociological affiliations, he was moved throughout by a fierce nationalism and by the love of violence and adventure.

When he ran in Milan for a parliamentary seat in the elections of Nov. 16, 1919, he got less than 5,000 votes out of 346,000. But the deep social unrest prevailing in Italy in 1920 gave Mussolini a chance, and though the danger of any bolshevist or socialist success had entirely faded by the end of the year, Mussolini and his squads of violent young men appeared to the frightened upper classes as a guarantee of security. Thus, with the army conniving. Mussolini's followers set for themselves the task of "restoring order" and breaking up the socialist and progressive movements and organizations. With a boastful ruthlessness, with the proud sacrifice of all ethical scruples to success, the local *squadristi*, under the leadership of men such as Dino Grandi, Balbo. Roberto Farinacci and others. set out for the conquest of power in the name of youth against nhat they called "the tottering parliamentarism" of the "senile" and undecided liberals. The lack of resistance on the part of the government. the army and the police emboldened the fascists, who had formed themselves into the National Fascist party in Nov. 1921.

In the folloning year Mussolini completely abandoned his original socialist. antimonarchist and anti-Catholic program. He had no definite doctrine to offer. "Our program is simple: we wish to govern Italy. They ask us for programs, but there are already too many. It is not programs that are wanting for the salvation of Italy, hut men and will power." On Oct. 28, 1922, the famous "march on Rome" was staged. Though the Fascists and the Nationalists were outnumbered in the Italian parliament by ten to one, and though with some show of resolute action the Fascists could easily have been stopped, the king refused to sign the proclamation of the state of siege which his government had prepared. and on Oct. 29 invited Mussolini to form the new government Though the new prime minister at first accepted a coalition cabinet and preserved some of the forms of the iiberal state, within a very few years all the trappings of parliamentarism were gone, all other parties outlawed. all civil liberties and constitutional guarantees suppressed and a full dictatorship established. The process was accelerated by the reaction of the country and of the civilized world to the murder of the socialist deputy Giacomo Matteotti in June 1924, on the eve of his exposure of the graft and corruption of the Fascist party. Highest Fascist officials were alleged to have been implicated in the murder. In his effort to save his regime from the outraged feelings of the country, Mussolini established a totalitarian order in which the state was completely identified nith the Fascist party. nhich in turn was identified with its leader. Though he professed to fight bolshevism, he successfully adopted its methods, without, however, being able to carry them. in the different climate of Italy, as far as they were carried in Russia and later on in Germany. The different *squadristi* organizations had been reformed on Feb. 1, 1923, as the Milizia \-olontaria per la Sicurezza Nazionale.

Fascism in its beginnings was not a doctrine and had no clearly elaborated program. It was a technique for gaining and retaining power by violence, and with an astonishing flexibility it subordinated all questions of program to this one aim. But it was dominated from the beginning by a definite attitude of mind which exalted the fighting spirit, military discipline, ruthlessness and action and rejected contemptuously all ethical motives as weakening the resoluteness of will. Fascism is power politics and *Realpolitik* in their most naked form; all theoretical considerations are subservient to what is regarded as the "inexorable dynamics" of the factual situation. Ultimately everything depends upon the ever-changing decisions of the leader, decisions which cannot be discussed. but are blindly obeyed and immediately executed. Thus fascism could present itself in a given situation as a bulwark of the social order against social revolution, against Marxism and the proletariat, and could in a different situation become the propagandist and spearhead of a proletarian world revolution against conservatism and wealth, against *bourgeoisie* and capitalism.

With its stress upon the irrational, upon instincts and activism, fascism insists upon the "iron logic of nature" which will always make the strong prevail over the weak, the more resolute over the irresolute, and thus aims at educating the nation to develop its strength, courage and resolve. and by these means to ensure its victory. All fascist activity is devoted to this preparation for what it regards as the inevitable and beneficial struggles which form the life of nations. Fascism, therefore, repudiates above all the idea of peace and harmony. "War alone brings up to their highest tension all human energies and puts the stamp of nobility upon the peoples who have the courage to meet it. Fascism carries this antipacifist spirit over even into the lives of individuals. It is education for combat." These words by Mussolini are amplified by his famous statement that "War is to the man what maternity is to the woman. I do not believe in perpetual peace; not only do I not believe in it, but I find it depressing and a negation of all the fundamental virtues of man." Therefore, to continue in Mussolini's words, "The whole nation must be militarized. . . I consider the Italian nation in a permanent state of war." The creed of fascism is heroism, the praise of audacity and danger, devotion and sacrifice for the nation and its necessary wars.

Fascism regards itself as a rejection. a complete and uncompromising denial of the principles of liberalism and democracy, as elaborated and realized in the British, American and French revolutions of the 17th and 18th centuries. It is a return to an authoritarian order, based upon the subordination of the individual and the inequality of caste and rank. The liberty of the individual is denied in favour of the state, the inequality of men is proclaimed as immutable and beneficial. The "bourgeois" achievements which liberalism had secured from the time of the English revolutions of the 17th century on have not only been abandoned. but derided and combated. From the beginning fascism acted as the implacable enemy of democracy and of the rights of man. Society is to be built strictly upon a hierarchical order: the leaders are not to be elected, nor are they to be responsible to the people; on the contrary, the people are responsible to the leaders whose appointment depends only upon those above them. Military discipline and blind obedience are to permeate the whole of civilian life. One of the famous slogans of fascism was *credere, obbedire, combattere* ("have faith. obey, fight"), and another was *Mussolini* ha *sempre ragione* ("Mussolini is always right").

The 18 years of the Fascist regime from 1922 to 1940 were devoted to the military preparation of the Italian nation for a coming struggle for what was regarded as the mission of the Italian people, the rebirth of the Roman empire. To this goal the economic life of the country was completely subordinated. Fascist economy, like communist economy, can be regarded as a permanent war economy. The authoritarian and centralized pattern of political life found its replica in the new economic institutions. Fascist inefficiency in Italy did not allow. however, the full realization of governmental goals. Much of the *stato corporativo (see* CORPORATE *STATE)* remained in the blueprint stage.

The basic law of April 3, 1926, established six main economic sectors, within which capital and labour were represented by national confederations of employers and employees. The professions were organized in a separate national confederation. However, civil servants, government officials of all kinds and teachers were placed under the direct control of the secretary of the Fascist party, because their employer was, directly or indirectly, the state. The economic corporations, too. were not regarded as independent agencies. but as instruments of public administration dependent upon the will of the head of the government. With the approach of the Abyssinian War of 1935–36 the control of all economic activities by the party was intensified. This control apparently did not increase the efficiency and productivity of the Italian economy, either in the outright military field or in the nominally civilian areas. The Italian military debacle in World War II revealed the glaring inefficiencies and insufficiencies of Fascist economics. The standard of living and the real wages of the Italian workers and farmers remained extremely low in comparison with other European countries throughout the 20 years of the Fascist regime. Nevertheless, the Fascist leadership did not cease painting a picture of coming Italian grandeur for the benefit of the Italian masses. The cult of the Roman empire and of its expansion was stimulated in every possible way.

In a speech before the senate on March 30. 1938, Mussolini painted a glowing picture of Italian armed strength and military preparedness. Italy, he declared. could raise an army of 9,000,000 men, of whom 5,000,000 were first-line fighters, ready to hurl themselves, under his personal direction, against any enemy. According to him, this army was amply supplied with the most modern instruments of destruction which would enable it to break through the stoutest defenses in conformity with the fascist maxim that the war must be decided within a few months. The powerful navy was principally composed of recently launched vessels which were to be used with boldness and decision. The air force was equal to any and would rain death and destruction on enemy territory. The quick success of Italian arms in any struggle would be guaranteed by ample reserves of supplies and by the fact that Mussolini himself would assume command of the operations.

When Italy. greedy for conquest, entered the war in 1940 to deal the deathblow to the British empire and its idea of liberty, the sordid reality, the inefficiency and corruption of Fascism were quickly revealed. The Italian armies and navy were everywhere ignominiously defeated, and Mussolini's regime was overthrown by the king in Italy in July 1943. It was saved by the Germans for a temporary existence as a Fascist republic in northern Italy. But the Anglo-U S. advance put an end to it in the spring of 1945; Mussolini died an ignoble death at the hands of partisans.

In many ways fascism can be regarded as an exaggerated and even absolutized nationalism which entirely obliterates both individualism and humanity. The nation becomes the supreme arbiter, its service the one supreme duty. Only actions, thoughts and sentiments which help to increase the power of the nation can be called good. This absolute devotion to the nation—not to a nation which is governed by ethical rules of divine or of rational origin, but to one which is an end in itself and which is entirely identified with the fascist party and its leader—becomes the guiding principle of all education in fascism.

This education is not confined to the schools alone nor to the youth organizations of the fascist party; like bolshevism in Russia. it determines everything printed in the press and in periodicals, heard over the radio, presented on the screen or stage, so that it ultimately colours every thought and every sentiment of the people. This kind of indoctrination works especially well because no other information or critical attitude or independent inquiry is ever allowed to reach the people. Fascism leads also to a complete destruction of all free cultural and intellectual intercourse with other nations.

But fascism is not a national attitude in the sense that it would be confined to certain nations. Though it is true that fascism finds a much better soil for its growth in the cultural and social traditions of certain nations, it represents a general attitude which can be found everywhere. Its rise was facilitated by the growing complexity of life in the age of masses and machines and by a feeling of disillusionment and cynicism in the postwar generation after 1914. Democracy, which has grown up in the last 300 years. represents, with its emphasis upon individual responsibility and individual decisions, the most difficult societal system, requiring a definite human maturity. Fascism can in many ways be regarded as an escape from this difficulty into the irresponsibility of following a leader who deprives the masses of their liberty and maturity but promises them social security and economic progress. Fascism. however, was in such complete opposition to the trends of the 18th and 19th centuries that its emergence found democracy completely unprepared for the heavy and decisive blows which its implacable enemy intended to deal it, through propaganda, terror and war. Thus it happened that fascism, which in the 1920s seemed confined to Italy, became in the 1930s a world-wide movement which put democracy not only on the defensive, but into mortal danger.

Mussolini could say in 1934, "Since 1929 fascism has become not merely an Italian phenomenon, but a world phenomenon." On Oct. 25, 1932, he had assured his audience at Milan of the coming world leadership of fascist Italy. "Today, with a fully tranquil conscience I say to you, that the twentieth century will be the century of fascism, the century of Italian power, the century during which Italy will become for the third time the leader of mankind." In that Mussolini was at least partly wrong, because the following years proved very quickly that even in the case of a world-wide victory of fascism the leadership would not fall to Italy. but to Germany, which in 1933 joined the ranks of the fascist powers and very quickly dwarfed Italy in importance.

Fascist principles had become accepted by 1936, to a varying degree. by the governments of Austria, Hungary, Poland, Rumania. Bulgaria. Greece and Japan. In most of these countries fascist parties were formed which imitated not only the doctrinal concepts of the Italian and German movements but also many of their external symbols, though every country had its peculiar national tradition expressed. Thus. while the Italian fascists donned black shirts and the Germans brown. the fascists in Hungary donned green shirts and used the cross and arrow instead of the fasces or swastika. In some of these countries the local fascist brand was a product of popular movements, not created by the government. This was the case in Rumania, where a young lawyer. Corneliu Zelea-Codreanu, founded in 1927 a Legion of the Archangel Michael for the Christian and racial renovation of Rumania, which later developed into the terrorist organization of the Iron Guard and. when disbanded by the government, constituted itself as a party, Totul pentru tara ("Everything for the fatherland"). Though this party had fought enthusiastically for a pro-German orientation of Rumanian policy, it was nevertheless sacrificed by the Germans to the needs of the hour and succumbed in bloody and tormented internal strife. Similarly, a full-fledged fascism came to poner in Greece under the leadership of Gen. Joannes Metaxas, who on Aug. 4. 1936, inaugurated the "third Hellenic civilization" with its symbol, the Spartan salute. The warlike virility of ancient Sparta and the imperial splendor of Byzantium were to be revived.

But the most important gain achieved by fascism outside of Italy and Germany was the fascist conquest of Spain The civil war started by Gen. Francisco Franco from Spanish Morocco on July 17, 1936, ended with the victory of the insurgents in March 1939. By a decree of Aug. 4, 1939, Franco assumed "in its entire plenitude the most absolute authority. The Chief is responsible only to God and to History." During World War II Spain supported, as far as its economic misery and backwardness permitted. the other fascist pouers. In July 1942, when fascist victory still seemed probable, Franco asserted that totalitarianism had "amply demonstrated its superiority" over democratic institutions. The Spanish fascist party, the Falangists, revived the dream of the great Spanish empire of the golden century, which had attempted to impress its civilization upon the whole world and which had ruled in the Americas and in the Pacific.

The victory of fascism in Spain seemed to bear witness to the growing international strength of fascism and to the apparent weakening of democracy Thus, fascist attitudes and movements could even infiltrate the democracies. Fascist propaganda mas relentlessly active. not only in Europe but throughout the western hemisphere. People were induced to believe in the "breakdown" of capitalism and in the inevitable upsurge of the "nave of the future." The German and Italian governments devoted special efforts to the organization of citizens of German and Italian descent abroad. and tried to teach them to put their loyalty to their racial origins above their loyalty to the country whose citizens they were. Fascist influence was very strong in France. but relatively weak in Britain.

In the United States the great number of fascist-type groups, the competition of presumptive leaders and their division into Protestant and Catholic groups prevented the formation of a strong fascist organization. This failure is explained by the habitual Republican or Democratic preferences of most citizens, the strength of popular optimism as to the future (reinforced for many by the efforts, if not always the success, of the New Deal in coping with the depression) and the insulating effects of the federal system, most notably upon Huey Long's "share-the-wealth" movement in Louisiana. A further factor was the strong traditional attachment of most U.S. citizens to the U.S. constitutional system. In Latin America the Integralista movement in Brazil was the outstanding example of a fascist party. In Asia a number of superpatriotic terrorist organizations of young officers and students tried to stamp out the influences of western liberalism in Japan and to bring Japan back to the military virtues and disciplines of the old order. Thus, by 1939, fascism had gained a rapidly growing strength over a wide geographic area.

The strength of fascism in the international scene mas much increased by the close co-operation of the leading fascist powers. From 1936 on, Germany and Italy entered into a number of political. cultural, economic and military agreements, and in 1937 this "axis" was extended to include Japan. While the fascist countries co-operated closely and formed their own "League of Nations" in the so-called Anti-Comintern pact which was later joined by Spain and Hungary. the democratic nations did not co-operate, and instead of strengthening the League of Nations as a bulwark against aggression. allowed it to disintegrate. Thus the world became safe for the aggression of fascist powers.

After 1938 the German form of fascism, known as National Socialism. became so predominant that it impressed its peculiar character upon all other (and even upon the older) forms of fascism. This is especially true of the acceptance of anti-Semitism by Italian and even Japanese fascism. Japan has no Jews and practically has never had any Jewish problem. The number of Jews in Italy was insignificant; they had been completely assimilated into the national life, had participated prominently in all Italian national movements and wars, and many of them from the beginning had belonged to the Fascist party, had been for years in Mussolini's inner circle. Official Fascist sources had repeatedly declared anti-Semitism an absurdity. But in 1938 Italian fascism suddenly accepted the German racial theory.

In May 1939 Italy and Germany concluded an outright defensive and offensive military alliance. The Soviet-German agreement of Aug. 1939 forced a reorientation in fascist propaganda. Until then fascism had always insisted that its official arch enemy was communism, and National Socialism especially had reserved its most violent diatribes for "Jewish communism," of which Moscow was regarded as the seat and centre. Now the propaganda against communism ceased entirely; National Socialism laid a new emphasis on its own proletarian revolutionary character which explained and made possible its understanding with communism. The attacks on "Jewish communism" were replaced by even more vitriolic attacks on "Jewish capitalism" and democracy, which was sometimes called plutocracy, the heart of which seemed to be first London, and then Washington.

The year 1939, with the conquest of the Czechs and Poles by Germany, gave the National Socialists also an opportunity to apply their fascist theories of racial inequality to other peoples than the Jews.

In the war which broke out in Sept. 1939 between Germany on the one hand and Britain and France on the other, fascists and communists not only collaborated against Poland, but joined in the denunciation of France and Britain as imperialist plutocracies and as responsible for the war. Later, Pres. Franklin D. Roosevelt was singled out by fascists and communists as a warmonger. On Sept. 27, 1940, Germany! Italy and Japan concluded, in Berlin, a formal fascist alliance with the intention of imposing "the new order" of fascist authoritarianism upon Europe, Asia and Africa. The new pact denied any hostile intention against the Soviet Union; in fact it was followed by a pact of friendship and neutrality between Japan and the U.S.S.R. in April 1941. During that year the attacks against the United States became more and more violent. On Oct. 23 the *Stampa* of Turin, one of Italy's best-known newspapers, depicted Secretary of State Cordell Hull and President Roosevelt as "throbbing with rage as they use phrases from the ghetto from which the latter has descended."

The fascists tried to prepare for the easy conquest of the democracies by undermining their understanding of the situation and by breaking or mollifying their will to timely action. The most refined technique of propaganda was coupled with a strategy of terror to produce the desired disintegration of the democracies. Since the time when the Spanish insurgents declared that the conquest of Madrid. which was then still in the hands of the republican government and which was being attacked by four columns moving toward the city. would be helped by a "fifth column" of Franco sympathizers within the city, the expression has been frequently used to designate the conscious and more often unconscious helpers of totalitarian penetration into the democracies. Fascist propaganda was ingenious in sowing disunity and distrust among the democracies, fulminating against "British imperialism" in the United States, against "Yankee imperialism" in Latin America, and narning the British of U.S. "intention" to liquidate, and partly inherit. the British empire. Depending upon the audiences for nhich it was destined, fascist propaganda raised doubts about democracy equally from the rightist as well as from the leftist point of view.

Though the fascist powers succeeded in conquering a large number of countries. they could in no way quench the spirit of national resistance. Small groups, succumbing to anti-British and anti-Semitic propaganda, everywhere co-operated with the Germans. Thus in France the defeat of June 1940 gave a reactionary group under Marshal Pétain, Pierre Laval and Admiral Darlan the chance of seizing power. Democracy in France was officially abolished, the achievements of the French Revolution abandoned and vilified, the famous symbols, "liberty, equality, fraternity," discarded in exchange for a mixture of the old French pre-Revolutionary order and an imitation of the German-Italian fascist models. In Norway a Major Vidkun Quisling established, with German help, a pro-German, anti-British government. Only in Poland were the Germans unable to find any "Quislings" or collaborators. The heroic uprising in Warsaw in Xug. 1944 under General Bor marked the climax of the spirit of resistance. which made itself felt in all countries overrun by the fascist alliance.

Fascism, which started in the early 1920s as a movement of purely Italian national significance, had entered at the beginning of the 1940s the struggle for world domination, so as to make the 20th century a fascist century. But its plans miscarried. World War II, started by the fascist great powers, ended in complete defeat for them.

Fascism survived the defeat of World War II only in Spain and in Argentina. In the German Federal Republic and in Japan the foundations of democracy were successfully laid, and one could hardly speak of a rebirth of fascism. The situation in Italy was different. Attempts at the revival of fascism were made, first in 1946 by Guglielmo Giannini who founded a newspaper and organization called *L'Uomo qualunque* ("The Common Man"). and later and more successfully by the Movimento Sociale Italiano. In the 1950s fascist attitudes gained in influence in France, especially in connection with the war in Algeria. A racialist policy recalling fascist attitudes was followed in the Union of South Africa uhen the elections of May 26, 1948. brought the Herenigde Nasionale party, the Reunited National party, under the leadership of Daniel Malan to power.

Fascist influences could be seen in the party's more extreme wings, the Nuwe Orde ("New Order") under Oswald Pirow, and the Ossewabrandwag ("Guard of the Oxen Cart") led by J. F. van Rensburg.

The stronghold of fascism in the western hemisphere was Argentina. There, in June 1943, a group of army officers who were deeply impressed by German National Socialist military achievements seized power. This group called itself G.O.U., Grupo de Oficiales Unidos ("Society of United Officers"). The three initials were also understood to stand for *gobierno, orden, unidad,* "authoritarian government," "order" and "national unity." The dominant figure among these officers was Juan Perón. On Oct. 17, 1945, he seized power, and the "glorious October seventeenth" was declared a national holiday in 1951. On Feb. 24, 1946. Perón was elected president of the Argentine republic. He tried to win over the masses, the *descamisados,* the "shirtless ones," to whom he promised far-reaching social reforms and a relentless fight against capitalism and Yankee plutocracy. He accused North American imperialists of wishing to dominate Latin America and presented his own system as a true democracy of social justice. He was supported by his wife, Eva Perón, who was the head of the María Eva Duarte de Perón Welfare foundation. Her death on July 26. 1952, weakened his hold on the people in spite of the proud slogan, Perdn *cumple,* "Perón accomplishes things." He was overthrown in Sept. 1955 by the armed forces. The legacy which he left was similar to that which Mussolini had left in Italy—widespread corruption, a profoundly shaken economic position and a rapid rise in the cost of living.

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(H. Ko.)

FAST AND LOOSE, a cheating game played at fairs by gypsies and sharpers. A strap, usually in the form of a belt, is rolled or doubled up with a loop in the centre, and laid edgewise on a table. The showman then bets that the loop cannot be caught with a stick or skewer as he unrolls the belt. As this looks to be easy to do the bet is often taken, but the sharper unrolls the belt in such a manner as to make the catching of the loop practically impossible.

From this game is taken the colloquial expression, "To play fast and loose."

FASTI, the plural of the Latin adjective *fastus,* but more commonly used as a substantive (derived from fas, meaning what is allowable by divine law). Fasti dies came to mean the days on which law business might be transacted without impiety, corresponding to modern "lawful days." The word fasti itself then came to be used to denote lists or registers of various kinds, which may be divided into two great classes.

1. Fasti *diurni,* divided into urbani and *rustici,* an official yearbook, with dates and directions for religious ceremonies, market days, etc. Until 304 B.C. the lore of the calendaria remained a monopoly of the priesthood; but Gnaeus Flavius then published the forum tables containing the requisite information. This list was the origin of the public Roman calendar. Ovid's Fasti is a poetical description of the Roman festivals of the first six months, written to illustrate the Fasti published by Julius Caesar after he remodeled the Roman year.

2. Fasti *magistrales, annales* or historici were concerned with everything relating to the gods, the emperors. etc., and the feasts and ceremonies established in their honour. They came to be denominated *magni,* by way of distinction from the bare calendar, or fasti *diurni.* Of this class, the fasti consulares were a chronicle of events in which the several years were denoted by the respective consuls. The fasti triumphales contained a list of persons who had obtained a triumph. The word fasti thus came to be used in the sense of "historical records." A famous specimen of this class is the fasti *Capitolini,* so called because deposited in the Capitol by Alexander Farnese, after their excavation from the Roman Forum in 1547. A considerable number of fasti of the first class have been discovered; but none older than the time of Augustus. The Praenestine calendar, arranged by the famous grammarian Verrius Flaccus, contains the months of January. March, April and December and a portion of February. The tablets give an account of festivals, as also of the triumphs of Augustus and Tiberius. Some kinds of fasti included under the second general head were. from the very beginning, written for publication. The Annales Pontificum—different from the calendaria properly so called—were annually exhibited in public on a white table, on which the memorable events of the year, with special mention of the prodigies, were set down in the briefest possible manner. In fact, all the state offices had their fasti corresponding in character to the consular fasti named above.

FASTING, in the strict sense of the word, denotes complete abstention from food and drink; but it is commonly applied also to the use of a diet somewhat severely limited, either by the rejection of certain customary kinds of food or by a diminution of the total quantity of food consumed. Fasting, in the former sense, is generally required in preparation for a surgical operation; in the latter sense it is often recommended for health's sake, and is voluntarily undertaken by many. Occasionally an individual will keep a prolonged fast, in the stricter sense, as a public view, in order to earn the reward of entertainment by giving a demonstration of unusual vitality. In recent times fasting has been used as a means of protesting against the alleged injustice of the law of the land, and even of defeating that law, the hunger-strike being practised with such persistency that it has led either to the release of the protesting prisoner or to his death. A close resemblance is to be seen between this modern application of the practice of fasting and an older use of it as an expression of overmastering desire and stern intention in the quest of justice. Thus men of different lands and ages have bound themselves by an oath to take no food until they have performed some act of revenge for their own honour, or for the sake of their people (cf. Acts xxiii. 12); and among the Celts it was not uncommon for a man who was refused a lawful request, to "fast against" the one who had denied him his right, so as either to persuade him to an act of justice or to bring upon his head the blood of the oppressed.

Commonest by far, however, of all the uses of voluntary fasting, in the past and at the present time, is its practice as an act of self-denial with definite religious intention. By the greater number of religions, in the lower, middle, and higher cultures alike, fasting is largely prescribed; and where it is not required it is nevertheless practised to some extent by individuals in response to the promptings of nature.

I. Religious Sanctions and Regulations.—Fasting is practised by all the peoples of the lower cultures, in which it is supported by the rudimentary science which takes the form of magical lore, as well as by a variety of crude religious beliefs. Special discipline is laid upon medicine-men and other experts, for the perfecting of their abnormal powers and for the ready performance of their peculiar tasks. But when danger threatens in all its many forms, fasting is required of individuals, of groups, and of the whole community, for the avoidance of various hostile influences; and the fear of punishment at the hands of the tribal authorities (including the gods), and, still more, of automatic results of a terrible nature, is sufficient to secure the strictest obedience.

Among the religions of intermediate development, now extinct, that of the Celts laid some stress on the practice of fasting, while the religion of the Teutons appears to have found little or no place for it. The ancient Mexicans and Peruvians resembled the Babylonians and Assyrians in that fasting was largely used by them in connection with penance and the offering of sacrifice; and, though the records do not show that fasting bulked very large in the religious life of the ancient Egyptians, there are clear indications of its use. The Romans appear to have used the practice but little until they came under the influence of the later Greek religion, in which fasting was required of all initiates by the guardians of the mystery-religions, and recommended to individuals by philosophers of various schools, Cynics, Stoics, Pythagoreans, and Neo-Platonists.

In the Far East, Hindu and Jain ascetics are committed by their faith to very severe fasting in conjunction with numerous other austerities; and abstinence in lesser degree is imposed upon Hindus generally by the requirements of caste-law, and by the performance of due accompaniments of pilgrimages and of preparation for certain festivals. Primitive Buddhism recommends moderation rather than extreme self-deprivation; but in practice in its various developed forms the religion covers a considerable amount of fasting, especially in Tibet, in direct contradiction of the Buddha's teaching. The higher Taoism of China imposes periods of strict abstinence upon its professors; and Confucianism has followed the practice of its great expounder in approving the customary observance of fasting as a preparation for the worship of ancestral spirits.

Judaism requires an annual fast on the Day of Atonement. For a long time the Jews observed four other annual fast-days appointed during the Babylonian exile to commemorate the siege and destruction of Jerusalem; and a fifth day was added subsequently in remembrance of the three days' fast of Esther. Additional voluntary fasts on the part of individuals were common, and at the beginning of the Christian era, Monday and Thursday in each week were kept as voluntary fast-days by the stricter Jews (cf. Lc. xviii. 12). The Qur'ān (ii. 179 sqq.) requires all Muslims other than young children and idiots to observe the ninth month (Ramadan) of the year as a fast, food and drink being forbidden from sunrise to sunset during each of the 30 days. Any who are prevented from keeping the fast by sickness or by the necessity of travelling, must fast for an equivalent period at another time. Voluntary fasts are also recommended on certain days in the year; and fasts are required in recognition of responsibility for specified offences and in discharge of obligation for the same: Muslim mystics (Sufis) and members of the darwesh orders practice much additional fasting for their special purpose of communion with the Divine.

In the Christian world there exists, at the present day, considerable diversity of opinion and practice in the matter of fasting; but on a historical survey it may be said that in no other religion has fasting been more widely approved, more rigorously required, and more extensively practised. The Founder Himself laid down no rules on the subject. He fasted (Lc. iv. 2); He declared that fasting would have a place in the practice of His followers (Mk. ii. 19 seq.); and He required that fasting, like the almsgiving and prayer with which it is associated, should be without ostentation (Mt. vi. 16 seq.). But it was left to the Church to prescribe the rules that were to govern the corporate practice of the fast. Out of the voluntary use of individuals there gradually arose a common mind and a common discipline, according to which a fasting preparation was required by the Church for the due observance of appointed festivals, and for the reverent reception of the benefits of Holy Baptism and Holy Communion. The preparation for the feast of Easter developed slowly from a fast of one day, 40 hours (the time during which the Lord's body rested in the tomb), two days or more, to the full 40 days of Lent; and in close association with it the pre-baptismal fast came to be required of catechumens. The fasting varied in rigour according to locality, but on the whole it involved real self-denial, and in places was literally a complete abstention from food and drink. From the 2nd century it began to be the custom in some countries to fast on Wednesday and Friday in each week, these days being knoun as "stations," when Christians considered themselves to be on guard. Under the influence of the Montanists this fasting increased in strictness, and by the end of the 4th century it had become a universal custom in the Church, Saturday being added to Friday as a "superposition" in many parts of the West. By the same date the fast before Communion, dictated long before this time by a growing appreciation of the full significance of the sacrament, had also become oecumenical. Dispensation from this fast, in particular, seems to have been very rarely granted, only the dying being recognized as necessarily exempt. Bishops prescribed additional fasts for their own dioceses as occasion required; voluntary fasts were added to these obligatory acts of discipline at the discretion of individuals; and, with the growth of monastic communities from the middle of the 4th century, special fasts began to be largely used.

The Eastern Church took an independent line in the development of appointed fast-days, and its present practice differs considerably from that of the Church in the West. In Lent the Saturdays (with the exception of Easter Even) are excluded from the fast as well as the Sundays. The Fast of the Apostles lasts for a week from the octave of Pentecost, which is the Sunday of All Saints, or in some cases until June 29, which is the Feast of St. Peter and St. Paul. The fortnight before the Feast of the Repose of the Virgin, which is celebrated on August 15, is kept as the Fast of the Mother of God. The Fast of the Nativity of our Lord, beginning on November 15, lasts until Christmas, thus covering a period of 40 days. And the Wednesdays and Fridays throughout the year are fast-days. The fast before Communion is generally insisted on.

The post-Reformation Church of Rome continued to fast, as in the middle ages, during Lent, on the Ember Days and Rogation Days, on the days appointed as Vigils, and on Fridays, the Wednesday and Saturday fasts having practically lapsed; but in 1781 a reduction was made in the severity of the fasting required of the English Roman Catholics by the introduction of a distinction between fasting and abstinence. Recent years have seen further concessions, and the new *Codex Juris Canonici*, issued in 1917, shows that abstinence from flesh meat is alone required on days of abstinence, no restriction being laid upon the quantity of food taken. Days of fasting which are not marked also as days of abstinence admit of any kind of food being taken at the one full meal that is allowed, flesh meat being forbidden, however, at the two smaller meals which are permitted. The strict fast before Communion, rarely excused at all before the present century, may now be modified in the case of any who are in serious ill-health, dispensation being granted both to lay-people and to priests.

At the Reformation the Church of England included in its Book of Common Prayer a list of days of fasting or abstinence, the two terms being used synonymously, and required that notice of these days should be given in church. No directions for their observance were issued, the matter presumably being left to every man's conscience; yet there can be no doubt that the list was issued with serious intention, for provision was made by law for the granting of dispensations by the archbishop of Canterbury, by diocesan bishops, and by incumbents of parishes, according to the nature of the case (25 Hen. VII., cap. 21, 5 Eliz., cap. 5). The list includes the 40 days of Lent, the Ember-days at the four seasons, the three Rogation-days, and all the Fridays in the year, except Christmas Day. The fast before Communion was not referred to; but in the form provided in 1661 for the ministration of baptism to such as are of riper years, the first rubric states that candidates "may be exhorted to prepare themselves with prayers and fasting for the receiving of this Holy Sacrament." On the whole the practice of English churchmen after the Reformation included less and less fasting until the time of the Tractarian movement. It was never entirely lost, and there were notable revivals of the practice in the Wesleyan and Evangelical movements; but the recovery of a true sense of its earlier obligation and importance and of a steady persistence in its practice dates from the second quarter of the 19th century. Special stress has been laid by the followers of the Tractarians upon the necessity of the fast before Communion; and this, together with the evangelical opposition which it has aroused, led to the insertion in the revised Prayer Book which was presented to parliament in 1928 of a new rubric stating that "It is an ancient and laudable custom of the Church to receive this Holy Sacrament fasting. Yet, for the avoidance of all scruple, it is hereby declared that such preparation may be used or not used, according to every man's conscience in the sight of God." The new Prayer Book also revised the list of days of fasting or abstinence, exciuding the Epiphany when it chances to fall on a Friday, and the Fridays in the octaves of Christmas, Easter, and the Ascension, and adding the Vigils before the Nativity of our Lord, Pentecost, St. John the Baptist, All Saints and St. Andrew.

In the other Reformed churches and in the Free churches which have separated themselves from the Church of England, fastinghas had its place; but the sense of its importance has generally diminished, and there has arisen not a little prejudice against its use.

II. Purposes of Fasting.—In any general survey of the different types of religious fasting, it is important to remember that great diversity exists between the mind and motives of men of different cultures and religions who yet do the same thing for what is ostensibly the same purpose, and that, in consequence, it is highly erroneous to suppose that the religious value of any one variety of fasting is constant in all cases that admit of being placed in that particular class.

(1.) Purificatory Fasting.—Under the influence of the mistaken idea that it is that which enters into a man which defiles him, the rejection of food and drink is often practised by those who would avoid every possibility of the contagion of evil at times of special importance. In the lower culture the initiation of lads and girls to adult membership of their tribe, admission to secret societies, and entry into the married state, are prefaced by a period of fasting, mainly on the basis of this idea; and the same precaution has much to do with the fasting that belongs to the ritual of mourning after a death and of preparation for the reception of sacred food. The endurance of fasting leads, sometimes, to the experience of seeing visions and hearing voices, and it is naturally adopted as a means thereto by "holy" men of all sorts who interpret the operation of the method they use with a physical or a psychological emphasis according to their understanding. Again, fasting is practised as a preparation for spiritual and sacramental communion, because the spirit is intent on its guest. For the sake of its own purgation and freedom of activity, it subordinates the desire for bodily food to the craving for spiritual sustenance. This is the ultimate basis of the Christian fast of purification before Communion. It is not prompted by a Manichaean conception of matter, but is due solely to concentration on the things of the Spirit and an ancillary rejection for the time being of the means of physical life. Thus, in the Church of England homily "of Fasting" the second "end" sperified is "that the spirit may be made more earnest and fervent to prayer"; and Hooker says (Eccl. Pol. v. 72) that the object of fasting is "to temper the mind, lest contrary affections coming in place should make it too profuse and dissolute."

(2.) *Sympathetic* Fasting.—The practice of fasting after a death is complex in its origin and significance. It may be connected with the sacrifice involved in making provision for the dead; it may have to do with the placation of the ghost; it may be purificatory, or it may be a contradiction of normal practice intended to sever connection with the departed; but in most cases it is undoubtedly to be regarded also as an expression of grief, whether formal or sincere. Such sympathetic fasting becomes a recurring practice in the case of a saint or deity who has conferred benefits and is to be duly honoured. Thus March 24 was observed as a day of fasting and mourning in the ritual of the Mater Magna, in memory of the mother's grief for Attis; the Shi'ah Muslims similarly commemorate the martyrdom of 'Alī and his two sons, Hasan and Husain; and the Christian observance of Lent is largely inspired by the thought of fellowship with Christ in His suffering during the 40 days in the wilderness and during the events leading to His death.

(3.) Penitential Fasting.—In the minds of wrongdoers who are suffering or anticipating the reward of sin and convicted by their consciences, fasting serves to attest the genuineness of their repentance, to turn aside the wrath of the offended gods, and either to forestall and cancel at an easy rate the punishment due to them, or to denote a readiness to accept whatever is right, if only reconciliation may be had. At the lowest there is a large element of commercialism; at its best it is the expression of a truly contrite heart, and is associated with "prayers and supplications" and with "strong crying and tears." Such penitential fasting is found particularly in Jewish and Christian practice; and it may be said of all Christian restraint in the matter of food and drink that it partakes of this character.

(4.) Meritorious Fasting.—The fasting that is undertaken in order to obtain reward or to secure power is sometimes held to work magically, as in the Intichiuma ceremonies of the tribes in Central Australia, where fasting is practised for the increase of the totem food supply. Or again, it is a personal appeal for favour, as when Jain girls fast in order to win a good husband and a happy married life. Both ideas are mingled in the fasting which is practised as a means of gaining power to exorcise evil spirits and to secure the "holiness" which is the reward of works of supererogation.

(5.) Disciplinary Fasting.—This figures in those religions attaching great importance to moral conduct, and it is regarded as a reasonable and useful practice, even by those who consider all other forms of fasting to be misconceived and vain. When it is undertaken as a reaction from surrounding voluptuousness, and in protest against prevailing licence, it is apt to be unduly severe; but normally it is a reasonable part of the soul's preparation for the maintenance of self-control in times of strong temptation. The Lenten discipline of Christians is shared by not a few to whom its religious significance makes no appeal, solely because they recognize its moral value.

III. Criticism and Rejection of Fasting.—Fasting may be an irksome discipline, and there are many who, having absolved themselves from its practice, find reasons why it is no longer required.

Thus, it is frequently urged that the strenuous conditions of modern life make it practically impossible, and that the use of frequent and light meals renders unnecessary a discipline which was, perhaps, of some service when men ate less frequently but more immoderately. The plea of difficulty and inutility may be reinforced by arguments drawn from quite a different quarter. Zoroastrianism taught that "he who fasts commits a sin," for he rejects that which is good, in so doing he tortures in himself another part of the good creation, and he weakens himself for the conflict with evil which is his proper work. Protests have also been made in the name of true religion by Old Testament prophets and early Christian writers, who have resented the abuse of fasting as a formal and merely external act, unblushingly offered as the accompaniment of an immoral life. "Behold, in the day of your fast ye find your own pleasure, and exact all your labours. Behold, ye fast for strife and contention, and to smite with the fist of wickedness: ye fast not this day so as to make your voice to be heard on high." (Isai. lviii. 3 seq.) To the rebuke of the religious critic may be added the unfavourable verdict of some who regard the matter from medical and psychological standpoints, doubt as to the wisdom and efficacy of fasting as an aid to devotion and self-control being seriously increased by the citation of numerous cases in which physical and mental evil has resulted from excess.

In spite of such criticism the practice of fasting persists, and it is likely to continue so long as men are capable of religious and moral aspiration. For it has the authority of very widespread use from time immemorial; it is supported by ecclesiastical authority in by far the greater part of Christendom; and, above all, it is rooted in some of the strongest emotions incident to human nature. There will always be the few who practise fasting rigorously, according to the strict interpretation of the term; the many will no doubt continue, according to a growing fashion, to regard fasting as a term which covers self-denial in general, and will impose it upon themselves in a variety of forms, including the discipline of some sort of abstinence in respect of food and drink at stated times. (O. H.)

FASTOLF, SIR JOHN (d. 1459), English soldier, in some part the prototype of Shakespeare's Falstaff, was the son of a Norfolk gentleman, John Fastolf of Caister and is said to have been squire to Thomas Mowbray, duke of Norfolk, before 1398. He served with Thomas of Lancaster in Ireland during 1405 and 1406, and in 1408 made a fortunate marriage with Millicent, widow of Sir Stephen Scrope of Castle Combe in Wiltshire. In 1413 he was serving in Gascony, and took part in all the subsequent campaigns of Henry V. in France. He must have earned a good repute as a soldier, for in 1423 he was made governor of Maine and Anjou, and in February 1426 created a knight of the Garter. But later in this year he was superseded in his command by John Talbot. On Feb. 12, 1429 when in charge of the convoy for the English army before Orleans he defeated the French and Scots at the "battle of herrings" On June 18 an English force under the command of Fastolf and Talbot was defeated at Patay. According to the French historian Waurin, who was present, the disaster was due to Talbot's rashness, and Fastolf only fled when resistance was hopeless. Other accounts charge him with cowardice, and John of Bedford at first deprived him of the Garter, though after inquiry he was honourably reinstated. This incident was made unfavourable use of by Shakespeare in Henry *VI*. (pt. i. act. iv. sc. i.). Fastolf continued to serve with honour in France, and was trusted both by Bedford and by Richard of York. He returned home in 1440, when past sixty years of age. But the scandal against him continued, and during Cade's rebellion in 1451 he was charged with having been the cause of the English disasters through minishing the garrisons of Normandy. In his later days he showed himself a grasping man of business. A servant wrote of him: — "cruel and vengible he hath been ever, and for the most part without pity and mercy" (*Paston* Letters, i. 389). He had large estates in Norfolk and Suffolk, and a house at Southwark, where he also owned the Boar's Head Inn. He died at Caister on Nov. 5, 1459. There is some reason to suppose that Fastolf favoured Lollardry, and this circumstance with the tradition of his braggart cowardice may have suggested the use of his name for the boon companion of Prince Hal, when Shakespeare found it expedient to drop that of Oldcastle. In the first two folios the name of the historical character in the first part of Henry VI. is given as "Falstaffe," not Fastolf. Other points of resemblance between the historic Fastolf and the Falstaff of the dramatist are to be found in their service under Thomas Mowbray, and association with a Boar's Head Inn. But Falstaff is in no true sense a dramatization of the real soldier.

The facts of Fastolf's early career are to be found chiefly in the chronicles of Monstrelet and Waurin. For his later life there is much material, including a number of his own letters, in the *Paston Letters*. There is a full life by W. Oldys in the *Biographia Britannica* (1st ed., enlarged by Gough in Kippis's edition). See also Dawson Turner's History of Caister Castle, Scrope's History *of Castle Combe*, J. Gairdner's essay On the Historical Element in Shakespeare's Falstaff, ap. *Studies in English History*, Sidney Lee's article in the *Dictionary of* National Biography, and D. W. Duthie, *The* Case of Sir John Fastolf and other Historical Studies (1907).

FAT, the name given to certain animal and vegetable products which are oily solids at ordinary temperatures, and are chemically distinguished as being the *glyceryl* esters of various fatty acids. (See OILS. FATS AND WAXES.) Fat is a normal constituent of animal tissue, being found even before birth; it occurs especially in the intra-muscular, the abdominal, and the subcutaneous connective tissues. In the vegetable kingdom fats especially occur in the seeds and fruits, and sometimes in the roots. Physiological subjects concerned with the part played by fats in living animals are treated in the articles, CONNECTIVE AND SUPPORTING TISSUES; NUTRITION; OBESITY; METABOLIC DISEASES.

FATALISM, the attitude of mind which accepts whatever happens as having been bound or decreed to happen. Such acceptance may be taken to imply belief in a binding or decreeing agent; and the development of this implication in ancient Greek and Roman mythology, with its personified Moirai, Fata or Parcae, is discussed in the article FATE. Here, however, we are concerned with fatalism in its relation to later modes of thought.

We may speak loosely of fatalism as synonymous with determinism; but it is useful to make a distinction. Whereas determinism (*q.v.*) can be represented as compatible with moral responsibility, fatalism properly understood would reduce practical ethics to nothing but the advice that we should resign ourselves indifferently to the course of events. Strict fatalism, therefore, is not to be sought in the major Christian controversies arising from differences between Augustinian and Pelagian, semi-Pelagian or Molinist doctrine on free will, on grace and on predestination (*qq.v.*), wherever the notions of merit and of guilt (sin) retain any sense of actuality. Among Christians, indeed, the Quietists, with their uncritical reliance on inspiration, may be regarded as having in practice approached more closely to the fatalistic norm of behaviour than any of the commonly recognized partisans of determinism, Calvinists, Jansenists, etc.

Primitive Islam taught that everything is ruled by the decree of almighty God; but influence from pre-Islamic fatalism in Arabia and fatalistic doctrines in Iranian religion (especially Zervanism) soon changed this tenet into belief in an inexorable fate (kismet, *nasib*), and submission to the will of God became resignation to fate's decree. (See Helmer Ringgren, Fatalism in Persian Epics [Uppsala, 1952] and Studies in Arabian Fatalism [Uppsala, 1955].)

The common confusion between "fate" and "chance" can be removed by linguistic analysis. The proposition "it happened by chance" means that there appeared to be no intrinsic necessity for a coincidence; and this is obviously different from saying that something happened of necessity, by fatal design. Misunderstanding arises only when the proposition is put into the form "chance caused it to happen," which is admissible colloquially but is nonsensical if taken literally. The calculation of probability (*q.v.*) is an attempt to introduce an element of fatal order into the field of chances.

FATA MORGANA. A mirage frequently seen in the Straits of Messina, consisting of an apparent vertical elongation of an object situated on the opposite shore.

See MIRAGE.

FATE. The idea of fate as an impersonal force that absolutely predetermines all events was, to the ancient world as it is to the modern, a philosophical or theological conception rather than a popular notion. For Greece, the nearest approach to such an idea was the concept of an "allotment" (moira, *moros,* aisa), made to an individual either by the gods together or by Zeus alone: it was now and then almost identified with Zeus. The individual could not escape the portion of misfortune contained in it, though, according to the *Odyssey,* he might increase this through his own folly, as Aegisthus did by deliberate neglect of a divine warning. Patroclus (*Iliad* xvi, 845) says that his death is due to Zeus and Apollo, but four lines later blames "cruel moira and the son of Leto" (Apollo). Again, the Iliad states that it was the *moira* of Achilles to die soon after he had killed Hector. But he had his choice, for he might have preferred to stay quietly at home, in that case to enjoy a long but inglorious life. There might be a *moira* for a whole nation, at least in post-Homeric belief. Persia, according to Aeschylus, was apparently to conquer in Asia but to meet misfortune overseas—a doom foolishly precipitated by Xerxes. On occasion the "allotment" was personified. In Homer. a man must undergo "such things as Moira (Aisa) span upon the thread of his birth," in which connection he sometimes mentions the Clothes (Spinners). Often the plural form moirai is found. The Moirai were conceived as very old women (though art does not represent them so). From the time of Hesiod onward they were even given individual names—Clotho (Spinner), Lachesis (Allotter) and Atropos (Inflexible). Some fanciful persons, much later, assigned different tasks to the three; the holding of the distaff to Clotho, the spinning to Lachesis and the cutting of the thread to Atropos (see H. J. Rose. Handbook of Greek *Mythology,* p. 24 and references). But fundamentally the Moirai belonged to folk belief; their primary function was to assist at a birth and then and there to determine the career of the child, as the Moires still do in modern Greece.

The Romans identified their obscure native deities the Parcae with the hloirai, and, evidently under the influence of Greek myth, pluralized their *fatum,* the "spoken" decree of the gods. Tertullian mentions Fata *scribunda,* Fates who write — presumably, the child's destiny. The phraseology is archaic. and the idea of writing seems to be Etruscan, not native Latin. The identification of the Parcae with the Moirai rested on a very doubtful etymology deriving Parcae from pars. This use of fate had an interesting development. When the neuter gender became extinct in spoken Latin. its plural came to be thought of as a feminine singular; hence

Italian *fata*, French *fée*. The Fates had become a fairy. See also ANANKE; FATALISM; NORNS. (H. J. R)

FATEHPUR, a municipality, with tehsil, and a district in the Allahabad division of Uttar Pradesh, India. The town is 73 mi. S.W of Allahabad by road and rail. Pop. (1951): town 24,301; tehsil (642 sq mi) 358,151.

FATEHPUR DISTRICT has an area of 1,625 sq.mi. It is in the extreme southeastern corner of the Doab or tract of country betneen the Ganges and the Jumna, which respectively mark its northern and southern boundaries. The central part is almost perfectly level and consists of highly cultivated land interspersed with tracts impregnated with saltpetre (*usar*) A ridge of higher land, forming the watershed of the district, runs along it at an average distance of about 5 mi. from the Ganges. The country near the banks of the two rivers is cut up into ravines and nullahs running in all directions, and is almost entirely uncultivable. Besides the Ganges and Jumna the only rivers of importance are the Pandu, a tributary of the Ganges, and the Arind and Nun, both falling into the Jumna.

The area comprising this district was conquered in 1194 by the Pathans; but after a desperate resistance, it was wrested from them by the Moguls. In 1736 it was overrun by the Marathas, who retained possession of it until, in 1750, they were ousted by the Pathans of Fatehpur. In 1753 it was conquered by the nawab of Oudh. In 1765, by a treaty between the East India company and the nawab, it was made over to the Delhi emperor, who retained it till 1774, when it was again restored to the nawab wazir's dominions. Finally in 1801, the nawab, by treaty, reconveyed it to the company in commutation of the amount which he had stipulated to pay in return for the defense of his country. In 1951 the population was 908,985. Trade is mainly agricultural, but Fatehpur is noted for ornamental whips, and Jafarganj for artistic curtains.

FATEHPUR-SIKRI, a town in Agra district, Uttar Pradesh, India, 26 mi. S.W. of Agra. Pop. (1951) 8.959. The modern town lies beside one of Akbar's capitals, a site chosen as auspicious as the result of the birth of three sons to the emperor, one of whom, Salim, became the emperor Jahangir. These events followed upon Akbar's visit to the hermit Salim Chishti (d. 1572) at Sikri. Thereupon, he personally directed the building of a mosque and a tomb for the hermit, and gradually surrounded it with a magnificent series of private and public buildings from 1572 onward. The whole is enclosed in a battlemented wall of red sandstone with nine gateways. Sikri was Akbar's favourite residence, but after 1588 he ceased to use it as a capital and it became deserted. Although it is a Moslem foundation the buildings show strong Hindu influences. These may be seen in the palace of Jodh Bai, Akbar's wife, with its blue enamel roof, and in the Hawa-khana, whose decorative elements derive from western Indian architecture. Even the tomb of Salim Chishti, of white marble inlaid with mother of pearl. its windows magnificent with marble tracery, has brackets to support the cornice whose elaborate style shows clear Hindu influence. Other notable buildings are the houses of Miriam and Birbal, the latter with exuberantly carved decorations and an unusual roof, and the Diwan-i-Khas (private audience hall), with a single central pillar of carved red sandstone whose capital bears the ends of four diagonally radiating galleries, the whole forming an audience platform for the emperor and his ministers. The Jamma Musjid (great mosque), symmetrical in plan. has a fine façade, but its great glory is the southern gateway, the Buland Darawaza (victory portal), which has been described as the most perfect architectural achievement in India. The sandstone used, now weathered to a glorious rose colour, was soft when quarried, and thus particularly sensitive to the delicate work of skilful carvers; and the whole has preserved the artistic conception of a great emperor. (A. H. CE.)

FATHER, the begetter of a child, the male parent. The word is used of male ancestors more remote than the actual male parent, and of ancestors in general, and is the orthodox term for the First Person of the Trinity. One who stands as a spiritual parent to another is his "father," *e.g.*, godfather, and bishops or archbishops are given the title Right or Most Reverend Father in God. In the Roman church the pope is the Holy Father, while "father" is applied to a "regular," a member of one of the religious orders, and so to a confessor, whether regular or secular, and to any Roman priest. It is also used sometimes of sub-members of a religious society or fraternity in the English church. Of transferred uses, other than religious, mention may be made of the application of the word Father to the first founders of an institution, a constitution, an epoch, and so on; thus the earliest, settlers at Plymouth, Mass., are called Pilgrim Fathers, the earliest settlers in other portions of New England, Puritan Fathers, and the framers of the United States constitution are the Fathers of the Constitution. In ancient Rome the members of the senate are the Patres *conscripti,* the "conscript fathers." The senior member of a society is often called the father. Thus the member of the British house of commons or of the U.S. house of representatives, who has sat for the longest period uninterruptedly, is the father of the house.

See FATHERS OF THE CHURCH.

FATHERS OF THE CHURCH. The "fathers of the Church" are the great bishops and other eminent Christian teachers of the earlier centuries, who were conspicuous for soundness of judgment and sanctity of life, and whose writings remained as a court of appeal for their successors, especially in reference to controverted points of faith or practice. A list of fathers drawn up on this principle will begin with the Christian writers of the 1st century whose writings are not included in the New Testament: where it ought to end is a more difficult point to determine. Perhaps the balance of opinion is in favour of regarding Gregory the Great (d. 604) as the last of the Latin fathers, and John of Damascus (d. *c.* 760) as the last of the fathers of the Greek Church. A more liberal estimate might include John Scotus Erigena or even Anselm or Bernard of Clairvaux in the West and Photius in the East. The abbé Migne carried his Latin patrology down to the time of Innocent III. (d. 1216), and his Greek patrology to the fall of Constantinople (1453); but, while this large extension of the field is much to the advantage of his readers, it undoubtedly stretches the meaning of *patrologia* far beyond its natural limits. For ordinary purposes it is best to make the patristic period conterminous with the life of the ancient Catholic Church. In the West the Church enters the mediaeval stage of its history with the death of Gregory, while in the East even John of Damascus is rather a compiler of patristic teaching than a true "father."

A further question arises. Are all the Christian writers of a given period to be included among the "fathers," or those only who wrote on religious subjects, and of whose orthodoxy there is no doubt? Migne, following the example of the editors of *bibliothecae patrum* who preceded him, swept into his great collection all the Christian writings which fell within his period; but he is careful to state upon his title-page that his patrologies include the "ecclesiastical writers" as well as the "fathers" and "doctors" of the Church; and an "ecclesiastical writer" is not necessarily orthodox. It is clear that in the circumstances the terms "father," "patristic," "patrology" must be used with much elasticity, since it is now too late to substitute for them any more comprehensive terms.

By the "fathers," then, we understand the whole of extant Christian literature from the time of the apostles to the rise of scholasticism or the beginning of the middle ages. However we may interpret the lower limit of this period, the literature which it embraces is immense. Some method of subdivision is necessary, and the simplest and most obvious is that which breaks the whole into two great parts, the ante-Nicene and the post-Nicene. This is not an arbitrary cleavage; the Council of Nicaea (A.D. 325) is the watershed which actually separates two great tracts of Christian literature. The ante-Nicene age yields priceless records of the early struggles of Christianity; from it we have received specimens of the early apologetic and the early polemic of the Church, the first essays of Christian philosophy, Christian correspondence, Christian biblical interpretation: we owe to it the works of Justin, Irenaeus, the Alexandrian Clement, Origen, Tertullian, Cyprian. In these products of the 2nd and 3rd centuries there is much which in its own way was not surpassed by any of the later patristic writings. Yet the post-Nicene literature, considered as literature, reaches a far higher level. Both in East and West, the 4th and 5th centuries form the golden age of dogmatic theology, of homiletic preaching, of exposition, of letter-writing, of Church history, of religious poetry. Two causes may be assigned for this fact. The conversion of the empire gave the members of the Church leisure and opportunities for the cultivation of literary taste, and gradually drew the educated classes within the pale of the Christian society. Moreover, the great Christological controversies of the age tended to encourage in Christian writers and preachers an intellectual acuteness and an accuracy of thought and expression of which the earlier centuries had not felt the need.

The ante-Nicene period of patristic literature opens with the "apostolic fathers," *i.e.* the Church writers who flourished toward the end of the apostolic age and during the half century that followed it, including Clement of Rome, Ignatius of Antioch, Polycarp of Smyrna and the author known as "Barnabas." (The term *patres apostolici* is due to the patristic scholars of the 17th century. *See* Lightfoot, *St. Clement of Rome,* i. p. 3; "sub-apostolic" is perhaps a more accurate designation.) Their writings, like those of the apostles, are epistolary; but editions of the apostolic fathers now usually admit also the early Church order known as the *Didachē,* the allegory entitled the *Shepherd* of *Hermes,* and a short anonymous apology addressed to one Diognetus. A second group, known as the "Greek Apologists," embraces Aristides, Justin, Tatian, Athenagoras and Theophilus; and a third consists of the early polemical writers, Irenaeus and Hippolytus. Next come the great Alexandrians, Clement, Origen, Dionysius; the Carthaginians, Tertullian and Cyprian; the Romans, Minucius Felix and Novatian; the last four laid the foundations of a Latin Christian literature. Even the stormy days of the last persecution yielded some considerable writers, such as Methodius in the East and Lactantius in the West. This list is far from complete; the principal collections of the ante-Nicene fathers include not a few minor and anonymous writers, and the fragments of many others whose works as a whole have perished.

In the post-Nicene period the literary output of the Church was greater. Only the more representative names can be mentioned here. From Alexandria we get Athanasius, Didymus and Cyril; from Cyrene, Synesius; from Antioch, Theodore of Mopsuestia, John Chrysostom and Theodoret; from Palestine, Eusebius of Caesarea and Cyril of Jerusalem; from Cappadocia, Basil, Gregory of Nyssa and Gregory of Nazianzus. The Latin Rest was scarcely less productive; it is enough to mention Hilary of Poitiers, Ambrose of Milan, Augustine of Hippo, Leo of Rome, Jerome, Rufinus and a father lately restored to his place in patristic literature, Niceta of Remesiana. Gaul alone has a goodly list of Christian authors to show: John Cassian, Vincent of Lerins, Hilary of Arles, Prosper of Aquitaine, Salvian of Marseilles. Sidonius Apollinaris of Auvergne, Caesarius of Arles, Gregory of Tours.

The period ends in the West with two great Italian names, Cassiodorus and Pope Gregory I, after Leo the greatest of papal theologians.

The reader to whom the study is new will gain some idea of the bulk of the extant patristic literature, if we add that in Migne's collection ninety-six large volumes are occupied with the Greek fathers from Clement of Rome to John of Damascus, and seventy-six with the Latin fathers from Tertullian to Gregory the Great. The Greek patrology contains, however, besides the text, a Latin translation, and in both patrologies there is much editorial matter.

For a discussion of the more important fathers the student is referred to the articles which deal with them separately. In this place it is enough to consider the general influence of the patristic writings upon Christian doctrine and biblical interpretation. Can any authority be claimed for their teaching or their exegesis, other than that which belongs to the best writers of every age? The decree of the council of Trent (*ut nemo . . . contra unanimum consensum patrum ipsam scripturam sacram interpretari audeat*) is studiously moderate, and yet it seems to rule that under certain circumstances it is not permitted to the Church of later times to carry the science of biblical interpretation beyond the point which it had reached at the end of the patristic period. Roman Catholic writers, however, have explained the prohibition to apply to matters of faith only, and in that case the Tridentine decree is little else than another form of the Vincentian "canon," *curandum est* ut *id teneamus quod ubique, quod semper, quod ab omnibus creditum est.* The fathers of the first six or seven centuries, so far as they agree, may be fairly taken to represent the main stream of Christian tradition and belief during the period when the apostolic teaching took shape in the great creeds and dogmatic decisions of Christendom. The English reformers realized this fact; and notwithstanding their insistence on the unique authority of the canon of Scripture, their appeal to the fathers as representatives of the teaching of the undivided Church was as wholehearted as that of the Tridentine divines. Thus the English canon of 1571 directs preachers "to take heed that they do not teach anything in their sermons as though they would have it completely held and believed by the people, save what is agreeable to the doctrine of the Old and New Testaments, and what the Catholic Fathers and ancient Bishops have gathered from that doctrine."

The patristic writings are no longer used as an armoury from which opposite sides may draw effective weapons, offensive or defensive; nor on the other hand are they cast aside as the rubbish of an ignorant and superstitious age. All patristic students now recognize the great inequality of these authors, and admit that they are not free from the faults of their times; it is not denied that much of their exegesis is untenable, or that their logic is often feeble and their rhetoric offensive to modern taste. But against these disadvantages may be set the unique services which the fathers still render to Christian scholars. Their works comprise the whole literature of the Church during the decisive centuries which followed the apostolic age. They are important witnesses to the text of the New Testament, to the history of the canon, and to the history of interpretation. It is to their pages that we owe nearly all that we know of the life of ancient Christianity. We see in them the thought of the ancient Church taking shape in the minds of her bishops and doctors; and in many cases they express the results of the great doctrinal controversies of their age in language which leaves little to be desired.

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For English readers there are three series of translations from the fathers, which cover much of the ground; the Oxford *Library of the Fathers,* the *Ante-Nicene Christian Library* and the *Select Library of Nicene and Post-Nicene Fathers.* Satisfactory lexicons of patristic Greek and Latin are still a desideratum: but assistance may be obtained in the study of the Greek fathers from Suicer's *Thesaurus,* the *Lexicon of Byzantine Greek* by E. A. Sophocles, and the *Lexicon Graecum suppletorium et dialecticurn* of Van Herwerden; while the new great *Latin Lexicon,* published by the Berlin Academy, is calculated to meet the needs of students of Latin patristic literature. For a fuller list of books useful to the reader of the Greek and Latin fathers *see* H. B. Swete's *Patristic Study* (2nd ed. 1900); Edgar J. Goodspeed, *A History of Early Christian Literature* (1941); Fulbert Cayre, *Manual* of *Patrology (1936).*

FATHOM, a measure of length, being the distance from the tip of one middle finger to the tip of the other, when the arms are stretched out to their widest extent (a word common, in various forms, to Scandinavian arid Teutonic languages; cf. Danish *favn,* Dutch *vaam* and Ger. *Faden,* and meaning "the arms extended"; the ultimate origin is a root pet, seen in the Gr. *πεταννύναι,* to spread). This length has been standardized to a measure of 6 ft., and as such is used mainly in soundings as a unit for measuring the depth of the sea.

Fathom is also used in the measurement of timber, when it is equivalent to 6 sq.ft.; similarly, in mining, a fathom is a portion of ground running the whole thickness of the vein of ore, and is 6 ft. in breadth and thickness.

The verb "to fathom," *i.e.,* to sound or measure with a fathom line, is used figuratively, meaning to go into a subject deeply, to penetrate, or to explore thoroughly.

FATIGUE, a condition of impairment, resulting from prolonged mental or physical activity or both, usually removable by rest. The term is used ambiguously, sometimes referring to the organic state of exhaustion or lowered energy following work; sometimes to the feelings of tiredness or boredom experienced at such times; and often to the decline in efficiency of performance during a continuous work session. S. H. Bartley used the term fatigue for the lowered feelings and the term impairment for the organic tissue changes.

Research in pilot fatigue and in combat and operational fatigue in World War II and the Korean war led to a broader use of the term to describe the effects of factors other than work, such as sleep loss, fear and emotional strain, cold and high altitude, or sheer ennui from immobility and endless waiting with nothing to occupy the mind. In industry, it is realized that fatigue symptoms can result from a wide range of factors, such as low morale, frustrated drives, poor working environment or unsatisfactory socio-economic status.

Through all these meanings of fatigue there runs a common thread, but research fails to show any close correspondence between changes in organic state, subjective feelings and performance level. Thus a worker may suffer considerable deterioration in his feelings even though his output remains high. Attempts to find an organic decrement to parallel closely the decrement in the output of workers have been successful only in grossly muscular types of performance. Hence, fatigue must be considered a complex, mutually independent group of deteriorative changes that are ordinarily reversible (*i.e.,* overcome by adequate rest and change of activity) but that in extreme cases can cause irreversible organic damage or severe mental disturbance.

Measurement of Fatigue. — Because of its complex nature, fatigue must be measured from three different angles: the subjective, the physiological and the objective.

Subjective. — The first of these is difficult to do accurately, even though it is by far the most significant for the worker himself, because it is concerned with his own feelings of discomfort, satiation, pain and weariness. To measure these qualitative changes, the worker rates himself, at stated intervals during the work session, on a feeling-tone scale, indicating the degree of his tiredness at that moment. These ratings are plotted on a graph to show the course of development of subjective fatigue. Investigators agree in finding a much more rapid decline in feelings than in output of work; but in the long run those persons who show the greatest deterioration in feelings also show the largest drop in efficiency.

Physiological. — On the physiological side, fatigue is measured by changes in the energy exchange rate of the body, called the metabolic rate. This can be done by recording pulse, blood pressure, temperature and breathing; or by analyzing the products of metabolism, such as the amount of carbon dioxide expired from the lungs in relation to the oxygen intake, or the quantity carried off through the blood stream of such waste products as lactic acid, phosphorus, cholesterol, creatinine, or glandular secretions such as the 17-ketosteroids from the adrenal cortex. These methods yield reliable results when gross muscular work is involved, but the changes accompanying predominantly mental or sedentary work are small and difficult to measure reliably. This type of work yields increases in metabolic rate up to 28%, but part of this must be attributed to the muscular and emotional components of the task. All mental work is accompanied by tensions in the small muscles in and about the head and neck, and even in the larger skeletal muscles of posture. Much of it also involves emotional strain, with resulting use of extra energy by the glands and smooth muscles controlled by the autonomic nervous system. Muscle tensions are measured by recording electrical action currents directly from the muscles.

Emotional tension is reflected in a changed resistance of the skin to a weak electric current passed through it and can be recorded with a galvanometer.

Objective. — Fatigue is measured from the objective or functional side in one of two ways: either by analyzing the worker's performance to determine the output in successive periods of a continuous work session, or by testing his efficiency periodically in some brief activity other than the set task. After 1950 researchers used the critical flicker fusion rate rather widely for this purpose. This is the speed at which a disk consisting of alternate black and white sectors must be rotated to be seen as a uniform gray surface by the observer. Fatigue lowers this rate. When it is desired to study muscular fatigue in a limited part of the body, an ergograph is used, such as the finger ergograph invented by Angelo Mosso (1890). This permits the subject to pull his finger repeatedly against a known weight, recording the extent of each pull until exhaustion is reached. The resulting record, called an ergogram, typically shows a short period of maximum output, followed by a slow decline, which is accelerated toward the end. The breakdown occurs in a very few minutes, depending on the weight pulled. More complex tasks, using the whole body, show a less rapid decrement and may even undergo an improvement for a time, called warming up.

Mental tasks show a similar declining output curve, but rarely does complete exhaustion occur; frequently an equilibrium is reached, at which level work can go on indefinitely. Mental workers actually obtain short involuntary rests at frequent intervals, called blocks, of which they themselves may not be aware. This may indicate the operation of an automatic protective mechanism of the nervous system. It is not the difficulty of the mental task in the usual sense that determines the severity of the fatigue decrement, but rather its sameness, continuity and uninterestingness. Some psychologists prefer to distinguish this type of decrement from genuine fatigue, calling it satiation or boredom. They point out that it is not a real capacity change, merely a weakening of motive.

Fatigue in Industry. — Although occasional studies of fatigue in industrial workers were made as early as 1893, it was not until World War I, when industry was called upon to meet excessive production demands, that systematic research was begun. Typical of the agencies set up for this purpose is the Industrial Fatigue Research board of Great Britain. Studies of a wide variety of determinants of efficiency have been made. Although increased production is a major objective in such research, the health and welfare of the worker have not been ignored as ends in themselves. Attention has been directed to ways of alleviating fatigue and improving morale.

Studies fall into two general categories, those concerned with causal factors in the work itself, and those having to do with the worker's environment, both physical and social, at work and outside.

Length of Work Day and Rest Pauses. — When attempts have been made to add extra hours to the work day or work week, as was tried in England as a war emergency step, with schedules up to 60 hours per week, the long-run effects were detrimental; a return to previous schedules was soon made. Apparently a work day of 8 hours and a work week of 4—44 hours are optimal. Next in importance to length of day are the frequency and length of rest pauses. If pauses are short, they must be more frequent, especially in heavy work. As to the manner in which the rest is spent, it depends on the task. With physical tasks, the rest time is best spent in complete relaxation. With light tasks or mental work, however, there is some profit from change of posture, light entertainment, conversation or a "coffee break."

Too long a break may make resumption of work harder, because it necessitates warming up to the task again. Often the recuperative effect of a change of task is nearly as beneficial as a rest.

Methods of Working. — Sometimes the nature of the task is less important than the manner in which it is performed. Time and motion study, begun by F. W. Taylor, has revealed many ways of reducing energy expenditure through analysis of the manner in which tasks are performed.

Industrial physiology, by concentrating attention on the physiological cost, has contributed much to the reduction of fatigue while maintaining output at a maximum. An important problem in all repetitive work is that of monotony and its dulling effect on attention. With the rapid growth of automation after 1950, new problems in fatigue of this type arose. Workers who formerly performed active manipulations came to act as mere observers or checkers, and the problem of maintaining alertness at a maximum became acute. In this type of work boredom sets in, sensory acuity is reduced and attention wanders, with serious consequences to efficiency.

Work Environment. — Chief among the factors in the work setting causing accelerated onset of fatigue are inadequate lighting, too weak or improperly diffused to avoid glare or eliminate shadows; excessive amounts of noise, creating nervous tension; and poor atmospheric conditions. The latter includes such special factors as temperature. humidity, ventilation and air circulation. Workers can endure reasonably high temperatures if humidity is low, and even the discomfort from excessive humidity combined with heat can be lessened if the air is in rapid circulation. Stale air is depressing, but becomes less so when adequately circulated. When temperatures rise to above 100° F., however, with humidity constant, fatigue onset occurs twice as fast as in temperatures between 40° and So°. Excessive heat produces rapid pulse, inadequate blood circulation, cramps, heat stroke and exhaustion. Some relief is gained by increasing chloride intake. In certain industries the atmosphere is contaminated by fumes or toxic dust; this adds to worker fatigue by undermining physical health, thereby increasing accident rates.

General Environment. — Industrial psychologists have found that fatigue and boredom of workers are importantly related to social factors, such as the amount of recognition received from management. irritations from supervisors or fellow workers, and financial or other personal worries not having a direct relation to the job. One of the studies frequently quoted in support of this is that of Roethlisberger and Dickson, performed at the Hawthorne plant of Western Electric company. This study, which was planned to determine the effects on output of periodic rest periods during the work day. demonstrated instead the stimulating effect on workers of being given special recognition by management. The workers chosen for the study were placed in a special room and given special attention with reference to lunches and other details, in order to maintain controlled conditions. As a result, their production improved, regardless of whether they were given rest periods or not. L. Hornstra (19jj) considers fatigue a psychosomatic expression of partial frustration. It is lessened to the degree that work is satisfying and congenial, and even when the task itself is disagreeable the situation as a whole may be satisfying provided needs are being met through performance of the task.

See also PSYCHOLOGY, APPLIED.

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FATIGUE OF METALS is the progressive change of structure and mechanical properties of metals produced by frequently repeated or fluctuating loading. Specifically: the term is applied to the progressive deterioration of the cohesion of metals as a result of which fracture is produced by the repetition of stress cycles of maximum intensity appreciably lower than the stress intensity that would cause fracture upon a single application.

The majority of mechanical failures of structural and machine parts occurring in operation can be attributed to fatigue. A number of fatal accidents to airplanes were found to be the result of fatigue, mainly of wing spars; the accidents in 1954 involving two of the early Comet jet airliners were attributed to fatigue failures in the pressure cabin. Thus in the design of aircraft. particularly long-range transport planes with expected service lives exceeding 30,000 flying hours. structural fatigue has emerged as a major design problem.

The physical appearance of a fatigue fracture is significantly different from that of a fracture produced by a single load application. Moreover, fatigue fractures occur suddenly, without noticeable permanent deformation, and thus apparently without preliminary warning, unless the surface of the repeatedly stressed part is kept under careful observation for incipient and growing cracks.

The characteristic appearance of the fracture surfaces indicates the progressive nature of the transcrystalline fatigue-failure mechanism: a smooth zone of brittle separation, showing clamshell markings (traces of the fatigue crack at various stages of growth) starts from one or several local faults, usually located at the surface, and spreads gradually inward until the remaining cross section fails, producing a separation surface of coarse crystalline appearance. The smooth portion of the separation surface is frequently discoloured by oxidation. particularly when the fatigue cracks take years to grow to critical size.

Historical Survey. — Fatigue fractures were observed and reported as soon as metals were used under conditions of repeated or fluctuating stress. The first published report (Germany. 1837) referred to fractures observed in steel cables used in mine hoists. In 1842 the problem emerged in England in connection with failures in locomotive axles, and was discussed in 1849 and 1850 in a series of meetings of the Institution of Mechanical Engineers. In 1849 the so-called Iron Commission, appointed "to inquire into the application of iron to railway structures," published its report containing an investigation (by H. James and D. Galton) into the behaviour of cast-iron bars subjected to pulsating bending strains; in this investigation the concept of an endurance or fatigue limit was first established; below this limit fatigue does not exist.

Between 1858 and 1870 the results of an extensive series of classical experiments on iron and steel subjected to repeated axial, torsional and bending stresses were published by A. Woehler, a German engineer.

The term fatigue was introduced into the engineering literature in 1854 in a paper by F. Braithwaite in the Proceedings of the Institution of Civil Engineers, following a suggestion of Joshua Field, fellow of the Royal society, then president of the institution. The term is used with respect to repeated stressing due to mechanical forces (mechanical fatigue), to repeated transient temperature forces caused by temperature cycling in machine parts operating at elevated temperatures (thermal fatigue) as well as to noise from jets or other sources (acoustic fatigue).

The volume of fatigue research has increased considerably since 1870: first in connection with the development of locomotives and rolling stock of increasing weight, leading to increasingly severe fatigue effects in rails and bridges; later in connection with the development of heavy machinery (marine engines, turbines), as well as with the use of high-strength steel in automobile construction; and, finally, in connection with the use of lightweight alloys in the construction of airplanes. as well as the use of high-temperature alloys for heat exchanger and other machine parts subject to elevated temperatures. including nuclear reactor parts. most of which are subject to thermal fatigue.

The application of the metallurgical microscope in the study of the structural changes in metals produced by repeated stresses initiated a new phase of research. The classical work. between World Wars I and II. on microstructural changes under repeated stresses by H. J. Gough, provided the first basic knowledge concerning the micromechanism of fatigue. and laid the foundation for subsequent research work aided by improved microscopic techniques and the development of the electron microscope.

Many of the important but very complex engineering problems. such as the effect of the dimensions of the stressed parts, the accumulation of damage under variable stress amplitudes, the effect of combinations of various types of stress, the effect of residual stress fields, etc.. are still largely unsolved, with the result that engineering design for fatigue relies heavily on empirical safety factors and large-scale prototype testing

Micromechanism of Fatigue. — Tno stages can be distinguished in the progress of fatigue: (1) that of initiation of damage, ending in the formation of submicroscopic cracks; and (2) that of growth of microscopic and macroscopic cracks. Such distinction attempts to delimit the stage of propagation of an optically resolvable crack from the stage preceding its visual identification. The latter is closely related to the heterogeneous plastic glide under repeated stressing which differs significantly from that produced by a single stress application.

The effect on the crystal structure of rapid cyclic stressing is a sharp concentration of glide processes in widely and fairly regularly spaced glide bands ("striations") observable on the polished metal surface, which tend to grow steadily in width and in intensity. It is within the most pronounced striations that fatigue cracks are initiated at an early stage of repeated stressing, and along which they subsequently propagate. The concentration of slip into striations may be due to the development, with increasing number of applied stress cycles, of localized elevated temperatures.

That localized thermal softening has a significant effect in the initiation of fatigue cracks is suggested by the observation within the striations of heat stains in certain metals and of recrystallization, polygonization, diffusion and precipitation in other metals and alloys. (See also ALLOYS.)

Surface Effects. — Corrosion and Fretting Fatigue. — The initiation of fatigue damage at or near surfaces of cyclically stressed parts is the cause of the pronounced surface sensitivity of fatigue performance. Any effect that impedes the slip or blocks it before it reaches the surface impedes or delays the process of crack initiation and thus increases the fatigue life. The creation of very thin surface layers subject to high-intensity compressive residual stresses resulting from the elastic restraint on enforced volume expansion of this layer imposed by the unstrained core is particularly effective.

The volume expansion may be produced by forcing foreign particles into the atomic lattice near the surface (carburizing, nitriding, cyaniding), or by cold-working the surface layer (shot-peening, cold-rolling). Similarly, changes produced in the surface by mechanical polishing and grinding are highly effective in increasing the fatigue life. (See SURFACE HARDENING; IRON AND STEEL INDUSTRY: Theory of Hardening and Tempering.)

Surface effects are particularly significant when the stress gradients are steep, with the maximum stress intensity at the surface coinciding with the residual compression (bending, torsion, roots of notches).

Fatigue life is reduced by any mechanical effect that induces premature localized slip in the surface, such as tool marks and other accidental defects, as well as drill holes and grooves. It is also sharply reduced by surface damage resulting from the effects of a corrosive medium, particularly when the corrosive action is simultaneous with the repeated stressing (corrosion fatigue); in general the corrosive effect of fluids on metal surfaces is amplified by fatigue stressing. Most wetting fluids, without necessarily being chemically corrosive (for instance distilled water), reduce the fatigue life of many metals in comparison with their fatigue life in air; however, surface damage by chemical corrosion (for instance in sea water) accelerates this effect considerably. Even air is corrosive with respect to fatigue: tests in vacuum suggest a slight increase of fatigue life with decreasing pressure.

Surface damage inducing fatigue cracking is also caused by relative motion of the cyclically stressed surface with reference to other metal surfaces in rubbing contact with it. The rapidly developing friction heat and surface oxidation produces "fretting fatigue" which is characteristic of fatigue failures in bearings, grips and particularly riveted or bolted connections of cyclically stressed structures.

Statistical Aspects. — The number N of stress cycles of amplitude S that is sustained prior to fracture (fatigue life) increases as the amplitude decreases. The form of the relation between S and N (Woehler diagram or S-N diagram) depends on the type of stress (tension, torsion, bending or combined stress), the geometry of the stressed structural part (local concentrations of stress), the range of the repeated stress cycle (difference between maximum and minimum stress) and the mean (sustained) stress on which it is superimposed, as well as on environment (temperature, corrosive atmosphere, radiation). It is limited, on the one hand, by a minimum stress amplitude, the "fatigue limit" S_0, which decreases with increasing N, on the other, by a minimum number of stress cycles, the "minimum life" N_0, which increases with decreasing S. Fatigue fractures do not occur unless the stress amplitude S is larger than S_0, and the number of its repetition N larger than N_0.

The fatigue life N associated with a specified stress amplitude S or with a sequence of variable stress amplitudes is a highly statistical variable, probably because the micromechanism of fatigue damage is closely related to local imperfections of the surface and of the crystal structure. Depending on the degree of control imposed on the conditions of repeated stressing and on the geometry and surface conditions of the stressed part, as well as on the environment, the fatigue life under relatively well-controlled, nominally identical conditions is subject to a range of variation (ratio between the maximum and minimum values) of about five to ten; the range increases with increasing number of tests.

The prediction of the fatigue life on the basis of tests or observations is, therefore, subject to considerable error, and the characteristic relation between S and N cannot be definitely specified. To every combination (S, N) the numerical probability P (between zero and one) that this combination will in fact produce fracture, or the probability $l = (1\text{-}P)$ that it will not produce fracture must be attributed. The S-N relation is thus a three-dimensional S-N-P or S-N-l relation, and the fatigue life is represented by the "mortality function" $P(N)$ or the "reliability function" $l(N)$ expressing, respectively, the probabilities of fracture P or of survival l at different values of N. The functions are limited by the minimum life N_0 for which $P(N_0) = 0$ or $l(N_0) = 1$; as N_0 tends toward infinity, S_0 tends toward the true endurance limit. The S_0-N_0 diagram below and along which survival is certain thus delimits the range of fatigue under constant stress amplitudes.

Prevention of Fatigue. — The large majority of mechanical service failures in modern engineering practice are the result of fatigue. Therefore, the importance of adequate fatigue design can hardly be overestimated. While selection of fatigue resistant rather than high-strength metals and the improvement of their fatigue performance by surface treatment are of considerable importance, the most significant preventive factor is the careful design of even the smallest structural detail so as to avoid sharp re-entrant corners, abrupt changes of sections and other sources of intense stress concentration, as well as sources of fretting fatigue.

See also MATERIALS, STRENGTH OF; METALLURGY; METALLOGRAPHY (on the microscope structure and examination of metals); METALS.

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FATIMA (FATIMA BINT MOHAMMED THE PROPHET) (c. 606–632), daughter of the prophet Mohammed by his first wife, Khadija, was born in Mecca. She married her cousin 'Ali ibn Abi Talib (see ALI), a devoted follower of Mohammed, and their sons, Hasan and Husain (see HASAN AND HUSAIN), became the only male perpetuators of Mohammed's line.

This Family of the House of Mohammed was hounded by misfortune. Fatima and 'Ali were the losers whenever they clashed with 'A'isha, the favourite wife of Mohammed. Both felt that they were deprived of their inheritance by Abu-Bakr (*q.v.*), the first caliph.

Fatima died in Medina shortly after Mohammed, but her memory has been kept alive through the tragic history of her family and descendants, many of whom were massacred for political reasons in 680 at Karbala, Iraq.

As Fatima's family failed politically, disappointed followers, the Shi'a, endowed its members with great moral virtues, religious insight and. finally, with divinity. In this process the role of Fatima "the virgin" is curiously similar to that of the Virgin Mary in Roman Catholicism. She is accorded a high place of honour in heaven. Her symbol, "the Hand of Fatima," is frequently displayed in religious processions.

Fatima's husband and sons became the first Imams or spiritual leaders of Shi'ite Islam, which still expects the return of one of their descendants as the divine Mahdi who shall rule on earth. Sunnite, or orthodox, Islam also venerates the Family of the House but absolutely refuses to endow any of them with a divinity denied even to Mohammed.

Several Shi'ite dynasties claimed descent from Fatima. The most important was the Fatimid caliphate (909–1171; see FATIMITES) of north Africa, Egypt and Syria, which withstood the crusaders but succumbed to Saladin.

See Henri Lammens, *Fatīma et les Filles de Mahomet* (1912); Peter Hagop Mamour, *Polemics on the Origin of the Fatimi Caliphs* (1934).
(N. A.)

FÁTIMA, a village and sanctuary in Santarém district, central Portugal, about 18 mi. E. of Leiria by rail, on the tableland of Cova da Iria. The sanctuary is dedicated to the Virgin Mary, and the celebrations held there on the 12th and 13th of each month from May to October are attended by great numbers of pilgrims.

On May 13, 1917, three young peasant children, Lucia dos Santos (or Abóbora) and her two cousins, Francisco and Jacinta Marto, saw a vision of a lady while tending sheep at a spot now marked by a small chapel. In accordance with her promise, the vision was repeated on the 13th of each month until October, except for August when the children were at Valinhos pasture (near Aljustrel, the village of their birth), where they saw the lady on Aug. 19.

The lady revealed herself on Oct. 13 as the Lady of the Rosary and asked for a chapel to be built for her there. After initial opposition the visions were accepted as the appearance of the Virgin Mary by the bishop of Leiria on Oct. 13, 1930. In the same year, Papal indulgences were granted to pilgrims and devotion in other ways mas also favoured.

The content of the devotion consists of frequent recitation of the rosary, works of mortification for the conversion of sinners, devotion to the Immaculate Heart of Mary, the consecration of Russia to the Immaculate Heart, prayer for world peace and a communion of reparation by the faithful on the first Saturday of each month.

The first national pilgrimage to Fátima took place in 1927 and the Basilica was begun in 1928 and consecrated in 1953. With a 213-ft. tower surmounted by a 7-ton bronze crown and a crystal cross, and flanked by hospitals and retreat houses, it faces a vast square, in which is the little Chapel of the Apparitions.

The celebrations include the blessing of the sick and a torchlight procession in which the crowned image of the Virgin of Fátima is carried. Numerous cures have been reported, though publicity for them has not been sought.

See C. C. Martindale, *The Message of Fatima* (1950).

FATIMITES, also called FATIMIDS, the name of a dynasty called after Fatima, daughter of the prophet Mohammed, from whom and her husband the caliph 'Ali, son of Abu Talib, they claimed descent. The dynasty is also called 'Obaidi (Ubaidi) after 'Obaidallah, the first sovereign, and 'Alawi, a title which it shares with other dynasties claiming the same ancestry. Three sovereigns, who reigned in northwestern Africa before the annexation of Egypt, are worthy of mention: al-Mahdi 'Obaidallah 297 (909); al-Ka'im Mohammed 322 (934); al-Mansur Isma'il 334 (945). For the history of the Fatimite caliphs in Egypt, see EGYPT: History.

The dynasty owed its rise to the attachment to the family of the Prophet which was widespread in the Moslem world and the belief that the sovereignty was the right of one of its members. Because, however, of the absence of the principle of primogeniture there was difference of opinion as to the person whose claim should be enforced, and a number of sects arose maintaining the rights of different branches of the family. The Fatimites were supported by those who regarded the sovereignty as vested in Isma'il, son of Ja'far al-Sadiq, great-great-grandson of 'Ali, through his second son Husain. Of this Isma'il the first Fatimite caliph was supposed to be the great-grandson. The line of ancestors between him and Isma'il is, however, variously given, even his father's name being quite uncertain; and in some of the pedigrees even Isma'il does not figure.

Apparently when the family first became of political importance their Alid descent was not disputed at Baghdad, and the poet al-Sharif al-Radi (d. A.H. 406: A.D. 1015), in whose family the office of naqib (registrar of the Alids) was hereditary, appears to have acknowledged it (*Dīwān,* ed. Beirut, p. 972). When their success became a menace to the caliphs of Baghdad, genealogists were employed to demonstrate the falsity of the claim, and a considerable literature, both official and unofficial, rose in consequence. The founder of the dynasty was made out to be a scion of a family of heretics from whom the terrible Carmathian sect had originated; later on (perhaps because of the role played by Jacob, son of Killis, in bringing the Fatimites to Egypt), the founder was made out to have been a Jew, either as having been adopted by the heretic supposed to be his father, or as having been made to personate the real 'Obaidallah, who had been killed in captivity.

The uncertainty of the genealogies offered by their partisans makes the problem insoluble. What seems to be clear is that secretly within the Abbasid empire propaganda was carried on in favour of one or other Alid aspirant, and the danger which any such aspirant incurred by coming forward openly led to his whereabouts being concealed except from a very few adherents. What is Known then is that toward the end of the 3rd Islamic century the leader of the sect of Isma'ilites, who afterward mounted a throne, lived at Salamia, near Emesa (Homs), having agents spread over Arabia, Persia and Syria and frequently receiving visits from pious adherents who had been on pilgrimage to the grave of Husain. Such visitors received directions and orders such as are usual in secret societies. One of these agents, Abu 'Abdullah al-Husain called al-Shi'i, said to have filled the office of censor (muhtasib) at Basra, received orders to carry on a mission in Arabia and is said at Mecca to have made the acquaintance of some members of the Berber tribe Kutama, south of the Bay of Bougie. These persons persuaded him to travel home with them in the character of teacher of the Koran, but according to some authorities the ground had already been prepared there for a political mission. He arrived in the Kutama country in June 893 and appears very soon to have been made chief, thereby exciting the suspicion of the Aghlabite ruler of Qairwan, Ibrahim ibn Ahmad, which, however, was soon allayed. His success provoked a civil war among the Berbers, but he was protected by a chief named Hasan ibn Harun, and displayed sufficient military ability to win respect. Nine years after his arrival he made use of the unrest following on the death of the Aghlabite Ibrahim to attack the town of Mila, which he took by treachery and turned into his capital; the son and successor of Ibrahim, Abu'l-'Abbas 'Abdullah, sent his son al-Ahwal to deal with the new power, and he defeated al-Shi'i in some battles, but in 903 al-Ahwal was recalled by his brother Ziyadatallah, who had usurped the throne, and put to death.

At some time after his first successes al-Shi'i sent a messenger (apparently his brother) to the head of his sect at Salamia, bidding him come to the Kutama country and place himself at the head of affairs, since al-Shi'i's followers had been taught to pay homage to a mahdi who would at some time be shown them. It is said that 'Obaidallah, who now held this post, was known to the court at Baghdad and that on the news of his departure orders were sent to the governor of Egypt to arrest him: but by skilful simulation 'Obaidallah succeeded in escaping this danger and with his escort reached Tripoli safely. Instructions had by this time reached the Aghlabite Ziyadatallah to be on the watch for the mahdi, who was finally arrested at Sijilmasa (Tafilalt) in the year A.H. 292 (A.D. 905); his companion, al-Shi'i's brother, had been arrested at an earlier point, and the mahdi's journey to the southwest must have been to elude pursuit.

THE EARLY FATIMITES

The invitation to the mahdi was premature, for Ziyadatallah had sent a powerful army to oppose al-Shi'i, which, making Constantine its headquarters, had driven al-Shi'i into the mountains: after six months al-Shi'i secured an opportunity for attacking it and won a complete victory. Early in 906 another army was sent to deal with al-Shi'i, and an earnest appeal came from the caliph al-Muktafi, addressed to all the Moslems of Africa, to aid Ziyadatallah against the usurper. The operations of the Aghlabite prince were unproductive of any decided result, and by Sept. 906 al-Shi'i had got possession of the important fortress Tubna and some others. Further forces were immediately sent to the front by Ziyadatallah, but these were defeated by al-Shi'i and his officers, to whom other towns capitulated, till Ziyadatallah found it prudent to retire from al-Urbus or Laribus, which had been his headquarters, and entrench himself in Raqqada, one of the two capitals of his kingdom, Qairwan being the other.

By March 909 Raqqada had become untenable, and Ziyadatallah resolved to flee from his kingdom; he made for Egypt and thence to Iraq: .his final fate is uncertain. The cities Raqqada and Qairwan were immediately occupied by al-Shi'i, who proceeded to send governors to the other places of importance in what had been the Aghlabite kingdom and to strike new coins, which, however, bore no sovereign's name. Orders were given that the Shi'ite peculiarities should be introduced into public worship.

Al-Shi'i's Victories.—In May 909 al-Shi'i led a tremendous army westward to the kingdom of Tahert, where he put an end to the Rustamite dynasty and appointed a governor of his own; he thence proceeded to Sijilmasa where 'Obaidallah lay imprisoned, with the intention of releasing him and placing him on the throne. After a brief attempt at resistance, the governor fled, and al-Shi'i entered the city, released 'Obaidallah and presented him to the army as the long-promised imam. The day is given as Aug. 26, 909. 'Obaidallah had been in prison more than three years. Whether his identity with the mahdi for whom al-Shi'i had been fighting was known to the governor of Sijilmasa is uncertain. If it was, the governor and his master the Aghlabite sovereign might have been expected to make use of their knowledge and outwit al-Shi'i by putting his mahdi to death. Opponents of the Fatimites assert that this was actually done and that the mahdi presented to the army was not the real 'Obaidallah, but (as usual) a Jewish captive, who had been suborned to play the role.

The chief command was now assumed by 'Obaidallah, who took the title "al-Mahdi, Commander of the Faithful," thereby claiming the headship of the whole Moslem world: Raqqada was at the first made the seat of the court, and the Shi'ite doctrines were enforced on the inhabitants, not without encountering some opposition. Revolts which arose in different parts of the Aghlabite kingdom were, however, speedily quelled.

The course followed by 'Obaidallah in governing independently of al-Shi'i soon led to dissatisfaction on the part of the latter, who, urged on it is said by his brother, decided to dethrone their mahdi, and on the occasion of an expedition to Ténés, which al-Shi'i commanded, organized a conspiracy with that end. The conspiracy was betrayed to 'Obaidallah, who took steps to defeat it, and on the last day of July 911 contrived to assassinate both al-Shi'i and his brother. Thus the procedure which had characterized the accession of the Abbasid dynasty was repeated. It has been conjectured that these assassinations lost the Fatimites the support of the organization that continued to exist in the east, where the Carmathians figure as an independent and even hostile community, though they appear to have been amenable to the influence of the African caliph.

Establishment of the **Dynasty.**—'Obaidallah had now to face the dissatisfaction of the tribes whose allegiance al-Shi'i had won, especially the Kutama, Zenata and Lawata: the uprising of the first assumed formidable proportions, and they even elected a mahdi of their own, one Kadu ibn Mu'arik al-Mawati, who promulgated a new revelation for their guidance. They were finally defeated by 'Obaidallah's son Abu'l-Kasim Mohammed, who took Constantine, and succeeded in capturing the new mahdi, whom he brought to Raqqada. 'Obaidallah ousted other opponents by ruthless executions. By the middle of the year 913 by his own and his son's efforts he had brought his kingdom into order. After the style of most founders of dynasties he then selected a site for a new capital, to be called after his title Mahdia (*q.v.*), on a peninsula called Hamma (Cape Africa) south-southeast of Qairwan. Eight years were spent in fortifying this place, which in 921 was made the capital of the empire.

Invasions of Egypt.—After defeating internal enemies 'Obaidallah turned his attention to the remaining Abbasid possessions in Africa, and his general Habasah ibn Yusuf in the year 913 advanced along the northern coast, taking various places, including the important town of Barca. He then advanced toward Egypt, and toward the end of July 914, being reinforced by Abu'l-Kasim, afterward al-Ka'im, entered Alexandria. The danger led to measures of unusual energy being taken by the Baghdad caliph Muktadir, an army being sent to Egypt under Mu'nis and a special post being organized between that country and Baghdad to convey messages uninterruptedly. The Fatimite forces were defeated, partly because of the insubordination of the general Habasah, in the winter of 914, and returned to Barca and Qairwan with great loss. A second expedition was undertaken against Egypt in the year 919, and on July 10 Alexandria was entered by Abu'l-Kasim, who then advanced southward, seizing the Fayum and Ushmunain (Eshmunain). He was presently reinforced by a fleet, which, however, was defeated at Rosetta in March of the year 920 by a fleet despatched from Tarsus by the Abbasid caliph Muktadir, most of the vessels being burned. Through the energetic measures of the caliph, who sent repeated reinforcements to Fostat, Abu'l-Kasim was compelled in the spring of 921 to evacuate the places which he had seized and return to the west with the remains of his army, which had suffered much from plague as well as defeat on the field. On his return he found that the court had migrated from Raqqada to the new capital Mahdia (*q.v.*). Meanwhile other expeditions had been despatched by 'Obaidallah toward the west, and Kekor (Kakur) and Fez had been forced to acknowledge his sovereignty. The remaining years of 'Obaidallah's reign were largely spent in dealing with uprisings in various parts of his dominions, the success of which at times reduced the territory in which he was recognized to a small area.

Al-Ka'im.—'Obaidallah died on March 4, 933, and was succeeded by Abu'l-Kasim, who took the title al-Ka'im biamr allah. He immediately after his accession occupied himself with the reconquest of Fez and Nekor, which had revolted during the last years of the former caliph. He also despatched a fleet under Yakub ibn Ishak, which ravaged the coast of France, took Genoa and plundered the coast of Calabria before returning to Africa. A third attempt made by him to take Egypt resulted in a disastrous defeat at Dhat al-Humam, after which the remains of the expedition retreated in disorder to Barca.

The later years of the reign were troubled by the uprising of Abu Yazid Makhlad al-Zenati, a leader who during the former reign had acquired a following among the Berber tribes inhabiting the Jebel Aures, including adherents of the 'Ibadi sect. After having fled for a time to Mecca, this person returned in 937 to Tauzar (Touzer), the original seat of his operations, and was imprisoned by al-Ka'im's orders. His sons, aided by the powerful tribe Zenata, succeeded in forcing the prison, and releasing their father, who continued to organize a conspiracy on a vast scale and by the end of 943 was strong enough to take the field against the Fatimite sovereign, whom he drove out of Qairwan. Abu Yazid proclaimed himself a champion of Sunni doctrine against the Shi'is, and ordered the legal system of Malik to be restored in place of that introduced by the Patimites. Apparently the doctrines of the latter had as yet won little popularity, and Abu Yazid won an enormous following, except among the Kutama, who remained faithful to al-Ka'im.

On the last day of Oct. 944, an engagement was fought between Qairwan and Mahdia at al-Akhawan, which resulted in the rout of al-Ka'im's forces, and the caliph's being shortly after shut up in his capital, the suburbs of which he defended by a trench. Abu Yazid's forces were ill-suited to maintain a protracted siege, and since, because of the former caliph's forethought, the capital was in a condition to hold out for a long time, many of them deserted and the besiegers gained no permanent advantage. After the siege had lasted about ten months Abu Yazid was compelled to raise it

(Sept. 945); the struggle, however, did not end with that event, and for a time the caliph and Abu Yazid continued to fight with varying fortune, while anarchy prevailed over most of the caliph's dominions. On Jan. 13, 946, Abu Yazid shut up al-Ka'im's forces in Susa which he began to besiege and attempted to take by storm.

Mansur.—On May 18, 945, while Abu Yazid was besieging Susa, the caliph al-Ka'im died at Mahdia. and was succeeded by his son Abu Tahir Isma'il, who took the title Mansur. He almost immediately relieved Susa by sending a fleet, which joining with the garrison inflicted a severe defeat on Abu Yazid, who had to evacuate Qairwan also; but though the cities were mainly in the hands of Fatimite prefects, Abu Yazid was able to maintain the field for more than two years longer, while his followers were steadily decreasing in numbers and he was repeatedly driven into fastnesses of the Sahara. In Aug. 947 his last stronghold was taken, and he died of wounds received in defending it. His sons carried on some desultory warfare against Mansur after their father's death. A town called Mansura or Sabra was built adjoining Qairwan to celebrate the decisive victory over Abu Yazid, which, however, did not long preserve its name. The exhausted condition of northwest Africa resulting from the protracted civil war required many years of peace for recuperation, and further exploits are not recorded for Mansur, who died on March 19, 952.

Widening Authority. — His son, Abu Tamim Ma'add, was 22 years of age at the time and succeeded his father with the title Mu'izz lidin allah. His authority was acknowledged over the greater part of the region now constituting Morocco, Algeria and Tunisia, as well as Sicily, and he appears to have had serious thoughts of endeavouring to annex Spain. At an early period in his reign he made Jauhar, who had been secretary under the former caliph, commander of the forces, and the services rendered by this person to the dynasty made him count as its second founder after al-Shi'i. In the years 958 and 959 he was sent westward to reduce Fez and other places where the authority of the Fatimite caliph had been repudiated; after a successful expedition he advanced to the Atlantic. As early as 966 a fresh invasion of Egypt was prepared; but it was delayed, it is said, at the request of the caliph's mother, who wished to make a pilgrimage to Mecca first; and her honourable treatment by Kafur when she passed through Egypt induced the caliph to postpone the invasion till Kafur's death.

DECLINE OF THE FATIMITES

After the conquest of Egypt in 969 (see EGYPT: *History),* Mu'izz resolved to follow Jauhar's pressing invitation to enter his new capital Cairo. With his arrival there in Aug. 972 the centre of the Fatimite power was transferred from Mahdia and Qairwan to Egypt, and their original dominion became a province called al-Maghrib, which immediately fell into the hands of a hereditary dynasty, the Zeirids, acknowledging Fatimite suzerainty. The first sovereign was Bulukkin, also called Abu'l-Futuh Yusuf, appointed by Mu'izz as his viceroy on the occasion of his departure for Egypt; separate prefects were appointed for Sicily and Tripoli; and at the first the minister of finance was to be an official independent of the governor of the Maghrib. On the death of Bulukkin in 984 he was succeeded by a son who took the royal title al-Mansur, under whose rule an attempt was made by the Kutama, instigated by the caliph, to shake off the yoke of the Zeirids, who originated from the Sanhaja tribe. This attempt was defeated by the energy of Mansur in 988; and the sovereignty of the Fatimites in the Maghrib became more and more confined to recognition in public prayer and on coins and to the payment of tribute and the giving of presents to the viziers of Cairo. The fourth ruler of the Zeirid dynasty, called Mu'izz, endeavoured to substitute Abbasid suzerainty for Fatimite: his land was invaded by Arab tribesmen sent by the Fatimite caliph, with whom in 1051 Mu'izz fought a decisive engagement, after which the dominion of the Zeirids was restricted to the territory adjoining Mahdia; a number of smaller kingdoms rising up around them. The Zeirids were finally overthrown by Roger II of Sicily in 1148.

The Last **Fatimite** Caliph. — After the death of al-Adid, the last Fatimite caliph in Egypt, in 1171 some attempts were made to place on the throne a member of the family, and at one time there seemed a chance that the Assassins, who formed a branch of the Fatimite sect, might help in this project. In 1174 a conspiracy for the restoration of the dynasty was organized by 'Umarah of Yemen, a court poet, with the aid of eight officials of the government; it was discovered and those who were implicated were executed. Two persons claiming Fatimite descent took the royal titles al-Mu'tasim billah and al-Hamid lillah in the years 1175 and 1176, respectively; and as late as 1192 we hear of pretenders in Egypt. Some members of the family are traceable till near the end of the 7th century of Islam. The doctrines of the Fatimites as a sect: apart from their claim to the sovereignty in Islam! are little known, and we are not justified in identifying them with those of the Assassins, the Carmathians or the Druses, though all these sects are connected with them in origin. A famous account is given by Makrizi of a system of education by which the neophyte had doubts gently instilled into his mind till he was prepared to have the allegorical meaning of the Koran set before him and to substitute some form of natural for revealed religion. In most accounts of the early days of the community it is stated that the permission of wine drinking and licentiousness and the community of wives and property formed part of its tenets. There is little in the recorded practice of the Fatimite state to confirm or justify these assertions; and they appear to have differed from orthodox Moslems rather in small details of ritual and law than in deep matters of doctrine. Their legal system. as standardized in the writings of the *kadi* of al-Mu'izz, al-Nu'man, was generally in close agreement with the Malikite school of orthodox Islam. The feature of their political organization which distinguished them from other Moslem dynasties and caused them to be regarded with hostility and suspicion was the emphasis laid upon missionary propaganda, particularly among the depressed artisan classes in the cities. the chief missionary *(da'i)* being one of their principal secretaries of state.

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FATTY ACIDS or ALIPHATIC CARBOXYLIC ACIDS, a class of compounds of carbon, hydrogen and oxygen that are important in industry and in biochemistry. Fats and fatty oils are formed in chemical reactions in which fatty acids and glycerin take part. The many derivatives of fatty acids are prepared by modifying the hydrocarbon chain or by utilizing the reactions of the carboxyl group.

See BIOCHEMISTRY: *Fats and Amino Acids;* CARBOXYLIC ACIDS; HYDROGENATION; OILS, FATS AND WAXES: *Fat Hardening or Hydrogenation;* SOAP.

FAUBOURG, the French name for a portion of a town which lies outside the walls, hence properly a suburb. The name survives in certain parts of Paris, such as the Faubourg Saint-Antoine, the Faubourg Saint-Germain, etc., which have long since ceased to be suburbs. It may be derived either from *fors-bourg,* "outside the borough" (*cf. forbourg, fourbourc,* 13th century; and *horsborc,* 14th century); or from *faux-bourg,* "false borough" *(cf. falsus burgus,* which occurs in very late medieval Latin).

FAUCES, in anatomy, is the passageway between the mouth and the pharynx. It is bounded above by the soft palate and below by the tongue. On either side are the anterior and posterior pillars between which lie the tonsils. In architecture fauces is a term given by Vitruvius to narrow passages on either side of the tablinum, through which access could be obtained from the atrium to the peristylar court in the rear; therefore the term often applied to narrow connecting passages in Roman houses. See also ANATOMY, GROSS; MOUTH; SALIVARY GLANDS: THROAT.

(F. L. A.)

FAUCHER, LÉONARD JOSEPH (LÉON) (1803–1854), French politician and economist, was born at Limoges on Sept. 8, 1803. With the revolution of 1830 he was drawn into active political journalism on the Liberal side. He was on the staff of the Temps from 1830 to 1833, when he became editor of the *Constitutionnel* for a short time. He was editor from 1839 until 1842 of the *Courrier Français*. Faucher belonged in policy to the dynastic left, and consistently preached moderation to the more ardent Liberals. He advocated a customs union between the Latin countries to counterbalance the German *Zollverein,* but narrowed his proposal in 1842 to a customs union between France and Belgium. In 1843 he visited England to study the English social system, publishing the results of his investigations in a series of *Études sur l'Angleterre* (2 vol., 1845), published originally in the *Revue des deux mondes.* He was elected in 1847 to the chamber of deputies for Reims as a free-trader. After the revolution of 1848 he represented the department of Marne in the constituent assembly, where he opposed the limitation of the hours of labour, the creation of the national relief works in Paris and the abolition of the death penalty. Under the presidency of Louis Napoleon he became minister of public works, and then minister of the interior, but was compelled to resign office on May 14, 1849. In 1851 he was again minister of the interior until Napoleon declared his intention of resorting to universal suffrage. He died at Marseilles on Dec. 14, 1854.

His miscellaneous writings were collected (2 vol., 1856) as *Mélanges d'économie politique et de finance,* and his speeches in the legislature were printed in vol. ii of *Léon Faucher, biographie et correspondance* (2 vol., 18: 5).

FAUCHILLE, PAUL AUGUSTE JOSEPH (1858–1926), French authority on international law, born at Lille, Fr., on Feb. 11, 1858, studied law in Paris. His doctorate thesis, *Du blocus maritime* (Paris, 1882), remains a classic of international comparative law. He was responsible for the second edition of Henry Bonfils' *Manuel de droit international public* (1898), which he was subsequently to expand till it became the monumental *Traité,* 4 vol. (1922–26). He established, under the auspices of the University of Paris, the Institut des Hautes Études Internationales in 1920.

Fauchille died at Fontenay-aux-Roses (Seine) on Feb. 9, 1926.

FAULHABER, MICHAEL (1869–1952), German Catholic churchman and prominent opponent of the Nazis, was born at Heidenfeld on March 5, 1869. He studied philosophy and theology in Würzburg and Rome and was ordained a priest in 1892. He was a lecturer at the University of Würzburg (1899–1903) and professor of theology (Old Testament) at the University of Strasbourg (1903–10), subsequently serving as bishop of Speyer (1911–17) and archhishop of Munich and Freysing (1917–52). He was created a cardinal in 1921. Faulhaber collided early with the Nazis: whose neopaganism was repugnant to him. and he played a part in causing the failure of Hitler's putsch in 1923. Ten years later. with the Nazis in power. he delivered to vast thrones his famous sermons entitled *Judaism, Christianity, and Germany* (translated by George D. Smith. 1954). He emphasized that the teachings of the New Testament were but a logical sequel to those of the Old. and that exceptions taken to the latter were basically exceptions to the moral law in general. He added that the German tribes had become civilized only after they had been converted to Christianity and that Christian values were fundamental to German *Kultur.* Throughout these sermons. as well as those which were to follow until the collapse of the Third Reich, there runs a thread of vigorous criticism of Nazi theories and Nazi practices which the cardinal repeated in communications to the government. An attempt on his life was made in 1934, and his residence was attacked in 1938.

He died in Munich on June 12, 1952.

Cardinal Faulhaher's book *The Women of the Bible* appeared in English in 1938 (new ed. 1955). Among his other publications was *The Moral Teachings of the Gospels* (1936; *Die Sittenlehre des Evangeliums*). (F. A. Hs.)

FAULKNER (FALKNER), **WILLIAM** (1897-1962), U.S. author, was born on Sept. 25, 1897, at New Albany, Miss., into a family with deep southern roots. He was, among other things. an aviator in World War I, a student at the University of Mississippi. a postmaster, a Hollywood writer, a farmer and winner of the 1949 Nobel prize in literature. He died July 6, 1962.

After false starts as poet (*The Marble Faun* [1924]) and novelist (*Soldiers' Pay* [1926], *Mosquitoes* [1927]), he discovered his métier with his third novel, *Sartoris* (1929), the first in a series of works, laid in "Yoknapatawpha" county, Miss., on the past, present and future of the south. The "saga" includes, most notably, *The Sound and the Fury* (1929), *As I Lay Dying* (1930), *Light* in *August* (1932), *Absalom, Absalom!* (1936), "The Bear" (in *Go Down, Moses, and Other Stories* [1942]), and *Intruder in the Dust* (1948).

Divided into four sections, the first three of which are given to the streams of consciousness of three brothers in the Compson family — Benjamin, an idiot; Quentin, a Harvard student who commits suicide; Jason, a mean-spirited storekeeper — The *Sound and the Fury* chronicles the decay of a patrician family. *As I Lay Dying,* another stream-of-consciousness novel which moves kaleidoscopically through 15 minds, recounts the bizarre odyssey of the poor-white Bundrens, who, after awaiting the death of Mrs. Bundren, journey against all odds 40 mi. to bury her. *Light in August* counterpoints the stories of Lena Grove, placidly walking across the south in search of the father of her unborn child, and Joe Christmas, who, uncertain of his colour, vacillates between white and black, finally to be lynched as a Negro. *Absalom, Absalom!* is an impressive record of the rise and fall of the plantation dynasty of Thomas Sutpen, whose career before, during and following the Civil War becomes a symbol of the race-contorted history of the south.

"The Bear," one of Faulkner's most powerful stories and a key to his central themes, celebrates the initiation into manhood of Isaac McCaslin through the hunting of an animal at once legendary, symbolic and superbly actual, and at the same time treats movingly the problem of interracial relations. *Intruder in the Dust* combines the story of the Negro Lucas Beauchamp charged with the murder of a white man, the maturing of the boy "Chick" Mallison who helps exonerate Beauchamp in a rather crudely contrived detective yarn, an overwrought plea by Chick's uncle Gavin Stevens for southern autonomy, and the analysis of "not a racial outrage but a human shame." Outside the Yoknapatawpha series, Faulkner's most ambitious work was the 1955 Pulitzer prize novel, *A Fable* (1954), a modern rendering of Passion week in which the Unknown Soldier of World War I, as the latter-day Christ, speaks against the corruption of the world's leaders and for the faith of the mass of humanity.

Dealing with all levels of southern society, Faulkner saw the south as doomed by its sinful exploitation of land and man. U.S. readers first found Faulkner's experimental style prolix, turgid and unnecessarily obscure, and his characters excessively brutal. But the nightmare world which these readers came to accept as a set of symbols for personal and social disintegration, more readily impressed European readers, to whose violently changing lives and societies Faulkner addressed himself with particular force both naturalistically and symbolically. Emphasizing the presence of the past, the power of doom, and the value of endurance, Faulkner transcended his region and his country to speak to the world.

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FAULT. In geology, a fault is a dislocation in the rocks of the crust of the earth. The fault plane or surface is a fracture along which the rocks on opposite sides have slipped past each other. Most, if not all, earthquakes are due to movement along faults. Faults range in size from those that are detected only under the microscope to others that are many hundreds of miles long. In some instances, the movement is distributed over a fault zone composed of countless individual faults that occupy a belt hundreds of feet wide.

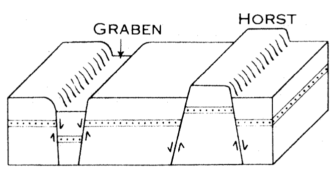

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FIG. 1.— GRABEN AND HORST

Origin. — Faults are due to compressional or tensional forces that cause fracturing in the earth's crust. Thrust faults are the result of compressional forces where the easiest relief is upward.

Strike-slip (wrench or lateral) faults are similarly due to horizontal compression, but in such cases the easiest relief was in a horizontal direction at right angles to the compressional force. Gravity faults, also called by some geologists normal faults, are often considered to be the product of horizontal tension in the crust, but this tension may be the result of vertical compressional forces acting from below.

Classifications and Examples.—A gravity fault or normal fault is one in which the hanging wall has gone down relative to the footwall (the block above the fault plane or surface is called the hanging wall; the block below is called the footwall, fig. 4); such movement involves lengthening of the crust of the earth at right angles to the strike of the fault.

Gravity faults are found throughout the world. In the Great Basin province of Utah and Nevada, such faults bound many of the mountain ranges on one or both sides. The mountains have been uplifted relative to the adjacent valleys many thousands of feet along these faults. One of the best examples is that along the west side of the Wasatch range of Utah. The Teton range of Wyoming is bounded on the east by a large gravity fault. A block that has dropped relatively downward between two gravity or normal faults dipping toward each other is a graben (fig. 1). The Rhine graben of Germany, bounded on both sides by gravity faults, is 180 mi. long and 20 to 25 mi. wide. A block that has been relatively uplifted between two gravity faults that dip away from one another is a horst (fig. 1). A tilted block that lies between two gravity faults dipping in the same direction is a tilted fault block.

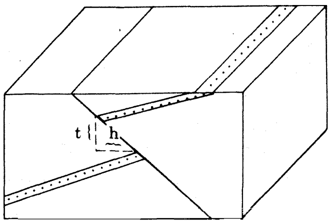

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FIG. 2.—THRUST FAULT, (T) THROW. (H) HEAVE

A thrust fault (fig. 2) is one in which the hanging wall has gone up relative to the footwall; it involves a shortening of the crust of the earth at right angles to the strike of the fault. Some thrust faults are folded, generally after displacement along them has ceased. Thrust faults with an initial low angle of dip and a net slip measured in miles are often referred to as overthrusts (fig. 3).

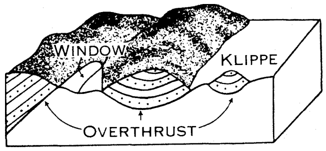

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FIG. 3.—OVERTHRUST SHOWING WINDOW AND KLIPPE

One of the best known thrust faults in North America, the Lewis overthrust, is found along the east side of the Rocky mountains in Glacier national park of Montana. Along this thrust ancient Pre-Cambrian rocks have been thrust eastward over younger Cretaceous rocks for at least 10 mi. Large thrust faults are also characteristic of the Appalachian region in the so-called Valley and Ridge province of Virginia and Tennessee.

Along the Moine overthrust in the northwest highlands of Scotland the Moine schists have been thrust northwestward for at least 15 mi. Thrust faults along which the movement is tens of miles are common in the Alps. Many overthrusts have been folded and deeply eroded. In places erosion may cut so deeply that in a circular or elliptical area the footwall block is completely surrounded by the hanging wall block; this is called a window (fig. 3; Fr. *fenêtre,* Ger. *Fenster).* Elsewhere, an isolated mass of the hanging wall may be completely surrounded by the footwall; this is known as a thrust outlier (fig. 3; Fr. *écaille,* Ger. *Klippe*).

In another group of faults the dip is essentially vertical and the movement is largely horizontal. Such faults are called strike-slip faults. wrench faults or lateral faults. Along a series of faults trending northwestward in California, the northeast block has been displaced southeasterly relative to the block southwest of the fault. During the San Francisco earthquake in 1906 the maximum movement along the San Andreas fault was 21 ft. The total movement along this fault during the last few millions of years appears to have been several tens of miles. Another large fault of this type is the Great Glen fault that extends northeast-southwest across Scotland from Inverness to Oban. Along this fault the block to the northwest has moved southwesterly 65 mi. In the South Island of New Zealand the northeasterly trending Alpine fault is a strike-slip fault along which the displacement is many tens or even hundreds of miles.

Movement Along Faults.—In describing movement along faults the intersection of the fault plane with the surface of the earth is called the fault trace (fig. 4). The trend or direction of

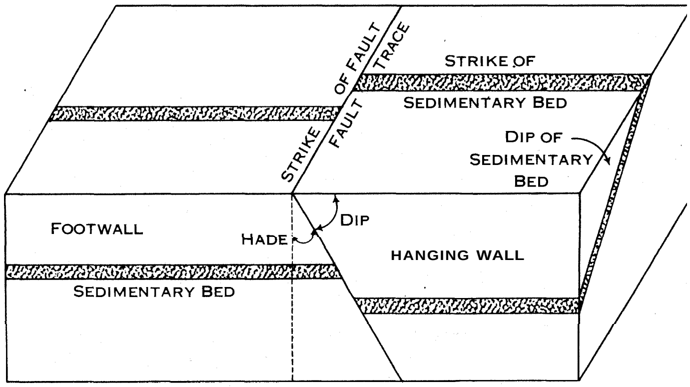

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FIG. 4.—TERMINOLOGY APPLIED TO FAULTS

the fault trace is called the strike and is defined by the angle the trend makes with a north-south line. Faults may be vertical, horizontal or inclined at any angle. Although the angle of inclination of a specific fault tends to be relatively uniform, in some instances the inclination may differ considerably from place to place. The angle of inclination measured from the horizontal is called the dip (fig. 4). The angle of inclination or deviation from the vertical is called the hade.

The walls of the fault plane in many instances are smoothly polished and marked by scratches called slickensides. These scratches indicate the direction in which the two blocks on opposite sides of the fault plane have moved relative to each other. In some instances, the rocks along a fault plane have been crushed to a very fine-grained claylike substance known as fault gouge. In other cases the fragmental rock is relatively coarse-grained with fragments ranging from an inch in diameter to many feet; such material is known as fault breccia (*q.v.*) or crush breccia.

In general. the displacement of the blocks on the opposite sides of the fault plane must be considered in relative terms; the absolute movement relative to some datum, line or plane such as sea level, is generally unknown. The movement along a fault may be rotational, in which the blocks rotate relative to one another, or translatory, in which no rotation is involved.

Although it is clearly recognized that a rather elaborate terminology is necessary to describe the relative movements along faults and the effects on the disrupted strata, complete unanimity of definition has not been achieved. The most common terminology and the one adopted here is a modification of the terminology advocated by a committee of the Geological Society of America in 1912.

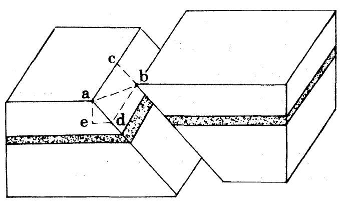

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FIG. 5.—TERMINOLOGY APPLIED TO MOVEMENT ALONG FAULTS, (AB) NET SLIP. (AC) STRIKE SLIP, (CB) DIP SLIP, (AE) VERTICAL SLIP. (ED) HORIZONTAL SLIP

The net slip is the total displacement; it is the distance measured on the fault surface between two formerly adjacent points situated on opposite sides of the fault plane (*nb* of fig. 5). The inclination that the net slip makes with a horizontal line in the fault plane is called the pitch or rake (angle *cab* of fig. 5). To describe the net slip quantitatively, it is necessary to give its pitch, the amount of the displacement and the direction of the relative movement. The strike slip, measured in the fault

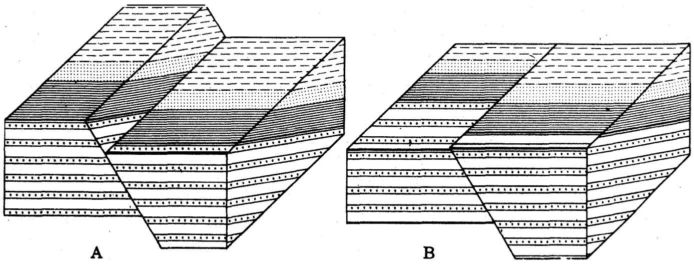

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FIG. 6.— EFFECTOF FAULTING ON DISRUPTED STRATA, (A) BEFORE EROSION (B) AFTER EROSION

plane, is the horizontal component of the net slip (bd of fig. 5). The dip slip is the component of the net slip measured directly down the dip of the fault plane (cb of fig. j). The vertical slip is the vertical component of the net slip; it is a measurement of the relative vertical movement along the fault plane (ae of fig. 5). The horizontal slip is the horizontal component of the dip slip; it is a measurement of the relative movement of the two blocks toward or away from each other (ed of fig. 5).

Effect on Disrupted Strata.— The apparent movement of a fault may be very different from the actual movement. Thus, in fig. 6 (A), the hanging wall has moved down relative to the footwall. But when the left-hand block has been eroded to the level of the right-hand block (fig. 6 [B]), their relation suggests that the right-hand block moved forward relative to the left-hand block. Of course. this might actually have been the case, and a solution of such problems is possible only if some other planar feature, such as a dike or an older fault, has also been displaced by the fault. The throw and heave are measured in a vertical section at right angles to the trend of the fault plane (fig. 2). The throw *(t)* is the vertical component of the apparent movement in such a section; whereas the heave (*h*) is the horizontal component. Many geologists define throw and heave differently; defining throw the same as vertical slip and heave the same as horizontal slip (as defined above).

For discussion of faults in relation to the occurrence of gas and oil see FORAMINIFERA; GEOPHYSICAL PROSPECTING; MINE PROSPECTING AND DEVELOPMENT. See also GEOLOGY; EARTHQUAKE.

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FAUNUS, an Italian rural deity. the bestower of fruitfulness on fields and cattle. As a herdsmen's god he was identified with Inuus, the fertilizer of cattle. His identification with the god worshiped at the Lupercalia (*q.v.*) is controversial. He is above all a woodland deity and identified with the sounds of the forest; thus he is called Fatuus ("the speaker") and has a female counterpart, Fatua or Fauna, either his daughter or wife, allegedly identical with the Bona Dea (*q.v.*). He is sometimes prophetic (as in the *Aeneid,* vii), and as Incubo has charge of nightmares and buried treasure (cf. fairies, pucks, etc.). He is identified with the Greek Pan (*q.v.*) and under this influence may be pluralized: fauni, woodland spirits conceived as satyrs (*q.v.*). Rationalizing mythologists made him an early king of Latium, the son of Picus and father of Latinus. He had two festivals (Faunalia): on Dec. 5 in the country, an occasion of gaiety and spirited dancing (Horace, *Carmina,* iii. 18); and an urbanized form on Feb. 13 (Ovid, Fasti, ii, 193 ff.), which took place at the temple of Faunus in Rome.

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FAURE, FRANÇOIS FÉLIX (1841–1899), president of the French Republic, was born in Paris on Jan. 30, 1841, the son of a small furniture maker. He made a fortune as a tanner and merchant at Havre. and was elected to the National Assembly on Aug. 21, 1881. He sat on the Left, interesting himself chiefly in matters concerning economics, railways and the navy. He was undersecretary for the colonies (1882–85 and 1888), and in 1893 was made vice-president of the chamber. In 1894 he obtained cabinet rank as minister of marine under Charles Dupuy. In the January following he was unexpectedly elected president of the Republic upon the resignation of Jean Paul Casimir-Périer. His fine presence and his tact on ceremonial occasions rendered the state some service when in 1896 he received the tsar of Russia at Paris, and in 1897 returned his visit, after which meeting the momentous Franco-Russian alliance was publicly announced.

The latter days of Faure's presidency were embittered by the Dreyfus affair, which he was determined to regard as chose *jugée.* But at a. critical moment in the proceedings he died (Feb. 16, 1899).

See E. Maillard, Le Prdsident F. Faure (1897); P. Blupsen, *Félix* Faure *intime* (1898); and F. Martin-Ginouvier, F. Faure devant l'histoire (1895).

FAURÉ, GABRIEL (1845–1924), French musical composer, was born at Pamiers (Ariège) on May 12, 1845. He studied at the school of sacred music directed by Niedermeyer, first under Dietsch. and subsequently under Saint-Saens. He became "maître de chapelle" at the church of the Madeleine in 1877, and organist in 1896. Fauré was made professor of composition at the Conservatoire (1896), and director (1905). He retired in 1920 and died on Nov. 4, 1924. His work at the Conservatoire. extending over nearly a quarter of a century, had great importance in the history of French music. Roger-Ducasse. Ravel and Florent Schmitt were among his pupils. He himself wrote music in all forms. but his fame rests mainly on his exquisite songs and on a considerable body of original and interesting chamber music Recognition came to him slowly, probably because of the quality of unexpectedness in his compositions. Among the more familiar of his chamber music works are two sonatas for violin and pianoforte. two sonatas for violoncello, a posthumous string quartet and two quintets for pianoforte and strings. For a bibliography of his works see Octave Séré, Musiciens *français,* d'aujourd'hui (jth ed. 1910).

FAURIEL, CLAUDE CHARLES (1772–1844), French scholar and writer who played a considerable, though unspectacular, part in the revival of historical and literary studies in France after 1815. He was born at St.-Étienne on Oct. 21. 1772, and received a good education in the Oratorian colleges of Tournon and Lyons. Republican by conviction, he served in the army before becoming private secretary to the minister of police, Joseph Fouché (*q.v.*), in 1799 and then, three years later, resigned the post when affronted by the ambition of Bonaparte. About. this time his first literary efforts—some articles in the *Décade philosophique* (1800)—won the approval of Madame de Staël, and he contracted with Madame de Condorcet a liaison which lasted until her death in 1822. His friendship with François Guizot procured for him, after the July revolution in 1830, the chair of foreign literature at the Sorbonne, and in 1836 he was elected to the Académie des Inscriptions. He died at Paris on July 15, 1844.

Fauriel was a reluctant writer and an unreliable historian, but his undoubted scholarship and particularly his tenure of office at the Sorbonne were largely responsible for the subsequent development of the study of comparative literature in France. His publications include Chants *populaires* de la *Grèce moderne* (2 vol., 1824–25), a work serving the causes of poetry and Greek independence and the first to bring Fauriel before a wide public; *Histoire* de la Gaule *méridionale sous* la domination des *conquérants germains* (4 vol., 1836), the only completed section of a projected general history of southern Gaul; *Histoire* de la *Croisade contre* les *hérétiques* albigeois (1837), a translation of a provençal poem on the Albigensian crusade; and two posthumously published works—Histoire de la *poésie provençale* (3 vol., 1846; Eng. trans., 1860) and Dante et les origines de la langue et de la *lit*te'rature italiennes (2 vol., 1854).

Fauriel's *Mémoires* were found with the papers of Madame de Condorcet and were published by L. Lalanne under the title Les *Derniers Jours du Consulat* (1886; Eng. trans., 1885).

See also J. B. Galley, Claude Fauriel (1909).

FAUST (FAUSTUS), the name of a magician and charlatan of the 16th century who has become famous in legend and literature. The real Faustus died *c.* 1540, but the scanty references to him in contemporary sources suggest the possibility that there were two men (Georgius and Johann) using that surname. In 1507 it is known that a certain Georgius Sabellicus, calling himself Faust Junior. the chief of necromancers, the second magus, palmist, astrologer and so on, obtained toward the end of Lent the post of schoolmaster at Kreuznach. Ger., through the good offices of Franz von Sickingen, "a man very fond of mystical lore." He grossly abused the trust placed in him by indulging in "the most dastardly form of lewdness" with the boys and fled from punishment, as is reported in a letter from Johannes Tritheim. abbot of Sponheim monastery, near Kreuznach. Two years later. on Jan. 1j, 1509, a certain Johannes Faust *"ex Simern"* was granted the degree of B.A. by the faculty of theology in the University of Heidelberg. and the university matriculation records show that he was placed first on the list of 1j and duly paid his fees. According to Conrad Mutianus Rufus, canon of St. Mary's church, Gotha. in Sept. 1j13 Georg Faust, "the demigod of Heidelberg." was heard bragging and boasting in an Erfurt inn. The account book of the bishop of Bamberg records that on Friday. Feb. 10, 1520, Dr. Faust received ten gulden for casting the bishop's horoscope. Kilian Leib, prior of Rebdorf in Bavaria, says that on June 5, 1528, a Georgius Faustus of Helmstedt claimed to be the commander and preceptor of the knights of St. John at Hallestein. on the borders of Carinthia. Only ten days later, on June 15, 1528, the records of Ingolstadt show that Dr. Georg Faust was banished from the town as a soothsayer; and Dr. Faust. "the great sodomite and necromancer." was refused a safe conduct by the city of Niirnberg on May 10, 1532. On June 25, 1535, "the famous necromancer" Dr. Faust was in Münster, where. as reported in the *Waldeck Chronicle,* he prophesied accurately that the bishop would recapture the city that evening. Finally. "the philosopher Faust" seems to have prophesied accurately early in 1540 "a very bad year" for the Venezuelan expedition, according to Philipp von Hutten, who met his death on it.

This is the last mention of Faust while he was still alive. He appears to have been fairly well known and widely traveled. probably not without education, but with an evil reputation. All the observers are agreed about this; but opinions were divided about his prowess in magic. The humanists, and Tritheim in particular. scoffed at his claims and derided him as a braggart. The fampus classical scholar Joachim Camerarius (1500–74) speaks of his "juggler's tricks"; and Philipp Begardi, a physician in Worms, said that his promises were great and so was his fame, but that his deeds were "very petty and fraudulent." The contemporary demonologists. with the exception of Xugustin Lercheimer and Johannes Wier. who showed him up as a trickster in *De praestigiis daemonum,* ignored Faust almost completely, and no serious history of magic has ever included him among the noted practitioners. But the Reformed clergy. Luther and Melanchthon among them. strengthened the widespread and popular belief in the diabolical powers of "the famous necromancer." A Swiss Protestant pastor, Johannes Gast, who had once dined with Faust in Basel, declared in his *Sermones conviviales* (1548) that the dog and horse with him were demons and that the wicked sorcerer had finally been strangled by the devil. Faust himself, by referring more than once to the devil as his *Schwager* ("crony'! or "brother-in-law"), probably gave rise to this flight of fancy which brought him into line with a perdurable tradition. From time immemorial those who were credited with supernatural powers were also rumoured to have died violent or mysterious deaths; and the legend of Faust as it developed thereafter was the 16th-century Lutheran version of the myth of the magus. among whose earliest known representatives were the Persian magi.

The sages and mages of antiquity were greatly revered and believed to be of divine origin. but they mere also greatly dreaded because of their mysterious power, and from the earliest times magic was abused in the hands of charlatans and evil-intentioned practitioners. Magicians as a class were already losing caste under the Roman empire when Christianity precipitated their downfall by claiming a monopoly of miracles; and the church's striking declaration *Habet diabolus Christos suos* ("The devil has his own Christs") effected a revolution in public opinion which transformed the pagan deities into demons and their priests into devil worshipers. The mighty magus of ancient times was reduced to the status of a black magician, a downfall that was symbolically and dramatically represented in the legend of Simon Magus (*q.v.*). On the other hand the legend of Theophilus of Adana, who, in order to regain the office from which he had been deposed, agreed to serve the devil and gave him a sealed denial of Jesus Christ, first brought into prominence the notion of an infernal pact, which had been admitted by St. Augustine and other fathers of the church and which derived from Jewish incantation ceremonies. Mariolatry saved Theophilus from the consequence of his bargain; but a species of diabolatry (belief in the almost unlimited power of the devil), which flourished among the early Lutherans, spelled eternal damnation for Faust, and all the more so because he had recourse to magic in order to satisfy his craving for knowledge. This was evil in itself according to the antihumanistic tendency of the Reformed Churches. The *Sturm und Drang* writer Friedrich Maximilian von Klinger later deliberately identified the hero of his sombre novel *Fausts Leben, Tnten und Höllenfahrt* (1791) with Johann Fust of Mainz, the reputed coinventor of printing. who died in 1465; and both hc and Heinrich Heine declared that the confusion had arisen in the popular mind because of superstitious fear of the dissemination of knowledge.

It may seem strange that such a shady and relatively obscure sorcerer as Faust should have become the representative black magician of his age rather than his far more famous contemporaries. Tritheim. Xgrippa von Nettesheim. Paracelsus and Nostradamus. who were also involved in occult speculations and practices and were also suspected of commerce with the devil. But Faust attained to posthumous fame because of his first biographer. the anonymous author of the first *Faustbuch,* published by Johann Spies in Frankfurt-on-Main in 1587. The book is of unequal merit; for bookmaking of the crudest kind underlies the collection of magical feats which forms its nucleus. These tales, taken from Lercheimer and other demonologists. had been told about the ancient magi and retold in the middle ages and later about such reputed wizards as Virgil, Merlin. Simon Magus, Gerbert (Pope Silvester II), Albertus Magnus. Roger Bacon, Zyto and many more. They were now attributed to Faust, baldly and badly narrated and still further disenchanted by the clodhopping humour shown at the expense of Faust's dupes. Disenchantment also spoils the evocation of Helen of Troy, a devil disguised as a wanton, doll-like minx; but the genuinely poetic idea which summons her up from Hades to ensure Faust's damnation set Christopher Marlowe's imagination aflame and is one of the reasons why the legend put on immortality. The other is to be found in the intense conviction of the author. a God-fearing, devil-fearing Lutheran, of the truth of the tale he was telling. His descriptions of the nether regions and of the fearful state of mind of his heart-hardened hero have spiritual intensity and are still impressive, as can be seen from Thomas Mann's highly effective use of many such passages verbatim in his *Doktor Faustus* (1947). Moreover, in the creation of Mephostophiles (for whose name. of which this was the original form. he was also responsible), the author attained to such realism in his presentation of the savage. embittered, remorseful and yet ruthless fiend as to inspire unquestioning belief.

The book ran like wildfire through Europe. It was translated speedily into Low German. Danish. Dutch. English and French, and. somewhat later, into Polish and Czech, while revised and augmented editions, one of them in rhyme, followed on each other's heels in Germany. Its career was halted there by the appearance in 1599 of Georg Rudolf Widmann's *Faustbuch,* which dislocated and swamped the sadly diminished tale with a spate of learned and sermonizing commentaries and further disfigured it by retelling it with a rabidly anti-Catholic and anti-Semitic bias. This version was re-edited in 1674 by Johann Nikolaus Pfitzer and cut into little hits by Christlich Meynenden in 1725 to form a popular chapbook, by which time the original Spies version was forgotten.

But it had served its turn; for the Elizabethan prose translation by "P. F., Gent." in 1592 or earlier inspired Christopher Marlowe's *The Tragicall History of D. Faustus* (published 1604), in which the tragic power and passion latent in the original attained a summit unsurpassed in Faustian literature. Marlowe, who followed his source closely, took over a good deal of the farcical element and introduced a comic subplot, thus admitting elements of decay into the tragic organism which, decomposing the legend with a speed almost equal to the swiftness of its flowering, brought it finally to the compost heap with William Mountfort's *The Life and Death of Doctor Faustus. With the Humours of Harlequin and Scaramouche* (1697) and John Thurmond's pantomime *Harlequin Doctor Faustus* (1724). It underwent a similar but less radical deterioration in Germany, where English strolling players presented Marlowe's drama early in the 17th century. German versions soon supplanted the probably mangled English text and, to judge by the playbills and accounts which have survived, sensationalized it with many spectacular effects, introduced some indigenous elements and diversified it with a great deal of clowning. Faust dramas of this kind were enacted for 200 years on the popular stage; and the puppet-play texts, many of them still extant, suggest that on the whole the Marlovian scheme was adhered to in the booths, as well as on the boards. The puppet plays themselves, streamlined and artless: with some tense and moving scenes, allowed a large part to Casper the clown; but, however much shortened Faust's part might be in consequence, his tragic end was often floodlit with poetry, and his eternal damnation was never in doubt.

This fact had to be taken into account by the fabricators and editors of the extremely lucrative magical manuals circulating at the time. With a view to increasing sales, they used Faust's name on the title page and sometimes in the body of incantation ceremonies deriving ultimately from Akkadian-Chaldean inscriptions through the Greco-Roman papyri and Jewish rituals; and in order to reassure prospective purchasers of these various so-called Faustian *Höllenzwänge* ("harrowings of hell"), they either wrote preambles showing how the dangerous bilateral pact with the devil could be avoided or they ignored the subject and concentrated on the unilateral pact which constrained the spirits to obedience without any bodily or spiritual harm to the exorcist. The great Faustian ritual classic *Magia Naturalis et Innaturalis* (in the Weimar grand-ducal library and well known to Goethe) went even further. After giving the text of the unilateral pact, it also communicated the wording of a bilateral pact, with the soul of the exorcist at stake, and then gave the religious ceremony to be performed in order to break the agreement. Exceedingly pious in tone, these manuals mere in great demand during the 17th and 18th centuries, when it was believed that with their help buried treasure could be located and raised; and they popularized the notion that infernal pacts could be renounced by the grace of God.

But the name of Gotthold Lessing is the first great name associated with the salvation of Faust in literature. The desire and pursuit of knowledge appeared to this enlightened rationalist as one of the noblest instincts of the human mind, and he left a scheme and some scenes pointing toward the hero's reconciliation with God. Published in 1784. they had great influence; and from then onward the innumerable Faustian authors have been divided into two camps: the traditionalists and the salvationists. Even before the appearance in 1808 of Goethe's *Faust,* part i, with its promise of salvation in the prologue, several dramatists had attempted to realize this ideal; and others continued to do so both before and after the publication of his *Faust,* part ii, in 1833, although the awe-inspiring conclusion to this masterpiece of modern literature should have discouraged his successors. For it is more than salvation to which Goethe's Faust attains in the final act, which is an apotheosis of the hero as a representative of striving and seeking humanity, who may spend a lifetime erring but will be redeemed by the active pursuit of knowledge and truth. Goethe is unique in having solved the seemingly insoluble problem of grafting a humane and rationalistic ethic onto the dire assumptions of the legend; but the introduction of love interest into the cosmic conflict with the appearance of Gretchen diminished its grandeur in Faustian literature as a whole, although this is not nearly so much the case with the tragic traditionalists, on some of whom Don Juan and Byron have left their mark. None of them can hold a candle to Marlowe; but there are works of real interest, power and beauty among them. Klinger's and Thomas Mann's contributions have already been mentioned. To them should be added: Adelbert von Chamisso, *Faust, Ein Versuch* (1804), Christian Grabbe, *Don Juan und Faust* (1829), Nikolaus Lenau, *Faust: Ein Gedicht* (1836), Woldemar Nürnberger, *Josephus Faust* (1847), Heinrich Heine, *Doktor Faust: Ein Tanzpoem* (1851) and Paul Valéry, *Mon Faust* (1946). None of these poets has been able to accept Goethe's optimistic conclusion; and Lenau and Valéry, in particular, have stressed the dangers inherent in the notion of attaining to absolute knowledge with its correlative poaer. In their works the annihilating instinct of mankind faces the incorruptibility proclaimed by Goethe; and the fear of the Faustian spirit of insatiable scientific inquiry has been given modern expression.

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FAUSTINA, ANNIA GALERIA, the younger, daughter of Antoninus Pius, and wife of Marcus Aurelius Antoninus. She is accused by Dio Cassius and Capitolinus of gross profligacy, and was reputed to have instigated the revolt of Avidius Cassius against her husband, but this may be untrue, as he was always devoted to her. She died in A.D. 175 or 176 (so Clinton, *Fasti rom.*) at Halala, near Mount Taurus, in Cappadocia, whither she had accompanied Aurelius. Charitable schools for orphan girls (hence called *Faustinianae*) were founded in her honour.

See Capitolinus, *Marcus Aurelius;* Dio Cassius lxxi. 22, lxxiv. 3; E. Renan, in *Mélanges d'histoire et des voyages,* 169–195.

FAUSTUS, SAINT of Riez (*c.* 400–*c.* 490), bishop of Riez, France, and one of the chief exponents of Semi-Pelagianism, was born in Roman Britain about the year 400. He and probably his family went to southern Gaul in the first years of the 5th century. Faustus joined the newly founded monastic community on the Îles de Lérins, of which he became the third abbot about 433. After some 20 years as abbot. Faustus was elected bishop of Riez in the Basses-Alpes and from then on played a leading role in the ecclesiastical life of 5th-century Gaul. He died about 490. Although he was liturgically venerated as a saint before the 19th century in Riez (feast day, Sept. 28), this cultus has completely disappeared.

Faustus was a significant theologian and a celebrated preacher. His sermons, many of which were reworked and used by Caesarius of Arles (*q.v.*), can still be found attributed to other names in the sermon collections gathered in 6th-century France. As a theologian, Faustus in his two books *De gratia* gave the final form to the Gallic anti-Augustinianism today called Semi-Pelagianism. For Faustus, grace was indeed necessary for true virtue and salvation, but he conceived grace as something extrinsic to man, which was rendered operative through man's own natural initiative toward salvation (*credulitatis affectus*). Without naming Faustus but citing his very words, the second Council of Orange (529) rejected Faustus' doctrine.

Faustus' works were printed by J. P. Migne, *Patrologia Latina,* vol. lviii, 523–557, and A. Engelbrecht, *Fausti Reiensis opera,* in the series "Corpus Scriptorum Ecclesiasticorum Latinorum," vol. xxi (1891).

See G Weigel, S J., *Faustus of Riez* (1938). (G. Wl.)

FAUVISM: *see* Painting.

FAVARA, a town of Sicily. province of Agrigento. 8 mi E. of the city of that name by rail. Pop. (1951), 25,2jj An agricultural centre with sulfur and other mines, and a fine castle (1280) of the Chiaramonte family.

FAVART, CHARLES SIMON (1710–1792), French dramatist and one of the creators of French *opéra comique,* was born in Paris. Nov. 13. 1710. After his father's death he carried on his business as pastry cook, meanwhile writing librettos for light operas. He became stage manager of the Opéra Comique in 1743, and in 1745 married Marie Duronceray (1727–72), a singer and actress. She attracted the attentions oi Maurice de Saxe, Favart's patron, who used his power over them both to make her his mistress. Favart's best play, *Les Trois Sultanes* (1761), is a comedy based on a similar triangular situation. Here song and dance play a less important part than in Favart's other works, the best of which is *La Chercheuse d'esprit* (1741). Favart became director of the Opéra Comique in 1758. He died in Belleville. May 12, 1792. His *Mémoires et correspondance littéraires, dramatiques et anecdotiques* (1808) throws light on the writer and his times.

See A. Font, *Favart. L'opera-comique et la come'die-vaudeville au XVII^e^ et XVIII^e^ siècles* (1894); A. Iacuzzi, *The European Vogue of Favart* (1932). (*D.* Ks.)

FAVERSHAM, a market town, river port and municipal borough in the Faversham parliamentary division of Kent, Eng., on a creek of the Swale, 9 mi. W.N.W. of Canterbury by road. Pop. (1951) 12,293. Area 4.7 sq.mi. It is a member of the Cinque Port of Dover. The Early English church of St. Mary of Charity (restored in 1754) has some remains of frescoes (*c.* 1305) on one of the columns and 14th-century paintings in the chancel. A brass cornmemorates King Stephen. whose remains are said to have been transferred at the Dissolution to a tomb in the Trinity chapel from the Cluniac abbey which he founded. Matilda, his queen, was also buried in the abbey. The fragment of the outer gateway that remains forms part of the house wherein Thomas Arderne (Arden) was murdered in 1550. This event is the theme of *The Lamentable and True Tragedie of M. Arden of Feversham in Kent,* one of the earliest English domestic dramas.

Faversham's grammar school was founded in 1527, forfeited at the Dissolution and restored by Elizabeth I in 1576. The original building (1587) still exists.

Traces of Roman settlement have been found, but the town (Favreshant in Domesday Book) owed its early importance to its situation as a port on the Swale near Watling street and surrounded by fertile country. In 811 it was called the king's town "of Fefresham" and a witenagemot was held there under Athelstan. In 1086 it was assessed as royal desmesne, and a market held. When King Stephen founded the abbey in 1147, he endowed it with the manor and hundred of Faversham. which caused many disputes between the abbot and men of Faversham concerning the abbot's jurisdiction.

Faversham was probably a member of Dover from the earliest association of the Cinque Ports, certainly as early as Henry III, as shown by a charter of 1252. All the liberties of the Cinque Ports were granted to the barons of the town in 1302. The governing charter till 183j was that of Henry VIII, granted in 1545 and confirmed by Edward VI.

Faversham creek is navigable up to the town for vessels up to 300 tons. The shipping trade is considerable, chiefly in oils. timber, agricultural feeding stuffs and fertilizers: both coastwise and from continental ports. The oyster fisheries were formerly managed by a very ancient guild, the Company of Free Dredgermen of the Hundred and Manor of Faversham, but since 1929 by the statutory company. Hops and cherries are largely grown in the neighbourhood. Brewing. brickmaking. the quick ireezing and canning of fruit and vegetables and the grading and packing of apples and pears are carried on. There are a shipyard and light engineering works in the town, also large oil depots.

FAVORINUS (fl. and century A.D.), skeptical philosopher and sophistic rhetorician of the Roman empire. whose life. as he said. was remarkable because "being a Gaul, he lived as a Greek; being a eunuch [an androgyne], he was sued for adultery: and, being in dispute with the emperor, he suffered nothing." Born in Arles, he is known to have lived in Rome. in Athens, in Corinth and in Ephesus and to have been highly esteemed for his learning and for his eloquence. Plutarch, Herodes Atticus and Aulus Gellius were his friends; Polemo of Laodicea, his bitterest rival. Falling into disfavour with the emperor Hadrian, he appears to have retired to comfortable exile in Chios until the end of the reign.

Favorinus wrote philosophical discourses. declamations, a *Miscellaneous History* and memoirs. His serene discourse *On Exile* was printed by M. Norsa and G. Vitelli from a Vatican Greek papyrus in 1931. Editions of Dio Chrysostom (*q.v.*) include two orations (xxxvii and lxiv) now usually ascribed to Favorinus: the *Corinthiaca*, an outstanding specimen of rhetorical exercise in the Asianic style; and *On Fortune.* Only fragments remain of his other works; the historical ones are collected by C. Miiller, *Fragmenta historicorum Graecorum,* iii (1849).

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FAVRAS, THOMAS DE MAHY, MARQUIS DE (1744–1790), French royalist, was born on March 26, 1744, at Blois. In 1772 he became first lieutenant of the Swiss guards of the count of Provence (afterward Louis XVIII). He retired in 177j and married in 1776 Victoria Hedwig Caroline, princess of Anhalt-Bernburg-Schaumburg, whose mother, deserted by her husband Prince Carl Ludwig in 1749, had found refuge with her daughter in the house of Marsbal Soubise. After his marriage he went to Vienna to press the restitution of his wife's rights, and spent some time in Warsaw.

In 1787 he was authorized to raise a patriotic legion to help the Dutch against the stadholder William IV and his Prussian allies. Returning to Paris at the outbreak of the French Revolution, he became implicated in schemes for the escape of Louis XVI. He was commissioned by the count of Provence, through the comte de la Chbtre, to negotiate a loan of 2.000.000 fr. from the bankers Schaumel and Sartorius. Favras was betrayed, however, and, with his wife. was arrested on Christmas eve, 1789.

In the course of a trial of nearly two months' duration the witnesses disagreed, and even the editor of the *Révolutions de Paris* (no. 30) admitted that the evidence was insufficient, but an armed attempt of the royalists on the Chhtelet on Jan. 26, which was defeated by La Fayette, sealed his fate. He was hanged on the Place de Grève on Feb. 19, 1790.

Favras was generally regarded as a martyr to his refusal to implicate the count of Provence, and Madame de Favras was pensioned by Louis XVI.

The official dossier of Favras's trial for high treason against the nation disappeared from the Châtelet, but its substance was preserved in the papers of a clerk.

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FAVRE, JEAN ALPHONSE (1815–1890), Swiss geologist, born at Geneva on March 31. 181j, was for many years professor of geology in the academy at Geneva and afterward president of the federal commission with charge of the geological map of Switzerland. One of his earliest papers was "On the Anthracites of the Alps" (1841). and later he gave special attention to the geology of Savoy and of Mont Blanc and to the ancient glacial phenomena of those Alpine regions. He died at Geneva in June 1890.

FAVRE, JULES CLAUDE GABRIEL (1809–1880), French statesman, was born at Lyons on March 21, 1809, and was an advocate by profession. From the time of the revolution of 1830 he declared himself a republican. After the revolution of 1848 he was deputy for Lyons to the constituent assembly. On Dec. 2, 1851, he tried with Victor Hugo and others to organize an armed resistance to Louis Napoleon in the streets of Paris.

After the coup d'etat he withdrew from politics, resumed his profession and distinguished himself by his defense of Felice Orsini, the perpetrator of the attack against the life of Napoleon III.

In 1858 he was elected deputy for Paris, and was one of the "five" who gave the signal for the republican opposition to the empire. In 1863 he became the head of his party, and delivered a number of addresses denouncing the Mexican expedition and the occupation of Rome. These addresses, eloquent, clear and incisive, won him a seat in the French academy in 1867. With Thiers he opposed the declaration of war against Prussia in 1870, and at the news of the defeat of Napoleon III at Sedan he demanded from the legislative assembly the deposition of the emperor.

In the government of national defense he became vice-president under Gen. Louis J. Trochu, and minister of foreign affairs, with the onerous task of negotiating peace with victorious Germany. He proved to be less adroit as a diplomat than he had been as an orator, and committed several irreparable blunders. His statement on Sept. 6, 1870, that he "would not yield to Germany an inch of territory nor a single stone of the fortresses" was a piece of oratory which Bismarck met on Sept. 19 by his declaration to Favre that the cession of Xlsace and of Lorraine was the indispensable condition of peace. He arranged for the armistice of June 28, 1871, without knowing the situation of the armies and without consulting the government at Bordeaux. He neglected to inform Gambetta that the army of the east (80,000 men) was not included in the armistice, and it was thus obliged to retreat to neutral territory.

Favre withdrew from the ministry, discredited, on Aug. 2, 1871, but remained in the chamber of deputies. Elected senator on Jan. 30, 1876, he continued to support the government of the republic against the reactionary opposition until his death on Jan. 20, 1880.

His works include many speeches and addresses, notably *La Liberte' de la presse* (1849), *Défense de F. Orsini* (1866), *Discours de réception à l'Académie française* (1868), *Discours sur la liberte' intérieure* (1869).

In *Le Gouvernement de la Défense Nationale*, 3 vol., 1871–75, he explained his role in 1870–71. After his death his family published his speeches in eight volumes.

See G. Hanotaux, *Histoire de la France contemporaine* (1903, etc.); also E Benoît Lévy, *Jules Favre* (1884).

FAVUS, a highly contagious ringworm of the scalp, occurring occasionally also on other parts of the skin and in the nails. It is endemic among the poor population in many areas of eastern and southeastern Europe and in the middle east. It is uncommon in western Europe and in the U S. Favus is caused by the invasion of the skin and the hair by fungi of the Achorion group, leading to the formation of hard, cup-shaped, sulfur-yellow crusts with a mouse-nestlike odour. In contrast with other fungous diseases of the scalp, favus irreparably destroys the hair follicles. Unsightly permanent spotty baldness and scarring result in the involved areas.

Treatment of this disease is difficult, particularly because many members of one family may have it and transfer it to each other. *See* also RINGWORM OF THE SCALP. (RD. B. S.)

FAWCETT, HENRY (1833–1884), English politician and economist, was born at Salisbury on Aug. 25, 1833, the son of a successful businessman. He was educated at King's College school, London, and at Peterhouse and Trinity hall, Cambridge. He was seventh wrangler in 1856, and was elected to a fellowship at his college. He then entered Lincoln's Inn. His brilliant prospects, however, were shattered when he was blinded by a shooting accident in 1858. Nevertheless he fished, rowed, skated, walked and rode, and even learnt to play cards and at Trinity Hall, Cambridge, he entered cordially into the social life of the college. He now specialized in political economy. He was a loyal follower of Mill, and as a popularizer of his economic theory and a demonstrator of its principles by concrete examples he had no rival. His power of exposition was illustrated in his *Manual oj Political Economy* (1863), of which in 20 years as many as 20,000 copies were sold.

In 1863, Fawcett stood and was elected for the chair of Political Economy at Cambridge. He was already known in political circles as an advanced Radical, and in 1865 he was elected M.P. for Brighton. In 1867 he married Millicent, daughter of Newson Garrett of Aldeburgh, Suffolk (*see* FAWCETT, DAME MILLICENT GARRETT, G. B. E.).

Fawcett was a severe critic of Liberal Administration and protested against the limited scope of the Elementary Education Bill, Gladstone's method of abolishing army purchase, certain grants to the royal family, and methods of Indian finance. In short he was a thorough going radical who was looked at askance by the Liberal Party. Constructively he accomplished some reform in Indian finance methods, and secured public attention to the preservation of commons, and of New Forest and Epping Forest. As an opponent of the Disraeli government (1874–80) Fawcett came more into line with the Liberal leaders. When the Liberal party returned to power in 1880 Gladstone offered Fawcett a place in the new government as postmaster-general (without a seat in the cabinet). He showed himself a most capable head of a public department. To his readiness in adopting suggestions, and his determination to push business through instead of allowing it to remain permanently in the stage of preparation and circumlocution, the public was mainly indebted for five substantial postal reforms:—(I) The parcels post, (2) postal orders, (3) sixpenny telegrams, (4) the banking of small savings by means of stamps, (5) increased facilities for life insurance and annuities. In connection with these last two improvements Fawcett, in 1880, with the assistance of James Cardin, took great pains in drawing up a small pamphlet called *Aids* to *Thrift,* of which over a million copies were circulated gratis. A very useful minor innovation of his provided for the announcement on every pillar-box of the time of the "next collection." In the post office, as elsewhere, he was a strong advocate of the employment of women. Proportional representation and the extension of franchise to women were both political doctrines which he adopted very early in his career, and never abandoned. He died at Cambridge on Nov. 6, 1884, and was buried in Trumpington churchyard, near Cambridge.

In the great affliction of his youth Fawcett bore himself with a fortitude which it would be difficult to parallel. The kindness evoked by his misfortune, a strongly reciprocated family affection, a growing capacity for making and keeping friends—these and other causes tended to ripen all that was best, and apparently that only, in a strong but somewhat stern character. His acerbity passed away, and in later life was reserved exclusively for official witnesses before parliamentary committees. Frank, helpful, conscientious to a fault, a shrewd gossip, and a staunch friend, he was a man whom no one could help liking.

See Leslie Stephen, *Life of Henry Fawcett (1885).*

FAWCETT, DAME MILLICENT GARRETT, G.B.E. (1847–1929) the eighth child of Newson Garrett, merchant shipowner of Aldeburgh, Suffolk. Educated at a private school, she married at 20 Professor Henry Fawcett M.P., afterwards postmaster-general. Her husband's blindness and the perfect sympathy between them led to the closest interdependence of their activities. Under his inspiration she wrote an elementary manual on political economy. After his death in 1884 she lived in London with her sister Miss Agnes Garrett and her daughter Philippa, who like her father achieved the distinction of being Senior Wrangler at Cambridge.

Her best known work was begun immediately after marriage and continued for 50 years, as a leader—after the first few years the chief leader--of the constitutional movement for women's suffrage. The changes it wrought in women's status are typified by the fact that in 1867, after her first speech at the first meeting advocating women's suffrage, she and another were referred to in parliament as "two ladies, wives of members of this House, who had disgraced themselves" by speaking in public. Yet the quality of the supporters whom the movement immediately secured is shown by those who spoke at the same meeting—J. S. Mill, Charles Kingsley, John Morley, Sir Charles Dilke, James Stansfeld, Professor Fawcett.

The work that ensued put a heavy strain on Mrs. Fawcett's predominant qualities—her invincible tenacity of purpose, unfaltering faith in ultimate victory combined with sagacious appreciation of present difficulties, and unfailing humour. Practically every session for 50 years, save when the nation was at war, a

Woman's Suffrage bill was introduced into parliament, occasionally to achieve a second reading victory, but always to be talked out, blocked or defeated. Every year's work meant a growing volume of meetings, petitions, processions, press campaigns, etc. After 1905, when the militant suffrage campaign began, this army became divided into two main forces, which fought separately without turning their arms against each other.

Mrs. Fawcett was always passionately patriotic. During the South African War, the Government sent her to investigate the concentration camps for Boer women and children. The report she produced vindicated (her opponents said white-washed) their administration. The outbreak of the World War was the heaviest blow of her political life. Immediately the whole strength of her organization was turned to efforts for "sustaining the vital forces of the nation." In Jan. 1918, the national change of heart towards women's claims for which her patient work had paved the way, was consummated by the passing of the Representation of the People Act, enfranchising about six million women. A year later, her National Union of Women Suffrage Societies having become the National Union for Equal Citizenship, she retired from active leadership. She wrote *The Women's Victory end* After (1919), and *What I Remember* (1924). The order of D.B.E. was conferred on her after the war, and she was given the G.B.E. in 1925. She died in London, Aug. 5, 1929. (E. F. R.)

FAWKES, GUY (1570–1606), English Gunpowder plot conspirator, the only son of Edward Famkes of York, a member of a Yorkshire family and advocate of the archbishop of Tork's consistory court, mas baptized at St. Michael le Belfrey at York on April 16, 1570.

His parents being Protestants. Fawkes was educated at the free school at Tork. Soon after his father's death his mother remarried. Fawkes's stepfather was connected with many Roman Catholic families and was probably a Roman Catholic himself, and Fan kes became a zealous adherent of the old faith. In 1593 he went to Flanders and enlisted in the Spanish army, assisting at the capture of Calais by the Spanish in 1596 and gaining some military reputation.

The **Gunpowder** Plot.——In 1604 Thomas Winter, at the instance of Robert Catesby (*q.v.*), in whose mind the Gunpowder plot had now taken definite shape, introduced himself to Fawkes in Flanders, and as a "confident gentleman," "best able for this business," brought him on to England as assistant in the conspiracy. Shortly afterward he was initiated into the plot, after taking an oath of secrecy, meeting Catesby, Thomas Winter, Thomas Percy and John Wright at a house behind St. Clement's. Since he was unknown in London, and because of his exceptional courage, coolness and probably his military experience, Fawkes was entrusted with the actual accomplishment of the design; when the house adjoining the parliament house was hired in Percy's name, he took charge of it as Percy's servant, under the name of Johnson. He acted sentinel while the others worked at the mine in Dec. 1604. and on the discovery and hiring of the adjoining cellar, beneath the house of lords. he arranged in it the barrels of gunpowder, which he covered with firewood and coals and with iron bars to increase the force of the explosion.

When all was ready in May 1605, Fawkes was dispatched to Flanders to acquaint Sir William Stanley (who had betrayed the city of Deventer to the Spaniards in 1587) and the intriguer Hugh Owen with the plot. He returned in August and brought fresh gunpowder into the cellars to replace any spoiled by damp. A slow match mas prepared which mould give him a quarter of an hour in which to escape from the explosion. For the discovery of the scheme, see GUNPOWDER PLOT.

Fawkes behaved with the utmost fortitude when arrested. He refused stubbornly to give information concerning his accomplices: on Nov. 8 he gave a narrative of the plot, but it was not till the 9th when the fugitive conspirators had been taken at Holbeche. that torture wrung from him their names. His signature to his confession of this date, consisting only of his Christian name and written in a faint and trembling hand, is probably a ghastly testimony to the severity of the torture which James had ordered to be applied if he would not otherwise confess. He was tried, together with Robert and Thomas Winter, John Grant, Ambrose Rokewood, Robert Keyes and Thomas Bates, before a special commission in Westminster hall on Jan. 27, 1606.

Fawkes suffered death in company with Thomas Winter, Rokewood and Keyes on the 31st, being drawn on a hurdle from the Tower to the parliament house, opposite which he was executed. He made a short speech on the scaffold, expressing his repentance, and mounted the ladder last and with assistance, being weak from torture and illness.

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FAYAL, a Portuguese island forming part of the Azores archipelago. Pop. (1950) 23,923; area, 66 sq.mi. Fayal (*i.e.,* "the beech wood") was so called from the former abundance of the *Myrica faya,* which its discoverers mistook for beech trees. It has an excellent harbour at Horta (*q.v.*), a town of 8,614 inhabitants. Cedros (2,912) and Feteira (2,525) are the other chief towns. The women of Fayal manufacture fine lace from the agave thread. They also execute carvings in snow-white fig-tree pith, and carry on the finer kinds of basketmaking. A small valley, called Flamengos, perpetuates the name of the Flemish settlers, who have left their mark on the physical appearance of the inhabitants. (See AZORES.)

FAYETTEVILLE, a city of Arkansas! U.S., the seat of Washington county, is located in a circle of hills: part of the beautiful Ozarks. The home of 13 governors, and Archibald Yell: the first congressman from Arkansas, a historic stop on the Overland Mail route, Fayetteville is the site of the University of Arkansas (established 1871). There was no settlement there when the city was staked as a site for the county seat in 1828. The city was first named Washington Courthouse, but changed to Fayetteville, after Fayetteville, Tenn.. in 1829. It was incorporated in 1836, received a city charter in 1859, which was abolished by act of the legislature in 1867; was reincorporated as a town in 1869; and in 1906 again became a city. The town acquired an educational reputation through its early schools, especially Sophia Sawyer's Female seminary (1839) and Arkansas college (1852). The latter was the first degree-granting college in Arkansas.

Within 30 mi. of both the Missouri and Indian territory borders, Fayetteville suffered severely during the Civil War. The battle of Pea Ridge (March 7–8, 1862) was fought in neighbouring Benton county and the battle of Prairie Grove (Dec. 7, 1862) just 10 mi. west of town. After the battle of Fayetteville (April 18, 1863) the town was held by federal troops until the end of the war. The dead of thqse battles are buried in Fayetteville's National and Confederate cemeteries.

While industry exists, Fayetteville is primarily a residential community. For comparative population figures see table in ARKANSAS: Population. (W. J. LE.)

FAYETTEVILLE, a city of North Carolina, U.S., the seat of Cumberland county and one of the state's oldest and most historic towns. The city is 50 mi. S.S.W. of Raleigh on the west bank of the Cape Fear river at the head of navigation, 120 mi. from the ocean. The town is located in a region noted for its production of cotton, tobacco and other crops. For more than a century this area was the centre of the nation's naval stores industry, the chief products being tar and turpentine. After 1870 this industry declined and finally disappeared. Textiles and lumber are the largest industries. Others include tobacco sales warehouses, food processing, cotton seed, fertilizer, furniture, brick and stone. It has had a council-manager form of government since 1949.

Highland Scots established the original settlement there in 1739 and named it Campbellton. A few years later other Highlanders founded the village of Cross Creek, one mile northwest of Campbellton, where they found two creeks whose currents crossed. In 1783 the two settlements united and were incorporated as Fayetteville, the first community so honouring the Marquis de La Fayette. Fayetteville served as the state capital from 1789 to 1793. There on Nov. 21, 1789, the second state ratifying convention approved the Constitution of the United States, which had been rejected the previous year at Hillsboro By 1820, with a population of approximately 3,500, Fayetteville was second only to Wilmington in size and commerce. It was the centre of the state's "wagon trade" and in the 1850s was the eastern terminal of the longest plank road ever built in the United States. Gen. William T. Sherman occupied the town in March 1865.

Points of interest include the Market House (built in 1838), which houses a public library and historical museum; the armory of the Fayetteville Independent Light infantry, organized in 1793; the State Teachers' College for Negroes (founded in 1877 and one of the earliest schools of its kind); and many monuments and old halls and houses. About 10 mi. northwest of the city are Fort Bragg and Pope air force base.

For comparative population figures *see* table in NORTH CAROLINA: *Population.* (H. T. *L.)*

FAYOLLE, MARIE EMILE (1852–1928), French soldier, entered the Polytechnique in 1873, joined the 16th regiment of artillery in 1875, entered, in 1889, the École de Guerre, where he was professor of the artillery course 1897–1907 and where, against orthodox opinion, he urged the importance of concentration of fire and the obstacle it offered to an attacker. Made a general of brigade in 1910, Fayolle, on the outbreak of World War I, was given command of the 70th reserve division, which, with the 77th, formed under Gen. Henri Pétain the 3rd army corps and played a brilliant part in the offensive of hlay 1915. In June 1915 Fayolle was given command of the 33rd corps, uhich he directed during the attack at Souchez and Vimy of September; in Feb. 1916 he was given the 6th army, which took part in the battle of the Somme, and in May 1917 succeeded Pétain at the head of the centre group of armies (holding the Champagne and Verdun fronts). After a few weeks in Italy he was recalled in Feb. 1918 in expectation of the German offensive, and in March took command of all the forces engaged between Péronne and Barisis—the reserve army group—and definitely checked by March 31 the German attempt to break through; he also carried out the two great offensives of July 18 and Aug. 8, 1918, and after the Armistice was entrusted with the occupation of the Rhine provinces. General Fayolle became a marshal of France on Feb. 21, 1921. He died on Aug. 27, 1928.

FAYRFAX, ROBERT (1464–1521), English composer, called by Anthony à Wood "the prime musician of the nation," was born at Deeping Gate, Lincolnshire. on April 23, 1464. Nothing is known of his career until 1497, when he was granted the first of a series of benefices by way of reward for his services as a singer and composer. He is referred to as one of the "Gentlemen of the King's Chapel," a position he held until the year of his death. Since Chapel Royal duties were of an occasional nature. Fayrfax was able to settle at St. Albans, Hertfordshire, where he directed the choir and played the organ at the abbey from 1498 onward. He gained the degrees of bachelor and doctor of music at Cambridge in 1501 and 1504 respectively, and wrote a five-part motet, *Aeterne laudis lilium,* for Elizabeth of York, who visited St. Albans in 1502. The work submitted for his Cambridge doctorate was the Mass *O quam glorifica,* based on a hymn melody for Vespers of the Assumption.

Fayrfax was made a "poor knight" of Windsor in 1514, and so received an extra pension; his position was such that frequent requests were made for the provision of music destined for court entertainments. On every New Year's day from 1516 to 1519 he was paid considerable sums of money for copying or composing books of songs and anthems. His greatest hour came in June 1520. when he was called upon to take charge of the Chapel Royal musicians when they accompanied Henry VIII to his meeting with Francis I at the Field of Cloth of Gold. Fayrfax died at St. Albans on Oct. 24, 1521.

The Masses by Fayrfax are based on antiphons such as *Regali ex progenie* (Nativity of the Blessed Virgin Mary), *Tecum principium* (Christmas) and *Alloquio dulcis,* the first nord of whose fifth line—"Albanus Domini laudans mirabile nomen"—gives the Mass its title and shows it to be in honour of St. Alban. The music of Fayrfax, which was published by the American Institute of Musicology (1960), proves him eminently worthy of the praise bestowed on him during his lifetime. (D. W. ST.)

FAYUM (FAIYUM), a *muhafazat* (governorate) of upper Egypt. having an area of 691 sq.mi. and a population (1960) of 839,000. The capital, Medinet-el-Fayum, is 81 mi. S.S.W. of Cairo by rail. The Fayum proper is an oasis in the Libyan desert, and is connected with the Nile by the Bahr Yusuf, which reaches the oasis through a gap in the hills separating the governorate from the Nile valley.

Southwest of the Fayum, and forming part of the governorate, is the Gharak depression. Another depression, entirely barren, the Wadi Rayan, covering 280 sq mi., lies west of the Gharak. The whole region is below sea level. and save for the gap mentioned is encircled by the Libyan hills. The lowest part of the governorate, the northwest end. is occupied by the Birkat Qaroun, or Lake of Qaroun, whose surface level is 140 ft. below that of the sea.

Differing from the typical oasis, the fertility of which depends on the nater obtained from springs, the cultivated land in the Fayum is formed of Nile mud which is brought down by the Bahr Yusuf and distributed from it by irrigation canals. More than 400 sq mi of the Fayum is cultivated, the principal crops being cereals and cotton. Completion of the Assuan dam, ensuring a much fuller supply of water, enabled thousands of acres of land to be brought under cultivation. Three crops are obtained in 20 months.

The governorate is noted for its figs and grapes, the figs being of exceptionally good quality. Olives are also cultivated. Rose trees are very numerous and most of the attar of roses of Egypt is manufactured in the governorate. The Fayum also possesses an excellent breed of sheep. The Lake of Qaroun abounds in fish.

hledinet-el-Fayum (or Medina), the capital of the governorate, is a great agricultural centre. pop. (1957) 89,448; area. 8 sq.mi. Mounds north of the town mark the site of Arsinoe, earlier Crocodilopolis. where was worshiped the sacred crocodile kept in the Lake of Moeris (*q.v.*). Besides Medina there are several other towns in the governorate, among them Senuris and Tomia to the north of Medina and Senaru and Abuksa on the road to the lake, some of which are served by railways. Near the lake are many ruins of ancient villages and cities. Fayum did not figure in the military operations of the summer and fall of 1942, Rommel's army having advanced and retreated along the coast line farther north. The British 8th army, however, took precautions against a possible drive farther south through the desert toward Cairo.

See H. J. L. Beadnell, *The Topography and Geology of the Fayum Province of Egypt* (1905); "Preliminary Report on Neolithic Pottery . . . From the Northern Fayum" in *Man,* no. *96 (1925).*

FAZUGHLI, a village and area in the Southern Fung district, Blue Nile province, Sudan, on the Blue Nile river, on the borders of Ethiopia. The area, composed of Fazughli East and Fazughli West, has a population of (1956) 13,507. The inhabitants are Bertat, Gumuz and other Negroid tribes, with Fung chiefs, of whom the principal is the Mek, living near Jebel Fazughli. His kingdom was part of the old Fung empire *(see* SENNAR). The villagers wash gold on the banks of the Blue Nile and in the beds of numerous watercourses. Pop. of village (1956 est.) 1.000. At Geissan, a trade route comes in from Abyssinia, by which coffee, cattle and gold are imported. The chief crop is millet and coarse tobacco is also grown along the river. (A. W. M. DY.)

FEALTY: *see* FEUDALISM; SEIGNORY.

FEAST AND FESTIVAL, as the terms are used in religion, are essentially synonymous ("festival" being the adjective form used also as a noun), properly describing an anniversary that is observed with rejoicing; "feast" is thus the opposite of "fast" *(see* FASTING). More generally, "feast" and "festival" also are applied to all such annual ceremonies and are not confined to those observed with rejoicing. This article deals only with festivals in early religions and in modern non-Judaeo-Christian religions. The feasts of the Christian liturgical year are described in the article CHURCH YEAR, and in many separate entries such as EASTER; CHRISTMAS; etc. Jewish festivals are discussed in the article

JEWISH HOLIDAYS. The word holiday ("holy day") in the purest sense also means a religious festival, but it has come to be used to describe any day on which a community or individual is relieved from the obligation of work, and hence has a largely secular connotation; secular holidays are discussed in the article HOLIDAY.

Major religious feasts and festivals, with few exceptions, are annual. The religious year not only represents a span of time but is also a representation of sacred events of the past eternally recurring. Just as the Christian year beginning with Advent is a re-enactment of sacred events, the year in other religions also presents a sacred cycle. Among historic religions, the cyclic re-creation of time is most explicit in the Zoroastrian New Year. The unrestrained character of most New Year festivals represents cyclic chaos before creation, and is most pronounced in primitive religions, though it survives in the Hindu *holi* and similar rites.

Festivals have an educational and social as well as religious character. In primitive cults having no written records, seasonal recital of mythology at festival time serves the function of transmitting traditional lore within the tribe. Festivals bind a religious group into a unity transcending family and local ties. Muslims of Arabia and Indonesia come into a socioreligious relationship despite separation by common observance of the festival associated nith the fast of Ramadan. Continuity between living and dead is maintained by communal offerings at festivals. and the cosmic order underlying social order is maintained by honouring the gods. Unity of "denominations" within religions, such as Shivites in Hinduism or Shi'ites in Islam, is secured by sectarian observances. The solidarity of the Greek or Mesopotamian city was celebrated by festal worship of the local deity, while larger political solidarity was preserved by subordinating local festivals in the context of a great national calendar. In primitive religions the festivals of the village deity perform the same role.

Great feast days recapitulate the history of religion in any given place. The pre-Christian cult of the dead in northern Europe survives in All Saints' day. The Thai New Year includes older primitive and Hindu aspects incorporated into the later Buddhist celebration. and the Sikh festival of hola is an adaptation of the older Hindu *holi*.

Primitive Religions. — The religious and social or tribal aspects of festivals cannot be separated, all activities being endowed with a religious or at least traditional character. In the Fiji Islands the inauguration of a new chief is celebrated as the re-creation of the world. In the Trobriand Islands the *baloma,* or spirits of the dead, are invited to join in harvest festivities. After dancing and feasting, they are dismissed. In this way the co-operation of the spirits with the living is assured. Among many groups, including Indian tribes of British Columbia, the entire social structure is transformed at festival times, religious ceremonial being performed by secret societies embracing the entire tribe rather than by usual social units. Initiation into manhood involves whole tribes in public festivities. Harvest, beginning of hunting, fishing or plowing seasons, first-fruit and harvest, and totemic gatherings are the commonest occasions for festivals in primitive societies.

Mesopotamia. — The cultures of the Tigris-Euphrates valley from the 4th millennium B.C. to the Persian conquest in the 6th century B.C displayed great continuity in religion. The central idea underlying festivals was that man was created for *dullu,* service of the gods, and that such service would assure man's well-being. Heaven nas an exact counterpart of earth, the gods having human characteristics. Worship included feeding, mashing and entertaining images. Daily service by priests was climaxed by great seasonal festivals. New Year (Akitu) in spring was the only festival celebrated continuously in all periods. Lasting from the 1st to the 10th of Nisan (March/April), it included a recounting of the Epic of Creation, public penance by the king for any misdeeds affecting the state, and divination of prosperity for the coming year. The king. then assumed the role of Tammuz, the vegetation god, and was married to the goddess Ishtar, thus assuring divine rule. The midsummer festival of Tammuz was widely celebrated. In addition to these, each temple had its own local calendar. The temple in which festivals were celebrated included a large court through which worshipers would pass, deposit gifts and hear liturgies. The role of the worshiper was passive, priests performing all cultic acts. (See also BABYLONIA AND ASSYRIA: Religion.)

Egypt. — The Egyptian cultus bore some external resemblance to the Mesopotamian. Most festivals were celebrated by priests alone. On a few great festivals, however, images of gods were fed and entertained by being carried in procession. The "coming forth" of Min, the fertility god, was typical. The statue was carried in public by priests together with lettuces, Min's sacred plant. The image was placed on a throne and offerings presented. Dancing and feasting accompanied such "comings forth." The greatest festivals were observed by towing barges bearing portable shrines along the Nile. The festival of Opet in which the god Amon was towed by the king's barge from Luxor to Karnak lasted as long as 27 days. At the Feast of the Valley Amon was towed to the graves of the kings to pour libations. Festivals in honour of the dead with offerings and lights were held at the beginning of each year.

The purpose of these and most Egyptian festivals was to celebrate and maintain the continuity of the living, the dead and the gods. Later cults included that of Osiris (*q.v.*), which spread to the Greek world. This included annual performances or religious dramas which developed into the well-known Hellenistic mysteries. After Osiris' coming forth in procession to be killed by his mythological foe, several days of mourning were held before his rising, which was celebrated with general festivity by his devotees. Mystery cults with their dramatic celebration embodied an element of personal devotion and offered salvation by identification of the devotee with the god which was not found in the official cult. the influence of which declined in Hellenistic times. (See also EGYPT: History: *Ancient* Religion; MYSTERY.)

Greece. — Festivals of ancient Greece were local in origin, each city-state having its o n calendar. The feasts of the country dneller were agricultural and chthonic, the gods of the Olympic pantheon being honoured in cities. The great festivals of 5th-century Athens. the influence of which extended to the rest of Greece, were the Dionysia and the Panathenaea (*qq.v.*). Processions, such as that portrayed on the frieze of the Parthenon, were a prominent feature of each festival. Public feasts were held, the citizens being entertained at the expense of the city. Drama. particularly tragedy, and games were parts of celebrations. Sparta's chief feast was the Hyacinthia. The festival of Soteria (deliverance) was held at Delphi. Festivals were observed with civic holidays which became secularized in later times. The religious meaning of the official cults declined in Hellenistic times, and mystery cults imported from Egypt and Asia Minor rose in importance. Festivals of these cults were celebrated only by initiated devotees. The mysteries of Osiris mentioned above were typical. (*See* also AGRIONIA; APATURIA; BUPHONIA; CARNEIA; DELIA: DAPHNEPHORIA; DEMETRIA; DIASIA; ANTHESTERIA; DELPHINIA; PYANOPSIA; THARGELIA; THESMOPHORIA.)

Rome. — The official cult of Rome included festivals for most of the gods of the pantheon. The oldest cult was the domestic worship of the hearth, which was elaborated into the cult of the vestal virgins who tended the hearth fire of the state. As the Greek pantheon was romanized, Greek characteristics of celebration were adopted. The festival of Mars (*q.v*), the war god, mas distinctively Roman, however. Celebration included a war dance by priests, running and rapid dancing being methods of instilling martial power. The feast of Saturn (*q.v.*) resembled a Greek harvest feast. Social distinction was forgotten, and all restrictions relaxed; thus the Saturnalia became associated with all forms of licence.

All festivals of the official calendar were civic holidays, and keeping the feasts was required by patriotism. The civil character of religion after the establishment of the empire became more pronounced, and imported mystery cults and Christianity answered actual religious needs. The cult of the Great Mother of Asia Minor, Cybele, and of Mithra, an Iranian deity, were popular. The great festival of Cybele was kept at the beginning of spring when the goddess was borne in procession to music. The story of the goddess seeking the body of her dead lover, and of the revival of Attis, was related. The mourning and rejoicing paralleled that of the Osiris cult of Egypt. (See also AMBARVALIA; BACCHANALIA; LECTISTERNIUM; LUPERCALIA.)

Northern Europe. — Festivals of pagan Germanic, Celtic and Slavic peoples were seasonal and observed with feasting and drinking, often to excess: They were generally celebrated in sacred groves. Four great seasonal festivals were kept: autumn (harvest), winter (Germanic Yule), spring and midsummer. At Germanic festivals sacrificial animals were eaten. According to the Ynglinga Saga, Odin ordained autumn sacrifices to celebrate a good year, Yule for growth and summer for victory. Among Saxons the dead were commemorated at autumn, while winter commemorations were common in Scandinavia. Celtic festivals were solar in character. The main ones were Sambain (Nov. 1) and Beltane (*q.v.;* May 1). On these days bonfires were lighted to represent the waning and waxing sun, and worshipers danced around the flames to acquire the power of the sun. These were essentially fertility rites. The May queen and May king of Beltane have survived in folk custom. At these times household fires were rekindled. Feb. 1 and Aug. 1 were also celebrated. Among Slavs the summer and winter solstices were major festivals. Popular pagan festivals were assimilated to saints' days after Christianization. St. John's eve (June 23) assumed characteristics of older midsummer festivals, and the Germanic cult of the dead was associated with All Saints' day. Ceremonial bathing at midsummer among pagan Slavs was reinterpreted as baptism.

Iran. — The festivals of ancient Iran have survived in the Parsee (Zoroastrian) community of Bombay, composed of refugees from Islamic invasions of the 8th century. Of the character of festivals in ancient times little is known, most information coming from Arab narratives of the middle ages. Each month of the Zoroastrian year had one sacred day (yasan) in honour of one of the *Amesha Spentas* (beneficent spirits) and *Yazatas* (angels) of Ahura Mazda. The great Parsee festivals are Nauruz (New Year), the feast of Mihrajan (Mithra), the 6th of Fravartin and the 11th of Din, birth and death days of Zoroaster. There are also six seasonal feasts celebrating the creation of heaven, water, earth: trees, animals and man, each lasting five days. The last also commeniorates the dead, a platform being erected in each home to bear flowers and fruit for the dead. Nauruz is also the feast of Ahura Mazda and the traditional day of creation, the celebration of which represents an annual re-creation of time. Ritual fire, the devotional centre of the Parsee temple, is rekindled.

Islam. — The great festivals of Islam are limited by tradition to two celebrated in conjunction with two of the "five pillars," or religious obligations, of Islam; pilgrimage (hajj) and the fast of Ramadan (*q.v.*). Few festivals other than these have developed, and such as have are shunned by the more orthodox. Cults of saints exist among mystical brotherhoods (dervish orders) and in the sectarian faith of Iran and parts of India (Shi'ism). Mohammed's insistence on the equality of believers, however, discouraged a multiplicity of saints' days. The radical break of Islam with earlier Arab paganism excluded older folk festivals from the calendar. The nomadic character of early Muslim life and the desert ideal of simplicity has been a deterrent to extravagant celebration such as that of Hinduism where local traditions are strong.

The pilgrimage which each Muslim is to perform at least once in life unless prevented by illness begins on the 8th of Dhu 'l-Hijja, the last month of the Muslim year. Having performed preliminary devotions, the pilgrim sets out from Mecca for the Mount of Mercy (Jabal ar-Rahma) about nine miles distant. On his return two days later, sacrifices are offered in the wayside village of Mina. The "great festival" (id *al-kabir* or 'id *al-adha;* Turkish *Qurban Bairam,* "Sacrifice Bairam") is celebrated throughout the Muslim world for three days beginning on the day of sacrifice in Mina. New clothes are worn, friends visited and gifts exchanged. The communal prayers are of a more archaic and solemn form than usual. The other major festival follows the fast of Ramadan, the ninth month. During this month no food is eaten from sunrise to sunset. During the first three days of the following month, Shawwal, the "little festival" (id as-Saghir or 'id *al-fitr,* "Festival of Fast-Breaking"; Turkish *Küchük* Bairam) is celebrated. Graves are visited and decorated on both festivals. (See also BAIRAM; RAMADAN.)

While orthodox (Sunnite) Islam does not sanction other feast days, sectarian (Shi'ite) Islam and the mystical Sufi tradition have introduced others such as the *maulid* (birthday) of the Prophet, first celebrated in 1207. Festivals of saints (*wali*) preserve primitive traits and are celebrated at local sanctuaries. The feast of Nebi Musa (Moses) is observed at a shrine near Jericho. Birthdays of founders of dervish orders regarded as saints by members of the brotherhoods are observed. The chief festival in Shi'ite Islam is the 10th of the month of Muharram, which commemorates the death of Husain, son of the caliph Ali, regarded by Shi'ites as the legitimate leader of the faithful and successor of the Prophet. His tomb in Iraq is a place of pilgrimage. A passion play depicting the death of Husain is performed. Among other Muslims, this day is remembered as the traditional day on which Adam and Eve were expelled from the Garden, and on which Noah left the ark. Other lesser days include Lailat al-qadr ("Night of Power") and the 15th of Shaaban, which, while not an official New Year, is kept with festivities resembling New Year celebrations. Such local unofficial festivities are often overladen with local superstitions.

Holy days of other faiths have been assimilated to popular Islamic usage. The day of 'Ashura (10th of Muharram) was the original fast day in imitation of the Jewish Day of Atonement before Mohammed prescribed the entire month of Ramadan. The Coptic Easter is observed by Egyptian Muslims, though naturally without its Christian meaning, and the Zoroastrian New Year (Nauruz) is observed in Iran. None of these, however, is sanctioned by orthodoxy.

All festivals are movable, the Muslim calendar consisting of a year of lunar months totaling 354 days. After 33 years! festivals are celebrated in all months of the western calendar. This removes the great feasts from the influence of non-Islamic seasonal rites, despite persistence of local customs in some unofficial celebrations. New Year festivities, prominent in other religions, have a minor role in Islam.

Buddhism. — Since Buddhism originated not as a popular religion but as a monastic order, the earliest festivals were associated with the monastic calendar and initiation into the *Sangha* (order). The first popular festivals commemorated events in the life of the Buddha. Buddhism, originating in the 6th century B.C. in India, spread rapidly throughout eastern Asia, but became extinct in its own homeland by the late middle ages. Thus festivals vary with country and sect. and have assimilated characteristics of various cultures. The festive calendar of northern (Mahayana) Buddhism, which recognizes several mythological Buddhas, Bodhisattvas and sectarian founders, is more complex than that of the southern (Theravada) school, where these figures are unknown.

Southeast Asia. — Festivals of Thailand illustrate the celebrations of the Theravada. Influences from pre-Buddhist indigenous and Hindu sources are prominent. Trut, or New Year (March/April), is of a mixed character. Buddhist monks exorcise ghosts from the vicinity and are presented with gifts. Oblations are made to various gods of Hindu origin. As people meet. water is playfully thrown by one on the other. Gambling, usually frowned upon, is permitted for the three-day festival. The main religious festival is Wesak (Pali Vishakha-puja), celebrated on the full moon of the month Vishakha (April/May), commemorating the birthday, enlightenment and death of the Buddha. Lasting for three days, it includes distribution of food and alms, decoration of dwellings with garlands and lanterns, and offerings of flowers to Buddha images. Captive birds are released in memory of the Buddha's compassionate nature. Other festivals include those at the beginning and end of the *vassa,* or rainy period, from June to October, when monks remain in the monastery. This is the traditional time for taking vows. The Magha-puja festival celebrates the Buddha's exposition of the *patimokkha,* or rule of monastic discipline. At the royal temple 1,250 tapers are lighted to commemorate the exposition to a like number of original monks.

Festivals in Burma and Ceylon follow the Thai pattern. Lesser festivals are associated with pilgrimage sites such as the temple containing the relic of the Buddha's tooth in Kandy, Ceylon.

Tibet.—Festivals in Mahayana lands vary greatly. In Tibet the birthdays of Padmasambhava (8th century A.D.), founder of Buddhism in Tibet, and Tson-k'a-pa (14th century), founder of the dominant sect, are celebrated in addition to events in the life of the Buddha. New Year (February) is celebrated with feasting, visiting and a relaxation of monastic discipline. The chief festival is sMon-lam (supplication), following the three-day New Year. Special religious observances are held for 11 days. Festivals of the various Bodhisattvas ("gods" of northern Buddhism) are also held. A feature of most Tibetan festivals is the propitiation of demons, a vestige of the Bon religion of pre-Buddhist days. This is prominent in the "Procession of the Thunderbolt" (Phurba, Sanskrit Vajra), an annual expulsion of demons from the country. This and most other major festivals are celebrated with fairs and masked plays.

China.—Specifically Buddhist festivals include the Buddha's birthday, when images are taken from temples, bathed and clothed, and legendary birthdays of various Mahayana figures, notably Kwan-yin, Bodhisattva of mercy; Mi-li Fo (Maitreya Buddha); and 0-mi-to Fo (Amida Buddha). On these days fairs are held near temples with theatrical performances.

Japan.—All sects join in celebrating the Buddha's birthday with floral offerings. Each of the sects observes the birthday of its founder and favourite Mahayana Buddha, these celebrations often exceeding those of the historical Buddha in elaborateness. Thus the sects of Zen, Shin, Shingon. Nichiren, Jōdo and others have their own calendars. Theatrical performances using classical dance forms are often given. One of the oldest festivals, Urabon-E, with elaborate temple dances re-enacts the story of Moggaliputta, the disciple of Buddha who saved his mother from hell by his offerings to the *Sangha*.

Jainism.—Like Buddhism, Jainism arose as a monastic movement in the 6th century B.C., but has not spread beyond India. Major festivals are associated with the monastic year. They are restrained in character, Jainism being intensely ascetic. The eight days of Pajjusana in August is a period of penance. During these days the birthday of Mahavira, founder of the Jain order, and the giving of the *Kalpa Sutra*, an important scripture. are celebrated with processions. Other festivals include an adaptation of the Hindu Diwali, and legendary birthdays of the 23 *tirthankaras*, predecessors of Mahavira, the last of a series of saviours. The strict sect of Digambaras observes the bathing in milk of the huge statue of the tirthankara Gommateshvara in Mysore several times each century.

Hinduism.— Festivals of contemporary India are derived from the sectarian Hinduism of the period after the writing of the Puranas (*c.* 4th century A.D.). Ancient festivals were mostly seasonal and observed with sacrifices described in the Vedas. The "four month festivals" were celebrated at the end of winter and at the beginnings of the rainy season and autumn. The Ashvamedha (horse sacrifice) was the most elaborate Vedic festival. Probably a spring fertility rite in origin, it was celebrated by a king who wished to claim universal sovereignty. A horse was let loose for a year to wander, protected by a royal guard which claimed for the king all land covered. At the end of the year, it was returned and sacrificed amid much feasting and unrestrained celebration. Vedic festivals were similar to those of other early Indo-European peoples, but as the Aryan invaders were absorbed by indigenous Dravidian peoples, these festivals fell into disuse and were replaced by those of medieval Hinduism.

Modern festivals are mostly connected with the worship of the great gods Shiva, Vishnu (generally in form of one of his avatars or incarnations) and Shakti. Many are associated with a place of pilgrimage sacred to a deity. Seasonal festivals, as holi, are celebrated by all sects and are popular, not sectarian, in origin. Some festivals are common to northern India, others to the south where Dravidian culture is strong. Many are purely local and are observed with fairs.

Holi, perhaps least religious in character, has features of a fertility rite. It is celebrated for five days in March/April with bonfires, unrestrained street dancing and processions. Red powder is thrown by celebrants on each other, and images of gods are borne in decorated cars. In Orissa the spring festival is associated with the Dolayatra (swing festival) in which images of Krishna, an avatar of Vishnu, and his consort Radha are ceremonially entertained in a swing. A seasonal festival restricted to the Dravidian south is Pongal, or the boiling of new rice. This is celebrated for three days and is the traditional Tamil New Year. In Bengal the New Year is marked by the worship of the Ganges.

Sectarian festivals are numerous among the devotees of Vishnu, since that god has several avatars. He is worshiped at Puri in Orissa as Jagannath (Juggernaut; *q.v.*), or lord of the norld, his image being pulled in an immense car by devotees at the Rathayatra festival (June/July). Prayers, offerings. dancing and bathing are performed and religious narratives read. A Krishna festival of the Maratha country is the Rasayatra commemorating the dancing of the god with the cow-maids (*gopi*) of legend. The birthday of Krishna is celebrated in August/September and that of Rama, another avatar, is celebrated in March/April. In all festivals the image is bathed, clothed and entertained according to ritual prescription (*puja*) and Puranas are read.

Shiva has no avatars, and so his calendar is simpler. The 14th day of each lunar period is especially sacred, and that of Magha (January/February) is observed as the Shivarati festival.

The great festival of Shakti (called also Durga and Kali), consort of Shiva worshiped as a deity in her own right in Bengal, is the Durga-puja. Celebrated in September/October, it is a time for family reunion and social gathering as well as religious observances. Animal sacrifices, virtually unknown elsewhere, are offered in Calcutta.

Purification by bathing is a feature of most Hindu festivals. This is particularly evident at those observed at places of pilgrimage located at confluences of rivers.

Other major festivals include Dashara (worship of the Ganges), Lakshmi-puja (goddess of wealth), Sarasvati-puja (goddess of knonledge) and Diwali. celebrated at night with lights. Birthdays of traditional sages and founders of sects are also celebrated.

Hindu festivals have spread to the predominantly Buddhist lands of southeast Asia and Nepal. They are preserved unmixed with other types in Bali. (See also HINDUISM: Festivals.)

Sikhism.— Festivals of Hinduism have been adapted by Sikhism, a monotheistic faith founded in the Punjab in the 16th century by the Hindu reformer Nanak. The orgiastic Hindu holi has been refined and the red powder thrown is allegorized as sat nam ("true name"; *i.e.*, of god), the name having been changed to *hola*. The Sikh calendar also includes festivals of the gurus, or teachers, and of martyrs.

China.—Popular Chinese religion is an amalgam of Confucian, Taoist and Buddhist beliefs imposed on a background of more primitive folk belief. Great Confucian festivals such as the imperial sacrifices at solstices and equinoxes are no longer observed, Confucianism as a state religion having collapsed with the fall of the empire. Specifically Buddhist (see above. Buddhism) or Taoist festivals are observed only by a small percentage of the population, though each religion has had a profound influence on popular festivals. The carnival spirit of later Taoism is particularly evident. Festivals associated with temples, Buddhist or Taoist, are local in spirit and usually accompanied by fairs and theatrical performances. The specifically religious motivation is secondary to the social character of the holiday.

The great festivals are seasonal. New Year is celebrated officially for a month beginning in late January or early February. It is preceded by an expulsion of demons and by theatrical performances. Offerings are made to gods of hearth and wealth, and to ancestors. The spring festival (Ch'ing-ming) is observed with sweeping of graves and rekindling of hearth fires. Ceremonial meals at ancestral tombs and family reunions mark the festival, which usually coincides with Easter. Before the rise of Buddhism in China, the festival had an agrarian fertility quality which has been displaced by the commemoration of the dead, The Feast of the Souls in August and the winter festival in November also commemorate the dead. The midautumn festival, like New Year, is a festival of the living and gay in character. An altar is built out-of-doors and "moon cakes" are offered to the "old man in the moon." This is a family festival, and the role of women is prominent. In addition to these seasonal festivals, each temple may have its own patron deity whose birthday is celebrated. Such festivals are rooted in village life.

Japan. — Shinto, the ancient religion of Japan, was obscured by the introduction of Buddhism in the 6th century A.D., though it survived as a popular nature religion, particularly in rural areas. and in mixed form with Buddhism. The revival of Shinto and its purification from Buddhist elements began in the 17th century, but was completed only with the Meiji restoration of 1868. The present form of festivals is therefore recent, though elements of celebration are ancient. Purification is a prominent feature of all Shinto festivals. Ceremonial bathing, food and cloth offerings and waving of "purification viands" with recitation of ritual formulas (norito) are modes of ritual, New Year is celebrated with ceremonial house cleaning, giving of presents, presentation of cakes to household shrines, and offerings of rice to sources of household water. Many Shinto festivals are observed at local shrines.

After 1945 and the disestablishment of Shinto as the state religion, the religious meaning of the festivals diminished, though they remain as legal holidays. "Sect Shinto," a generic term covering various cults of modern origin, observes birthdays of sect founders as well as days of patron deities. (See also SHINTO: Shinto After *World* War II.)

Traditional Festivals and Modern Thought. — The growth of modern nationalism and the impact of western civilization, leading to either religious reform or secularism and an attendant decline in the value of tradition, has diminished the meaning of many festivals. This is particularly true of China, Japan and to some extent India. While in Muslim lands religious observances re-enforce political unity and, internationally, Islamic solidarity, traditional piety has diminished. In China the spring festival has been perpetuated under communism, though without religious overtones, Modern Hindu philosophy and religious reform have resulted in a calculated neglect, on the part of the educated classes, of traditional festivals rooted in Puranic lore. As modern trends modify traditional beliefs, festivals are reinterpreted, secularized or discarded in many cases.

See also references under "Feast and Festival" in the Index volume.

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FEATHER, a horny outgrowth of the skin peculiar to birds. Collectively, in any individual, feathers form a complete body covering. While they are supposed on good general grounds to have evolved from the scales of reptilian ancestors, no intermediate gradations are known to exist between the two. Birds may therefore be distinguished from all other animals by the possession of feathers alone, though this class is distinguished from others by many characters (see BIRD). Feathers are composed entirely of a single horny substance, keratin, but in spite of this fact they are among the most remarkable of organic structures with reference to the variety and complexity of their structure and function.

A complete adult feather is bilaterally symmetrical and comprises a tapering axial rod, the shaft (rachis), to which are attached a large number of lateral tapering rods, barbs (rami), forming an acute distal angle with the rachis, and carrying many minute elongated barbules (radii) both on their distal and proximal faces, uhich interlock with those of adjacent barbs so as to form a coherent membrane, the vane (vexillum), in the exposed portion of the feather. In the covered basal portion the barbs do not cohere and their structure is loose and fluffy. The outer (dorsal) surface of the vane differs notably in colour and also in other respects from the ventral surface.

The rachis exhibits clearly differentiated dorsal, ventral and lateral surfaces, and tends to be quadrangular in cross-section. It is structurally continuous nith a short cylindrical quill (calamus), which is inserted in a pit of the skin, the follicle, and uhich differs also from the rachis by complete absence of barbs; the calamus possesses a terminal opening, the inferior umbilicus, enclosing the papilla, and a ventral pit, superior umbilicus, at its junction nith the rachis from which small tufts of barbs or a complete afterfeather emerges. The calamus is hollow and the cavity is subdivided by a series of horny concave partitions, persistent remains of the feather caps that protect the apex of the pulp during the growth of the feather. The fibrous wall of the rachis on the other hand encloses a relatively massive medulla composed of air-filled vesicles of microscopic size, and thus the rachis combines strength and lightness.

The barbs are somewhat lath-shaped, set on edge and tapering to a point Their intimate relation to the rachis may be brought out by dissecting a feather previously softened by a bath of 5% caustic potash. The dissection shows that the lateral surfaces of the rachis are composed of flattened bases of barbs, the barb petioles, bent at an obtuse angle from the free portion of the barbs, overlapping one another serially and bound firmly to the central part of the rachis by keratin fibres. Each petiole carries an extension of the series of proximal barbules which thus appear in the intact feather to arise from the rachis itself. The distal barbules overlap the proximal barbules of the next barb, and each bears a series of hooklets (hamuli) which catch in a groove continuous along the surface of the proximal series. This arrangement ensures firmness of union together nith freedom of movement. In the fluffy, covered portion of a body feather the barbules become relatively long delicate threads (cilia) and do not bind the successive barbs together. In the different kinds of feathers of the same species and a fortiori of different species, there is an immense amount of variation of the structures described above.

The afterfeather (called in older literature aftershaft or hyporachis) is borne on the ventral surface of contour feathers with its own ventral surface applied to the homologous surface of the main feather. Its shaft is inserted in the superior umbilicus of the main feather, with which it shares a common calamus. Its degree of development is highly variable not only in different birds, but also in different tracts of the same bird. In the cassouary and emu the afterfeather is equal in length and size to the main feather; but in other birds it does not exceed the length of the fluffy portion of the main feather, usually much shorter, and always narrower and entirely fluffy in structure. In fowl it is well-developed in unspecialized contour feathers, but is practically absent, or represented only by a few barbs, in the flight and tail feathers. Pattern, rarely present, is a mirror image of the corresponding portion of the main feather due to a kind of twinning process in its origin.

Kinds of Feathers and Their Arrangement. — The definitive plumage (teleoptiles) bears the full brunt of the external environment during the active life of the individual, and during the long process of evolution of birds has become extraordinarily diversified. It is customary to distinguish three main kinds of definitive feathers in any individual: first, the contour feathers. including all those visible externally uhich define the form of the body; second, the filoplumes; and, third, the down feathers (plumules). Among the contour feathers, those of flight (remiges). and the tail feathers (rectrices, steering feathers) are specially distinguished from the general body covering. Contour feathers are not, as popularly supposed, evenly distributed over the surface of the body of the bird, but arise only from certain tracts (pterylae), separated by regions of almost naked skin (apteria). To this rule the only exceptions are the ostrich-like birds (superorder Palaengnathae), the penguins (order Sphenisciformes) and the South American "screamers" (family Anhimidae), in vrhich the even distribution of plumage has probably been secondarily acquired. The classical work on the pterylosis of birds is that of Nitzsch; cf., also, Nenton's *Dictionary* of *Birds.* The pterylae differ in their conformation in different species of birds and hence are of service in systematic ornithology.

The wing tract comprises the flight feathers proper (remiges) and their coverts (tectrices). The former comprise primaries, arising from the hand, and attached to its skeleton; secondaries, arising from the forearm, and attached to the ulna; and tertials, arising from the upper arm, and attached to the humerus. The latter comprise on the upper surface of the wing the greater, median and lesser coverts, the first of which cover the bases of the remiges, the second and third overlapping in ascending order with decrease of size. The dorsal (spinal) tract extends the whole length of the bird, excepting the head, along and on each side of the spinal column. In fowl this tract may be subdivided from in front backwards, though not separated by apteria, into the regions of the hackles, the cape, the back, and the saddle, which are distinguished by the forms and patterns of the constituent feathers. This tract is highly variable in different species of birds. On the ventral surface of the bird are the breast tracts, which are paired, extending from the neck backwards in diverging pterylae, betueen which is a ventral (abdominal) tract, extended on either side of the middle line around the region of the umbilicus and meeting in front of the anus. The tracts of the ventral surface of the body are likewise highly variable in different groups and species of birds. The tail tract includes the tail feathers (rectrices) and their coverts. In addition to the above, there are to be distinguished the head tract, the humeral tract (scapulars), the femoral tract and the crural tract.

Filoplumes are inconspicuous hair-like feathers arising at the bases of contour feathers and bearing a small tuft of barbs at the apex. They appear to be present in all birds, but only in certain species do they project beyond the contour feathers (*e.g.,* on the thighs of cormorants).

The down feathers are usually completely concealed by the contour feathers. They are usually scanty and occur both in the pterylae and apteria, but they form in many birds, such as gulls and ducks, a thick underclothing comparable to the underfur of seals. Their barbs do not form coherent vanes, but are long, loose, soft and fluffy. Their structure is much simplified and a rachis may be entirely lacking. In herons they reach a special development and form large patches on the breast and thighs, known as powder down, and their tips disintegrate into a fine scaly powder which becomes distributed over the plumage to which it lends a peculiar sheen; and apparently the powder also functions as protection against wetting.

The nestling down (neossoptiles) are the first feathers to be formed from the papillae of the tracts, and thus they occupy the positions of the definitive contour feathers by which they are later replaced. They develop before hatching in most birds and constitute the downy covering of the chicks. Each consists of a circlet of delicate barbs attached directly to a horny ring (the calamus), a shaft being lacking. They are soon pushed out of their follicles by the developing juvenile feathers and lost. Filiform barbules occur in a roughly paired arrangement best developed near the bases of the barbs.

Moulting. — If a feather is lost for any accidental reason the papilla at the bottom of the follicle is capable of replacing it immediately. But in addition to this there is in all birds a naturally occurring annual shedding and replacement of all feathers; this is known as moulting. Feathers, like hairs, are dead structures, but their growth is not so continuous; each rapidly attains a certain length in its growth and must then serve all purposes until it is replaced. The general purpose of the annual moult may thus be conceived to be a process of compensation for the wear and tear of the bird's existence. It occurs at a variable time after the breeding season, and is usually gradual. In penguins, however, the entire plumage is shed at one time. Flight feathers are usually shed and replaced in a certain order and the poner of flight is not lost. In many birds there is a second moult intimately related to the breeding season. The males of ducks and geese assume an inconspicuous "eclipse" plumage similar to that of the female after this moult, which follows immediately after the breeding season, and retain it for several months; during a large part of this time the birds are incapable of flight owing to simultaneous loss of the flight feathers, but when they are replaced the decorative male plumage is resumed. In other birds a special "nuptial" plumage covering the mating and breeding season is assumed in males, and dropped soon after the young appear. The process of moulting is a severe strain on the bird owing to the tremendous supply of blood to the skin necessary for the growth of the new feathers.

The Development of Feathers. — Feathers arise from cutaneous papillae consisting of a relatively massive dermal core covered by a thin layer of epidermis; those of contour feathers make their first appearance in embryonic life as elevations on the surface of the body. In the case of fowl they arise between the sixth and ninth days of incubation, and are grouped from the first in the definitive feather tracts. New papillae are not formed thereafter and there is therefore complete correspondence in number and arrangement between the embryonic papillae and the contour feathers of the adult. Before hatching, the papillae become sunk beneath the surface of the skin in tubular follicles lined with epidermis and opening on the surface of the skin. After the formation of the nestling feathers. new feathers arise from the papillae at the bottom of the follicles after moulting or plucking of the preceding feather. The papilla is necessary for the origin of a feather; if it be destroyed, no feather forms thereafter from the operated follicle; it is in fact a true feather germ. nhich has the capacity to form a feather characteristic of the age. the sex and tract of the individual to which it belongs.

The developing papilla gives rise to a feather cylinder enclosed in a horny sheath. which soon emerges from the mouth of the follicle ("pin-feather"). As the cylinder grows in length the sheath ruptures at its apex and the tip of the feather formed within emerges and unfolds, the remainder following during the process of growth. The cylinder is composed of a thick epidermal wall and a dermal core (the pulp), richly supplied with blood for the nutrition of the rapidly growing feather. In the epidermal wall three layers may be distinguished: the external *stratum corneum* nhich forms the sheath, a thick *stratum intermedium* which forms the feather, and an internal *stratum cylindricum* in immediate contact with the pulp. These layers are derived from a ring of embryonic epidermal cells, the "collar," which surrounds the persistent dermal papilla, the immediate source of the pulp. Feather cylinders are inclined posteriorly from the start and thus exhibit an external (dorsal) surface, corresponding to the dorsal surface of the feather along which the rachis of the feather develops, and an internal (ventral) surface. This is an expression of an innate bilateral symmetry of the papilla nhich may be demonstrated by rotating the papilla along its long axis. in which event the resulting feather is inverted with its ventral surface up and its dorsal surface down. Papillae also possess the innate specific properties of the tracts to which they belong. so that, *e.g.,* a papilla of the saddle tract transplanted to the breast tract produces a saddle feather in the new location. Supplementing these two innate properties of the papilla, bilateral symmetry and tract specificity, parts of papillae tend to retain their prospective significance; striking results may be shown by transplanting a dorsal sector of one papilla to a groove in the ventral surface of another, producing twin conjoined feathers in a single follicle face to face—of the same sort if the graft be from the same tract or of different sorts if the graft be from a different tract. Bfodifications of the same technique may lead to the production of single "chimaera" feathers, part of which exhibits the characters of one tract and the remainder those of another. In short, these three properties of the papilla permit a variety of experiments analogous to those performed on the egg in experimental embryology.

The organization of the feather cylinder may be clearly shown in preparations in which the wall of the cylinder is split longitudinally. beginning at the opening of the collar, and spread out flat with the inner surface up. This represents a fixed moment in a moving panorama. The apexes of the barbs of opposite vanes —at this time "ridges" of the stratum intermedium — meet in the ventral line of the cylinder; the bases arise from the collar and the rachis. As the panorama moves each barb ridge increases in length (axial growth) and moves along the collar towards the rachis to which it becomes attached (tangential growth). Thus each barb, when completely formed, describes a half spiral in the wall of the cylinder. Within each ridge the barbules differentiate.

The axial growth of a regenerating feather is very rapid: about the middle of its period of growth the increase in length of a saddle feather of a Brown Leghorn capon is about 2 mm. per day, that of a feather from the posterior part of the breast tract is about 2.5 mm. and that of a tail feather about 5 mm. All of this growth takes place near the collar and the type and pattern of the feather is determined in the same region. The total time required for regeneration of feathers also varies in the different tracts, rates and time combining to determine the length finally attained.

Colours of Feathers. — Among the factors that combine to form the colours of feathers, the behaviour of certain cells, originating external to the feather germ proper, is of outstanding significance. These are the pigment-bearing cells (melanophores). When fully formed, they are very large cells filled with black. brownish or reddish granules, and are situated in a row near the summit of the barb ridges along their entire length during the development of the feather. They send out processes along the rows of the barbule-forming cells and feed the granules into each cell, gradually exhausting their supply in this function. Thus the pigmentation of the vane is determined. An excellent account of this process may be found in R. M. Strong's paper. Similarly the pigmentation of the shaft and of the barbs is derived from the melanophores.

Melanophores have a very curious origin. They have been traced back to the neural crest of the embryo, situated on each side of the spinal cord. They are at first small unpigmented cells (melanoblasts), which have the capacity of migrating into areas to be pigmented later, such as the choroid coat of the eye as well as into the feather germs, there increasing in size and developing their pigment. It is possible to catch them in transit by removing small pieces of skin and underlying neural crest cells at about 70 hours of incubation of a chick embryo, and to demonstrate their presence in the case of a pigmented breed by grafting the piece to an embryo of the same age of a white breed of fowl. If the transplant is made to one wing bud, a chick results which has one wing with pigmented feathers and the other wing with white feathers. Moreover, if the donor belongs to a barred breed of fowl, the barred pattern forms on the host feathers of the pigmented wing; but if the donor belongs to a solid black breed the pigmented wing of the host is solid black. This may be generalized by saying that the genetic constitution of the donor determines the behaviour of their melanophores.

The range of colours determined directly by the melanophores is limited to black, gray and brownish. Other pigmentary colours are produced by the presence of diffuse (nongranular) fatty pigments (lipochromes) present in appropriate cells; red is always so determined, and orange and yellow usually. Such chemical, or absorptive, colours remain the same from whatever angle, with reference to the source of light, they may be examined.

Structural colours are produced by a superficial colourless layer of extreme thinness, ranging slightly above or below 1/1000 mm., overlying pigment; in transmitted light only the colour of the pigment appears — gray or yellowish in the green feathers of a parrot for instance. In the case of blue feathers, there is. in addition to the superficial colourless layer, a layer of polygonal cells with highly refractive walls overlying brown, black or orange melanophores. Blue never occurs as a pigment. All metallic or prismatic colours, to which the flashing brilliance of hummingbirds, for example, is due, are structural colours. These change, as is well known; they alter with the position of the observer with reference to the source of light, "always in the order of the rainbow." This iridescence is due to the nature of the thin superficial colourless layer. The more generally accepted view has been that the superficial layer, oning to fine striation, acts like a grating dispersing the light in prismatic fashion; but the eminent physicist A. A. Michelson (1911) regards this as exceptional and classes the phenomenon of iridescence with the reflection from polished metal surfaces or thin layers of aniline dyes.

Sexual Dimorphism of Feathers and its Control.—We may take the well-known difference in plumage between hen and cock of the domestic fowl to begin with. Breeding is more or less continuous throughout the year and the plumage does not show seasonal variations; the feathers of the body of the hen are relatively uniform and inconspicuous in form, colour and pattern, while those of the male are much more diversified in the various tracts. This, however, is not the case in all breeds; in Seabright Bantams, as an example, the males also are "hen-feathered." In a highly dimorphic breed, such as the Brown Leghorn, the male is quite resplendent compared with the modest female. The long, drooping, lacy, golden feathers of the saddle tract of the cock, compared with the short, round-tipped, stippled feathers of the hen of this breed, are a good example. However, the same potentialities are present in both sexes, and the differences are due mainly to the sex hormone of the female secreted by the ovary which suppresses cock plumage. If the ovary of the female be removed, the bird assumes the plumage of the cock, whereas castration in the male does not modify the type of its plumage, however fundamentally it may alter other sex-characters. In the Seabright, the testes of the male likewise suppress cock plumage, and castrates of both sexes are cock-feathered.

Here is a relatively simple mechanism for control of sexual plumage dimorphism. But it is by no means the only, or perhaps even the most common, mechanism of control in birds. Where the sex dimorphism is seasonal, as is usual in wild birds, and the male dons his decorative plumage only for the short breeding season after a second moult, castration often does not alter the seasonal change, which is attributed to action of the genes (*e.g.*, the indigo bunting, and African weaver finches). In pheasants, the sex dimorphism of the feathers seems to rest on a combination of genic and endocrine factors (Danforth). In short, whatever the functional significance of the sex dimorphism of plumage may be, it appears to depend in different cases upon different mechanisms of control presumably evolved to suit different habits of life in most cases.

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(F. R. L.)

Commercial Applications of Feathers. — The chief purposes for which feathers become commercially valuable may be comprehended under four divisions: — (1) Bed and upholstery feathers; (2) quills for writing; (3) ornamental feathers; and (4) miscellaneous uses.

Bed and Upholstery Feathers. — The qualities which render feathers available for stuffing beds, cushions, etc., are lightness, elasticity, freedom from matting and softness. These are combined in the most satisfactory degree in the feathers of the goose and allied aquatic birds. Goose feathers and down, when plucked in spring from the living bird, are most esteemed. The down of the eider duck, Somateria *mollissima,* is valued above all other substances for lightness, softness and elasticity; but it has some tendency to mat, and is consequently more used for quilts and in articles of clothing than unmixed for stuffing beds. The feathers of swans, ducks and the domestic fowl are also largely employed for beds; but in the latter bird, the feathers are harsher and less downy than are those of the natatorial birds generally.

Quills for Writing. — The earliest period at which the use of quill feathers for writing is recorded is the 6th century; and from that time till the introduction of steel pens early in the 19th century they formed the principal writing implements of civilized communities. It has always been from the goose that quills have been chiefly obtained, although the swan, crow, eagle, owl, hawk and turkey all have been laid under contribution. Swan quills are better than are those from the goose, and for fine lines crow quills have been much employed. Only the five outer wing feathers of the goose are useful for writing, and of these the second and third are the best, while left-wing quills are more esteemed than those of the right as they curve outward and away from the writer using them. Quills obtained in spring from living birds are the best.

Ornamental Feathers. — Feathers do not appear to have been much used in Europe for ornamental purposes till the close of the 13th century; during Elizabeth's reign feathers began to occupy an important place as headdress ornaments of women. Ostrich feathers hold a pre-eminent position among ornamental feathers; and the ostrich is the only bird reared exclusively for the sake of its feathers. Ostrich farming is one of the established industries of South Africa, and is also practised in North Africa, Argentina, Arizona and California. The feathers are cut from the living animal and the stumps withdrawn later. In the male, the long feathers of the tail and wings are white, and the short feathers of the body are jet black, while the tail and wing feathers of the female are white, tinged with a dusky gray. The feathers of the male are consequently much more valuable than those of the female, and are separately classified in commerce. The art of the plumassier embraces the cleaning, bleaching, dyeing, curling and making up of ostrich and other plumes and feathers.

In addition to those of the ostrich, the feathers of certain other birds form articles of steady commercial demand. Among these are the feathers of the South American ostrich, Rhea *americana,* the marabout feathers of India obtained from *Leptoptilos dubius* and L. *javanicus,* and of Africa from L. *crumeniferus,* the aigrettes of the heron, the feathers of the various species of birds of paradise, and of numerous species of hummingbirds.

Miscellaneous Applications of Feathers.—Quills of various sizes are extensively employed as holders for the sable and camel hair brushes used by artists, etc. Feather brushes and dusters are made from the wing feathers of the domestic fowl and other birds; those of a superior quality, under the name of vulture dusters, being really made of American ostrich feathers. A minor application of feathers is found in the dressing of artificial flyhooks for fishing. (W. P. P.)

FEATHER STARS, the popular name for the beautiful starfish (*q.v.*) of the class Crinoidea (see ECHINODERMA), from their branched feathery arms; also called comatulids.

FEATHERSTONE, an urban district in the Pontefract parliamentary division of the West Riding of Yorkshire, Eng., 9 mi. E. of Wakefield. Pop. (1951) 13,935. Area 6.9 sq.mi. Roman remains have been found in the area. Purston park has been developed, and the town hall was opened in Jan. 1956. The town's main industries are coal mining and agriculture.

FEATLEY or FAIRCLOUGH, **DANIEL** (1582–1645), English divine, was born at Charlton, Oxfordshire, on March 15, 1582. His varied activities included a "scholastick duel" with James I in 1625, and the publication of (1) the report of a conference with some Jesuits in 1624, (2) a devotional manual entitled *Ancilla Pietatis* (1626), (3) *Mystica Clavis,* a Key opening divers *Difficult* Texts of *Scripture* in 70 Sermons (1636). He was appointed provost of Chelsea college in 1630, and in 1641 was one of the subcommittee "to settle religion." He sat in the Westminster assembly 1643, and was the last of the Episcopal members to remain. For revealing its proceedings he was expelled and imprisoned. He died at Chelsea on April 17, 1645.

FEBRONIANISM, the name given to a powerful movement within the Roman Catholic Church in Germany, in the latter part of the 18th century, directed towards the "nationalizing" of Catholicism, the restriction of the monarchical power usurped by the papacy at the expense of the episcopate, and the reunion of the dissident churches with Catholic Christendom. It was thus, in its main tendencies, the equivalent of what in France is known as Gallicanism (*q.v.*). The name is derived from the pseudonym of "Justinus Febronius" adopted by Johann Nikolaus von Hontheim (*q.v.*), coadjutor bishop of Trèves (Trier), in publishing his work De statu ecclesiae *et* legitima potestate Romani *pontificis.*

Papal Fallibility. — The main propositions defended by "Febronius" were as follows: The constitution of the Church is not, by Christ's institution, monarchical, and the pope, though entitled to a certain primacy, is subordinate to the universal Church. Though as the "centre of unity" he may be regarded as the guardian and champion of the ecclesiastical law, and though he may propose laws, and send legates on the affairs of his primacy, his sovereignty (*principatus*) over the Church is not one of jurisdiction, but of order and collaboration (*ordinis et consociationis*). The Roman (ultramontane) doctrine of papal infallibility is not accepted "by the other Catholic Churches" and, moreover, "has no practical utility." The Church is based on the one episcopacy common to all bishops, the pope being only *primus* inter pares. It follows that the pope is subject to general councils, in which the bishops are his colleagues (*conjudices*), not merely his consultors; nor has he the exclusive right to summon such councils. The decrees of general councils need not be confirmed by the pope nor can they be altered by him; on the other hand, appeal may be made from papal decisions to a general council. As for the rights of the popes in such matters as appeals, reservations, the confirmation, translation and deposition of bishops, these belong properly to the bishops in provincial synods, and were usurped by the papacy gradually as the result of a variety of causes, notably of the False Decretals (see DECRETALS). For the health of the Church it is therefore necessary to restore matters to their condition before the False Decretals, and to give to the episcopate its due authority. The main obstacle to this is not the pope himself, but the Curia, and this must be fought by all possible means, especially by thorough popular education (*primum adversus* abusum ecclesiasticae potestatis remedium), and by the assembling of national and provincial synods, the neglect of which is the main cause of the Church's woes. If the pope will not move in the matter, the princes, and notably the emperor, must act in co-operation with the bishops, summon national councils even against the pope's will, defy his excommunication, and in the last resort refuse obedience in those matters over which the papacy has usurped jurisdiction.

The Revolt of the Princes. — The views of Febronius had but little originality. In the main they were those that predominated in the great general councils of Constance and Basel in the 15th century; but they were backed by him with such a wealth of learning, and they fitted so well into the intellectual and political conditions of the time, that they found a widespread acceptance. The book, indeed, was at once condemned at Rome (February 1764), and by a brief of the 21st of May the pope commanded all the bishops of Germany to suppress it. The papal condemnation met with a very mixed reception; in some dioceses the order to prohibit the book was ignored, in others action upon it was postponed pending an independent examination, in yet others (nine in all) it was at once obeyed "for political reasons," though even in these the forbidden book became the "breviary of the governments." The Febronian doctrine, in fact, exactly fitted the views of the German bishops, which were by no means disinterested. It must be remembered that the bishops were at this time great secular princes rather than Catholic prelates; with rare exceptions, they made no pretence of carrying out their spiritual duties; they shared to the full in the somewhat shallow "enlightenment" of the age. As princes of the Empire they had asserted their practical independence of the emperor; they were irked by what they considered the unjustifiable interference of the Curia with their sovereign prerogatives, and wished to establish their independence of the pope also. In the ranks of the hierarchy, then, selfish motives combined with others more respectable to secure the acceptance of the Febronian position. Among secular rulers the welcome given to it was less equivocal. Even so devout a sovereign as Maria Theresa refused to allow "Febronius" to be forbidden in the Habsburg dominions; her son, the emperor Joseph II., applied the Febronian principles with remorseless thoroughness. In Venice, in Tuscany, in Naples, in Portugal, they inspired the vigorous efforts of "enlightened despots" to reform the Church from above; and they gave a fresh impetus to the movement against the Jesuits, which, under pressure of the secular governments, culminated in the suppression of the society by Pope Clement XIV. in 1773.

Roman Victory. — Whether the "Febronian movement" would have led to a reconstitution of the Roman Catholic Church on permanently Febronian lines must for ever remain doubtful. The French Revolution intervened; the German Church went down in the storm; and in 1803 the secularizations carried out by order of the First Consul put an end to the temporal ambitions of its prelates. Febronianism, indeed, survived. Karl Theodor von Dalberg, prince primate of the Confederation of the Rhine, upheld its principles throughout the Napoleonic epoch and hoped to establish them in the new Germany to be created by the congress of Vienna. He sent to this assembly, as representative of the German Church, Bishop von Wessenberg, who in his diocese of Constance had not hesitated to apply Febronian principles in reforming, on his own authority, the services and discipline of the Church. But the times were not favourable for such experiments. The tide of reaction after the Revolutionary turmoil was setting strongly in the direction of traditional authority, in religion as in politics, and that ultramontane movement which, before the century was ended, was to dominate the Church, was already showing signs of vigorous life. Moreover, the great national German Church of which Dalberg had a vision — with himself as primate — did not appeal to the German princes, tenacious of their newly acquired status as European powers. One by one these entered into concordats with Rome, and Febronianism from an aggressive policy subsided into a speculative opinion. As such it survived strongly, especially in the universities (Bonn particularly had been, from its foundation in 1774, very Febronian), and it reasserted itself vigorously in the attitude of many of the most learned German prelates and professors towards the question of the definition of the dogma of papal infallibility in 1870. It was, in fact, against the Febronian position that the decrees of the Vatican Council were deliberately directed, and their promulgation marked the triumph of the ultramontane view (see VATICAN COUNCIL, ULTRAMONTANISM, PAPACY). In Germany, indeed, the struggle against the papal monarchy was carried on for a while by the governments on the so-called *Kulturkampf,* the Old Catholics representing militant Febronianism. The latter, however, after Bismarck "went to Canossa," sank into a respectable but comparatively obscure sect, and Febronianism, though it still continued some hold on opinion within the Church in the chapters and universities of the Rhine provinces, became practically extinct in Germany. The Modernist crisis (1907) brought no challenge to Catholic unity in Germany, since Catholic scholarship there was far enough advanced to parry the blow easily. The effect of the Hitlerian doctrines on the German Catholic population was not entirely clear at the start of World War II.

BIBLIOGRAPHY —*See* A Fortescue's article "Febronianisrn" in Hasting~*Encyclopaedia of Religion and Ethics,* and the article of Friedrich Lauchert in the *Catholic Encyclopedia.*

FEBRUARY (Lat. *Februarius*) is the second month of the modern calendar, with 28 days (29 in bissextile or leap years). In the early Roman calendar it was the 12th month, primarily devoted, in anticipation of the new year, to ceremonies of purification and the cult of the dead: hence its name, derived from februare, "to purify."

The designation of leap-year day as February 29 is relatively modem and only gradually prevailed. In the Julian calendar, as still in some liturgical calendars, the extra day was inserted before the 24th. This accounts for the term bissextile, since the Romans (counting back, inclusively, from March 1) called both days the sixth. (F. R. WN.)

FÉCAMP, a seaport and bathing resort of northern France, in the *département* of Seine-Maritime, 28 mi. N.N.E. of Havre on the Ouest-État railway. Pop. (1954) 17,193. The town stands at the mouth of the small river Fécamp, and occupies the bottom and sides of a narrow valley opening out between high cliffs.

The town grew up round the nunnery founded in 658 to guard the relic of the True Blood which, according to the legend, was found in the trunk of a fig tree drifted from Palestine to this spot, and which still remains the most precious treasure of the church. The original convent was destroyed by the Northmen, but was re-established by Duke William Longsword as a house of canons regular, later converted into a Benedictine monastery. King Richard I greatly enlarged this, and rebuilt the church. The dukes of Normandy improved the harbour, but later the town was overshadowed by the rising port of Havre.

The abbey church of La Trinité dates mostly from 1175 to 1225, and has a fine central tower and chapel screens. The *hôtel-de-ville* with a municipal museum and library occupy the remains of the abbey buildings (18th century). The church of St. Btienne (16th century) and the Benedictine liqueur distillery[1], are of some interest. There are a tribunal and chamber of commerce, a board of trade arbitrators and a nautical school. The harbour is tidal with docks capable of receiving ships drawing 26 ft. at spring-tide, 19 ft. at neap-tide. Fishing for herring and mackerel is carried on and Fecamp sends a large fleet to the codbanks of Newfoundland and Iceland. The chief exports are oil cake, flint, cod and Benedictine liqueur. Imports include coal, timber, tar, hemp and peanuts. Steam sawing, metal-founding, fish-salting, shipbuilding and repairing, and the manufacture of ship's biscuits and fishing-nets are among the industries.

FECHNER, GUSTAV THEODOR (1801–1887), German scientist and philosopher, who pioneered in psychophysics, was born on April 19, 1801, at Gross-Sarchen, Lower Lusatia, where his father was pastor. Fechner took his degree in biological science in 1822 at the university in Leipzig, where he spent the rest of his life. He became interested in mathematics and physics and was appointed professor of physics in 1834, but, after a long illness and partial blindness, turned in 1843 to the study of philosophy, experimental aesthetics and psychophysics. He died at Leipzig on Nov. 18, 1887.

Fechner's philosophy conceives the world as highly animistic, even plants and the stars being animated; God, the soul of the universe, has an existence analogous to man, and natural laws are the modes of the unfolding of God's perfection. Fechner was a remote disciple of Friedrich von Schelling and learned much from Johann Herbart.

Though he received attention as a philosopher, Fechner's fame stems chiefly from his experimental work described in Elemente der Psychophysik (1860), which he intended merely as verification for his philosophy. The basic postulate of Fechner's psychophysics was that mind and body appear to be separate entities but are actually only different sides of one reality. What appears from a subjective viewpoint as the mind appears from an external or objective viewpoint as the body; Fechner uses the illustration that a circle appears concave or convex depending on whether or not the observer stands inside or outside the circle. The apparent dualism is due to the impossibility of taking both viewpoints simultaneously.

Fechner's originality lies in his development of psychophysical methods by which experienced sensation could be measured in relation to the physical magnitude of the stimulus.

Through his psychophysical experiments he derived an equation between stimulus and sensation, and thus, he believed, between body and mind, and he felt that this demonstrated the validity of

[1]The liqueur is said to have been made by the monks as far back as 1510; since the Revulution it has been produced by a secular company. The familiar legend D.O.M. (*Deo Optimo Maximo*) on the bottles preserves the memory of its original makers.

the identity hypothesis. The equation, Fechner's law, which states that the intensity of a sensation is proportional to the logarithm of the stimulus, can be written

$$\text{sensation intensity} = C \log \text{stimulus intensity},$$

where C is a constant that must be experimentally determined for each sense modality. Ernst Heinrich Weber had originally postulated this constancy in 1834. and the formula is therefore sometimes called the Weber-Fechner law. The law has been criticized on logical grounds, and experimental evidence indicates that it does not have the universal applicability Fechner claimed. Nevertheless. it has proved useful, particularly to researchers in vision and hearing.

Through his influence on Wilhelm Wundt (*q.v.*), Fechner's psychophysical methods and formulations became one of the cornerstones of early psychology. *Elemente der Psychophysik,* though its philosophy did not stand the test of time, gave psychology methods for the measurement of sensation and thereby results that could be expressed in the language of mathematics.

Fechner's chief works, in addition to *Elemente der Psychophysik*, are: *Massbestimmungen uber die galvanische Kette* (1831); *Das Biichlein vom Leben nach dem Tode* (1836; Eng. trans., 1882); *Nanna, oder iiber das Seelenleben der Pflanzen* (1848); *Zendavesta, oder über die Dinge des Himmels und des Jenseits* (1851); *Vorschule der Asthetik* (1876); *Die Tagensansicht gegeniiber der Nachtansicht* (1879). In addition to scientific and philosophical papers, he wrote poems and satires under the pseudonym of Dr. Mises.

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(T. E.)

FECHNER'S LAW: *see* FECHNER, GUSTAV THEODOR; PSYCHOPHYSICS; WEBER'S LAW.

FECKENHAM, JOHN (*c.* 1515–1584), English ecclesiastic, last abbot of Westminster, was born at Feckenham, Worcestershire. Educated at Gloucester hall, Oxford, as a Benedictine student, he was professed at Evesham. On the surrender of the abbey to the king (1540), he became chaplain to Bishop Bell of Worcester and to Bonner of London, and in 1544 received the living of Solihull. About 1549 Cranmer sent him to the Tower of London, but being released by Mary in 1553, he was made prebendary of St. Paul's, rector of Finchley, then of Greenford Magna, chaplain and confessor to the queen, and dean of St. Paul's (1554). He was sent by the queen to prepare Lady Jane Grey for death, and when Elizabeth was sent to the Tower, Feckenham interceded for her, even at the cost of displeasing the queen.

The royal abbey of Westminster having been restored to its primitive use, Feckenham was appointed abbot in 1556 On the accession of Elizabeth. he opposed all legislation for changes in religion, and, when the hour of trial came, refused the oath of supremacy, rejecting also Elizabeth's offer to remain with his monks at Westminster if he would conform to the new laws. The abbey was dissolved (July 12, 1559), and within a year Feckenham was sent by Archbishop Parker to the Tower. After 14 years' confinement, he mas released on bail and lived in Holborn, where he devoted himself to works of charity. In 1577 he was committed to the care of Cox of Ely with strict rules for his treatment; and in 1580 he was removed to Wisbeach castle where he died on Oct. 16, 1584.

See E. Taunton, *English Black Monks of St. Benedict* (1897).

FEDERAL BUREAU OF INVESTIGATION (FBI). Established in 1908 as the investigative arm of the U.S. department of justice. the Federal Bureau of Investigation is a fact-finding agency which does not evaluate the results of its investigations or recommend prosecutive action. In general, it is responsible for the enforcement of all federal criminal statutes except those specifically delegated to other federal agencies. In 1958 there were approximately 140 federal matters over which it had investigative jurisdiction. The two primary areas of FBI activity are general investigations and security operations. Within the latter field, it has jurisdiction over espionage, sabotage and subversive activities on a nation-wide scale.

In addition to investigating violations of laws of the United States. the FBI is charged aith collecting evidence in cases in which the United States is or may be a party in interest and with other duties imposed by law. It reports the results of its investigations to the attorney general, chief legal officer of the United States. his assistants and the various U.S. attorneys in federal districts throughout the United States for decisions as to prosecutive action. The FBI is also a service agency which assists law enforcement agencies in identification, technical and training matters.

History. — Originally known as the Bureau of Investigation, the FBI was created by the then attorney general Charles J. Bonaparte on July 26. 1908. The internationally known name, Federal Bureau of Investigation, was adopted on July 1, 1935.

In 1924 John Edgar Hoover was appointed director of the bureau by Harlan Fiske Stone, then attorney general, and he was reappointed by each succeeding head of the department of justice. Hoover inaugurated the policies which constitute the foundation of the present organization. Political considerations were divorced from personnel appointments, and promotions were placed on a merit basis.

Less than a decade after this reorganization, the FBI was faced with enlarged responsibilities. A wave of lawlessness in the early 1930s aroused considerable public concern. Local police officers, often inadequately trained and hampered by the restrictions imposed by state boundaries, were unable to cope effectively with the modern weapons and transportation available to organized criminal gangs. To meet this situation, congress passed a number of laws which extended the jurisdiction of the FBI. In 1932 the federal kidnapping statute was enacted, making unlawful the interstate transportation of a kidnapped person. All kidnapping cases referred to the FBI the following year were solved. The federal Bank Robbery act was passed in 1934 to stem the rising tide of bank robberies. Again in 1934, special agents of the FBI were authorized by congress to carry firearms and to make arrests. With the passage of these and other crime bills, the FBI was given authority to act against the criminal gangs which previously had met little effective opposition. In 1934 alone, three vicious fugitives who had gained national notoriety were killed. John Dillinger, Charles Arthur (Pretty Boy) Floyd and Lester Gillis, alias "Baby Face" Nelson, met death while resisting arrest. In 1935 Russell Gibson and Kate and Fred Barker fell before the guns of special agents. The arrest of Alvin Karpis by Hoover in 1936 marked the end of the powerful Barker-Karpis gang, while Alfred James Brady and an accomplice were killed in a gun battle with FBI agents in 1937. Numerous other kidnapers, bank robbers and lesser criminals were sent to federal penitentiaries during this period.

The war on crime was not halted but was overshadowed as the inteniational developments leading to World War II placed additional responsibilities on the FBI. During this period, federal statutes relating to subversive activities were the basis for counteraction by the bureau against intelligence operations of foreign powers. Several espionage agents were arrested before the outbreak of hostilities in Europe On Sept. 6. 1939, a presidential directive was issued providing that the FBI should take charge of investigative work in matters relating to espionage. sabotage, subversive activities and related matters. The president also called upon all enforcement officers, both federal and state, to report all information in these fields promptly to the FBI, which was charged with the responsibility of correlating this material and referring matters under the jurisdiction of any other federal agency with responsibilities in this field to the appropriate agency. The FBI's responsibility in these matters was reiterated by presidential directives of Jan. 8, 1943, and July 24. 1950. By agreement, the armed forces handle investigations concerning their uniformed personnel. This action by the president obviated the confusion experienced in World War I when more than 20 agencies investigated security in the United States.

The scientific techniques which had been developed by the FBI in its war against organized gangsterism were employed to thwart the spy and the saboteur. In June 1941 the FBI climaxed its investigation of a Nazi espionage ring in New York city with the arrest of 33 persons. All pleaded guilty or were convicted in federal court.

An efiective pan-American intelligence force was created under the bureau's leadership to oppose the activities of Axis spy and sabotage rings in the western hemisphere. From July 1, 1940, through June 30, 1946, more than 15,000 Axis operators and sympathizers in South America were expelled, interned or rendered harmless. More than 460 spies, saboteurs and propaganda agents were apprehended, and 30 secret radio transmitters were eliminated.

In 1939 the FBI undertook a program of surveying industrial plants engaged in the manufacture of strategic war material. Before it had concluded its responsibility in this program, more than 2,300 plants had been surveyed and recommendations made for their protection. In the period preceding the attack on Pearl Harbor new field offices were opened in the continental United States and its territorial possessions. Additional personnel was trained by the FBI to investigate the flood of complaints regarding suspicious activities which citizens were encouraged to report, and its rolls of clerical and investigative employees reached an allotted peak of 14,300.

A mass of intelligence information had been accumulated by Dec. 7, 1941, when Japan attacked at Pearl Harbor. By the following day. 1,771 potentially dangerous enemy aliens had been arrested and detained. As formal declarations of war were made, German and Italian aliens, known or suspected to be dangerous, were arrested. In all, more than 16.000 such apprehensions were made by the FBI with the assistance of local law enforcement authorities in an orderly manner and in marked contrast with the disorganized vigilante activities of World War I. Precautions against espionage and sabotage were increased.

In 1942 eight saboteurs, landed by submarine from Germany, were quickly taken into custody. German plans to send such groups to the United States every six weeks were thwarted. Two additional saboteurs were dispatched by Germany in 1944 and were quickly apprehended. The normal channels for enemy agents to enter the country were closed, and spies were then sent to the United States as refugees. Spies intercepted by the FBI often became double agents. identifying other espionage agents and transmitting misleading information to their principals.

After the war the nation found itself confronted with a crime wave of serious proportions. In 1945 major crimes increased 12.3% over 1944. Crime in 1946 continued its upward trend, increasing 7.6% over 1945. The war-born scarcity of consumer goods created a lucrative market for stolen merchandise and contributed to the reactivation of old criminal gangs. The finely geared machinery of the FBI was able to face this condition without pause.

During the postwar period there was increased public concern in matters relating to Communism and the infiltration of government and essential industry by persons whose loyalty was subject to question. On Aug. 1, 1946, congress passed the Atomic Energy act, charging the FBI with the responsibility of determining the character, associations and loyalty of employees of the Atomic Energy commission and of all persons having access to restricted atomic energy data. Following the issuance by the president on March 21, 1947, of executive order 9835, the FBI was given the duty of investigations concerning the loyalty of employees and applicants for positions in the executive branch of the federal government. The result was to increase greatly the investigative work of the FBI.

On April 5, 1952, congress transferred responsibility for the bulk of applicant-type investigations to the United States civil service commission, and provided that the FBI should handle those cases where information indicated questionable loyalty or where the position involved was sensitive and important.

On July 20, 1948, 12 leaders of the Communist party were indicted under the Smith act as members of a conspiracy teaching and advocating the overthrow of the constitutional form of government of the United States by force and violence. Following the trial and conviction of 11 of these leaders, the FBI arrested other Communist officials. Other investigations by the FBI in the security field developed evidence of plots to transmit government secrets and information relating to atomic energy and other secret projects to foreign nations. It scrutinized even more closely organizations which advocated policies not in keeping with the United States' constitutional form of government.

Statistics. — The effectiveness of FBI operations is indicated by the statistics reflecting its accomplishments through the years. In the five-year period which ended June 30, 1952, 34,629 fugitives had been located in cases investigated by the FBI. Fines, savings and recoveries in bureau cases totalled more than $227,400,000, and there were 44.746 convictions in cases which were presented in court during that five-year period.

The close of the 1952 fiscal year brought to 438 the number of cases investigated by the FBI under the federal kidnapping statute. Of these, 436 were solved. In the 1952 fiscal year alone there were 156 convictions in bank robbery cases investigated by the FBI. These convictions resulted in sentences totaling 1,533 years and fines and recoveries amounting to $2 53,369.

Six years later, during the 1958 fiscal year, convictions in cases investigated by the FBI rose to 11,457, resulting in sentences totaling more than 30.000 years and fines totaling more than $1,666,000. Also, more than 9,000 fugitives were apprehended and recoveries resulting from FBI investigations totaled more than $130,000,000, including 16,500 stolen automobiles. Not shown in statistical data, however, are the accomplishments of the FBI in the area of security and counterespionage investigations.

Co-operative Services. — The FBI Laboratory. — On Nov. 24, 1932, the FBI laboratory mas established to provide scientific crime detection facilities to authorized law enforcement agencies. Services of the FBI laboratory are available cost-free to state and municipal law enforcement agencies, as well as to other government agencies. Its technical equipment ranges from simple laboratory instruments to complicated spectrographs and huge copying cameras Its technicians, who represent many fields of chemistry, physics and engineering, include experts in firearms identification, serology, spectrography, metallurgy, explosives, hair and fibre analyses and handwriting identification. During the fiscal year which ended June 30, 1958, the laboratory completed 165,462 scientific examinations of 137,142 specimens of evidence. Examinations in the laboratory clear the innocent as well as convict the guilty. Laboratory experts are available to testify without charge in state courts concerning the results of their examinations.

The Identification Division. — A national fingerprint file was established on July 1, 1924, when the FBI was given custody of 810,188 fingerprint cards previously maintained by the U.S. penitentiary at Leavenworth, Kan., and by the International Association of Chiefs of Police. Approximately 20,000 fingerprint cards are received each working day far processing at the Identification division. By July 1958 the FBI had more than 149,000,000 fingerprint cards in its continuously increasing identification files. In addition to fingerprints submitted on criminal charges, these included fingerprints of military personnel, government employees, aliens, prisoners of war and private citizens who voluntarily submitted their fingerprints for protection against loss of identity in the event of amnesia or disfiguring fatal accidents.

Police Instruction. — In 1935 the FBI National academy was established to train selected members of law enforcement agencies as police executives and instructors for their local departments. The 12-week training course is conducted at Washington, D.C., and at the FBI academy on the U.S. marine base in Quantico, Va., by members of the FBI training staff and recognized outside experts. No tuition or fees are charged. The two sessions of the National academy, completed during the 1958 fiscal year, raised the total of graduates to more than 3,500. Among these graduates were police officers and officials from every state as well as several other countries and U.S. territorial possessions. The benefits of their training had been transmitted to thousands of their fellow police officers. Approximately 25% of these graduates were the heads of their law enforcement agencies.

At the request of local authorities, the FBI co-operates in police training schools, affording training in such matters as firearms, fingerprint classification. traffic control, defensive tactics and other courses of value to law enforcement. In its annual conferences with state and local law enforcement agencies, the FBI provides a medium for the discussion of common problems related to law enforcement in the various local areas. Such publications as the FBI *Law Enforcement Bulletin* and the *Uniform Crime Reports* bulletin further aid in keeping law enforcement officers abreast of developments in crime detection and trends in crime. Published monthly, the FBI *Law Enforcement Bulletin* provides a medium for exchange of ideas between law enforcement agencies. The *Uniform Crime Reports* bulletin is a statistical analysis of local crime on an annual and semiannual basis. Tabulations on offenses committed are submitted to the FBI monthly and annually by more than 5.500 law enforcement agencies throughout the United States.

Administrative Organization. — Headquarters of the FBI are maintained in Washington, D.C., where all administrative and investigative functions are co-ordinated. Serving under the director are an associate director, two assistants to the director and several assistant directors who control such activities as the domestic intelligence. investigative. training and inspection, records and communications, administrative and identification divisions and the FBI laboratory. In 1958 there were 53 field offices of the FBI in key cities in the United States and its territories. Each field office was headed by a special agent in charge who was responsible to the director for the supervision of the bureau's activities in his field division. Under his direction were varying numbers of special agents. assigned according to the needs of the service. (J. E. H.)

FEDERAL COUNCIL OF EVANGELICAL FREE CHURCHES. This body was formed to give expression to the unity in matters of spiritual principle which had been found to exist among the evangelical free churches of England and to co-ordinate their activities and resources. It represents the denominations as organized corporate bodies. Though its aims are convergent with those of the National Council of Evangelical Free Churches. its constitution and area of operation were defined differently.

The original document consisted of a "Declaratory Statement concerning Common Faith and Practice" (with a preamble) and a constitution. The governing body of the federation was organized as a federal council. consisting of representatives elected annually by the supreme authorities of the federating churches; but its powers were advisory and not executive except under conditions explicitly defined.

See ECUMENICAL MOVEMENT.

FEDERAL GOVERNMENT is the government of a federal community. Such a community is characterized by a territorially diversified pattern of foci of attention. objectives, values, interests and beliefs that calls for two levels of government. one to deal with the common, the other with the ter itorially diverse and differentiated loci of attention. Since such patterns'are rarely stable over any considerable period of time. federal government is highly dynamic and the equilibrium of power is continually shifting. The political system of which the federal government is the most important part, and which is often called federalism, is. therefore. a process rather than a static design. This point needs emphasizing in order to bring out the contrast with older conventional views, which laid stress on the problem of sovereignty (*q.v.*) and the resultant distinction between a federal state (*Bundesstaat*) and a federation (or confederation') of states *(Stuatenbund)*. While not without importance. especially for international law. this dichotomy obscures rather than illumines the vital aspects of federalism and federal government.

While federal systems have had primary importance in providing the opportunity for separate communities to organize themselves in larger unities. as illustrated by the history of Switzerland. the United States. Canada. Australia. Germany and a host of more recent examples. a federalizing process may also be important in solving problems of overconcentration of governmental power, as is demonstrated by the Commonwealth of Nations, the French union and a number of formerly colonial situations, such as Algeria and Puerto Rico.

Federal governments often evolved out of leagues or confederations. It was so in the United States, Switzerland and the Netherlands. Hence, federal government typically exhibits some of the organizational features of confederations. In the early city leagues, no less than in the Swiss and Dutch unions, the American confederation and finally the League of Nations and the United Nations, there is always found a charter or agreement, embodying three features: (1) an assembly of representatives of the constituent members; (2) an executive organ of some sort; and (3) an arbitral or judicial body; arbitration is ordinarily supposed to eliminate the recourse to arms between members. The common objectives of these confederations were different, but there was always the objective of defense against dangers to which all the members were alike exposed.

Distribution of Legislative Functions. — Because of the variety of possible origins. every federal government is likely to be different from every other. The composition of federal representative assemblies as well as the distribution of their legislative functions shows this clearly. Many federal constitutions contain long catslogues of what the federal legislature may do; the United States constitution is relatively simple as compared with the German basic law. It goes without saying that such divisions of the "competencies" — that is, the sphere within which each may operate — must and will vary according to time and place. Economic and social life, military and geographical factors, all play their role in determining the particular arrangement. Jurists have made a great deal of the difference between a central government with powers specifically delegated to it. such as that of the United States, Switzerland and Germany, and one in which the powers are specifically delegated to the provinces, as is the case in Canada. What really matters is that there be some balance between the two, and that whatever distribution of functions might be delegated, it is the constitution that determines the governmental structure as a whole.

A comparison of the several federal constitutions shows that certain matters, such as foreign affairs. customs, money and currency. posts and national defense. are invariably attributed to the federal authorities. On the other hand, certain matters, such as education and cultural affairs. the police and local government, are usually left to the component units. But the focal point of modern life, namely, the economy in all its ramifications of technology, welfare and taxation. is handled with the widest variation, created by judicial interpretation of the constitution as well as by amendments broadening the scope of federal jurisdiction.

Amending Process. — Every federal system of government provides for participation of local units in the process of amending and altering the constitution. How do the local units — states, cantons, *Länder*, provinces, dominions or whatever—actually participate? Through their representatives in the federal representative assembly. or directly. or both? In the United States, as in Switzerland. the provisions for constitutional amendments developed organically. In both countries the component states' representatives in the federal representative assembly as well as the component states themselves have to assent by qualified majorities. In the Cnited States the state legislatures or special conventions ratify amendments proposed by congress; in Switzerland amendments proposed by the federal legislature (or by a popular initiative) are ratified by a majority of the cantons as well as by a majority of the Swiss people.

In Germany under the Weimar republic, no direct participation of the provinces *(Lander)* was required. This omission shows how weak was German federalism of the period between World Wars I and II. A feeble substitute for *Lander* participation was provided, but it was never actually invoked. Following this tradition, the amending power in the post-World War II Bonn constitution (*Grundgesetz,* or basic law) was lacking in federalistic character also, though the requirement of a two-thirds majority in the states' council (*Bundesrat*) proved of.some consequence.

In some of the later federal systems, notably the proposed European Political Community. real participation of the component units was provided, coupled with provisions that distinguished between more and less important articles of the constitution.

Federal Executives. — The second feature of a confederation appertains to the executive sphere. The component units have a part either in selecting the federal executive, or in conducting the executive work for the whole, or in both. The federal structures in the United States, Switzerland, Germany and the dominions of the British Commonwealth all exhibit such arrangements. To be sure, the local units have only a small share in selecting the federal executive. Thus, in the United States, voting by the states in the electoral college is a partial recognition of the states; the president is not elected by a majority of the whole people but by a majority of state majorities.

Another form of state participation as such in the executive sphere is the constitutional right of the U.S. senate to advise on and consent to presidential appointments "Senatorial courtesy" reinforces this power. Another recognition of the states' position is the civil service rule according to which each state is given a certain quota of appointments. In Switzerland, the president and the executive council are elected by the two houses of the legislature; hence the cantons have an important voice. The strength of local autonomy is further recognized in certain customs: Bern and Zurich are always represented on the council, and council seats are evenly distributed among the other cantons. This means primarily that the French- and Italian-speaking cantons get at least one or tno members.

Constitutional Judiciary. — A judicial body for the settlement of disputes between central and local authorities is found in all federal systems. In the United States the supreme court is charged with this duty. Though on the whole favouring the federal government, it has not followed a one-sided course as between the central and local governments. The court was, indeed, nationally minded under Chief Justice John Marshall (1801–35). and several of his most famous decisions, such as *McCulloch* v. *Maryland* and Gibbons v. Ogden, asserted positions that favoured the central government. Later on, the court, in the course of the slavery controversy, shifted toward a states' rights position, which culminated in the ill-starred Dred Scott decision (1857). After the Civil War, the court returned to its earlier outlook. There was prevalent a feeling that the war had settled all questions in tavour of the central government.

At mid-20th century the court seemed to be federally minded in matters of civil rights, but inclined toward a states' rights point of view in certain other respects. Whatever the merits of detailed issues under dispute, however. the notion of judicial settlement of such disputes between local and central authorities remained as a clear indication of the federal nature of the U.S. governmental structure.

This is likeaise the case in Switzerland, and it is noteworthy that provisions about the administration of federal legislation by the cantons have not resulted in complications similar to those that arose in Germany under the Weimar republic This may be explained by several facts: no single canton is large in relation to the federation as a whole; the cantons have been less sharply divided by partisan issues (neither Communism nor Fascism assuming serious proportions); and the central government has practised marked moderation in employing force, relying rather upon persuasion and other kinds of pressure. Under the 1949 basic la , the Germans, it appeared, would follow similar methods.

Commonwealth and Dominions. — Interesting special problems in federalism are presented by the Commonwealth of Nations and the dominions composing it. The commonwealth represents a very loose federal system, which in terms of the antiquated approach must be described as a kind of league. Yet common citizenship, the bonds of a common cultural tradition and language, as well as informal institutional arrangements of various sorts, including the commonnealth conferences, provide a working federal bond among the several members. For example, it is often overlooked in discussions of this matter that Canada still formally depends upon the British parliament for amendments of its constitution. Nor can the weight of what remains of the British Colonial empire, administered by the United Kingdom, be gainsaid.

Australia and Canada provide two outstanding examples of working federalism. Their institutional setup is interesting in terms of the relation of federalism to parliamentarism; for they effectively combine the cabinet system of parliamentary government, on both the federal and the local level, with a functioning federal system. Canadian federalism is reinforced by the powerful sense of local differentiation and autonomy in the French-speaking part of Canada; in both Canada and Australia the continental dimensions of their territory make a territorial distribution of power natural. Elsewhere in the commonwealth, the federations of Rhodesia and Nyasaland (1953) and The West Indies (1958) present other examples of experimentation with various federal forms of government.

After 1947 India evolved a diversified federal system of its own that provided the basis for solving the problem of how to organize an effective democratic government for its richly differentiated people. It is the most complex federal system ever devised. Some would deny it true federal character because of the broad powers granted to the central government. But the weight of local traditions — linguistic, religious, cultural — is so great that the provinces tend to gain rather than lose in strength. The system is still evolving and the end is not in sight, but it is possible to argue that without the techniques of federalism, Indian constitutional government could not have been achieved.

European Unification. — The same may be emphatically asserted regarding the unification of Europe. Actually, the federalizing of Europe is taking the form of functional integration. Instead of setting up a federal union by concerted constitutional action, European states negotiated a series of separate treaties in particular functional areas. They also created a very loose framework, the Council of Europe, centred at Strasbourg, France, in which, after 1949, the 16 member states consulted with each other about common problems. A representative assembly, composed of delegates of the several parliaments, urged common action, though it possessed purely consultative functions. Its major achievements, besides creating a certain camaraderie and habits of working together, were in the cultural sphere; it was specifically excluded from the consideration of military problems. In the general field of economic co-operation, the Organization for European Economic Cooperation (O E.E.C.), inaugurated as the co-ordinating body of the European Recovery program, was operative; its most effective work was in overcoming currency problems through its subsidiary, the European Payments union (E.P.U.). Finally, in the military field, the Western European union (W.E.U.) sought to implement policies of the North Atlantic Treaty organization, but its activities were not of great consequence; it took the place of the unrealized European Defense Community (E.D.C.).

Besides these rather loose efforts toward federalizing all of Europe, much bolder efforts were undertaken by "Little Europe," the six states that mere ready to form a much closer union than the rest, namely. France, the German Federal Republic. Italy and Benelux (Belgium, the Netherlands and Luxembourg). They formed in 1951 the European Coal and Steel Community (E.C.-S.C). which began operation in 1953 as an effective supranational administration of two basic industries through the territory of the "Six." After the failure of the E.D.C. and its associated proposal for a European Political Community (E.P.C.), the Six formed a European Economic Community (E.E.C.) (1957) and a European Atomic Energy Community (Euratom). The first was to establish a common market, by elimination of all tariffs within the next 12 to 15 years and conjointly to develop common economic policies and a free movement of persons and capital. The second was to pool the resources of the Six for the development of nuclear energy. Europe's energy resources at mid-century were insufficient and growing more so; hence the development of nuclear energy appeared to many to be the means of economic survival. These two communities shared, as planned in early 1958, a representative assembly (not fully legislative, however) with the E C S.C.; it was also planned that they would have a common court.

Association: A New Dimension of Federalism. — The European developments sketched above raise an issue that has also cropped up elsewhere. How can states that do not feel ready to share fully in a federal union participate on a more limited scale? The answer given in Europe is: association. In the European Economic Community treaty, for example, it was provided that other states or union states might become associated with the community. The specific proposal was that of establishing a "free trade area" of adjoining states.

The United States, confronted with the problem of how to give maximum autonomy to Puerto Rico, which desired to preserve its cultural identity while yet remaining part of the United States, granted to the people of Puerto Rico the status of an associated state; the Free and Associated Commonwealth of Puerto Rico represented a novel departure for U.S. federalism. When the German Federal Republic was organized. west Berlin wished to participate but could not become a state because of the four-power control over all of Berlin. Consequently the free part of the city became "associated" with the federal republic; though not voting, its representatives participated fully in federal legislation, and the republic's laws applied to it. As with Puerto Rico. Berlin received substantial aid from the federal union with which it was associated

Conclusion.—Federalism is intimately related to modern constitutionalism. There is nothing in the distinction between federalism and decentralization that would imply an inherent superiority of one over the other; their advantages and disadvantages can be contrasted only in terms of the peculiar conditions of the time and place under which a particular government is supposed to operate A federal governmental structure provides a spatial or territorial, as distinguished from a functional, division of powers. Such a division operates as a rather effective restraint upon the abuse of governmental powers by the central authorities. Indeed, in many situations it is more likely to be effective than a functional division. for the latter can be more readily overcome by the extraconstitutional activities of a national party organization. In other words, what federalism does is to mobilize firmly entrenched local powers in support of the constitution and to offer them protection under the constitution as well. Localized groupings are treated in a manner analogous to the treatment of the individual citizen, to whom a sphere of relative independence, of civil liberties is likewise guaranteed.

Besides the constitutional considerations, there is a great advantage in providing an opportunity under a federal system for limited experimentation in one or more of the component units. This, however, may have perilous consequences. These dangers of federalism were illustrated in Germany. It is strange that the legend could grow up later that it was centralization that favoured Hitler, when, as a matter of fact, it was the relative autonomy of Bavaria that provided the seedbed for Hitlerism before and after the beer hall *Putsch* in Munich in 1923. It was likewise the autonomy of the *Länder* in the matter of citizenship that enabled Thuringia, after it had become National Socialist, to confer German citizenship upon Hitler, nithout which he could not legally have become either a candidate for the presidency or chancellor. By analogy, any markedly federalistic structure may provide a potential foothold and jumping board for an emergent totalitarianism. whether of the right or the left.

Federal structures of government share with all formalized constitutionalism the difficulty of adjusting a relatively rigid scheme to the shifting exigencies of a dynamic industrial society. Under modern conditions, areas of friction are bound to develop where technological change radically alters the conditions under which government has to be conducted. With competencies constitutionally divided between the central government and the local governments, as they are in the United States, governmentai functions emerge that can be performed only by one of these units and for uhich no prior constitutional provision has been made. The rigidities that arise, however. from such a division of powers are inherent in the federal scheme and are the price that must be paid for the advantages of greater variety and local freedom.

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FEDERALIST PARTY. The Federalist party organized the national government of the United States under the constitution of 1787. It may be regarded as in various important respects, the lineal predecessor of the U.S. Whig and Republican parties. The name "Federalists" (see ANTI-FEDERALISTS) was first given to those who championed the adoption of the constitution. Later it applied exclusively to a specific political group, less inclusive than the Federalists of 1787, which developed during the presidency of George Washington.

The palpable weaknesses of the Confederation of 1781–89 and the very real threats to the survival of the American nation were the reasons for the rallying together of this group. They sought an "energetic" central government because they feared "the mutability of the laws of the states", as James Madison put it The Confederation had demonstrated its inability to protect property rights, provide a public revenue, uphold the fiscal integrity of government, maintain and expand commerce and come to an understanding with Britain. The economic depression of 1785–86 once more unleashed leveling tendencies—resumption of paper-money issues in the states. assaults on contracts and the Shays's Rebellion. In consequence, the conflict over the constitution—and the appearance of political parties in America—was the difference largely between two kinds of property interests and not, as Jefferson put it later, between two philosophical positions. The Federalists were not aristocrats and monarchists, the anti-Federalists were not democrats. The Federalists saw political stability and economic growth in terms of sound fiscal policy. establishment and protection of banking and the expansion of commerce. The anti-Federalists spoke for the agricultural interests which, frequently weighed down by debt, were cheap-money men and hostile to tax programs of imposts and excises. The mechanics and artisans of Massachusetts, identified with commerce, were Federalists. The large land (and slave) owners of Virginia and the Carolinas were anti-Federalists. Most of the Federalists of 1787–88 became members of the later Federalist party.

The political group which became known as the Federalist party may be regarded as definitely organized practically from 1791; it was led, leaving President Washington aside, by Alexander Hamilton and John Adams. Hamilton's domestic and foreign policies gave the party its program and created the bitter hostility to it that made it so short-lived. He started out with the assumption that the constitution gave the central authority broad powers; he believed it necessary to use them to create a government with integrity and honour so that private accumulation could occur with safety, foreign credits and investment would be revived and diversification of economic enterprise take place. These required positive action by government, notably as regards debt management, money and credit, banking and stimulation of trade. In foreign relations. they required a settlement with Britain politically and commercially, and neutrality as war raged in Europe. Over the decade of the 1790s, the Federalists stood for the following: (1) the support and the achievement of the Hamilton program of the funding of the old Revolutionary War debt and the assumption of the state debts, the passage of excise laws, the creation of *a* central bank, the maintenance of a tariff system and favourable treatment of United States shipping; (2) neutrality in the war between France and Britain, breaking out in 1793; (3) approval of the Jay treaty of 1794, terminating the difficulties with Britain; and (4) the grant of crisis powers to the central government in 1798–99, when French demands almost forced open war. These measures achieved the survival of the republic, linking public and private credit. expanding commerce and foreign investment in America and assuring peace.

They provoked deep resentment and were bitterly fought; on these issues the first U S. political parties were formed. The Republicans (Democratic Republicans, later, the Democratic party), led by Thomas Jefferson and James Madison, were suspicious of central authority, friendly to the French Revolution and hostile to Britain. While the Federalists controlled the government until 1801. their incapacity or unwillingness to organize politically, their neglect of the arts of consultation, persuasion and discipline, and their failure to devise a program of broad national appeal (including agriculture, small property generally. and the little producers) doomed them. Hamilton in 1799 understood this. Should not. he wrote to one of his correspondents, a wider program be laid out, one that "will extend the influence and promote the popularity of government?" But then it was too late. The Federalists had been made synonymous with "favouritism. influence and monopoly." They never again held national office after Jefferson's victory in 1800. See DEMOCRATIC PARTY (U.S.).

Nevertheless the accomplishments of the Federalists were great. They organized the new federal government in all its branches, giving it an administrative machinery that in the main endured; they established the doctrine of neutrality toward European conflicts that stood America in such good stead while it continued a poor and defenseless country and was preoccupied with its own continental expansion; they laid the basis for the enduring friendship with Britain; and fixed the practice of a liberal construction of the constitution — not only by congress but above all by the United States supreme court, which, under the leadership of John Marshall (who had been appointed chief justice by Pres. John Adams), impressed enduringly on the national system large portions of the Federalist doctrine. These political accomplishments and the economic ones of fiscal integrity, credit worthiness and protection of the investing process and property are their impressive achievements and their claims to memory.

After 1801 the Federalist party never regained power. In attempts to do so, it impaired its morale by internal dissension. by intrigues and by inconsistent factious opposition to Democratic measures on grounds of ultrastrict construction. It took up, too, the Democratic weapon of state rights. and in New England carried sectionalism dangerously near secession in 1808 and also in 1812–14 during the movement, in opposition to the War of 1812, which culminated in the Hartford convention. By 1817 it was practically dead as a national party. It is sometimes said that Federalism died because the Republicans took over its principles of nationality and accepted its economic ideas. This is true in part. But it fell principally because its great leaders. John Adams and Alexander Hamilton, became bitter enemies; because neither was even distantly comparable to Jefferson as a party organizer and leader; because the party could not hold the support of its original commercial. manufacturing and general business elements; because the party opposed sectionalism to a growing nationalism on the issues that ended in the War of 1812; and because, after 1801, it failed to adjust itself to the growing democratic spirit of the country. In New England. where it persisted longest, it represented a "cordial union between the clergy, the magistracy. the bench and bar and respectable society" (Henry Adams); this inevitably had to fail in a dynamic. expanding America.

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FEDERAL RESERVE SYSTEM, THE. The federal reserve system is the central banking authority of the United States; as such it acts as a fiscal agent for the U.S. government, is custodian of the reserve accounts of commercial banks, makes loans to commercial banks, and is authorized to issue federal reserve notes which constitute a large fraction of the hand-to-hand currency of the country. Thus it has many of the functions characteristic of the Bank of England and of continental European central banks (see CENTRAL BANK).

Origins of the System. — Prior to the establishment of the federal reserve system and subsequent to the liquidation of the second Bank of the United States in 1836, there was no central banking institution in the United States. The provisions of the National Bank act of 1863, and the banking customs which emerged as a consequence thereof, produced a monetary and banking system which tended to concentrate the reserves of the commercial banks of the country in a small number of banks in a few financial centres, notably New York, with the result that unusual demands for currency or credit would periodically produce great financial stringency in the important financial centres. with consequent deflationary results. Similarly, the National Bank act did not provide a system for changing the quantity of currency so that it would be responsive to the changing needs of the business community or to the continued growth of the nation's economy. (See BANKING: History of Banking in the *United* States.)

In 1908 following the financial panic of 1907, congress established a national monetary commission, which came to be known as the Aldrich commission from its chairman, Sen. Nelson W. Aldrich, to study the requirements of a sound monetary system and to make legislative recommendations. The proposals of the national monetary commission were not embodied unchanged in the subsequent legislation, but the results of its work supplemented by the studies of others were influential in the discussions which led to the passage of the Federal Reserve act signed by Pres. Woodrow Wilson on Dec. 23, 1913. The Federal Reserve act has subsequently been amended, notably in 193j.

The Structure of the System. — The federal reserve system consists of (1) the board of governors of the federal reserve system; (2) the 12 federal reserve banks; (3) the federal open market committee; (4) the federal advisory council; and (5) the member banks. The functions of each of these will be treated in turn.

The Board of Governors. — The hoard of governors of the federal reserve system (known until 1935 as the federal reserve board) consists of seven members appointed by the president of the United States and confirmed by the senate. They are appointed for 14 years, one seat becoming vacant every two years. The chairman of the board is appointed by the president, from the membership of the board, for a period of four years. The members of the board of governors, which has its headquarters in Washington, D.C., devote their full time to the business of the board; they must not be directors, officers, employees or stockholders of any bank and not more than one of them may be appointed from any one federal reserve district. The president, in appointing members of the board of governors is required "to have due regard to a fair representation of the financial, agricultural, industrial and commercial interests, and geographical divisions of the country."

The board of governors of the federal reserve system is, in most respects, and in all important respects, the body which both supervises and controls the operation of the federal reserve system. The board determines the reserve reauirements of the member banks within the statutory limits it reviews and determines the discount rates established by the 12 federal reserve banks, it reviews the budgets of the federal reserve banks, its staff of examiners examines the operations of each of the federal reserve banks at least once a year, and in a number of other ways exercises substantial control over the operations of the system. The degree to which such control has been centralized in the board of governors was significantly increased in the Banking acts of 1933 and 1935.

The Federal Reserve Banks. — The country has been divided into 12 federal reserve districts in each of which there is a federal reserve bank. The districts are not necessarily coterminous with state boundaries. Federal reserve banks, all but two of which at mid-century had branches. are located. in order of the number given to the federal reserve district, in (1) Boston, Mass.; (2) New York city; (3) Philadelphia, Pa.; (4) Cleveland, O.; (5) Richmond, Va.; (6) Atlanta, Ga.; (7) Chicago, Ill.; (8) St. Louis, Mo.; (9) Minneapolis. Minn.; (10) Kansas City, Mo.; (11) Dallas. Tex.; and (12) San Francisco, Calif.

A federal reserve bank is a privately owned corporation established pursuant to the Federal Reserve act to serve the public interest. While it is privately owned (by the member banks; see below) the stockholders do not have the powers ordinarily associated with the stockholders of privately controlled corporations. Each member bank is required to subscribe to the stock of the federal reserve bank of its district in an amount equal to 6% of the member bank's capital and surplus. Half of this amount must be paid in while the remainder is subject to call. The maximum dividend which a federal reserve bank may pay to its member bank stockholders is 6% per annum.

Each federal reserve bank is governed by a board of directors of nine members. Three members, known as class A directors and three known as class B directors are elected by the member banks of the district. The class A directors may be bankers; the Class B directors must be actively engaged in the district in commerce, agriculture or industry and must not be officers, directors or employees of any bank. The class C directors are appointed by the board of governors. They must not be officers, directors, employees or stockholders of any bank. One of the class C directors is designated as chairman of the board and one as deputy chairman. The chairman of the board is by statute a federal reserve agent.

Thus a majority of the directors of a federal reserve bank are not active bankers and three, including the chairman and deputy chairman are not elected by the stockholders but appointed by the board of governors. The board of directors of a federal reserve bank is responsible for the conduct of the bank's affairs subject to the supervision of the board of governors.

This supervision while not detailed as to administrative procedure is significant. The board of governors must approve the appointment of the president and first vice-president of a federal reserve bank and the salaries of all officers and employees of each federal reserve bank are subject to approval by the board of governors.

The degree of control over the operations of the federal reserve banks by the board of governors of the federal reserve system together with the statutory limit on dividends payable to stockholders and with the practice of the federal reserve banks of paying 90% of earnings after dividends to the treasury as an interest charge on outstanding notes effectively results in the operation of the federal reserve banks in the public interest. Profit to the federal reserve banks is thus not a consideration in the formation of policy.

The Federal Open *Market Committee.*—This committee consists of 12 members, of which 7, the members of the board of governors serve *ex officio,* while j members are elected by the federal reserve banks. One of the five elected members is always chosen by the New York federal reserve district; the remaining four are chosen from federal reserve districts grouped for the purpose. The board of governors, if unanimous, always has a majority vote in the open market committee.

The committee is responsible for the determination of policy for the federal reserve banks operating as a system with respect to the purchase and sale of securities. This responsibility provides the system with one of its most powerful instruments of control over the money supply (*see* belon).

The Federal Advisory *Council.*—The council consists of 12 members each elected by the board of directors of one of the several federal reserve districts. It meets no less than four times a year. While its role is purely advisory, the board of governors being free to accept, reject or modify its advice, it may be influential in the formation of policy for the system.

The Member Bunks.—These consisted in the late 1950s, of some 6,750 banks of nhich approximately 4.850 were national banks; the remainder were banks chartered by the several states. All national banks (*i.e.,* banks operating under charters issued by the federal government) are required to be members of the federal reserve system. Banks operating under state charters may become members of the system if they meet the qualifications for membership and if accepted by the federal reserve system. The member banks represented something less than half of the banks of the U.S.; however, they held about 75% of the total bank deposits and more than 85% of total demand (commercial) deposits. Thus the policies of the federal reserve system have a direct effect on a large segment of total demand deposits, which constitute the largest part of the means of payment in the country, and indirectly influence the remainder.

Membership in the federal reserve system provides the member bank with certain advantages. The federal reserve banks are "banker's banks!' and they perform a variety of services for the member banks in that capacity. Among the most important of these is the clearing of checks which is done without cost to the member banks. *(See* CLEARINGHOUSE.)

The federal reserve banks also, free of cost or at a nominal charge, collect notes, drafts, maturing securities, etc., for the member banks, crediting the proceeds to the member bank's reserve account with the federal reserve bank. The federal reserve banks make coin and paper money available to the member banks without handling or shipment costs.

In addition to the important services noted above, the federal reserve banks hold the reserve deposits of the member banks and stand ready to make loans to member banks when the latter find it necessary temporarily to augment their reserve accounts in order to support an appropriate volume of loans and deposits (see BASKING: Principles *of* Banking) without disposing of other assets.

Membership in the federal reserve system does impose upon the member banks, however, some duties and responsibilities which are believed to deter some state chartered banks from seeking it. It requires member banks to comply with the reserve requirements established pursuant to law by the board of governors of the federal reserve system. The reserves must be held as deposits (without interest) with the federal reserve bank of the district in which the member bank is domiciled and they will in almost all cases be a larger proportion of deposits than will be true for a nonmember bank subject only to state law and regulation. Member banks must submit to regular examinations by the authorities of the federal reserve banks as well. in the case of national banks, as by the comptroller of the currency and in the case of state chartered member banks by the state banking authorities. They must honour all checks drawn upon them at par; *i.e.,* they must levy no remittance charges associated therewith. They must, moreover: hold assets of a quality somewhat higher than those permitted by the banking laws of many of the states.

Monetary and Credit Policies of the Federal Reserve System.—These policies, springing from the exercise of certain powers given to the system by statute, represent in terms of their influence upon the degree of economic stability. upon the level of economic activity and upon the price level. responsibilities which go far beyond the service functions described above. The federal reserve system through its power to alter the size, the availability and the cost of commercial bank reserves may influence greatly the magnitude of commercial bank deposits in the United States. Loans made by the commercial banks ordinarily emerge as increased deposits either in the bank making the loan or in another bank. Since member banks are required to hold a given proportion of their deposits as reserve accounts with the federal reserve banks, changes in the proportion which must be so held, changes in the cost of temporarily augmenting the reserves through loans from the federal reserve banks, or changes in the total size of the commercial bank reserves of the system will have effects upon the volurne of new loans and deposits (see BANKING: Principles of Banking). The federal reserve system exercises its regulatory powers in several ways. the most important of which may be described as the instruments of indirect control.

These instruments have to do with (1) the determination of the legal reserve ratio; *i.e.,* the proportion of its deposits which a member bank must hold in its reserve account; (2) the control of the discount rate, sometimes referred to as the re-discount rate; and (3j the control of open market operations; *i.e.,* the purchase or sale of securities in the open market by the federal reserve banks. Following a discussion of the bases of monetary and credit policy, the use of each of these will be described below.

The purposes of federal reserve policy are to facilitate the creation of a financial climate conducive to high level economic activity and to economic stability. The prevention of inflation or deflation, rapid rises or falls in the general price level. are essential parts of the task. Thus in a period of substantial inflationary pressure, particularly as is the typical case, when this emerges in a period of full or nearly full employment, the federal reserve system might be expected to use its powers in such a way as to restrict the growth of or actually reduce the supply of money.

On the other hand. in a period in which the signs of a recession appear or in a period of serious depression the system might be expanded to take action tending to lead to an expansion in the supply of money. It must be remembered that the term money as is used here refers principally to bank deposits, the most important means of payment (see QUANTITY THEORY OF MONEY).

Actions leading to either of the two results mentioned above may be taken through the exercise of any one or more of the instruments of indirect control mentioned above. Possible actions under circumstances in which inflationary pressures are strong and that, therefore. make efforts to reduce the actual or potential money supply, in order, include the following: (1) the federal reserve system might consider raising the legal reserve ratio. This action would increase the proportion of deposits which commercial banks are required to hold in deposit with the federal reserve banks and thus reduce the amount of new loans they could make. Since loans give rise to deposits, the potential money supply would be reduced. Any excess reserves in the system (excess reserves = actual reserve balances less required reserves) would be reduced or eliminated.

(2) Federal reserve bank sales of securities in the open market at the discretion of the federal open market committee would tend to reduce the actual size of commercial bank reserves. When the federal reserve sells securities the purchasers of the securities pay for them with checks on their deposits. This reduces deposits and since the amounts of the checks will be charged to the reserve accounts of the banks on which they are drawn, bank reserves are reduced. If, of course, the member banks should themselves purchase the securities, they will pay for them, in effect, by drafts upon their own reserve accounts. In any case. then. open-market sales of securities by the federal reserve banks have the effect of reducing bank reserves. Thus member banks will find themselves increasingly pressed to accommodate their loan customers and the actual or potential volume of deposits will be reduced.

(3) In the circumstances likely to follow upon open-market sales. the member hanks more frequently might be required to seek loans from the federal reserve banks of their respective districts. If, then, the federal reserve banks increased the interest rate—the discount rate at which such loans are available — member banks would find it increasingly costly to augment their reserves in this way. They mould, therefore, tend to be more restrictive and more selective in making loans. which tendency would be reinforced by the higher interest rates member banks would charge their customers as a consequence of the greater cost of reserves resulting from an increase in the federal reserve bank discount rate.

Thus to increase the reserve ratio. to undertake sales of securities in the open market and to increase the discount rate, would serve separately or in combination. to restrict the rate of credit expansion and thus reduce the actual or potential money supply. Clearly. opposite policies would be called for in a period of recession or in a period of deep depression. In such circumstances, the federal reserve system might be expected to reduce the legal reserve ratio, to reduce the discount rate and to undertake open-market purchases of securities. These steps taken separately or in combination could be expected to increase excess reserves. reduce the cost of temporary augmentation of reserves and produce an increase in the actual size of member bank reserves. Thus banks would be encouraged to increase their loans to customers. the potential money supply would be larger than otherwise would be the case and, if the demand for loans on the part of the business community is strong, loans and deposits will rise.

The instruments of indirect control described above have generally been conceded to be more powerful with respect to the prevention of inflation in times of high level economic activity than they are in connection with policies directed toward producing a revival from a period of depression. It should be noted that in the mid-1950s there was some growing controversy respecting the ability of the federal reserve through monetary policy alone to prevent an inflation.

In connection with attempts to prevent inflation under conditions of full employment, federal reserve has upon occasion supplemented the indirect controls described above with a series of selective controls. One of these relates to the control by the federal reserve of the margin requirements involved in the purchase of securities. The board of governors of the federal reserve system has, since 1934, had the power to limit the amount which lenders may make available on securities. Variable percentage requirements have been in effect since the inception of the program. ranging from 40% for several years prior to World War II to 100% in 1946 and 1947.

By executive order of the president of the United States in 1941, the federal reserve system was authorized to control the terms upon which credit could be extended to consumers for the purchase of important consumer durable goods. The regulation terminated in 1947, was reinstated briefly in 1948. terminating in the summer of 1949, was reinstated again after the outbreak of the Korean war and the authority to impose such regulations was finally repealed in the Defense Production act as amended in 1952. The consumer credit regulations sought to reduce the expansion of credit by controlling the minimum down payment required for the purchase of consumer durable goods and by controlling the maximum length of the amortization period of the loan and thus controlling the size of monthly payments. Similar regulations relating to the financing of real estate purchases were in effect from late 1950 until Sept. 1952.

Relation of the Federal Reserve System to Government. — The federal reserve system is an agency of government theoretically independent of the executive branch. The appointment of the members of the board of governors for terms of 14 years so arranged that one vacancy normally will occur every two years is designed, in part. to provide a substantial degree of independence. The board of governors is, of course, responsible to the congress of the United States.

Many students of banking and financial affairs hold the view that the federal reserve system should occupy such an independent position as an agency of government on the ground that the exercise of power over the banking system and over the supply of money should not be subject to political influence.

In general and with one notable peacetime exception. the independent conduct of the system's affairs has not been modified. During World War I, when the system was in its infancy, and again during World War II the system did, of course, accommodate itself to the full in providing means to facilitate the financing of the huge wartime expenditures. During these periods. large budgetary deficits had to be financed and the federal reserve system followed credit policies designed to ease the process.

In the period immediately subsequent to World War II, the policy of the treasury designed to insure continued low interest rates on the public debt involved the federal reserve system in practices which made the exercise of its normal powers to control the size and rate of expansion of the money supply difficult or impossible. This situation became clarified by the "accord" of March 1951 in which, it was announced. the treasury and the federal reserve system had reached agreement "with respect to debt management and monetary policies to be pursued. . . ." Thereafter. the federal reserve system again undertook with increasing independence of action to influence the flow of money and credit in the interest of controlling inflation and maintaining economic stability. (See BANKING: *History of Banking: The United States.*)

See Board of Governors, *The Federal Reserve System* (Washington, D.C., 1954) ; *G. L.* Bach, *Federal Reserve Policy Making* (New York, 1950). (FK. L. K.)

FEDERAL SAVINGS AND LOAN ASSOCIATION: see SAVINGS AND LOAN ASSOCIATION.

FEDERAL THEATRE PROJECT. Established on

Aug. 27, 1935, at a time when many theatre artists were unemployed, the Federal Theatre project was organized by the U.S. government under the Works Progress administration. Federal Theatre groups were set up wherever the relief rolls showed enough theatre people to operate a company; nine out of ten members had to come from relief rolls. and $9.00 out of $10.00 had to be spent for security wages. The object of Federal Theatre was twofold: to give employment to needy professionals in socially useful projects which would rehabilitate them and develop their skills; and to bring to thousands of people, hitherto unable to afford theatregoing, a theatrical program national in scope, regional and state in operation, and worthy of government support.

Employment of so many people (12,700 in 1936; 7,900 in 1939) required a broad program, including productions of the classics, children's theatre, religious plays, musical comedy, marionettes, circus, vaudeville, dance and radio. Special emphasis was given to regional festivals such as *The Lost Colony,* outdoor drama, Manteo, N.C., and to productions in San Francisco, where Federal Theatre built its own theatre out of admission funds. Federal Theatre also gave impetus to new plays such as *It Can't Happen Here,* by Sinclair Lewis, which opened simultaneously in 21 cities. The most effective new theatre form developed by Federal Theatre was the Living *Newspaper,* characterized by vivid exposition of factual material in a flashing, often witty, series of blackouts. Such dramatizations as *Power* and *One Third of a Nation* played to crowded houses throughout the country.

A service bureau acted as a clearinghouse, where plays were written. translated and tested in. production and where contracts were signed, royalties paid and research was carried on. The service bureau published *Federal Theatre Magazine,* a graphic story of nationwide theatre, and *Continental Theatre,* at that time the only magazine in the country giving monthly translations of news from European theatres.

Federal Theatre productions were seen by about 25,000,000 people, an estimated 65% of whom had never previously seen a play. Companies also toured various public and private institutions. By Oct. 1938 Federal Theatre was receiving widespread critical acclaim; 2.600 of its members had been returned to private employment; and although over half of Federal Theatre companies were giving free shows, box office admissions had reached the $2,000,000 mark. Support from schools, churches and many business, professional and community organizations was increasingly enthusiastic. Federal Theatre, however. was also sharply criticized. especially for its "Living Newspaper" series. From mid-1938, allegations that the project was communistic were made and the house of representatives subcommittee on appropriations voted to eliminate Federal Theatre. In spite of wide support from spokesmen in New York and Hollywood, all theatre unions and leading critics, Federal Theatre was ended on June 30, 1939.

See Hallie Flanagan, ***Arena: An Adventure in the American Theatre*** (1941). (H. F. D.)

FEDERAL TRADE COMMISSION, THE, a U.S. administrative agency. was created by federal legislative enactment in 1914. Congress gave the commission two distinct powers. The first was couched in language similar to that previously given to the bureau of corporations, which had been organized under the department of labour and commerce in 1903. In fact. the bureau had been transferred to and became a part of the commission. Under this power, the commission could investigate corporations and business and report its findings to congress, the president or the public at large. It could also, at the request of congress or either house, or the president or the attorney general, make investigations and report the results. The commission. in the industrial world. was to keep the public and the administrative and legislative departments of the government informed of the conditions in the several industries and to make special economic and legal studies and inform congress.

The second great power entrusted to it came into play when in the interest of the public welfare the commission deemed it necessary to issue a complaint against any offending business unit that was practising an unfair method of competition. It required the offender to reply, and testimony was taken under oath relative to the issue involved.

The statute required the commission either to dismiss the complaint in the event that the testimony was insufficient to establish an unfair method of competition in interstate commerce or, if a case was made out, to issue an order to cease and desist from the offending method. Many of the complaints issued have been based upon charges made by one competitor against another.

The policy of the commission in its earliest days was not to name the offender publicly but to make findings and issue an order to cease and desist. Since this did not seem to halt the practices complained of, the commission later named the offenders publicly when a complaint was issued.

Simultaneously with the passage of the Federal Trade Commission act, congress passed the Clayton Antitrust act, approved Oct. 15, 1914. Under it congress entrusted the commission with the prevention of unlawful price discriminations, tying contracts, stock acquisitions in competing corporations and interlocking directorates. The purpose of these provisions was to prevent certain practices which were regarded as lessening competition or tending to monopoly. but which it was feared would not always in themselves be sufficient to bring the person who practised them within the scope of the Sherman Antitrust act of 1890.

The commission was not long in finding that when one competitor in an industry violated legal rules of practice it was soon followed by many others. This frequently resulted in a deluge of complaints which would have absorbed more time than the legal section could spare. Thus a procedure called the Trade Practice submittal was inaugurated. The name was later changed to that of Trade Practice conference. In these conferences members of the industry concerned were assembled to consider and adopt fair trade practice rules to be submitted to the commission for its approval, the conferences being held under the auspices of the commission. After being subjected to public hearing and full consideration, the approved rules were promulgated by the commission. The early beginnings of the conference method go back as far as 1919. The commission thereafter held many industry trade conferences and set rules for the different trade or industrial groups. These cover industries whose capital investment and annual volume of sales total several billions of dollars.

An outstanding advantage of this method of regulating business practices is that it effectuates the wholesale abandonment and prevention of unfair methods of competition and trade abuses voluntarily, co-operatively and simultaneously. Correction is thus brought about on a friendly basis and at substantial saving of time and expense to the government and to business, and. at the same time, the public and industry generally are shielded from harmful effects of bad practices.

This plan worked so well that in some instances it brought about general correction of harmful practices throughout an entire industry without incurring the expenditure. of time and money which would otherwise be required to eradicate these evils by compulsory action through legal proceedings instituted against individual offenders.

Bforeover, this procedure of the commission afforded industry a means of proper self-regulation and co-operative effort nith the assistance and supervision of the government. Under the rules, industry and trade receive official guidance and assurance as to the inhibitions of the law. The rules constitute a convenient and authoritative code whereby manufacturers, distributors and buyers may readily be informed as to what the legal requirements are as they apply to the particular industry or trade. Law observance is promoted.

The rules operate as an effective deterrent to violations which result from ignorance, carelessness or even indifference, beside assisting in making compulsory correction more efficient. Consumer rights are carefully protected, and members of the industry who desire to serve the public conscientiously and with increased satisfaction are aided. The trade practice conference procedure thus came to be widely recognized as an official activity productive of great public good.

In order to speed up action with respect to complaints filed and to offer the respondent the privilege of disposing of his case without the cost of a trial, the commission devised a procedure before issuance of a complaint and trial of permitting the respondent to sign a statement of fact and agreement to discontinue the alleged unfair method of competition or practice, the subject matter and form of'the stipulation being prepared under supervision of the commission in accordance with the facts as disclosed by its investigation.

Administration of the Clayton act had for some time demonstrated its inadequacy as a restraint upon the growth of monopoly. The result was an amendment by the Robinson-Patman act on June 19, 1936. Designed to eliminate certain unfair and discriminatory practices not prohibited by the Clayton act and believed by congress to be injurious to commerce. the Robinson-Patman act, broadly speaking, was to promote equality of opportunity in business and check a tendency toward monopoly disclosed as a result of the Federal Trade commission's chain-store investigation, the investigation by a special committee of the house of representatives of the lobbying activities of certain groups. and congressional committee hearings held during consideration of the act itself. The act was not directed at any particular type or size of business organization but was applied to all merchants, large and small alike. It prohibited discriminations in price to purchasers of commodities of like grade and quality where the effect of such discriminations was substantially to lessen competition, in any line of commerce, unless such discriminations were justified by savings attributable to economies of operation effected by the particular method in which commodities were manufactured for, or were sold or delivered to. the purchaser receiving the discrimination. This passing on of savings by sellers to buyers was made permissive, however, not mandatory.

The Federal Trade Commission act was broadly amended March 21, 1938. by what is known as the Wheeler-Lea act. There were several reasons which induced congress to make these amendments. In a case before the supreme court of the United States in 1931, involving what was considered by the commission to be a dangerously misleading and false advertisement, the court held that the commission had no authority to ban the false advertising because it did not appear that the unfair practices were "methods of competition in commerce."

Congress accordingly amended the act so as to make unfair or deceptive acts or practices in commerce unlawful as well as unfair methods of competition, thus granting the purchasing or consuming public the same protection against unfair practices that a merchant or manufacturer already enjoyed against the unfair methods of a dishonest competitor. Congress also provided definite and substantial civil penalties, through suits to be brought by the attorney general, for violation of the commission's order to cease and desist after they became final. The review by the courts of the commission's orders to cease and desist, through the filing of petitions to review or set aside the same, was amended so as to require thereafter the petition to be filed within 60 days. Otherwise, the commission's order became final, and its violation thereafter subjected the offender to suits for civil penalties.

Prior to the passage of later amendments, there was no penalty for violation of the commission's orders, unless they were violated after they had been affirmed by a circuit court of appeals of the United States. Proof of such violation, after the order had been affirmed by the circuit court of appeals. formed the basis for contempt proceedings. Such proceedings might be brought in cases where. on review sought by the respondent, the courts affirmed the commission's orders, if such orders were thereafter violated.

The hearing examiners became an initial trial court on June 1, 1950. Appeals from that court might be made to the commission by respondents and commission attorneys, or the commission might schedule the issue for review on its own motion.

In response to the demand for greater consumer protection in the case of the deceptive advertising of commodities whose use might affect the public health. congress specifically prohibited the dissemination of the false advertisements of food, drugs, cosmetics and therapeutic devices.

Where the use of such commodities might be injurious to health, or where they are falsely advertised with fraudulent intent, criminal penalties are imposed. In a further effort to grant adequate protection to the public during the period pending the issuance of and final action upon the commission's complaint, the commission was authorized to bring suit in the several U.S. district courts, or in territorial courts, to enjoin the dissemination of the false advertisements of food, drugs, devices or cosmetics. Such temporary injunction was to remain in effect until the order of the commission to cease and desist became final. unless the complaint was dismissed by the commission or the order to cease and desist was set aside by the court on review.

Advertising over the radio became so extensive and so constantly necessitated the determination of what is fair and unfair in advertising through that medium that the commission, in 1938, established a Radio and Periodical division. This division took over the duties theretofore handled by the commission's Special Board of Investigation and, at the same time, its supervision was extended so as to cover mail-order catalogues and foreign-language newspapers. Thousands of pages of magazine and newspaper copy and thousands of radio and television continuities are scanned yearly. and the commission keeps in close touch with broadcasters and their clients. It was found necessary for the commission in the field of medicinal advertisements to add to its staff medical men as consultants.

The commission continued to operate under the Federal Trade Commission act as later amended and the Clayton Antitrust act (including the Robinson-Patman and Antimerger amendments) and was also authorized to act in a quasi-judicial and quasi-legislative capacity by acts dealing with export trade, wool and fur products labelling, flammable fabrics, trademarks, etc. Through its orders to cease and desist and through other means such as formal litigation leading to mandatory orders and voluntary co-operation the FTC protected businessmen from unfair competition and the consuming public from false, deceptive or dangerous trade and advertising practices.

(See also INTERSTATE COMMERCE.) (H. TH.; X.)

FEDERATION OF BRITISH INDUSTRIES. The Federation of British Industries is the largest national voluntary organization representing productive industry in the Cnited Kingdom. It was founded in 1916 and incorporated by royal charter in 1923. Through it industrial policy is shaped and expressed both nationally and internationally, and industry can develop activities to help itself. It has no connection with any political party. Apart from labour questions the scope of its work covers the whole range of industrial activity.

All the leading trade associations representing British industries are members, together with several thousand individual firms. Its governing body, the grand council, is elected by members every three years; about two-thirds of its members represent trade associations and the remainder individual firms and each of the ten F.B.I. regional councils. It is advised by 19 standing committees and many subcommittees dealing with specialized subjects ranging from taxation to overseas trade, and by the regional councils elected by members in the region, which deal with local issues and help to keep members in touch with the centre and vice versa. The president is elected annually, but usually holds office for two years. The staff of about 160 is under a director-general, assisted by a general secretary and four directors. The head office is in London and there are also offices in 14 industrial centres in the United Kingdom and representatives in about 100 countries overseas. By representations to ministers, by evidence to official inquiries. through government committees and by continuous liaison with government departments, the federation seeks to safeguard the interests of industry and to persuade the government in the fields of legislation and administration to create and foster conditions nationally and internationally in which industry can flourish. It also seeks to acquaint the press and the public with industry's problems and points of view and to give a lead to industry itself. Its expert staff gives direct service to members on export problems and many technical subjects such as taxation, fuel efficiency and trade effluent. (D. L. W.)

FEDERER, HEINRICH (1866–1928), a prolific Swiss novelist. was born at Brienz. Oct. 7, 1866. and died at Ziirich. April 29,

1928. Destined for the priesthood, he had to give up his pastoral duties because of his health and thenceforth devoted himself to literary work. He is one of the most poetic, richest and delectable of the so-called *Heimatkünstler,* or authors dealing mainly with native subjects, while his Roman Catholicism introduces a note that is rather unusual in German Swiss literature. His second subject was Italy, especially the Abruzzi. Among the best-known of his novels are *Berge und Menschen* (1911), *Jungfer Therese* (1913), *Das Mätteliseppi* (1916; his own favourite) and *Papst und Kaiser im Dorf* (1924). His short stories are equally charming, such as *Sisto e Sesto* (1913), an extraordinarily popular book and the collection under the title of *Lachweiler Geschichten* (1911). Federer's last work was a volume of reminiscences of his youth. *Am Fenster* (1927).

FEE, an estate in land held of a superior lord on condition of the performance of homage or service (*see* FEUDALISM). In English law "fee" signifies an estate of inheritance (*i e.,* an estate descendable to the heirs of the grantee as long as there are any in existence) as opposed to an estate for life. It is divisible into three types: (1) fee simple; (2) conditional fee; (3) fee tail. A fee farm rent is the rent reserved on granting a fee farm; *i.e*, land in fee simple, to be held by the tenant and his heirs at a yearly rent (*See* RENT.) Fee may also mean payment for professional services

FEEBLE-MINDEDNESS: *see* MENTAL DEFICIENCY.

FEEDS, ANIMAL. The materials on which animals are fed differ widely in chemical composition and nutritive value. For convenience they are divided into two general classes: concentrates and roughages. Concentrates include a large variety of feeds that have a high value because they are rich in easily digested nutrients, such as starch, fat and protein, and are low in fibre. or woody material, which is not well digested. Roughages have a much lower value because they are relatively high in fibre and contain less of the more digestible nutrients.

Good nutrition is necessary if animals are to be able to maintain health and produce satisfactory amounts of milk, eggs, meat. wool or work. Animals require each day food furnishing sufficient amounts of protein; energy. chiefly supplied by the carbohydrates and fat; essential minerals; and vitamins. Plenty of water and air are also needed.

This article deals with the nutritional value, supply and utilization of (1) proteins; (2) carbohydrates and fat; (3) minerals; (4) vitamins; (5) composition and valuation of animal feeds; (6) important concentrate feeds; and (7) important roughages. In addition to related articles referred to in this article, *see* also for production, marketing and other information on specific feeds the articles on such individual crops and products, as ALFALFA; CORN; COTTONSEED; SOYBEAN, etc.

Material on storage and processing and on feeders will be found in the articles CROP PROCESSING MACHINERY; FARM MACHINERY; FARM BUILDINGS. For feeds and feeding practices for specific animals *see* articles such as CATTLE; PIG; SHEEP etc

Protein.—A certain minimum amount of protein is needed for the daily repair of muscles, internal organs and other tissues of the body. In addition to this maintenance need, animals that are growing require much larger amounts of protein for the growth of the muscles and other parts of the body. Since milk, eggs and wool contain much protein, additional amounts of protein are needed for their production. Physical work, even hard work. does not perceptibly increase the protein requirement, because carbohydrates and fat can furnish the needed energy.

Proteins are complex substances. made up of a variety of amino acids. In the digestion of food the proteins are largely broken down into these amino acids, which are absorbed into the blood to nourish all parts of the body. For animals with simple stomachs, including humans, monkeys, swine, poultry, dogs, cats, hamsters, rabbits. guinea pigs mink and rats, the kind or quality of the protein in the ration is more important than the amount. These animals require daily the correct amounts of the following ten essential amino acids: arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. In addition to these, poultry need glycine and glutamic acid for growth. High quality protein contains the correct amounts of the essential amino acids. Such protein is supplied by eggs, milk and milk products, fish meal and meat by-products, and by soybean oil meal. Poor quality protein, such as found in corn grain (maize) contains too little of one or more essential amino acids to meet the needs of animals. Those feeds having poor quality proteins are made useful by combining with them other feeds which supply the lacking amino acids.

Fortunately, the quality of the protein in the food is of little importance for ruminants, including cattle, sheep, goats and the other animals that have four stomachs with a large paunch or rumen. This is because the bacteria that are important in the digestion of food in the paunch are able to make complete proteins. containing all the essential amino acids, from simpler nitrogen-containing compounds. They use the simple nitrogen compounds to build proteins in their cells. Then further on in the digestive tract, the animals digest the bacteria and thus secure by this indirect means protein of high quality from a food that might originally have had poor protein. By this method cattle and sheep are able to use urea, a nitrogen compound synthesized from the air, in place of protein. which is sometimes scarce and expensive. Only the ruminant animals can use urea instead of protein. Very young ruminants, such as calves. lambs and kids, however, need plenty of good-quality protein until the paunch develops sufficiently for this bacterial process to become well established. *See* also PROTEINS.

Carbohydrates and Fat.—Since the body temperature of warm-blooded animals is considerably above the usual temperature of the air, food nutrients must be oxidized, or burned, in the body to supply the necessary heat. In addition, even animals at rest must have a certain amount of energy-producing nutrients to enable them to carry on their normal vital functions. Growing animals need more energy than mature ones that are being merely maintained, because of the storage of energy-rich nutrients (protein and fat) in the growing tissues. For rapid fattening, for milk production and for work additional amounts of energy must likewise be supplied.

The need for heat and energy can be met by carbohydrates such as starch or sugar, or by fat. If the food of an animal furnishes more protein than is required for the special protein functions, the excess protein can be oxidized in the body to supply heat or energy.

Some of the carbohydrates in feeds, especially starch and sugars, are easily digested by animals and therefore have a high nutritive value. On the other hand, the complex carbohydrates that form the fibre of plants are digested less completely. Also, there is a large loss of energy in the process, this energy being converted into heat in the body. It thus can help keep the body warm, but has no value for productive purposes. Therefore, fibre has a low value in comparison with starch or sugar. Although humans and such animals as swine, poultry, dogs, cats and other animals with simple stomachs can digest but little of the fibre in feeds. cattle, sheep and goats are able to make much better use of it. This is because fibre is digested through the bacterial action that occurs in the paunch. or rumen of these animals. Horses and rabbits are also able to use fibre fairly well. as similar bacterial digestion takes place in the blind gut, or caecum. a greatly enlarged part of the large intestine. These classes of farm animals can, therefore, be fed to a considerable extent, and in some cases entirely, on hay and other roughages which are high in fibre.

Fat in feeds has a high value because it is highly digestible and because it supplies about two and one-quarter times as much energy as does starch or sugar. While fat has this high nutritive value, it can be replaced by an equivalent amount of digestible carbohydrates in the food, except for small amounts of essential fatty acids. It was found in experiments with laboratory animals, and pigs and calves, that very small amounts of certain fatty acids. especially linoleic and linolenic, contained in some fats, are necessary for growth and health. However, usual feeds supply ample amounts of these acids unless they have been removed by processing. *See* also CARBOHYDRATES; OILS, FATS AND WAXES.

Minerals. — Certain mineral nutrients are fully as essential for animal life as are protein. carbohydrates and fat. Among these are common salt (sodium chloride), calcium, phosphorus. sulfur, potassium, magnesium, manganese, iron. copper, cobalt, iodine. zinc, molybdenum and selenium. The latter six of these elements are poisonous to animals if excessive amounts are eaten.

All farm animals generally need common salt in addition to that supplied by their feeds, and they should be supplied nith it regularly. Of the other essential minerals. phosphorus and calcium are most apt to be lacking, because they are heavily drawn upon to produce bones and also milk. Good phosphorus supplements are steamed bone meal, dicalcium phosphate, or defluorinated phosphates (especially processed to remove most of the mineral element fluorine, which may injure animals). Calcium may readily be supplied by ground limestone, ground shells or marl that is high in calcium.

Small amounts of iodine are needed by the body for the formation of thyroxine, an iodine-containing compound secreted by the thyroid gland. This controls the rate of metabolism or body processes. A serious deficiency of iodine may cause goitre, a disease in which the thyroid gland enlarges greatly in a vain effort to produce thyroxine. In certain regions there have been heavy losses of newborn pigs, lambs, kids, calves and foals from goitre. The young so affected are born dead or weak, and the pigs are usually nearly hairless. Experiments have proved that this trouble can be prevented by supplying small amounts of iodine to the mother animals before the young are born. The simplest method has been to use iodized salt during this period instead of ordinary salt.

In a few districts the soil and forage are deficient in copper and cobalt, which are needed along with iron for the formation of hemoglobin, or red colouring matter of the red blood cells In these districts farm animals may suffer seriously from anemia. or a lack of red blood cells, unless the deficiency is corrected by means of a suitable mineral supplement. Trace amounts of molybdenum also are needed for certain enzymes in animal tissues. However, excess amounts of molybdenum are found in the soil and legume forages in limited areas of England, Holland, Australia, New Zealand and the U.S. Forages in these areas may cause severe diarrhea and loss of pigmentation in the hair coats of cattle. These symptoms can be prevented or corrected by feeding copper salts. Iron, which is used in hemoglobin formation, is amply supplied in all animal feeds, except milk. The only practical problem with iron deficiency occurs in young suckling pigs, before they start to consume other feeds in addition to milk.

Though manganese is essential for animals, sufficient is supplied by the usual rations for all farm animals except poultry. A lack of manganese may cause the nutritional disease of chicks and young turkeys called slipped tendon, or perosis, and also may cause a failure of eggs to hatch. Sufficient manganese is readily furnished in poultry rations by adding one-quarter pound of manganese sulfate to each ton of feed. So far as is known. the other minerals that are essential for farm animals are provided in ample amounts in their ordinary rations.

A number of practical rations for swine have been shown to result in zinc deficiency, especially in the presence of an excess of calcium. Adding 100 parts per million of zinc carbonate will overcome the symptoms otherwise observed, which include retarded growth rate and severe scaliness and cracking of the skin, called parakeratosis. A trace of selenium is necessary for normal health of animals, but the excessive amounts found in forages in some regions prove poisonous to animals and may cause death loss.

To furnish both calcium and phosphorus, livestock may be allowed free access to such a mixture as 60 lb. dicalcium phosphate and 40 lb. common salt. Trace mineralized salt should be used uhen copper or cobalt may be deficient. It is a good plan also to allow animals access to common salt separately, so that they will not be forced to eat more of the other minerals than they require to get the amount of salt they need. Mineral supplements are relatively inexpensive, and therefore suitable mixtures can be fed when there is any probability of rations being deficient in mineral elements. See FERTILIZERS AND MANURES: Influence of Fertilizers on Livestock and Human Food.

Vitamins. — The numerous scientific discoveries concerning the vitamins had a profound effect upon livestock farming by increasing the efficiency of animal production and preventing serious nutritional diseases. For example, before the functions of vitamins were known, pigs that were born in the fall in colder climates often failed to thrive, and many became paralyzed or died from pneumonia or other diseases. This fall-pig problem was solved through the use of improved rations that provided an ample supply of the essential vitamins.

Vitamin A is the vitamin that is most apt to be lacking in livestock feeds. It is required for growth, reproduction, milk production and even for the maintenance of mature animals. A serious deficiency makes animals especially subject to diseases of the respiratory tract, and thus pigs fed rations lacking vitamin A often die of pneumonia.

Feeds of plant origin that have a high vitamin A value really contain little or no actual vitamin A, which is colourless. Instead, they contain yellow-coloured carotene, which animals can readily convert into vitamin A. All green growing crops are rich in carotene, therefore animals that are on good green pasture have an abundant supply. In curing green crops into hay in the field some of the carotene is destroyed but enough remains so that well-cured, green-coloured hay is nearly always high in vitamin A value. The carotene content of green forage crops is preserved still better by making them into silage. Most seeds and their by-products have little or no vitamin A value. A notable exception is yellow corn, which has considerable, while white corn has little or none.

When cattle, sheep and horses have good pasture during the growing season and receive well-cured hay or hay and silage during the winter. they have an ample supply of vitamin A. For swine that are not on pasture, 5% to 10% of good quality alfalfa hay or other legume hay can be included in the ration as insurance against a lack of this vitamin. Alfalfa meal is also included in most commercial poultry rations to supply this vitamin.

Next to vitamin A, attention is given to vitamin D in livestock feeding. This vitamin is needed to enable animals to assimilate and use the minerals, calcium and phosphorus. A deficiency of the vitamin causes serious bone diseases such as rickets in young growing animals. Fortunately. sunlight that has not passed through window glass has vitamin D value. This is because the ultraviolet rays of sunlight penetrate the skin of animals and produce vitamin D from the provitamin in the tissues. It is strange that green forage crops growing in the bright sunlight contain little or no vitamin D. However, in the field-curing of hay considerable vitamin D is developed through the action of the sunlight on ergosterol in the hay crops Cod-liver oil and certain other fish oils are very rich in vitamin D.

Livestock that are outdoors in the sunlight much of the time have a plentiful supply of vitamin D. Under winter conditions in cold regions, cattle, sheep and horses ordinarily get ample amounts from the hay they are fed. Including 5% to 10% good-quality field-cured legume hay in swine rations during the winter not only supplies vitamin A, but also usually provides sufficient vitamin D. Because poultry have especially high vitamin D requirements, special vitamin D supplements are included in their rations, particularly under winter conditions, or when they are confined away from the direct sunlight.

The vitamins included in the vitamin B group are not important in the feeding of cattle, sheep and other ruminants. This is because the bacteria that aid in digestion in the paunch, or rumen, synthesize these vitamins and consequently provide such animals with plenty. Very young calves that are being raised on milk substitutes and other special diets may benefit slightly by the addition of yeast, a rich source of these vitamins, to their ration. Poultry, swine and other simple-stomached animals also require the B vitamins in their diets. The B vitamins include thiamine. riboflavin, niacin, pantothenic acid, choline. biotin, folic acid, vitamin B_6 and vitamin B_{12}. There is evidence that there are still other factors in this group (see VITAMINS). Of the B vitamins, riboflavin, niacin, pantothenic acid and vitamin B_{12} are the ones most likely to be deficient in ordinary feeds and at times special supplements are needed by pigs, poultry and laboratory animals for best results Choline may also be deficient in poultry feeds. The other B vitamins are found in adequate amounts in typical feeds so that special sources are usually unnecessary. Some of the B vitamins (biotin and inositol) and also vitamin K are synthesized by bacteria in the intestinal tract of animals and therefore the amount in the feed is of no importance

Vitamin E is necessary for normal hatchability of eggs, and it plays a role in preventing muscle stiffness and paralysis (dystrophy) in lambs and calves under certain conditions. Except for these instances natural feeds contain ample vitamin E to meet the needs of animals. Vitamin C, which prevents scurvy in humans and guinea pigs can be synthesized in the bodies of other animals and need not be supplied in their food.

Composition and Valuation **of** Feeds.—In order to combine the various feeds that may be available into rations that will meet the nutritive requirements of animals it is necessary, first of all, to have definite knowledge concerning their chemical composition. In the usual chemical analysis of feeds all the compounds are grouped for simplicity and ease of analysis into the following general classes: dry matter; protein; fat; crude fibre, often called merely fibre; nitrogen-free extract; and mineral matter or ash. The nitrogen-free extract includes the more digestible and valuable carbohydrates, such as starch and sugar. Analyses for the mineral elements, calcium, phosphorus, cobalt, copper, zinc and others, are sometimes made.

The standard reference books on livestock feeding and the publications of the U.S. National Research council contain extensive tables showing the chemical composition of many different feeds. Chemical analyses show merely the total amounts of the various classes of nutrients that a particular feed contains, but they do not give definite information concerning the extent to which animals can digest and use the nutrients. Digestion experiments are, therefore, conducted with animals to determine the amounts of nutrients in various feeds that are actually digestible. From the results of such studies the percentage of digestible protein and the amount of digestible energy, is commonly stated. The percentage of "total digestible nutrients" may also be calculated. This is the sum of the digestible protein, the digestible fibre, the digestible nitrogen-free extract and the digestible fat, the last being multiplied by 2.25. This is done because one pound of fat supplies two and one-quarter times as much energy as does one pound of digestible carbohydrates.

Tables stating the percentages of digestible nutrients in various feeds furnish useful information concerning their values. However, certain losses of energy occur during the absorption and utilization of food which are not deducted in determining the digestible nutrients The most important of these additional losses is the loss of energy in the work of digestion and metabolism. It is easy to see that energy is required for the movements of the jaws in chewing, for the movements of the digestive tract and for the increased work of the heart and lungs during digestion. Also the secretion of the digestive juices requires energy, and there are losses of energy in the heat produced by fermentations in the digestive tract. The energy used up in these processes takes the form of heat. and it may help to warm the body. However. it cannot be used for other purposes, because the body has no ability to convert heat into other forms of energy.

A further loss occurs through the speeding up of the body processes which always follows the eating of food. While nutrients are being absorbed from the digestive tract following a meal, more heat is produced than at other times. This effect is familiar to all of us, for we know that if we eat a meal when we are chilly, we will soon feel decidedly warmer. Likewise, if we eat too heartily in hot weather, we will suffer even more from the heat.

The losses of energy in the work of digestion are much higher in the case of feeds that are high in fibre than with grain and other concentrates that are low in fibre and therefore readily digested. For example, 30% of the energy in the nutrients from corn grain is used up in this work of digestion, while the loss is 60% in the case of wheat straw.

Many years ago O. Kellner in Germany and H. P. Armsby in the United States conducted long-continued experiments to determine the net nutritive values of typical feeds after all these losses were deducted. Their results and the studies of others on this question furnished valuable information concerning the actual productive value of typical feeds. Kellner expressed his results in terms of starch values, in which one pound of digestible starch is taken as the unit of energy. This system of measuring the net nutritive value of feeds has been widely used in European countries. In the United States, the method of Armsby has been generally followed, in which digestible energy, metabolizable energy. or net energy values are used.

TABLE *I.—Composition and Digestible Nutrients in Typical Livestock Feeds*

	Dry matter %	Protein %	Calcium %	Phosphorus %	Digestible protein %	Digestible energy kcal./lb.
Roughages						
Alfalfa hay	90.5	15.3	1.47	0.24	10.9	1.02
Timothy hay	89.0	6.6	0.35	0.14	3.0	0.99
Corn silage	27.6	2.3	0.10	0.07	1.2	0.37
Grass silage	25.8	3.2	0.32	0.12	1.9	0.31
Concentrates						
Corn grain	85.0	8.7	0.02	0.27	6.7	1.62
Oats grain	90.2	12.0	0.09	0.33	9.4	1.42
Soybean oil meal	89.3	45.8	0.32	0.67	42.1	1.56
Wheat bran	89.1	16.0	0.14	1.17	13.0	1.33

Source: NRC Publication 464

In Table I is shown the composition of some typical feeds with respect to dry matter, protein, calcium and phosphorus. The digestible protein and digestible energy values are also shown. Such values are useful in deciding which feeds will supply the nutrients needed by animals. Standard books contain tables showing the nutrient requirements of animals of various ages and sizes. Using these tables and others shoving the composition of feeds, it is possible to calculate the amounts of various feeds necessary to supply the nutrients needed by animals.

Important Concentrate Feeds.—First in importance among the concentrates are the cereal grains and the high-grade by-products of these grains that are secured in milling them for human food or in processing them for other purposes. All of the cereal grains, such as corn (maize), oats, barley, wheat and the grain sorghums, are rich in starch and high in digestibility, but they are low in protein and also in calcium, one of the important bone-building mineral nutrients. Moreover, their protein is of rather poor quality. The cereal grains are excellent livestock feeds when their deficiencies are made good by other feeds or by special supplements, such as amino acids, vitamins and minerals. They can to a considerable extent be used interchangeably. Certain cereal by-products are rich or fairly rich in protein, while others are low in this nutrient. In the first class are the by-products from milling wheat—wheat bran and wheat middlings; corn gluten feed, the chief by-product from the manufacture of starch from corn; brewers grains and brewers yeast from beer manufacture; and distillers grains from the production of distilled liquors and alcohol. Low-protein cereal by-products include hominy feed, the corn by-product from the manufacture of hominy and brewers grits; and corn feed meal, the by-product from making corn meal for human food.

Important among the concentrates are also other seeds, especially certain legume seeds, such as soybeans, field peas, horse beans (broad beans) and peanuts. The legume seeds are all high in protein, and soybeans and peanuts are also so high in fat, or oil, that they are important sources of oil for human food and industrial purposes.

From the processing of soybeans, peanuts and other oil-rich seeds for oil production, various oil meals are secured as by-products. In the older methods of processing these seeds, the fat, or oil. was removed by subjecting the crushed seeds to great pressure in hydraulic presses or in continuous screwlike expellers, but the oil meals thus produced still contained 5% or more of fat. In the newer solvent process, oils are extracted from the crushed seeds with a fat solvent, and the oil meals may contain less than 1% fat.

While solvent-process meals have very little fat, they are a little higher in protein than the hydraulic- or expeller-process oil meals, and are satisfactory feeds.

In the case of cottonseed and peanuts, which have woody hulls or husks, these are generally removed before the oil is separated in order to secure a more complete recovery of the oil and to produce a by-product with greater feeding value. Where the hulls are not removed. the by-product cannot legally be called oil meals in the United States, but are termed cottonseed feed and peanut feed. In Great Britain these by-products are called undecorticated oil meals.

Cottonseed oil meal, soybean oil meal and peanut oil meal all generally contain at least 41% protein and rank high in digestibility and feeding value. Cottonseed oil meal should not form more than about 9% of the rations for swine, to avoid injury from the effect of gossypol, a compound contained in varying amounts in this feed. However, cattle may safely be fed larger proportions of cottonseed oil meal. Newer processes have been devised for removing the gossypol and such meal can be fed to pigs and poultry in larger amounts. Linseed oil meal, the by-product from flax seed, has someuhat less protein, usually containing 32% to 34%. Because of its palatability and its laxative and conditioning effect, it is one of the most popular livestock feeds. Coconut oil meal, or copra oil meal, has only about 20% protein but ranks high as a feed for dairy cows.

From the beet sugar and the cane sugar factories come beet molasses, beet pulp and cane molasses or blackstrap molasses. These are palatable feeds, low in protein and high in carbohydrates. Important animal by-products are meat scraps and tankage from the meat packing plants, fish meal from fish processing plants and poultry waste and feather meal from poultry dressing plants. These usually have 50% or more of protein, which is of excellent quality and are, therefore, valuable protein supplements for swine and poultry. Excellent protein is also supplied by the dairy by-products — skim milk, buttermilk and whey, all available as dried products.

Important Roughages. — Among the roughages, first place should be given to the pasture plants for they generally furnish, during the growing season, most of the feed for beef cattle and sheep, much of that for dairy cows and even important amounts for swine and poultry. Because pasture usually supplies nutrients more cheaply than do harvested crops, it is important to fertilize and manage pastures so that an abundance of palatable forage is provided over as long a period as possible. For seeding pastures, a combination of grasses and legumes is used that is best adapted to the particular area. All green, actively growing pasture crops are fair to rich in protein and high in vitamins. When pasture plants become mature and weathered, their feeding value is greatly reduced.

Next in importance among roughages are the various kinds of hay, which is merely a grass or legume forage crop preserved by drying. Legume hay such as alfalfa or clover is much higher in protein, in calcium and usually in vitamin A value than is grass hay. Late cut hay, either legumes or grasses cut in the late bloom or seed stage of maturity, is worth much less than hay cut before the plants are in bloom or in the early bloom stage as it is less palatable, much higher in fibre and lower in protein and vitamins. Early cut and well-cured grass hay may even equal average legume hay in feeding value. except for the lower protein content. The use of special barn-drying procedures whereby air, sometimes heated, is blown through the partially dried hay to complete the drying process makes it possible to produce excellent quality hay even during rainy periods with little or no weather damage. Barn drying of hay often avoids the extensive loss of nutrients from leaching by rain and from prolonged exposure to the sun. *(See* also CROP DRYING AND PROCESSING; GRASSLAND.)

Green forage crops, such as corn, sorghum and the legumes and grasses, are preserved for winter feeding in the form of silage by placing the chopped forage in tower silos or in pits or trenches in the ground *(see* ENSILAGE). Silage is widely used, in addition to hay, as roughage for dairy cows, beef cattle, sheep and mature swine. Root crops, such as mangels or rutabagas (swedes), are raised extensively in some European countries for stock feed.

The straws from the cereal grains and corn cobs are very high in fibre and low in digestible nutrients. They can be utilized best for cattle, sheep or horses that are being maintained and not being fed for production or work. Such fibrous feeds require special supplements of protein, minerals and vitamins to give satisfactory results. *See* also NUTRITION; AGRICULTURAL EDUCATION AND RESEARCH.

See F. B. Morrison, *Feeds and Feeding,* zznd ed. (1956); L. A. Maynard and J. K. Loosli, *Animal Nutrition,* 4th ed. (1956).

(F. B. MN.; J. K. LI.)

FEELING, PSYCHOLOGY OF. The term "feeling" refers to the perception of events within the body. The term is a verbal noun denoting the action of the verb "to feel," which derives etymologically from the Middle-English verb *felen,* "to perceive by touch, by palpation." It soon came to mean, more generally, to perceive through those senses which are not referred to any special organ. As the known special organs of sense were the ones mediating the perception of the external world, the verb "to feel" came also to mean the perception of events within the body. Psychologists disagree on the use of the term "feeling." The definition above accords with that of R. S. Woodworth, who defines the problem of feeling and emotion as that of the individual's "internal state." Many other psychologists, however, still follow Kant in equating feeling to pleasantness and unpleasantness. In this article this narrow definition is avoided because it does violence to common usage without yielding any corresponding systematic advantages.

Subjectivity of Feeling. — Perception of external objects lends itself to verification by other people. When I perceive a book on my desk I can check on the presence or nature of the object perceived by asking others whether they see the book and how it looks to them. When I perceive a state of inflammation within my body—of my appendix, for example—no such simple checking on the presence and nature of the inflammation is possible. This obvious diiference between the perception of external and internal events is expressed by stating that feeling is characteristically subjective.

Problems of Feeling. — A consequence of the subjectivity of feeling is that its study is concerned with two relatively disparate problems. In studying the perception of an external object — of a book, for instance, we know perfectly well what the object is which we are perceiving, and our only problem is to ascertain how we perceive it. In studying the perception of an event within the organism, we often know practically nothing of the nature of this event. In consequence we are faced with two relatively distinct problems, namely, the problem of *how* we perceive the event and the problem of *what* the event is which we perceive.

In many instances of feeling, almost nothing about the nature of the event perceived was known until the 20th century. As a result, motivational systems were developed in which behaviour was related to events defined only in terms of a behavioural consequence. verbal or otherwise. An example is hedonism (*q.v.*), in which behaviour is considered to be determined by pleasure and displeasure. For rough predictions, hedonism is a useful doctrine. The fact, however, that all that is known essentially about pleasures is that they are called pleasures by the subject prevents any detailed systematic development of hedonism. Indeed, it leaves open the possibility that the correlation between pleasure and seeking behaviour is simply due to the fact that the subject labels as pleasures the events which he is in the habit of seeking.

Study of Internal Sensitivity. — After the 1850s great progress was made in knowledge of the internal sensitivity of the organism. (For details of this progress. *see* E. G. Boring's *Sensation and Perception in the History of Experimental Psychology,* ch. 13–14.) An idea of its magnitude is gained by noting that, whereas in 1846 E. H. Weber distinguished only two senses in addition to sight, hearing, taste and smell. C. J. Herrick in 1931 distinguished 23 classes of receptors involved in such additional senses. Much information has been gained on the perception of relatively simple localized stimulation within the body. It is known, for instance, that moderate increases in temperatures of the skin are perceived as warmth, moderate decreases as cold, checkerboard combinations of moderate increases and decreases as heat, intense increases as pain. Comparable information has not been gained, however. on the perception of such presumably widespread and heterogeneous internal states as the emotions.

Perception of Emotions.—A milestone in the psychology of feeling was William James's well-known theory of emotion, first formulated in 1884 and often called the James-Lange theory. The best-known formulation was presented by James in 1890, in his *Principles of Psychology* (vol. ii. p. 449), in which he wrote:

> Our natural way of thinking about the coarser emotions is that the mental perception of some fact excites the mental affection called the emotion, and that this latter state of mind gives rise to the bodily expression. My theory, on the contrary, is that *the bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur is the emotion.*

Subsequent evidence indicates that the perception of an emotion is not merely the perception of muscular and glandular responses. Indeed, James admitted this in 1894 by adding that the perception which initiates the emotion is affective in nature. Subsequent evidence also indicates. however, that the James-Lange theory is essentially correct, in that there is an internal sensory basis for feeling.

If emotion is in part a perception initiated by bodily responses, it is obviously desirable to know what these responses are. The best single answer to this question came from the work of the physiologist W. B. Cannon, who in a long series of experiments was able to show that the major emotions involve excitation of the sympathetic division of the autonomic nervous system, and that such excitation, because of the diffuse conduction, gives rise to a widespread set of specific responses of smooth muscles and glands—increase in heart rate, increase in blood pressure, inhibition of peristaltic movements, increased perspiration and many others. Carney Landis and William A. Hunt also showed that a loud sound yields a complex but highly specific skeletal startle response in man, and other investigators discovered a number of specific emotional pattern responses of the skeletal musculature in animals.

Search for "Affective Elements."—155th the emphasis of early experimental psychology on analysis of consciousness into elements. the question quite naturally arose: Does feeling consist of special affective elements? Attempts to answer this question led essentially to chaos. Wilhelm Wundt and E. B. Titchener held that there were special affective elements, different from sensations. Theodor Ziehen and Carl Stumpf denied the existence of such special affective elements. The two basic views were in turn starting points for further divergences. Titchener held that affective elements involved only one qualitative dimension, pleasantness-unpleasantness. Wundt held that they involved three: pleasantness-unpleasantness, strain-relaxation and excitement-depression. Those who agreed to the sensory nature of affective elements were likewise at odds. Ziehen considered pleasantness-unpleasantness to be an attribute of all sensations. Stumpf considered pleasantness-unpleasantness to be an attribute only of certain specific sensations, which he called feeling-sensations.

It is understandable how such disagreement could arise. An affective element, like any other entity in science, is a "construct"; it is not itself a datum, but a concept constructed by the psychologist to systematize his data; thus different psychologists may construct different concepts of affective elements. The fact that the disagreement did arise, however. suggests that the type of concept involved does not lend itself to successful systematization.

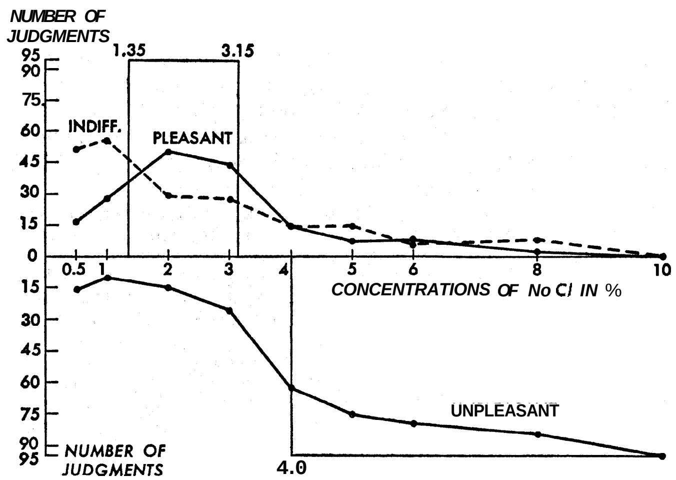
Something positive, however, came out of this chaotic chapter in the psychology of feeling, namely, the agreement of all these writers that pleasantness-unpleasantness is an important characteristic of feeling. A consequence of this was that the emphasis on psychophysics, so prevalent at the turn of the century, yielded, in the field of feeling, a very extensive psychophysics of affective value, as the dimension pleasantness-unpleasantness is called in English.

PSYCHOPHYSICS OF AFFECTIVE VALUE

Methods of Measurement.—Affective value is usually measured by one of the three so-called methods of impression. (1) In the method of single stimuli, the observer judges the affective value of a stimulus on a subjective scale. extending from very unpleasant through indifferent to very pleasant, usually involving five or seven steps. These steps are often represented numerically. (2) In the serial method the observer establishes the rank order of a set of stimuli with respect to affective value. This is done sometimes by having the observer select the most pleasant stimulus from the original set, then the most pleasant from the remaining stimuli, and so forth. sometimes by having him arrange the stimuli in a spatial order indicating their rank with respect to pleasantness. (3) In the method of paired comparison the observer judges the relative pleasantness of all possible paired combinations of a set stimuli. Thus, if stimuli a, b and c were involved, he would first be presented with a and b and judge nhich is the more pleasant, then with *b* and c and judge which of these two is more pleasant, and then with c and a and judge which of these two is the more pleasant. The frequency with which a stimulus is preferred, when paried successively with all the others, is considered a measure of its affective value.

The method of single stimuli, as described above, makes use of a scale defined in terms of categories. The work of S. S. Stevens in sensory psychophysics indicates that scales defined in terms of categories have a curvilinear relation to scales defined in terms of direct magnitude estimation. The face validity of the latter scales is greater. and Stevens' work shows that they yield remarkably simple and stable relations in sensory psychophysics. It is quite possible that the method of single stimuli with direct magnitude estimation will also prove fruitful in the measurement of affective value.

Relation of Affective Value to Intensity of Stimulation.—By and large, weak stimuli are judged to be indifferent, moderate ones pleasant, strong ones unpleasant. This is not, however. invariably the case. The best data on this relationship are those of R. Engel for the field of taste. Engel had observers judge

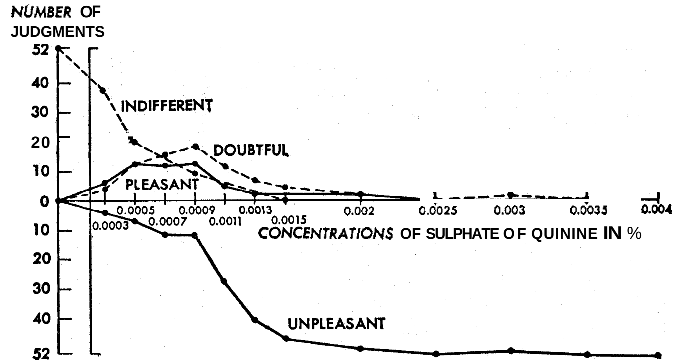


FROB "THE PSYCHOLOGY OF PLEASANTNESS AND UNPLEASANTNESS" BY J. G. BEEBE-CENTER (D. VAN NOSTRAND CO. INC , 1933)

FIG. 1.—AFFECTIVE VALUE OF COMMON SALT SOLUTIONS AS A FUNCTION OF STRENGTH OF STIMULUS. SEVEN OBSERVERS IN SEVEN SITTINGS. THE FIGURE SHOWS ALSO THE IDEAL STIMULUS RANGES FOR PLEASANTNESS AND UNPLEASANTNESS (AFTER ENGEL)

the affective value of various concentrations of sweet, sour, salt and bitter solutions in terms of the four categories: indifferent, pleasant. unpleasant and doubtful. His results are presented in fig. 1 to 4. It will be noted that. although the data for sour, salt and bitter conform to the principle stated above. those for sweet do not. Sweet apparently continues to be judged pleasant no matter how high the concentration.

Relation to Quality of Stimulation.—The relation of affective value to intensity of stimulation, discussed above, implies that to be thoroughgoing, a comparison of the affective value of two or more qualities must involve the complete functions relating affective value to intensity for these qualities. Even for an incomplete comparison the data must refer to corresponding inten-



FROM "THE PSYCHOLOGY OF PLEASANTNESS AND UNPLEASANTNESS" BY J. G. BEEBE-CENTER (D. VAN NOSTRAND CO. INC., 1933)

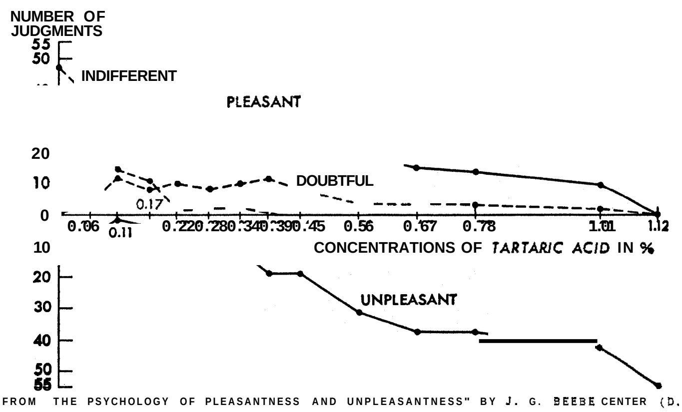
FIG. 2.— AFFECTIVE VALUE OF SOLUTIONS OF SULPHATE OF QUININE AS A FUNCTION OF STRENGTH OF STIMULUS. TEN OBSERVERS IN SIX SITTINGS (AFTER ENGEL)

sities in the case of the various qualities and must be expressed in terms of the same units. Few of the data on the relation of affective value to quality satisfy even the latter two conditions. When further account is taken of affective growth and decay. discussed below, it is not surprising to find that available results on the relation of affective value to quality of stimulus are often conflicting.

Engel's data on taste do not satisfy the requirements set forth above. Nevertheless, it seems safe to draw the following conclusions: (1) If intensity is measured in terms of multiple of thresholds, the order of pleasantness is, for the major part of the scale of intensities, sweet, sour, salt, bitter. (2) If, however, intensities are measured in terms of concentrations, the order of the tastes varies with the concentration; at 5%, sugar alone is pleasant; at 1% salt alone; at 0.1% sour alone.

In the case of vision the work of J. P. Guilford yields excellent data on the relation of aifective value to hue, with brightness and saturation held constant (fig. 5). As Guilford used not only a set of 18 colours. varying only in hue, but also 22 additional colours introducing variations in brightness and saturation, he was able further to specify, by an ingenious statistical analysis, the relative role of hue, brightness and saturation in determining affective value, and also their joint effectiveness in this respect. His conclusions were as follows:

(1) Hue determined AV [Affective Value] to the extent of about 67 percent for the women and 16 percent for the men. . . . (2) Tint [brightness] determined AV about 20 percent for the women, but only 5 percent for the men. In both cases, the lighter the tint, the more pleasing the color, all other things being equal. (3) Chroma [saturation] determined AV only about 5 percent for the women, but 13 percent for the men, the more saturated colors being preferred to the less saturated. (4) The three attributes combined account for at least 71 percent of the AV of color for women and 26 percent for the men. (J. P. Guilford, "The Affective Value of Color as a Function of Hue, Tint and Chroma," *Journal of Experimental Psychology*, 17:369 [1934].)



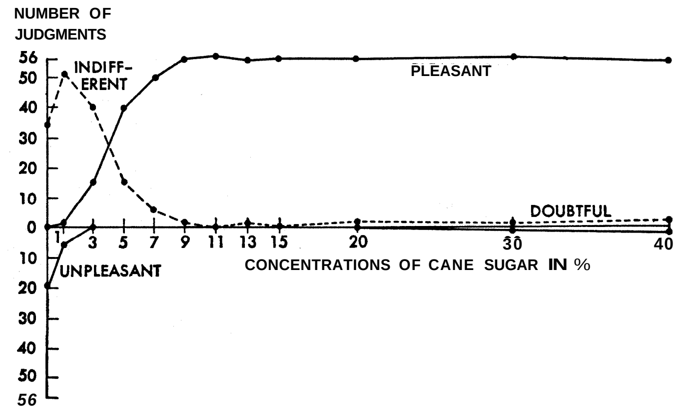
FROM "THE PSYCHOLOGY OF PLEASANTNESS AND UNPLEASANTNESS" BY J. G. BEEBE CENTER (D. VAN NOSTRAND CO INC, 1933)

FIG. 3.— AFFECTIVE VALUE OF SOLUTIONS OF TARTARIC ACID AS A FUNCTION OF STRENGTH OF STIMULUS. SEVEN OBSERVERS IN SIX SITTINGS (AFTER ENGEL)

With respect to tactile, kinaesthetic and organic sensitivity, knowledge of the relation of feeling to quality of stimulation is in a curious state. On the one hand, despite the close traditional relation between these senses and feeling, there is little experimental evidence relating affective value directly to quality of stimulation. On the other hand. there is strong evidence relating affective value to specific qualities of experience. The reason for this paradoxical situation is probably the obvious difficulty of ascertaining the nature of internal stimulation.

In 1924 J. P. Nafe published the results of an extensive experiment on the nature of conscious feeling. Observers were given a great variety of affective stimuli and asked to describe carefully and fully the resulting feelings. All observers ultimately agreed in describing pleasantness and unpleasantness as sensory pressures. In terms of quality, pleasantness was reported to be a bright pressure, unpleasantness a dull one. A subsequent experiment by Young suggested strongly that the identification of feeling with pressures was caused by laboratory atmosphere. An experiment by William A. Hunt, however, indicated that the basic correlation between pleasantness and bright pressure and between unpleasantness and dull pressure is correct.

Relation to Form. — Much specific information is available on the relation of affective value to form. This comes in part from the cumulative experience of artists, in part from experimental aesthetics (see AESTHETICS). One instance is the codification of



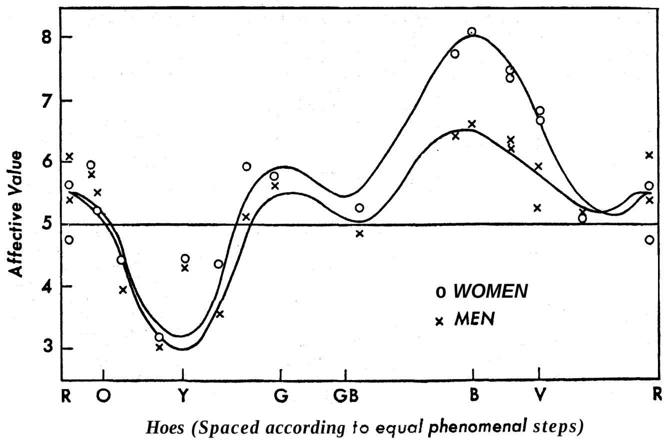
FROM "THE PSYCHOLOGY OF PLEASANTNESS AND UNPLEASANTNESS" BY J. G. BEEBE-CENTER (D. VAN NOSTRAND CO. INC., 1933)

FIG. 4.— AFFECTIVE VALUE OF SOLUTIONS OF CANE SUGAR AS A FUNCTION OF STRENGTH OF STIMULUS. TEN OBSERVERS IN SIX SITTINGS (AFTER ENGEL)

knowledge concerning music in the form of rules of melody and harmony. Another is the demonstration of the aesthetic superiority of the golden section: *i.e.*, of the division of a line at such a point that the ratio of the smaller part to the larger part is the same as the ratio of the latter to the whole.

Many attempts have been made to organize this specific information under a few general principles, but in many cases the principles are not stated with sufficient rigour to allow them to be tested experimentally. An exception to this failing is afforded by George D. Birkhoff's mathematical formulation of the classical principle. According to Birkhoff, the aesthetic measure of an object is given by the relation $M = \frac{O}{C}$ where M represents the aesthetic measure, O the orderliness and C the complexity. O and C are in turn defined, for various classes of aesthetic objects, in terms of specific and observable elements of form. Experimental tests of this measure, particularly the work of C. M. Harsh and his co-workers, show that it accords as well with the average judgment of a group of observers as does, on the average, the judgment of a single observer, and further that it corresponds closely to the judgments of those observers who emphasize the criterion of simplicity.

Relation to Repetition of Stimulation. — There is no question but that affective value varies with repetition of the stimulus. In one experiment, for instance, repetition of popular music re-



FROM "JOURNAL OF EXPERIMENTAL PSYCHOLOGY," 17 342–370 (AMERICAN PSYCHOLOGICAL ASSOCIATION, 1934)

FIG. 5.—AFFECTIVE VALUE OF COLOURS AS A FUNCTION OF HUE (FROM GUILFORD)

sulted in a decrease in affective value, repetition of classical music in an increase. In another it was found that when children were made to taste a single substance day after day for several weeks, their liking for such a substance as chocolate and their dislike of such a substance as vinegar both decreased markedly as the experiment progressed.

There is considerable question, however, as to what principle is involved in these variations of feeling. (1) One principle, which may be called the principle of growth and decay, states that with repetition there is an increase of pleasantness or unpleasantness to a maximum. followed by a subsequent decay. (2) Another principle, that of habituation, states that repetition results only in a decrease of pleasantness or unpleasantness. (3) A third principle, that of psychological satiation, states that decrease in pleasantness or unpleasantness does, indeed, usually accompany repetition, but that its effect is due not simply to repetition but to loss of interest. Choice between these alternatives is not possible on the basis of available data. The most promising approach would seem to be through the study of food preferences in the rat, in which past experience and nutritional status can be fully controlled.

FOOD PREFERENCES IN ANIMALS

Study of feeling, as noted above, is complicated by the fact that the event being perceived is not open to direct inspection by others—by an experimenter, for instance. A promising approach to the problem of what is being perceived when an object is judged pleasant or unpleasant is the study of food preferences in animals.

P. T. Young, who worked extensively in this field, distinguished three principal methods. (1) In the method of choice, two foods are presented simultaneously for a brief time; the choice, if any, made by the animal is noted, and the foods are then removed. Repetition of this procedure allows a quantitative statement of preference in terms of the frequency of choice of the two foods. (2) In the method of continuous exposure. two foodstuffs are again presented simultaneously, but in this case the presentation is of relatively long duration—Young used periods of 4 to 900 seconds. The criterion of preference here is the time spent by the animal in eating each of the two foods. (3) In the method of self-selection, extensively used by C. P. Richter, a nutritionally adequate set of foods or food components, each presented in a separate container, is continuously available to the animal. The criterion of preference here is the amount of each food or food component consumed by the animal per unit of time, usually per day.

The close relation of food preferences to need is well demonstrated by the work of Richter on self-selection of diets. An early experiment (1936) dealt with rats whose adrenal glands had been removed surgically. Normally such animals die in 10 or 1j days after the operation, apparently because of excessive loss of salt. Richter found that when given free access to salt, adrenalectomized rats took a sufficient amount to keep themselves alive and well. In some animals the salt intake increased 15-fold after adrenalectomy. Much the same picture developed in the case of rats whose parathyroids had been removed. Under ordinary conditions such animals show symptoms of tetany and eventually die. With free access to calcium lactate they lived indefinitely. In one animal voluntary intake of calcium lactate was increased 12-fold after the operation.

These findings suggested that normal animals might be able to select of their own accord the amounts of nutritive components they need. To test this hypothesis, Richter (1938) selected ten substances representing the ten dietary components thought to be necessary in a rat's diet, and gave a group of rats free access to these materials, presented in separate containers. The ten substances, together with the dietary components which they represent, are listed below:

Substance	*Dietary component represented*
1. Casein, autoclaved and purified	Protein
2. Sucrose	Carbohydrate
3. Olive oil	Fat
4. Sodium chloride (3% solution)	Sodium
5. Calcium lactate (2.4% solution)	Calcium
6. Dibasic sodium phosphate (8% solution)	Phosphorus
7. Potassium chloride (1% solution)	Potassium
8. Cod-liver oil	Vitamins A and D
9. Dried baker's yeast	Vitamin B complex
10. Wheat germ oil	Vitamin E

Richter found that the rats fed by this method remained in excellent condition, as judged by such criteria as growth and general activity. It is clear, therefore. that when given the opportunity, rats select dietary components in accordance with their nutritive needs.

What mechanism is here involved? Richter found that the preference threshold of rats for saline solutions was much lower in adrenalectomized rats than in normals. On the basis of these and other data, he concluded that a specific nutritive deficiency decreases the taste threshold for the substance involved, and that this lowered threshold results in selection and increases intake of that substance. Subsequent work by Carl Pfaffmann and his associates confirmed Richter's finding with respect to the preference threshold, but further showed that the taste threshold. determined electrophysiologically, was not affected by adrenalectomy. It follows that Richter's equation of preference threshold and taste threshold was wrong, and consequently that his theory was to that extent also wrong.

Later attempts to identify the mechanisms underlying food preferences include a series of elegant experiments by E. Stellar and R. A. McCleary, who studied the effect of preloading rats' stomachs with various solutions on the rats' preferences for those solutions. Stellar's conclusions from his own work with salt solutions were as follows:

> Water drinking and the drinking of salt solutions are under the control of at least three factors: taste and other sensory mechanisms in the mouth, gastric distention, and dehydration produced by the osmotic effects of hypertonic solutions on the stomach. The ascending limb of the preference-aversion [function] is partly a matter of response to dehydration, but, more particularly, is an increasing response to increasing taste stimulation. The descending limb is partly due to negative stimulation of the mouth, hut is largely the result of the increasing inhibition of drinking produced by increasingly hypertonic solutions in the stomach. (Stellar, Hyman and Samet, *Journal of Comparative and Physiological Psychology,* 47:225–226 [1954]).

The effect of one of these factors, the sensory factor, was studied extensively by P. T. Young, who concluded that results involving this factor may best be interpreted by assuming a so-called "intervening variable" termed "affective process" and defined by the relations found in the study of preferences. Such an intervening variable can be rigidly defined and can serve to systematize findings of studies of preferences. To do so gives a simple answer to the question, "What is the state perceived when we judge an event to be pleasant?" The answer is: an affective process; *i.e.,* a concept systematizing preference behaviour. This answer may well be right. But until more is learned about the nature of concepts, the answer is not very informative.

EFFECTS OF REWARDS AND PUNISHMENTS ON BEHAVIOUR

The study of the effects of rewards and punishments on behaviour constitutes another promising approach to the problem of what is being perceived when an object is judged pleasant or unpleasant. By far the best information on this subject came from the work of B. F. Skinner and his associates. Skinner pointed out that mankind is especially interested in behaviour that has an effect on the environment (operant behaviour), and that this kind of behaviour tends to be influenced by the feedback of its consequences (reinforcement). If now we arrange a situation in which one particular effect on the environment—depression of a bar by a rat—has one particular consequence—the making available of a pellet of food to the rat—we can study the way in which the frequency of the operant *bar-press* is related to the frequency of the reinforcement *food-pellet available,* and also to *deprivation* with respect to food and the occurrence of a signal predicting the reinforcement, the *discriminative stimulus.* Such situations are provided by so-called Skinner boxes, which also provide effective insulation from environmental disturbances, a system for recording the bar-presses or target-pecks and a system for programing the reinforcements. If it is remembered that Skinner's operant is defined in terms of specific effects on the environment, not of specific movements, it is clear that a Skinner box provides an extremely ingenious way of studying what the layman would term the effects of reuards and punishments on purposive behaviour.

In the case of rewards, the relation with which Skinner was especially concerned was that between frequency of operant and schedule of reinforcement. as distinct from, for example, kind of reinforcement. Reinforcement can follow every bar-press (continuous reinforcement) or only some (intermittent reinforcement). In the latter case it can follow the first bar-press after a given time (interval reinforcement) or the *n*th occurrence of a bar-press (ratio reinforcement). Furthermore, both interval and ratio may be fixed or variable. Also, reinforcement may be stopped completely. The effects on frequency of operant of many instances of all these schedules, and also of many combinations of schedules, were explored by Skinner and his associates (for details, *see* C. B. Ferster and B. F. Skinner, *Schedules of Reinforcement* [1957]). Most of the work was done on pigeons, but enough mas done on higher organisms and man to indicate that the principles found have great generality. The result is a vast enrichment of knowledge of how to control behaviour through rewards.

With respect to punishment. the outstanding findings of Skinner and his associates were (1) that moderate punishment does not eliminate permanently the operant behaviour which it follows, but only decreases its frequency temporarily, and (2) that the relative effects of different schedules of punishment are much the same as those of different schedules of rewards.

What is the physiological mechanism by which rewards and punishments influence behaviour? A great step toward answering this question was made by James Olds and Peter Milner in an experiment published in 1954. Olds and Milner ran rats in a Skinner box in which pressing of the bar yielded for the rat not a pellet of food but an electric shock in the brain by means of implanted electrodes. When the electrodes were implanted in the septal region, lying just in front of the thalamus, bar-pressing increased definitely as a function of such electrical "reinforcement."

THEORY OF FEELING

Sense Organs Involved.— In his famous work, *The Integrative Action of the Nervous System* (Yale University Press. 1906) C. S. Sherrington distinguished between three main groups of sense organs on an anatomical and functional basis. These groups and their fundamental characteristics are indicated in the table.

Sherrington went on to point out that a salient character of most of the reactions of the receptor-organs other than distance receptors is affective tone, and that they are particularly closely

Main Groups of Sense Organs and Their Fundamental Characteristics

Loci	Groups	Receptor-organs	Characteristics
Surface	Exteroceptive: Distance	light sound odours	End organs numerous. Connections closer to skeletal musculature than visceral; closely connected to vascular organs
	Exteroceptive: Other	contact warmth cold pain	
	Interoceptive	taste chemical other?	End organs few; afferent fibres few; connections closer to visceral musculature than skeletal. Closely connected to vascular organs
Underlying	Proprioceptive	in muscles in tendons in joints in blood vessels	Stimuli are events in organism

connected with consummatory reactions. This view of Sherrington's amounts to a definite hypothesis as to the sense organs involved in feeling: all sense organs other than the visual, auditory and olfactory.

Nature of Events Perceived.--What events are perceived in feeling? This question amounts to asking, "What internal events are identified by the organism?" and this in turn amounts to asking, "What internal events are invariant for a given identification by the organism?" In the special case of human organisms, identification is judged most readily in terms of specificity of verbal response.

So far as present knowledge is concerned, feeling is largely the perception of muscular contractions. Hunger pangs are in the main perceptions of hunger contractions in the stomach. Fear is in part the perception of complex pattern of muscular contractions. The pain called angina pectoris is the perception of the contractions of the heart musculature deficient in blood supply. Headache is thought to be the perception of tension of the neck muscles.

This is not to say that feeling is solely the perception of bodily movements. Temperature changes. changes in pressure, changes in chemical condition within the body are also perceived. The homeostatic mechanisms of the body. however, tend to minimize such changes. In any case, little information is available concerning the perception of such events.

Feeling a Feedback.— Whether or not the principal events perceived in feeling are muscular contractions, it seems pretty clear that such events are principally reactions of the organism. In the case of muscular contractions, this is naturally obvious. It is true also. however, of chemical and temperature changes so largely controlled by homeostasis. A consequence of this is that feeling is potentially a mechanism by which the internal consequences of reactions of the organism may feed back into the nervous system and affect subsequent reactions. Is this potentiality actually realized? To some extent. yes. Stellar, as noted above, considers that eating behaviour is in part influenced by a taste factor. Again, under certain conditions of intractable pain the patient may be considerably benefited by section of nerves mediating pain sensitivity. G. Razran reported an experiment by E. S. Ayrapetyants showing that a dog can be taught to lift its paws when visceral changes occur. This technique seems very promising for the study of feedback effects of feeling on behaviour.

Categorization of Internal Events.—So far, the theory of feeling has been simple and straightforward. We now come to a feature of feeling which has continued to puzzle psychologists for centuries. Subjects perceiving internal events very often characterize them as pleasant or unpleasant. What is being identified in the case of such a characterization?

Two things should be noted at once in this connection. The first is that characterization with respect to pleasantness or unpleasantness is but one of several characterizations often applied by a subject to events within his organism. Wundt, for instance, considered feeling to have the dimensions of tension-relaxation and excitement-depression besides pleasantness-unpleasantness The second thing to note is that characterizations with respect to pleasantness or unpleasantness are also applied to objects outside the organism — to colours, for instance.

A widespread view is that the basic feature of perception is categorization. "Perception," according to J. S. Bruner, "involves an act of categorization. Put in terms of the antecedent and subsequent conditions from which we make our inferences, we stimulate an organism with some appropriate input and he responds by referring the input to some class of things or events" ("On Perceptual Readiness," Psychological Review, 64:123 [1957]). According to this view the only difference between identifying an internal event by the word "pain" and identifying it by the word "pleasant" would be in the specificity of the identification. In both cases a class of events would be identified, a relatively small one in the case of pain, a large one in the case of pleasant. From this point of view, characterization as pleasant is a verbal response generalized to a large number of stimuli, and the only problem is to determine the way in which this generalization takes place. This is presumably by the selective effects of social approval and disapproval. What, however, guarantees that the responses "pleasant" to candy and warmth and "unpleasant" to vinegar and electric shock shall be useful, and thus maintained by social approval and disapproval? It is not the presence of common affective elements.

Sucrose is a reward which increases the frequency of antecedent behaviour. Almost all subjects judge sucrose to be pleasant. The same correlation is found for a large number of different substances. The suggestion is obvious that reward value and categorization as pleasant are closely related. The older interpretations of this relation started from the categorization, inferred a conscious affective element, and explained the rewarding effect as a consequence of this element. In effect, this interpretation proposed that a substance has reward value because it is consciously perceived as pleasant; *i.e.*, produces a state of consciousness in the person that contains the conscious affective element of pleasure. Psychologists have never been able to agree on the nature of this element. Worse yet, this explanation does not reveal how the substance evokes the element in consciousness or how, once evoked, the element influences behaviour.

One modern alternative to this view replaces the conscious affective element by a so-called intervening variable defined in terms of the stimulus-response relationships involved in both rewarded behaviour and the behaviour of categorizing as pleasant. An example of this view is that of P. T. Young, who termed the resulting intervening variable an affective process (see above, Food Preferences in Aninzals).

A second modern alternative eschews both conscious affective elements and affective processes in the form of intervening variables. The starting point here is that certain events are reinforcing in the sense that the behaviour which they follow increases in frequency, and the categorization is interpreted simply at the naming of this class of events. An example of this view is that of F. S. Keller and W. N. Schoenield, who write:

> When someone tells us that an object, a color or a design is "pleasant" or "unpleasant," he is reporting upon his own reactions to that object, color, or design. A positive, or a negative, reinforcer has been presented or withdrawn; a change in behavior has taken place, including, perhaps, incipient movements of approach or withdrawal; these movements (or others) provide the S ~(essentially, cues) for his verbal responses—his "affective judgments." (Principles of Psychology, Appleton-Century-Crafts, Inc., p. 350 [1950]).

Role of Categorization **of Behaviour.**—Both these modern alternatives, it might be added. are consistent with Freud's doctrine of motivation and that of John Dollard and N. E. Miller, who combine the Freudian clinical approach with the experimental approach of Clark Hull. Freud held that neurotic behavior was largely determined by repressed affective processes. This is essentially to hold that categorization, in terms of pleasantness and unpleasantness, is a factor in motivation — witness the difference between neurotic and normal — but not a basic one — witness the motivation of the neurotic. Dollard and Miller hold a similar view. "Labeling" emotion facilitates the adjustment of the individual, but emotion is an effective factor in motivation, whether labeled or not.

See also EMOTION; PERSONALITY; PSYCHOLOGY, EXPERIMENTAL; PSYCHOLOGY, HISTORY OF; PSYCHOPHYSICAL METHODS.

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FEHMIC COURTS, certain tribunals which, during the middle ages. exercised a powerful jurisdiction in Germany, and more especially in Westphalia. They are best regarded as survivals of ancient Teutonic local courts. Their alternative name of "free courts" is due to the fact that all freeborn men were eligible for membership and also to the fact that they claimed certain exceptional liberties. Their jurisdiction they eventually owed to the emperor, in whose name they exercised the power of life and death. The sessions were often held in secret, and these the uninitiated were forbidden to attend, on pain of death. Legend and romance have combined to exaggerate the sinister reputation of the Fehmic courts; but modern historical research has proved that they never employed torture, that their sittings were only sometimes secret, and that their meeting-places were always well known. They were, in fact, a survival of an ancient and venerable German institution; and if, during a certain period, they exercised something like a reign of terror over a great part of Germany, the cause of this lay in the condition of the times. which called for some powerful organization to combat the growing feudal anarchy.

The system became important after the division of the duchy of Saxony on the fall of Henry the Lion, when the archbishop of Cologne, duke of Westphalia from 1180 onward, placed himself as representative of the emperor at the head of the Fehme. The organization now rapidly spread. Every free man, born in lawful wedlock, and neither excommunicate nor outlaw, was eligible for membership. Princes and nobles were initiated, and in 1429 even the Emperor Sigismund himself became "a true and proper *Freischöffe* of the Holy Roman Empire." By the middle of the 14th century the sworn associates of the Fehme were scattered in thousands throughout Germany, known to each other by secret signs and passwords, and all of them pledged to serve the summons of the secret courts and to execute their judgment.

The organization of the Fehme was elaborate. The head of each centre of jurisdiction (*Freistuhl*), often a secular or spiritual prince, sometimes a civic community, was known as the *Stuhlherr*, the archbishop of Cologne being, as stated above, supreme over all (*Oberststuhlherr*). The actual president of the court was the Freigraf (free count) chosen for life by the Stuhlherr from among the Freischoffen, who formed the great body of the initiated. Of these the lowest rank were the Fronboten or *Freifronen*, charged with the maintenance of order in the courts and the duty of carrying out the commands of the Freigraf. The immense development of the Fehme is explained by the privileges of the *Freischöffen*; for they were subject to no jurisdiction but that of the Westphalian courts, whether as accused or accuser they had access to the secret sessions, and they shared in the discussions of the general chapter as to the policy of the society. At their initiation these swore to support the Fehme with all their powers: to guard its secrets, and to bring before its tribunal anything within its competence that they might discover.

The procedure of the Fehmic courts was practically that of the ancient German courts generally. The place of session, known as the Freistuhl (free seat), mas usually a hillock, or some other well-known and accessible spot. The *Freigraf* and Schoffen occupied the bench, before which a table, with a sword and rope upon it, was placed. The court was held by day and, unless the session was declared secret, all freemen, whether initiated or not, were admitted. The accusation was in the old German form; but only a *Freischöffe* could act as accuser. If the offence came under the competence of the court; *i.e.*, was punishable by death, a summons to the accused was issued under the seal of the Freigraf. This was not usually served on him personally, but was nailed to his door, or to some convenient place where he was certain to pass. Six weeks and three days' grace were allowed, according to the old Saxon law, and the summons was thrice repeated. If the accused appeared, the accuser stated the case, and the investigation proceeded by the examination of witnesses as in an ordinary court of law. The judgment was put into execution on the spot if that was possible. The secret court, from whose procedure the whole institution has acquired its evil reputation, was closed to all but the initiated, although these were so numerous as to secure quasi publicity; and the members present were bound under pain of death not to disclose what took place. Crimes of a serious nature, and especially those that were deemed unfit for ordinary judicial investigation—such as heresy and witchcraft—fell within its jurisdiction, as also did appeals by persons condemned in the open courts, and likewise the cases before those tribunals in which the accused had not appeared. The accused if a member could clear himself by his own oath unless he had revealed the secrets of the Fehme. If he were one of the uninitiated it was necessary for him to bring forward witnesses to his innocence from among the initiated, whose number varied according to the number on the side of the accuser. but 21 in favour of innocence necessarily secured an acquittal. The only punishment which the secret court could inflict was death. If the accused appeared, the sentence was carried into execution at once; if he did not appear. it was quickly made known to the whole body, and the *Freischöffe* who was the first to meet the condemned was bound to put him to death. A knife with the cabalistic letters was left beside the corpse to show that the deed was not a murder.

That an organization of this character should have outlived its usefulness and issued in intolerable abuses was inevitable. With the growing power of the territorial sovereigns and the gradual improvement of the ordinary process of justice, the functions of the Fehmic courts were superseded, though they were only finally abolished by order of Jerome Bonaparte, king of Westphalia, in 1811. The last *Freigraf* died in 183j.

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FEIJOA, a small tree (*Feijoa sellowiana*) of the myrtle family (Myrtaceae, *q.v.*), closely related to the guava (*q.v.*) and often called pineapple guava. It is a native of southern Brazil, Paraguay, Uruguay and parts of Argentina and is cultivated in various mild climates for its highly esteemed fruit. The tree grows about 15 ft. high and has olivelike leaves, dark green above and silvery-gray beneath, and large white flowers which are purplish-crimson within. The oblong fruit, about 2 in, long and dull green in colour marked with crimson, has a translucent, melting pulp with a delicious pineapple flavour. When mature the fruits fall, but must be kept in a cool place until sufficiently soft for eating. They are made into jam and jelly and are also crystallized. The feijoa was introduced into southern Europe in 1890 and about 10 years later was taken to California where it became extensively cultivated. The tree requires a dry climate, such as that of southern France and parts of California; it does not thrive in the moist climate of Florida and Cuba. It is usually propagated by seeds, which come fairly true to type, but cuttings may be rooted under glass and whip grafting effected by using seedlings with stems of the thickness of an ordinary lead pencil. Choice varieties are also perpetuated by the layering of low branches.,

FEIJOO Y MONTENEGRO, BENITO JERÓNIMO (1676–1764), Benedictine monk and scholar, one of the first Spanish essayists, was born at Casdemiro, Orense, Oct. 8, 1676. In his *Teatro critico universal* (1726–39) and *Cartas eruditas y curiosas* (1742–60) accepted ideas about education, medicine, science, justice, national character, literature and even the miraculous elements in religion were put to the test of rational doubt, personal experiment and the weight of erudite reference. He is the first characteristic figure of Spanish "enlightenment," aware of foreign progress and yet deeply patriotic. He died at Oviedo, Sept. 26, 1764.

See G. Delpy, *L'Espagne et l'esprit européen. L'oeuvre de Feijdo, 1725–1760* (1936). (R. F. B.)

FEININGER, LYONEL (1871–1956), U.S. modernist painter. known for the crystalline clarity and transparent structure of his seashores and cityscapes, was born on July 17, 1871, in New York city. He left the United States for Germany in 1887 to study music, but decided to become an artist instead. Music, however, was the first and principal influence in his life and art. Feininger studied painting in Hamburg, Berlin and Paris between 1887 and 1893 and then worked as a cartoonist for German humour magazines and the *Chicago Tribune*. Under the influence of the Cubists—especially Robert Delaunay—he began to paint important canvases around 1910 and soon established his own style. utilizing prismatic interpenetrating planes of colour. This work, with its intersecting light rays, so impressed the Blue Rider artists (Franz Marc and Wassily Kandinsky) that Feininger was invited to exhibit with them in Berlin in 1913. After World War I, Feininger joined the staff of the famous Bauhaus workshops and soon found himself in the company of Paul Klee as well as Kandinsky. The structural direction of his own work was closely akin to the aim of the Bauhaus: a synthesis of art, science and technology. In 1936, after the Nazi access to power, Feininger returned to the United States. During the remainder of his life he strove, in both oil and water colour, for the most sensitive refinement of his visionary, yet orderly, crystalline world. He died on Jan. 13, 1956, in New York city.

See A. J. Schardt and Alfred Barr, *Lyonel Feininger* (1944). (P. H. S.)

FEKE, ROBERT (*c.* 1705–*c.* 1750), U.S. portrait painter, whose work maintains the proud stance of a recent colonial aristocracy and achieves a surprising degree of sensuous splendour, was born at Oyster Bay, N.Y., on an unknown date. The place and date of his death are also unknown. Further uncertainties about his being termed a mariner, about his supposed travels and about his artistic training cause differences of opinion among scholars, but the record of his work is reasonably clear. This work was done from time to time in Boston, Mass., and Philadelphia. Pa.; but his home was in Newport, R.I., where he married Elinor Cozzens in 1742 and was visited in 1744 by a Scottish doctor, Alexander Hamilton, who noted the event vividly in his *Itinerarium*. About 1j portraits are signed and dated, and his manner is distinctive enough to warrant his authorship of about 50 more. Five examples in the Walker Art building, Bowdoin college, Brunswick, Me., include the most impressive of all, the "Samuel Waldo." Feke's observation of character was sporadic. The interest of his work is mainly in its technical development of colour and rendering of textures, despite its definite awkwardness.

See H. W. Foote, *Robert Feke, Colonial Portrait Painter* (1930); *L.* Goodrich, *Robert Feke* (1946). (VL. B.)

FELDSPAR or FELSPAR, a name applied to a group of minerals of great importance. Silicates of aluminum with potassium, sodium and calcium, and, rarely, barium, they constitute practically 60% of igneous rocks and serve as a basis of classification of these rocks, being important constituents, for example, of granite, syenite, diorite, gabbro and peridotite (*q.v.*). They occur in schists and other metamorphic rocks and through the processes of decomposition are sources of kaolin and other clays and of much of the world's soil. Following discussion of colour and chemical composition, feldspar is discussed in terms of its crystal structure, polymorphism, unmixing at low temperature and other properties.

Feldspar (predominantly potassium-rich) is used industrially in the manufacture of porcelain, and it also forms an important constituent of many ceramic glazes. Some of the coloured varieties are occasionally used as gems (moonstone) and for ornamental purposes. *(See* CHINAWARE; POTTERY AND PORCELAIN: *Modern Ceramic Techniques.)*

The name feldspar was used by J. G. Wallerius in his *Mineralogy* (1747) in the Swedish form *feltspat,* meaning "fieldspar," but it was subsequently written felspar by Richard Kirwan, who erroneously assumed the derivation of the name from *fels,* "a rock." The term felspar is used only in Great Britain. In German the old name is preserved in *Feldspat.*

A vast number of names exist to designate the different feldspar varieties. They are based on one or more of the following properties: chemical composition; crystallographic symmetry; morphological appearance; state of homogeneity or inhomogeneity; twinning; colour; lustre; and crystal-optical behaviour. They comprise a single mineral species ranging from the alkali potash feldspars (orthoclase or microcline and sanidine), the sodium feldspars (albite and analbite) and the potash-sodium (sanidine-analbite) series through the sodium-calcium feldspars (plagioclases).

The general characters and crystal structure of the feldspars are discussed below. Since certain of the feldspars can crystallize in more than one distinct form, either in the monoclinic or the triclinic systems, they are classified as polymorphous, and this character of polymorphism is discussed in relation to their chemical composition.

Feldspar has been the subject of considerable research relating to the origin of igneous rocks, the processes by which minerals are formed and the behaviour of solid solutions: in addition to the material in this article on unmixing of feldspars in solid solution at low temperatures, *see* GEOCHEMISTRY: *Geochemistry* of *the Lithosphere;* PETROLOGY: *Habit* of *Igneous Rocks.*

GENERAL CHARACTERS

The feldspars are fairly hard (about 6 on Mohs' scale) and relatively light for minerals (specific gravity ranges from 2.55 to 2.76).

Colour.—Pure feldspars are colourless, but as a result of the presence of minute inclusions or the development of alteration products, most natural feldspars are pink, brown, green, gray or dark. Bright green microclines are called amazonstone. Copper-red varieties (colour caused by iron oxide) are called aventurine. Iridescent varieties are moonstone, peristerite and labradorite.

Chemical Composition.—The chemical composition varies considerably, inasmuch as the feldspars form several series of solid solutions. The chemical formulas of the pure end members can be written as:

1.	$KAlSi_3O_8$	Alkali feldspars
2.	$NaAlSi_3O_8$	Alkali feldspars / Plagioclases
3.	$CaAl_2Si_2O_8$	Plagioclases
4.	$BaAl_2Si_2O_8$	Celsian

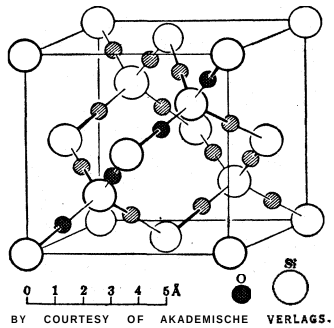
Members of the series between 1 and 4, that is, with barium replacing part of the potassium, are called hyalophane. Celsian and hyalophane are rare and of minor importance, and they will not be treated here in detail.

The distinction between alkali feldspars and plagioclases is not always clear-cut, because alkali feldspars may contain appreciable amounts of calcium and plagioclases may contain potassium. Feldspars may be considered alkali feldspars if they are monoclinic or if in the triclinic case the atomic ratio potassium/calcium is larger than one. They may be called plagioclases if they are triclinic and this ratio is smaller than one. Whereas the potassium-rich feldspars do not contain much calcium (and the calcium-rich ones do not contain much potassium), feldspars rich in sodium can take sizable amounts of both potassium and calcium (about 10 atomic per cent of each).

CRYSTAL STRUCTURE

Main Features.—As a first step in the process of understanding some of the most important features of the feldspar structure, *see* in fig. 1 the model of the more simple structure of a silica (SiO_2) modification, cristobalite. Note that every silicon atom is surrounded tetrahedrally by four oxygen atoms and that each oxygen atom is surrounded by two silicon atoms. Thus the structure is made up of SiO_4 tetrahedrons in such a way that each oxygen shares two tetrahedrons. The whole arrangement is a relatively loose SiO_2 framework with significant voids.

The framework is electrostatically balanced: one Si^{4+} plus two O^{2-}. This formula, SiO_2, multiplied by four equals Si_4O_8. If some of the Si^{4+} are replaced by Al^{3+}, one obtains $(AlSi_3O_8)^{1-}$ or $(Al_2Si_2O_8)^{2-}$. To neutralize this framework in which Si^{4+} is partially replaced by Al^{3+}, additional positive ions must be inserted within the voids of the structure.



BY COURTESY OF AKADEMISCHE VERLAGS. GESELLSCHAFT

FIG. 1.—UNIT CELL OF THE STRUCTURE OF CRISTOBALITE, A MODIFICATION (CUBIC) OF SiO_2. IN THE ACTUAL STRUCTURE THE OXYGEN AND SILICON IONS ARE CONTIGUOUS, AND THE RADIUS OF AN OXYGEN ION IS ABOUT FOUR TIMES THAT OF A SILICON ION

The feldsppr structure contains K^+, Na^+, Ca^{++} ions within the voids of an $(AlSi_3O_8)^{1-}$ to $(Al_2Si_2O_8)^{2-}$ framework to balance the negative charge. The number of the inserted positive ions K, Na, Ca to the total of (Al + Si) ions is always 1:4.

Symmetry.—The main features of the feldspar structure may be discussed through the use of the cubic cristobalite structure. The actual feldspar structure is too complex to be discussed here in detail. The feldspars have a symmetry much lower than cubic; it is monoclinic or triclinic depending on composition, temperature and distribution of the aluminum and silicon ions within the $(Si,Al)_4O_8$ framework.

All feldspars can be referred to a system of co-ordinates that differonly slightly for the differentvarieties. The extreme values for the crystallographic axes are *a:b:c* from 0.66:1:0.56 to 0.63:1:0.55; and for the angles between the axes are a from 90° to 95°; β from 116° to 117°; γ from $87\frac{1}{2}$° to $90\frac{1}{2}$°.

In those cases where α and γ = 90° the symmetry is monoclinic. If a and/or γ + 90° the symmetry is triclinic. All plagioclases are triclinic. Virtually continuous changes from monoclinic to triclinic symmetry are known or can be hypothesized as a function of changing composition, temperature or aluminum/silicon distribution.

Unit Cell.—The unit cell based on the conventionally chosen system of co-ordinates has the following approximate lattice constants (in Å = 10^{-8} cm.):

a (K rich) = 8.58; (K poor, Na rich) = 8.12
(K poor, Ca rich) = 8.18
b = 12.8 to 13.0
c = 7.1 to 7.2

Angles *a*, β, y are given above.

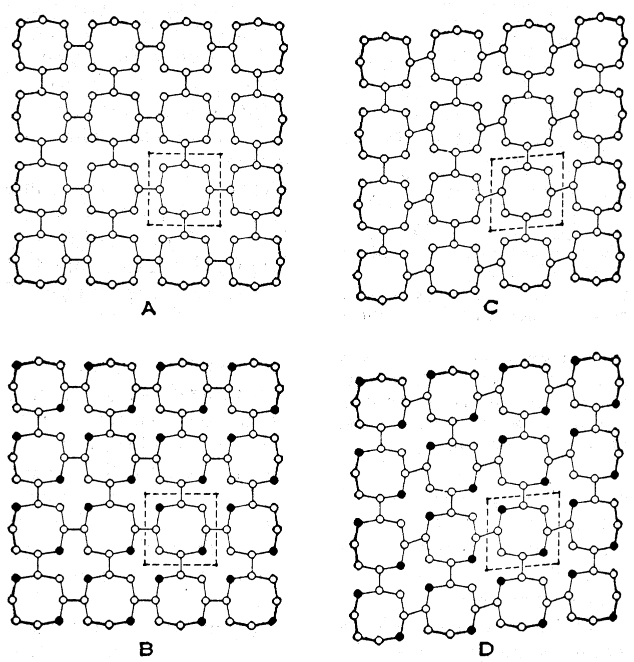
This cell contains four feldspar molecules $X(Si,Al)_4O_8$ where X = K,Na,Ca. It is side centred. X-ray photographs of the calcium-rich plagioclases (anorthite) indicate that their cell has a doubled *c* axis and is not side centred (due to an ordered superstructure of the aluminum and silicon atoms and of the calcium positions). Eight anorthite molecules ($CaAl_2Si_2O_8$) are in this doubled cell.

POLYMORPHISM

Potash Feldspar **($KAlSi_3O_8$).**—There are at least two polymorphic modifications. The modification stable at low temperature is the triclinic microcline, the one stable at high temperature is the monoclinic sanidine. Both modifications occur in nature. Long heating (months) at approximately 1,000° C. (near the melting point, which is 1,170° C.) changes microcline to sanidine. On the other hand, attempts to produce microcline either from sanidine or by direct synthesis were not successful. All potash feldspar synthesized in laboratory experiments appears to be sanidine. Geological times seem to be necessary for the formation of microcline. Whereas the crystal structure of sanidine became rather well known through the work of W. H. Taylor and his co-workers, the structure of microcline had not yet been determined in the

1950s. There was. however, evidence from both X-ray investigations and from several experiments concerned with the physical-chemical behaviour of the alkali feldspars to justify the hypothesis that the difference between sanidine and microcline is the result of a different distribution of the aluminum and silicon ions within the $AlSi_3O_8$ framework.

Fig. 2(A) and 2(B) show schematically in two dimensions how



BY COURTESY OF FRITZ LAVES

FIG. 2—TWO-DIMENSIONAL SCHEMATICS REPRESENTING THE SYMMETRY RELATIONS OF THE ALKALI FELDSPARS. (A) AND (B) DEPICT THE SANIDINE-MICROCLINE RELATION: CHANGES OF SYMMETRY AS A CONSEQUENCE OF DIFFUSIVE TRANSFORMATION. (A) AND (C) SHOW THE SANIDINE-ANALBITE RELATION: CHANGES OF SYMMETRY AS A CONSEQUENCE OF DISPLACIVE TRANSFORMATION. IN (C) AND (D), THE ANALBITE-ALBITE RELATION, NO CHANGE OF SYMMETRY OCCURS, DESPITE DIFFUSIVE TRANSFORMATION. THE ALUMINUM AND SILICON IONS ARE RANDOMLY DISTRIBUTED IN (A) AND (C); IN (B) AND (D) THEY ARE ORDERED

a difference in the aluminum/silicon distribution can produce a differencein symmetry. In both figures the dots represent the positions of aluminum and silicon. In fig. 2(A) the dots are not distinguished from one another, indicating that each position may be either aluminum or silicon; the aluminum and silicon are randomly distributed. The arrangement is symmetrical with respect to a vertical mirror plane. If, as drawn in fig. 2(B), the aluminum atoms are not distributed at random but take special positions. the mirror plane vanishes. Fig. 2(A) represents the disordered monoclinic case and fig. 2(B) (more or less distorted as in fig, 2[D]) represents the ordered triclinic case. The change from the one to the other might be called a diffusive transformation, as a diffusion of aluminum and silicon is necessary for the process. Obviously a diffusive transformation must be a more or less continuous process and its rate depends on the rate of the aluminum or silicon diffusion Considering the general structure of feldspars in which the aluminum and silicon atoms are tightly fixed by the relatively strong bonds to the oxygens that surround them one might suspect that the rate of exchange of aluminum and silicon is very low, esueciallv at low temneratures.

The crystallographic differences between microcline and sanidine are:

		Microcline	Sanidine
axes	a	8.58	8.56
	b	12.97	13.03
	c	7.22	7.18
angles	a	90° 39'	90°
	β	115° 56′	116°
	γ	87° 42′	90°

In the light of the above discussion, the following observations may be summarized:

1. Natural sanidines are known only from rocks that have been relatively quickly cooled. The disordered state appears to have been "frozen in."

2. Synthetic potash feldspar is apparently always monoclinic. No synthesis of triclinic microcline has been reported. Laboratory experiments apparently are of insufficient duration to allow the production of the ordered state.

3. There is evidence (interpretation of the twinning exhibited by microcline) that most potash feldspars, now microcline, originally crystallized as a monoclinic (disordered) modification. The transformation to the triclinic (ordered) state took place slowly with the passage of time.

4. Natural potash feldspars exist with angles α and y between 90° and those values characteristic for microcline, indicating that the diffusive transformation to the state stable at low temperature has not gone to completion.

5. Microcline when held at high temperature (1,000° C.) transforms slowly to sanidine (within months). During this process the values of angles α and y change continuously toward go° as a function of time. Similarly the optical properties change continuously from those of microcline to those of sanidine during such heat treatment.

6. Microcline is usually twinned. The width of the twin lamellae may range from millimetre size to submicroscopical bands (occasionally within the same twinned crystal). The over-all optical behaviour of such portions with submicroscopical twinning is more or less monoclinic and the optical properties of such material are very similar to those of common orthoclase.

7. It seems thus that those orthoclase crystals (which also appear monoclinic but are not sanidine), the optical behaviour of which approaches that of very finely twinned microcline. are distinguished from sanidine by a different aluminum/silicon distribution. Therefore, common orthoclase might be considered a5 somehow intermediate between sanidine and finely twinned microcline. This viewpoint is supported by X-ray evidence (qualitative interpretation of diffuse scattering).

8. Potash feldspar found in low-temperature veins and similar deposits is distinguished by a characteristic morphology (combination of prism, basal pinacoid and orthodoine or the forms [110], [001], [101]). It is usually glassy, or at least colourless, and is called adularia. As revealed by optical and X-ray investigations many adularia crystals consist of a virtually monoclinic core (with properties similar to common orthoclase) and a more or less triclinic rim. The triclinic portions of the rim follow a characteristic sector pattern and are arranged to each other in such a way that a monoclinic symmetry governs the morphology of adularia crystals.

Sodium Feldspar (**$NaAlSi_3O_8$**).—Two different modifications are known: albite, stable at low temperature; and analbite (or high albite), stable at high temperature. The transformation temperature lies around 700° C. Probably the structural differences between albite and analbite are analogous to those between microcline and sanidine; *i.e.,* the aluminum/silicon distribution is an ordered one in albite and a disordered one in analbite. In accordance with this hypothesis is the fact that it takes a month or more at about 1,000° C. to transform albite into analbite. As in the potash feldspars, no reversal of this process has been noted. Sodium feldspar crystallized in the laboratory has always proved to be analbite. even when synthesized at temperatures as low as zoo° C. Apparently laboratory times are too short to produce an ordered aluminum/silicon distribution.

It has been shown in the case of potassium feldspar how the change of the state of order/disorder is connected with a change of symmetry. Both modifications of sodium feldspar, analbite and albite have, however, the same (triclinic) symmetry. The diffusive transformation from albite to analbite and vice versa is therefore not accompanied by a symmetry change. The possibility of such relations is shown schematically in fig. 2(C) and 2(D).

Sanidine-Analbite Series (**$KAlSi_3O_8$–$NaAlSi_3O_8$**).—Sanidine and analbite form a virtually continuous series of mixed crystals at high temperature. These mixed crystals can be preserved at low temperature by cooling rapidly enough to prevent the diffusive transformation and the unmixing that starts below about 560° C. (see below). Fig. 3 shows the phase diagram of this series that is stable only at high temperature but unstable (undercooled) at low temperature. Mixed crystals that are potassium rich are monoclinic from room temperature up to the melting point, whereas sodium-rich members undergo a so-called displacive transformation, the transformation temperature being a function of the potash/sodium ratio. This kind of transformation that does not involve any change of the aluminum/silicon positions can be depicted schematically by the relations between fig. 2(A) and 2(C). As usual in the case of displacive transformations the modification stable at higher temperature has a symmetry higher than that of the modification stable at low temperature. Because no diffusion is involved in this kind of transformation it can take place very rapidly. It is neither possible to freeze in the monoclinic symmetry by quenching nor to retain the triclinic symmetry by quick heating.

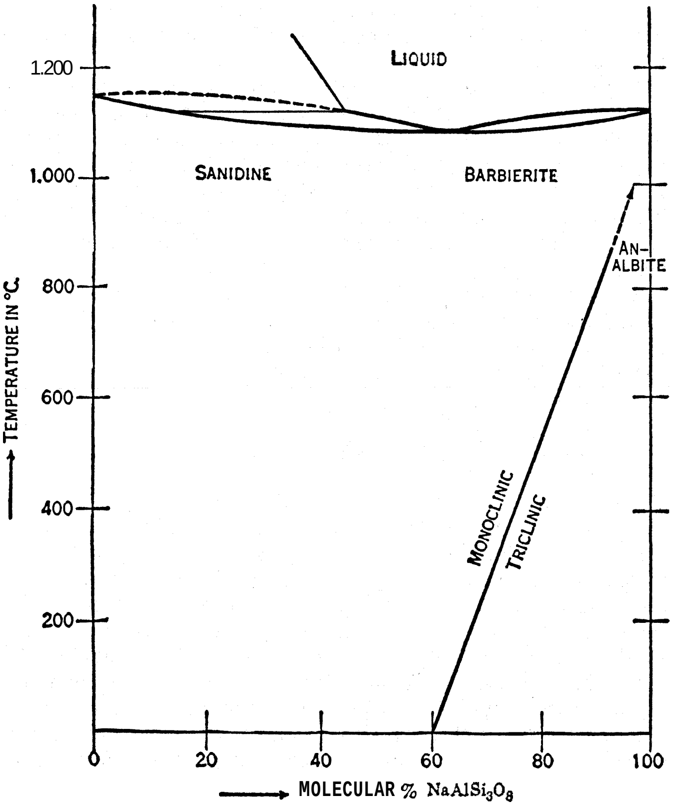


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FIG. 3.— PHASE DIAGRAM (NOT STABLE BELOW ABOUT 700° C.) OF THE SERIES SANIDINE-ANALBITE, BARBIERITE (see TEXT FOR EXPLANATION)

A publication (1952) by W. S. MacKenzie indicates that the line which in fig. 3 divides the monoclinic field from the triclinic one meets the sodium end of the diagram slightly below the melting point of $NaAlSi_3O_8$ (if equilibrium is reached by a prolonged heat treatment), so that at very high temperatures a monoclinic $NaAlSi_3O_8$ modification may exist. Such a modification was earlier proposed (on the basis of optical examination of natural material) and given the name barbierite, but its reality as a mineral has been disputed.

In summary, the alkali feldspars can be subdivided in the following way:

Al/Si distribution disordered
- K rich. sanidine (monoclinic, at high temperature)
- Na rich: barbierite (monoclinic, at very high temperature)
- Analbite (triclinic, at high temperature)

Al/Si distribution ordered
- K rich: microcline (triclinic, at low temperature)
- Na rich: albite (triclinic, at low temperature)

Unstable intermediate states are known at the potassium-rich side as common orthoclase and adularia (the latter predominantly as a low-temperature mineral).

The Plagioclases ($NaAlSi_3O_8$–$CaAl_2Si_2O_8$).—The polymorphism of the plagioclases appears to be very complex. Some details have already been given above for the sodium-rich end of the series. A. Kohler showed in 1942 that the optical properties of plagioclases that reach equilibrium at high temperature differ from those that approach equilibrium at low temperature. Some X-ray investigations with calcium-rich plagioclases have shown that there are significant differences between the sodium-rich and the calcium-rich plagioclases as far as polymorphous behaviour is concerned. This difference seems to result largely from the different aluminum-silicon ratio of the end members, which is 1:3 for the sodium end and 2:2 for the calcium end. The aluminum/-silicon ratio which equals 2:2 in anorthite ($CaAl_2Si_2O_8$) seems to be responsible for its superstructure, which is not found in the alkali feldspars. The *c* axis of the unit cell of anorthite is approximately twice that of albite. Another difference is that the anorthite unit cell is not side centred, a fact that appears to result from the position of the calcium ions compared with the position of the sodium (potassium) ions in the structure of the alkali feldspars. These conclusions have been drawn from the X-ray behaviour of anorthites after they were subjected to different heat treatments. The X-ray reflections which indicate that the unit cell is not side centred show a varying degree of diffuseness as a function of temperature (F. Laves and J. R. Goldsmith, 1951). After treatment at 1,500° C. these reflections are so diffuse that they almost disappear; after treatment at 1,000° C. all reflections are sharply defined. The reflections that correspond with those observable in photographs of the alkali feldspars remain sharp up to the melting point (1,550° C.). Heat treatment at intermediate temperatures produces intermediate diffuseness in the affected reflections. The time required to reach equilibrium is of the order of ten minutes.

The difference in structural properties of $NaAlSi_3O_8$ and $CaAl_2Si_2O_8$ leads to the conclusion that no complete solid solution series of mixed crystals is possible in the strictest crystallographic sense. not even at high temperatures. On the other hand. there is no reason to doubt the existence of a virtually complete solid solution series as established by N. L. Bowen as early as 1913.

The plagioclases are given different names as a function of their chemical composition: albite (0% to 10% anorthite [An]) ; oligoclase (10% to 30% An) ; andesine (30% to 50% An) ; labradorite (50% to 70% An) ; bytownite (70% to 90% An) ; anorthite (90% to 100% An).

UNMIXING AT LOW TEMPERATURE

The feldspars form virtually complete solid solutions at elevated temperatures. At low temperatures they unmix (if this process is not suppressed by relatively quick cooling). The degree of unmixing (as far as coarseness and composition of the unmixed products is concerned) is principally a function of temperature and time. The observation of natural feldspars and the interpretation of experimental work leads to the conclusion that the process of unmixing is much more readily accomplished in alkali feldspars than in plagioclases. This can be understood by the fact that the tightly bonded aluminum and silicon ions are much more reluctant to move by diffusion than the potassium, sodium or calcium ions (Goldsmith. 1952).

Unmixing of Alkali Feldspars.— Because all alkali feldspars have the same aluminum/silicon ratio (1:3) the unmixing process does not involve any aluminum/silicon diffusion. The first step will be the formation of potassium- sodium-rich domains by concentration fluctuations of sodium and potassium within the $AlSi_3O_8$ framework, with differences oi concentration that exceed those always present in a random distribution within a mixed crystal. If more time is available under favourable temperature conditions, these domains will develop into truly unmixed regions. and finally may even be observed macroscopically. In the beginning of the process the $AlSi_3O_8$ framework is still common to both the potassium-rich and the sodium-rich domains. As the unmixing process proceeds stress will be increased because of the difference in lattice constants of the potassium-rich and sodium-rich feldspars. This stress will finally lead to a truly two-phase system composed of potassium feldspar and sodium feldspar, separated by discontinuous phase boundaries. This material is called perthite. Earlier stages—where the phases are distinguishable only under a powerful microscope—are called microperthite. If the unmixing is developed on such a small scale that it can be detected only by X-ray methods or deduced by several other means, the material is called cryptoperthite. If the unmixed areas cannot be seen directly (even with a powerful microscope) but are the cause for a beautiful (white to blue) opalescence or schiller lustre displayed in characteristic crystallographical directions. one speaks of moonstone (*q.v.*). In fig. 4 a phase diagram is proposed with more detailed information on the temperatures at which unmixing should occur (if equilibrium is established) and on the compositions of the different phases in equilibrium.

Unmixed alkali feldspars usually show the potassium-rich material as the host in which the sodium-rich material is precipitated. The opposite is occasionally observed, plagioclase the host and the potassium-rich material precipitated within it. This material is usually called antiperthite.

Besides the degree of unmixing into potassium-rich and sodium-rich areas, the appearance of the products found in nature is further complicated by the different degree of aluminum/silicon order-disorder (discussed above) that may exist. The potassium-

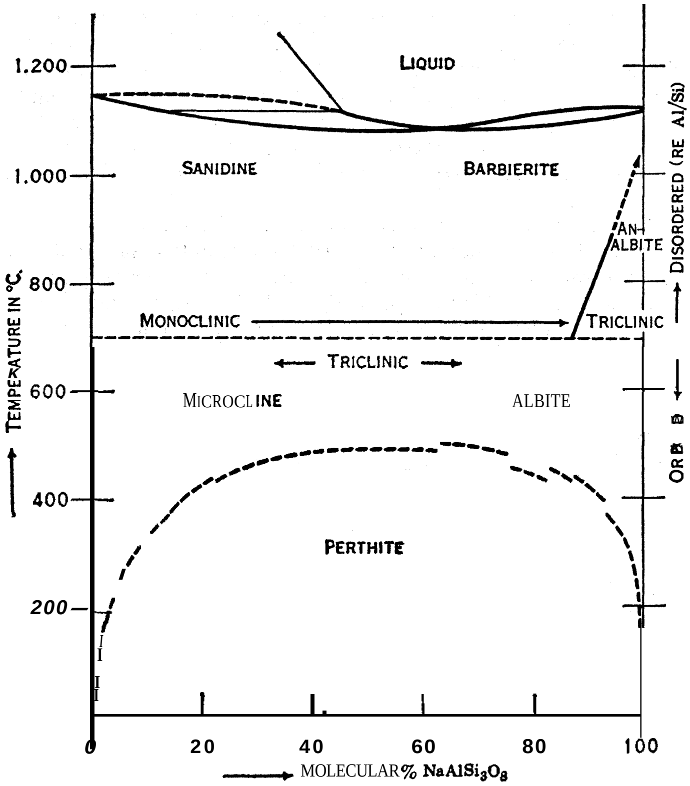

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FIG. 4.— PHASE DIAGRAM OF THE ALKALI FELDSPARS (IN PART HYPOTHETICAL)

sodium feldspars, especially those that are soda rich, exhibit a confusing variety of crystallographic and optical properties. This is a consequence, in addition to order-disorder relations, of composition and of variation in the temperature of the displacive transformation (discussed above). The symmetry change induced by this transformation may also produce twinning that may be submicroscopic. These complications are responsible for the uncertainties and confusion in descriptions found in many textbooks of the "mineral" anorthoclase, which does not exist as a true species.

The term anorthoclase is best defined as a feldspar of the composition between $Or_{70}Ab_{30}$ and $Or_{10}Ab_{90}$. It may or may not be homogeneous; it may be monoclinic or triclinic, or a mixture of both forms.

Unmixing of **Plagioclases.**—The plagioclases form a virtually complete series of mixed crystals at elevated temperatures from $NaAlSi_3O_8$ to $CaAl_2Si_2O_8$ (analbite-anorthite). Portions of this series are unstable at low temperature. There are (X-ray and optical) indications for two gaps of miscibility: (1) between albite and oligoclases; (2) between oligoclase and bytownite. The X-ray evidence for the first gap is the coexistence of reflections characteristic of two different feldspar structures in single-crystal photographs of plagioclases of compositions near $Ab_{90}An_{10}$. The optical indication for this gap is a characteristic bluish schiller exhibited by many plagioclases of this composition which are called peristerite. The second gap is inferred from ghost reflections on X-ray photographs of plagioclases, the composition of which lies between $Ab_{70}An_{30}$ and $Ab_{30}An_{70}$. These ghost reflections can be explained if one assumes periodically changing composition within the crystals. The optical indication for this gap is the beautiful schiller of all colours exhibited by many plagioclases in this compositional range, a schiller that is known as labradorizing.

Little is known, however, of the phase relations in the plagioclase feldspar system.

No textures within plagioclases are known that resemble those of the perthites in the alkali feldspars. In the alkali feldspars only the rather readily mobile potassium and sodium ions are required to move for a separation into $KAlSi_3O_8$ and $NaAlSi_3O_8$. In the plagioclases sodium and calcium can be segregated into $NaAlSi_3O_8$ and $CaAl_2Si_2O_8$ only if a simultaneous transport of aluminum and silicon ions takes place to maintain electrostatic neutrality.

The great difficulty involved in migrating aluminum and silicon even for short distances, as in the case of changing a disordered distribution to an ordered one (which does not involve large concentration changes), has been discussed.

OTHER PROPERTIES

Morphology and Twinning.— All feldspars show a similarity of crystal form, generally prismatic but flattened parallel to the side pinacoid face [010], or elongated parallel to the axis a with small prism faces. Sodium-rich sanidines (usually high in calcium) that are known from the rhombporphyries commonly have a characteristic habit with a rhomb-shaped cross section. They are elongated parallel to the *c* axis, only the prism and orthodome faces [110] and [201] being developed. The habit of adularia has been discussed. All feldspars cleave readily parallel to the basal pinacoid [001] and side pinacoid [010], producing angles of 90° in the monoclinic varieties and oblique angles in the triclinic ones. Twinned crystals are common and the twinning serves to distinguish various members of the group both in hand specimens and by optical methods under the microscope. In the monoclinic series the most common twin laws are the Carlsbad (twin axis *c*), the Manebach (twin plane [001]) and the Baveno (twin plane [021] or clinodome). In the triclinic series, in addition to these three laws the albite law (twin plane [010]) and the pericline law (twin axis b) are very common. They are usually developed as multiple twinning, visible (occasionally only microscopically) as fine striations on the cleavage planes, albite and pericline on [001] and pericline on [010]. Mechanical twinning after the albite and pericline law can be produced easily in analbite but not in albite, another physical consequence of the difference in the aluminum/silicon distribution.

Synthesis, Melting Point and Alterations.— With the exception of hyalophane, which contains barium, feldspars of all compositions have been prepared synthetically, but only as the high-temperature modifications, even at temperatures at which the low-temperature modifications are stable (see above). The alkali feldspars melt in the vicinity of 1,100° C. Addition of calcium raises the melting temperature to 1,550° C. for pure anorthite. Feldspars readily suffer chemical alteration, the most common products being kaolin, sericite, various zeolites and calcite. The anorthite-rich plagioclases, especially under conditions of retrograde metamorphism, break up into albite and a group of calcium aluminum silicates including prehnite, zoisite, epidote and garnet, this assemblage being referred to as saussurite. Albite is the most stable of the feldspars under the action of weathering and is commonly found in detrital sediments and as an authigenic, that is, formed in place and unaltered, mineral. Potassium feldspar is also known as an authigenic mineral in sediments (adularia or microcline).

More detailed information on mineralogical and crystallographical items and conceptions used in this article is given under CRYSTALLOGRAPHY and MINERALOGY. (F. H. L.; X.)

BIBLIOGRAPHY.—For more details and a survey of the pertinent literature on which this article is based *see:* F. Laves, "Phase Relations of the Alkali Feldspars," *Jour. Geol.*, vol. 60 (1952); J. R. Goldsmith, "Diffusion in Plagioclase Feldspars," *Jour. Geol.*, vol. 60 (1952); W. S. MacKenzie, "The Effect of Temperature on the Symmetry of High Temperature Soda-Rich Feldspars," *Am. Jour. Sci.*, Bowen volume (1952); H. Sørum, "Studies on the Structures of Plagioclase Feldspars," *Kgl. Norske Videnskab. Selskabs Skrifter*, no. 3 (1951).

Detailed descriptions of the physical properties of the different feldspar varieties are given in textbooks of mineralogy as listed in the article on MINERALOGY, and in the book of A. N. Winchell, *Elements of Optical Mineralogy*, part ii, *Descriptions of Minerals*, 4th ed. (1951).

FELDSPATHOID, one of a group of rock-forming minerals similar to the feldspars (see FELDSPAR) in general chemical composition but with a lower ratio of silica to alkalies or containing chloride. sulfide, sulfate or carbonate radicals. They are never associated with primary quartz. Nephelite (nepheline) and leucite (*qq.v.*) are the most important members of the group: sodalite, noselite, hauynite or haüyne (for these three see SODALITE) and cancrinite are rarer feldspathoids that occur only as accessory minerals in rocks; kalsilite and kaliophilite are phases of $KAlSiO_4$.

Structurally the feldspathoids are tectosilicates, the SiO_4 and AlO_4 groups being linked as in the feldspars with the metal atoms and the radicals fitting into cavities in this framework. They are all easily decomposed by acids which distinguishes them from feldspars. This property is associated with the high Al:Si ratio; the aluminum is removed in solution, the structure then collapsing, often with the formation of gelatinous silica.

Among the more important rocks characterized by the presence of feldspathoids are the intrusive nephelite-syenite and ijolite (*qq.v.*) and the lavas phonolite (*q.v.*), tephrite, basanite and nephelite-basalt. Nephelite is abundant in the nephelite-syenites of Arkansas. in the United States. Canada, Greenland, India. Norway and the U.S.S.R.: cancrinite and sodalite are frequently associated with nephelite as at Bancroft, Ont., and Miask, South Urals. (W. F. FG.; C. E. T.)

FELIX, SAINT, OF VALOIS (1127–1212), one of the founders of the order of Trinitarians (Order of the Most Holy Trinity), was born in the district of Valois, France, on April 19, 1127. He became a hermit in the forest of Galeresse, where he remained until 1187 when his disciple John of Matha (1160–1213) suggested to him the idea of establishing an order of monks who should devote their lives to the redemption of Christian captives from the Saracens. Obtaining the sanction of the pope about 1198, they founded the mother house at Cerfroid in Picardy. Felix died at Cerfroid on Nov. 4, 1212, and is commemorated on Nov. 20.

The Trinitarians (also known as Mathurins) had about 800 houses during the 15th century when their influence was at its greatest. In the 20th century the only surviving body was the Barefooted Trinitarian order, with fewer than joo members. centred at S. Crisogono in Trastevere, Rome. An order of Barefooted Trinitarian Sisters was established early in the 17th century.

FELIX, the name of three popes and two antipopes.

ST. FELIX I (d. 274), pope from 269 to 274, was elected on Jan. 5, 269, to succeed Dionysius. Felix was author of an important dogmatic letter on the unity of Christ's person (see P. Jaffé and W. Wattenbach, Regesta, n. 140). He was the focus of the emperor Aurelian's decision settling the dispute between Paul of Samosata (*q.v.*), deposed bishop of Antioch, and Domnus, his successor, in favour of him with whom "the bishops in Italy and Rome should communicate" (Eusebius, *Hist. Eccl.,* vii, 30). He died on Dec. 30, 274, and his feast day is May 30.

FELIX II (d. 365), antipope, was irregularly installed in 355 following the emperor Constantius' banishment of Pope Liberius. He was forced by popular pressure to retire upon Liberius' return in 358.

ST. FELIX III (d. 492), pope from 483 to 492, succeeded Simplicius on March 13, 483. His excommunication of the patriarch Acacius for Monophysitic sympathies in 484 was followed at Constantinople by a 35-year schism. Felix' synod of March 487 fixed conditions for readmission to the church of Africans who had been rebaptized by the Arian Vandals. He died on March 1, 492, and his feast day is Feb. 25. (H. G. J. B.)

FELIX IV (d. 530), properly Felix III, pope from 526 to 530, owed his election (on July 12, 526) to the influence of Theodoric, king of the Ostrogoths. After Theodoric's death, the election was freely confirmed. Felix wrote to Caesarius of Arles on St. Augustine's doctrine on grace and again condemned Pelagius and his disciples. He converted pagan temples into the Church of SS. Cosmas and Damian. To avoid a disputed succession Felix adopted the expedient of naming his own successor, the archdeacon Boniface (Pope Boniface II). Felix died on Sept. 22, 530. Dioscorus u-as elected as antipope, however, but when he died after a few weeks Boniface was recognized by all. (J. V. HN.)

FELIX V (Amadeus VIII of Savoy) (1383–1451). the last of the antipopes, was born on Dec. 4, 1383, and in 1391 became count of Savoy. In 1416 Savoy was erected into a duchy and in 1418 Amadeus added Piedmont to his dominions. In 1434 he retired to a hermitage at Ripaille near Thonon, France, where he founded and governed an order of knights-hermits. After the schismatic council of Basel deposed Eugenius IV. it elected Amadeus on Nov. 5, 1439, although he was not in orders. Amadeus accepted the election on Jan. 5, 1440, and was consecrated and crowned on July 24. As antipope, Felix V won scanty support, and he renounced his claims in 1449. He died at Geneva on Jan. 7, 1451. (E. A. R.)

FELIX, a missionary bishop from Burgundy, sent into East Anglia by Honorius of Canterbury (630–631). Under King Sigebert his mission was successful, and he became first bishop of East Anglia, with a see at Dunwich, where he died and was buried, 647–648.

FELIXSTOWE, an urban district and seaside town in the Sudbury and Woodbridge parliamentary division of East Suffolk, Eng., 11 mi. S.E. of Ipswich by road. Pop. (1961) 17,254. Area 6.2 sq.mi. Though on the east coast, it faces south and has a frontage both to the North sea and to the estuary of the Orwell opposite Harnich. with which it is connected by Eastern Region railway ferry. There is a small dock for yachts and river shipping. The church of St. Peter and St. Paul, mainly Early English, has traces of Norman work in the 12th-century nave. The town is built partly on a high cliff and slopes down to sea level toward the southwest where the beach is shingly with some sand; the sea mall and promenade, 2 mi. long, are laid out with public gardens and pavilions. and there is a promenade pier. Felixstowe has good golf links, and the open tournament of the East of England lawn tennis championship is held there in August. There are 11 yacht clubs within a 20-mi. radius of Felixstowe and yachting takes place in Harwich harbour and the Deben, Orwell and Stour rivers; there are also connections by steamer with Ipswich, up the Orwell. Near the dock is an R.A.F. seaplane station. The chief industry is catering for visitors, but there is some flour milling. glove making and manufacture of electrical components. The vicinity has yielded numerous Roman remains, and a 4th-century Roman fort off Reed pond (now destroyed by the sea) formed part of the coast defense of the Litus Saxonicum (the Saxon shore).

FELL, JOHN (1625–1686), dean of Christ Church (Oxford), bishop of Oxford and benefactor to Oxford university and its press, was born at Longworth, Berkshire. on June 23. 1625, the son of Samuel Fell, himself canon and later dean of Christ Church. John Fell became a student (*i.e.*, fellow) of Christ Church at the age of 11, and took his degree in 1643. During the Civil War he fought on the royalist side, being deprived of his studentship in 1648. He continued to live in Oxford. and nith a few friends carried on Church of England services throughout the Commonwealth (he had been ordained in 1647). At the Restoration in 1660 he was made canon and then dean of Christ Church. He was vice-chancellor. 1666–69. In 1676 he became bishop of Oxford while remaining dean. He died in Oxford on July 10, 1686.

Fell restored in the university the good order instituted by William Laud that had been lost during the Commonwealth, compelling attendance at lectures and keeping examiners up to their duties. In his own college of Christ Church he restored the main quadrangle (Tom quad) and built the tower over the gate, where he hung the bell (Great Tom) that still tolls nightly at 9 P.M. He instigated the building of the Sheldonian theatre, in which he installed the university press. He presented it with learned fonts acquired abroad, set up a type foundry and encouraged the foundation of a paper mill at Wolvercote, near Oxford. The "Fell" type that he introduced was discontinued in the 18th century, but rediscovered in 1874 and brought back into use. The university press printed Fell's own books, including editions of Theocritus, Aratus, the New Testament, Athenagoras, Theophilus of Antioch, Clement of Alexandria and Cyprian.

The verse

I do not love thee, Dr. Fell,
The reason why I cannot tell;
But this I know, and know full well,
I do not love thee Dr. Fell

is reputed to be the extempore translation of Martial's epigram

Non amo te, Sabidi, nec possum dicere quare;
Hoc tantum possum dicere, non amo te

made at Fell's request by the satirist Thomas Brown in order to avoid being expelled from the college for some undergraduate offense.

See C. E. Mallet, *A History of the University of Oxford*, vol. 2 (1924); *A Specimen of the Several Sorts of Letter Given to the University by Dr. John Fell, Oxford, 1693* (facsimile, 1928). (G. Hu.)

FELLAH (pl. FELLAHIN), Arabic for "plowman" or "tiller," a term used in Arabic-speaking countries, especially Egypt, to designate the peasantry as opposed to the Arabs of the desert and the townsfolk. See EGYPT: *Administration and Social Conditions: Living Conditions.*

FELLENBERG, PHILIPP EMANUEL VON (1771–1844), Swiss educator, was born on June 27, 1771, at Bern, Switz. He purchased in 1799 the estate of Hofwyl, near Bern, intending to make agriculture the basis of a new system, which he had projected, for elevating the lower and rightly training the higher orders of the state and welding them together in a closer union than had hitherto been deemed attainable. For some time he carried on his labours in conjunction with Pestalozzi, but incompatibility of disposition soon induced them to separate. Fellenberg's scheme at first excited a large amount of ridicule, but gradually pupils came to him from every country in Europe, both for the purpose of studying agriculture and to profit by the high moral training which he associated with his educational system. Fellenberg died on Nov. 21, 1844.

FELLING, an urban district in the Gateshead East parliamentary division of Durham, Eng., forming a southeastern suburb of Gateshead. The urban district stretches north to the Tyne and includes eight parishes. Pop. (1961) 35,602. The large industrial population is employed in the neighbouring collieries and manufactures, such as engineering, paint making at Felling Shore and Pelaw, and radar equipment at Bill Quay.

FELLOW, by origin a partner or associate, hence a companion, comrade or mate. The Old English *féolage* meant "a partner in a business." The word was, therefore, the natural equivalent for *socius,* a member of the foundation of an incorporated college, as Eton, or a college at a university. In the earlier history of universities, both the junior and senior members of a college were known as "scholars," but later, as now, "scholar" was restricted to those members of the foundation still *in statu pupillari,* and "fellow" to those senior graduate members who had been elected to the foundation by the corporate body, sharing in the government and receiving a fixed emolument out of the revenues of the college, as at Oxford and Cambridge. The academic usage of the term which dates back to the medieval university is generally applied to the members of the governing body or to holders of certain stipendiary positions called fellowships established for a fixed number of years and devoted to special study or research. The word is also used to designate privileged members of various learned societies and institutions.

In the United States the word first appeared in the 1650 charter of Harvard university which provided for five fellows among the officials of the governing body. However, in common usage the term "fellow" is applied in U.S. colleges and universities to selected students who have been awarded stipends for a year or more for graduate or postgraduate study. The selection of fellows is based mainly on intellectual and personal attributes, but financial need also may be considered. (J. M. Bk.)

FELLOWS, SIR CHARLES (1799–1860), British archaeologist, was born at Nottingham, where his family had an estate. In 1827 he discovered the modern ascent of Mont Blanc. He travelled in Italy, Greece and the Levant, and many of his sketches were used in illustrating *Childe Harold.* In 1838 he went to Asia Minor, making Smyrna his headquarters. He entered Lycia and explored the Xanthus from the mouth at Patara upward. Nine miles from Patara he discovered the ruins of Xanthus, the ancient capital of Lycia, and about 15 mi. farther the ruins of Tlos. He published his results in *A Journal Written During an Excursion in Asia Minor* (1839). Late in 1839, under the auspices of the British Museum, he again set out for Lycia, accompanied by George Scharf, who assisted him in sketching. This second visit resulted in the discovery of 13 ancient cities, and in 1841 appeared *An Account of Discoveries in Lycia, Being a Journal Kept During a Second Excursion in Asia Minor.* A third visit was made late in 1841, after Fellows had obtained a firman by personal application at Constantinople. He shipped a number of works of art for England, and in the fourth and most famous expedition (1844) 27 cases of marbles were dispatched to the British Museum. His chief discoveries were at Xanthus, Pinara, Patara, Tlos, Myra and Olympus. In 1845 he was knighted. He died in London on Nov. 8, 1860.

In addition to the works above mentioned, Fellows published the following: *The Xanthian Marbles; Their Acquisition and Transmission to England* (1843), a refutation of false statements that had been published; *An Account of the Ionic Trophy Monument Excavated at Xanthus* (1848); a cheap edition of his two *Journals,* entitled *Travels and Researches in Asia Minor, Particularly in the Province of Lycia* (1852); and *Coins of Ancient Lycia Before the Reign of Alexander; With an Essay on the Relative Dates of the Lycian Monuments in the British Museum* (1855).

FELLTHAM, OWEN (1604?–1668), English author best-known for his essays entitled *Resolves, Divine, Morall, and Politicall,* was born about 1604. He became the earl of Thomond's steward sometime before 1640, and spent most of his life at Great Billing, Northamptonshire, or at the earl's house in London, where he died on Feb. 23, 1668.

The first edition of the *Resolves* (1623) contained 100 essays written "when the author was but 18." The 2nd edition, *Resolves, a Second Centurie* (1628), contains a further 100 essays, and in the later editions the order of the two centuries is reversed. In the 8th edition (1661) the original 100 short, pithy essays are replaced by 85 more diffuse ones. Felltham's striking images, some of which were borrowed by the poet Henry Vaughan, are more original than his ideas. The 1661 edition included *A brief Character of the Low-Countries under the States,* printed separately in 1652 but written after a visit to Holland (*c.* 1628), some letters, and *Lusoria, or Occasional Pieces,* 41 poems including "An Answer to Ben Jonson's New Inn Ode" (he also contributed an elegy to *Jonsonus Virbius,* 1638), and the song "When, dearest, I but think on thee," erroneously attributed to Sir John Suckling. No further additions were made until *A Form of Prayer compos'd for the Family of the Right Honourable the Countess of Thomond* was added to the 12th edition (1709). The *Resolves* were reprinted from the 2nd edition in Temple Classics (1904).

See the articles by F. S. Tupper, *Modern Language Notes,* liv (1939); J. Robertson, *Modern Language Notes,* lvii (1943) and *Modern Language Review,* xxxix (1944). (J. Rn.)

FELO-DE-SE, a self-murderer; *i.e.,* a suicide. Not until the Suicide act, 1961, were criminal penalties for suicide and attempted suicide abolished in England. The Homicide act, 1957, provided that the survivor of a suicide pact is guilty of manslaughter rather than murder. Formerly, the property of a suicide was forfeited to the crown and his corpse subjected to degradation. Until 1823 a suicide was buried on the highway with a stake driven through the body. Virtually all such penalties were abolished before the end of the 19th century. There is great diversity in the U.S. law relating to suicide. In some jurisdictions suicide is declared a crime, and in many states an attempted suicide is punishable. Some states have held one who assists another to kill himself guilty of murder. There is substantial authority for the proposition that one who accidentally kills another while attempting suicide is guilty at least of manslaughter. (F. A. A.)

FELONY. In the English common law of crimes, offenses are classified as treasons, felonies or misdemeanours. In the modern law of England the procedures distinguishing trials of treason and felony cases were virtually eliminated by the Treason act, 1945. The law of the United States generally classifies crimes as either felonies or misdemeanours. The word felony appears first to have been applied to conduct disruptive of the feudal bond between vassal and lord, which had as its consequence the forfeiture of the fief or the lordship, as the case might be. Very early in the history of English law, however, the term was given to heinous offenses of other kinds. The most distinctive consequence of a felony conviction was the forfeiture of the felon's goods or lands to the crown. Forfeitures were abolished in England by the Forfeiture act of 1870 and have only rarely been authorized by U.S. criminal law. (See CONFISCATION AND EXPROPRIATION.) At the common law all felonies except mayhem (*q.v.*) were punishable by death. Whipping was substituted for the death penalty in cases of petty larceny by a 13th-century statute. In reality, however, recognition of "benefit of clergy" in the English law relieved the felon from capital punishment in many cases (see CLERGY, BENEFIT OF). The procedures of felony trials differed from those for other offenses. In the early law one charged with felony could not call witnesses in his behalf. Not until 1837 was the defendant's right to be represented by counsel at the trial given statutory recognition.

The consequences of commission or conviction of a felony are numerous and important in the modern law. In the Anglo-American countries one who has been convicted of a felony may be rendered ineligible to hold offices of public trust. In the United States the convicted felon suffers the loss of civil rights. such as the right to vote, not all of which are restored upon completion of the sentence. In many jurisdictions deadly force may be employed to prevent the escape of a felon from a valid arrest. Such force may also be employed to prevent the commission of a felony or, in some jurisdictions, a violent felony. In some states of the U.S. the court is obliged to provide counsel to indigent defendants in felony trials but not in those for misdemeanours.

Among the felonies recognized at common law were murder, manslaughter (see HOMICIDE), arson, rape, robbery, burglary and larceny (*qq.v.*). The number of felonies has been significantly enlarged by legislation, particularly in the modern period. The law of England has employed no consistent principle to determine the classification of an offense as a felony. In some instances crimes classified as misdemeanours involve greater social peril than many statutory felonies, and penalties for a misdemeanour may exceed those authorized for some felonies. In the United States the distinction between felony and misdemeanour is usually governed by the penalties attached to the offense. Thus a felony is often defined as an offense punishable by imprisonment in the state penitentiary, while a misdemeanour is punished by fine or a term in a local jail. Tested by any rational standard the classification of offenses in both the U.S. and English law is capricious and unsatisfactory. The need for legislative reconsideration of this important matter is common to most of the Anglo-American countries.

'See CRIMINAL LAW; MISDEMEANOUR; see also references under "Felony" in the Index volume. (F. A. A.)

FELSINA, a city founded by Etruscans on the site of modern Bologna (*q.v.*) in the Reno valley *c.* 510 B.C. Etruscan Felsina is known almost entirely from graveyards situated outside the city (notably at the Certosa, a monastery about 1 mi. W. of it) and from the remains of the large buildings inside the city.

Before Etruscan times, however, the Bologna.area was an important centre of Villanovan Iron Age cultures of the central European Urn Field type which dominated north and west central Italy from the Po river to northern Campania, and which in Tuscany and Latium provided the ethnic substratum of Etruscan culture (see VILLANOVANS; ETRUSCANS). Villanova. the type site, is 5 mi. N.W. of Bologna, and the cemeteries west of Bologna form the basis on which all Villanovan material culture is divided into phases: Benacci I (c. 1050–900 B.C.); Benacci II (c. 900–700 B.C.); and Arnoaldi (c. 700–450 B.C.), the latter overlapping but culturally distinct from the Etruscan period, to which belong Certosa period graves.

Cremations of Benacci I are characterized by rough biconical cinerary urns with impressed geometrical ornament. Bronze metalwork includes lunate razors, fibulae, elaborate horse bits and belt plaques of beaten raised work. In Benacci II pottery was elaborate, often exotic, and vessels of hammered bronze (buckets, cups and trays) showing Hallstatt (*q.v.*) connections become characteristic. Arnoaldi mas a phase of commercial prosperity and innovation in which close links were formed with Atestine culture (see ESTE). Pottery bore stamped designs of birds and humans; iron was prodigally used for weapons, chariots, etc; hammered bronze work, after first showing the influence of Vetulonia (*q.v.*) metalwork, produced (c. 500 B.C.) a series of attractive ceremonial buckets (situlae) with raised designs depicting scenes from Villanovan life. Gold jewelry and glass were known.

The Arnoaldi graves are culturally sharply separated from the Etruscan graves of the Certosa. These and the tombs of the Giardini Margherita were rich in Etruscan 5th–6th century metalwork (situlae, cistae and candelabra). Numerous fine Attic redfigure vases attest trade relations with Greece by way of Spina and the Adriatic. The earliest Etruscan tombs were marked with horseshoe-shaped stelae, carved in local Villanovan style.

By 350 B.C. Felsina had fallen to invading Gauls (Boii), who called it Bononia. It was captured by Romans in 196 B.C. and colonized in 189 B.C., and was linked in Roman times by the Via Aemilia with Rimini and by the Via Flaminia with Rome.

See A. Grenier, *Bologne villanovienne et étrusque (1912).* (WM. C.)

FELSITE, in petrology, a field name originally applied to older (pre-Tertiary) volcanic rhyolites and trachytes in which devitrification or other alteration has rendered the matrix dense and usually compact (see RHYOLITE; TRACHYTE).

Under the microscope the groundmass may often be resolved into exceedingly fine-grained quartz and feldspar. Well-formed crystals (phenocrysts) of quartz, orthoclase and plagioclase feldspar and biotite are usually present and sometimes abundant.

The German equivalents (felsophyre, felsite-porphyry) were originally separated from rhyolite proper solely on the basis of the difference in the megascopic appearance of the groundmass. In Britain, and to nearly as great an extent in America, however, the field name felsite came to be applied to any clearly nonbasaltic but otherwise unidentifiable fine grained volcanic or hypabyssal rock. Hence, the adjective "felsitic," meaning fine grained. The broadness of its denotation made it an extremely useful field term but condemned it for any other purpose. (F. Cs.)

FELSPAR: see FELDSPAR.

FELT, a class of fabrics or fibrous structures obtained through the interlocking of wool, fur or some hair fibres under conditions of heat, moisture and friction. Other fibres will not felt alone but can be mixed with wool, which acts as a carrier. Three separate industries manufacture goods through the use of these properties. The goods produced are wool felt in rolls and sheets. hats. both fur and wool, and woven felts, ranging from thin billiard tablecloths to heavy industrial fabrics used for dewatering in the manufacture of paper.

Felts of the nonwoven class are considered to be the first textile goods produced and many references may be found to it and its uses in the histories of ancient civilizations. The nomadic tribes of north central Asia still produce felts for clothing and shelter, utilizing the primitive methods handed down from antiquity.

Wool felts of the "true" or nonthread structure class are produced as both rolls and sheets. Roll felts are made in thicknesses from $\frac{1}{32}$ to $1\frac{1}{2}$ in., and up to 80 in. wide and 60 yd. long. Sheet felts are produced up to 4 in. thick usually as 36 in, squares but other rectangular sizes as well as ovals and circles are made. Wool felts of the better grades are made of all wool but the felting power of wool is such that as little as 10% wool in a blend with non-felting fibres is sufficient to produce a felt.

The wool fibres selected for felting are usually less than $1\frac{1}{2}$ in. in length and must be of good felting quality and strength. The fibres are scoured, treated to remove tar, paint and vegetable matter such as burrs, and then opened and blended to form a batch. The prepared blend is fed to a carding machine, which further opens, blends and combs the fibres into a web of single fibre thickness that is laid down on an endless apron to form a batt. In most roll felt manufacture two or more cards are set at right angles to each other so that the web from at least one is laid down at right angles to the others to produce "cross" in the batt and dimensional stability in the finished felt.

The carded batts are produced to predetermined weights, after which one or more batts, but usually several to a felt, are laid up on the hardening machine and sprayed with water. Hardening consists of drawing the moistened laid up batts between aprons across a steam chamber. Steam is forced into the batts to activate the fibres, after uhich the steamed section is drawn beneath a heavy heated platen. The platen is lowered onto the moist, hot batt and is agitated in a horizontal plane.

The heat, moisture and friction is sufficient to felt and interlock the fibres from the individual batts into a unified mass. After a requisite time the platen is raised, the hardened section drawn forward, and the next area, which has been steamed meanwhile, is subjected to the action of the platen. This operation is plate hardening; a similar operation done on a continuous basis between rollers is called roller hardening.

After the hardening operation, the lightly felted piece is rolled and allowed to cool and drain. Only the thickness of the batts is affected by hardening whereas area shrinkage or felting up to as much as 50% is accomplished in the next operation known as fulling. The hardened batt is passed through a fulling aid, usually a solution of soap or acid, although occasionally warm water will suffice, and is rolled up and placed in the fulling mill. One type of fulling mill consists of a binlike receptacle with a concave front, straight sides and a back that consists of one or more movable hammers that pound, turn and shrink the goods to the desired dimensions.

The scouring, dyeing, treating and finishing operations that follow are done much as for the production of woolen cloths. Sheet felts follow much the same process except that after carding the batts are cut up and plied to specified sizes and weights and then hardened, fulled and washed as individual sheets. Maximum dimensional stability, density and strength are obtained in the sheet felt process.

Hair felts, widely used in polishing operations, are made much as described above for sheet felts and are an important specialty item to the wool felt industry.

The uses of felt are myriad. Some of the more important include wicking, absorption, vibration isolation, insulation, padding and packaging, polishing, sealing and gasketing, as well as apparel and decorative fields.

Most felts are made to close specification requirements, particularly for mechanical and industrial applications where high standards of quality, reproduction and tolerances are constantly met.

Hat felts are made of both wool and fur. Wool hats are made much as already described for wool felts except that a narrow web is taken from the card and is collected on an egg-shaped mandrel. Two cone-shaped pieces are obtained from this starting shape by further felting operations from which the finished hat bodies are shaped and formed. Beaver, hare and rabbit furs are among the fibres used in fur felt hats and all of these must first be treated with strong chemicals in an operation known as carrotting in order to provide the fibres with optimum felting power.

In the manufacture of fur felt hats a blend of furs is air laid on a rotating perforated cone surface with a wet cloth and with a vacuum pulling from within. The fur collects and is removed as a fragile cone shape. After many wet finishing operations, including dyeing, the felted cone is molded to a rough hat shape. Many more dry finishing operations are required to reduce the rough hat to the finished article.

The manufacture of woven felts follows to a large degree the conventional woolen cloth practice. Wools of selected fineness, length and felting property are scoured, blended, combed and spun into yarns. The yarns are woven into the rough cloth structure required depending upon the type of end goods planned. The rough cloth is soaped and fulled or milled in the fulling mill where felting or shrinkage is carefully controlled to preset dimensions after which scouring, dyeing in the case of some of the lighter cloths, and other textile finishing operations follow.

Some special felts for the papermaking trade are made as endless belts zoo in. or more in width. Highly skilled operators hand weave or join the ends to produce the endless belt so that no joint or seam is discernible. Special machines are used to make this class of woven felts since the goods must be run as belts and therefore have to be loaded and unloaded from the side of the machines rather than from the front or back as is conventional.

(T. J. G.)

FELTHAM, an urban district in the Feltham parliamentary division of Middlesex, Eng., about 15 mi. W.S.W. of Charing Cross, London, by road. Pop. (1951) 44,861. Area 7.7 sq.mi. Hanworth, in the southern part of the district, was a royal hunting seat much favoured by Henry VIII; the castle was burned down in 1797 but the moat still remains. The records in the 19th-century church of St. George date back to 1300 and Oriel school has been so named because Adam de Brome, rector in 131j, founded Oriel college, Oxford. In Bedfont, in the northern part of the district, many Roman relics have been found. The parish church of St. Mary by the village green dates from the 12th century, and early English mural paintings have been found there.

The district includes part of London airport, most of Feltham marshalling yard which contains about 39 mi. of sidings, the central ordnance depot of the Royal Army Ordnance corps, the second oldest borstal institution (see BORSTAL SYSTEM) in the country and the ship hydrodynamics laboratory of the National Physical laboratories.

FELTON, CORNELIUS CONWAY (1807–1862), **U.S.** classical scholar, was born on Nov. 6, 1807, in West Newbury, Mass. His annotations on Wolf's text of the Iliad (1833) and his Greece, *Ancient* and Modern (2 vol., 1867) were outstanding works. He graduated from Harvard college in 1827, taught at various academies, and joined the Harvard faculty in 1829. In 1860 he became president of Harvard, a position he held until his death, at Chester, Pa., on Feb. 26, 1862.

Felton was a man of unusual intellectual breadth, and vigorously opposed the growing neglect of the humanities in American universities. He edited many classical texts and made several translations.

FELUCCA: see BOAT.

FENCE. **A** fence is a man-made barrier erected to restrict the movement of men or animals across boundaries. In early historical times the term was used in the sense of defense or of anything that served as a defense or protection as against heat, cold, rain or evil but especially against enemies, the Great Wall of China being the most awe-inspiring example. Castle walls of the middle ages, stockades of pioneer America, thorn fences of African villages and barbed wire entanglements of modern wars are examples of the continued use of fences as protection from foes. (See FORTIFICATION.)

As civilization advanced, fences were constructed to confine animals within bounds or keep them out of fields, to exclude unwelcome trespassers, and to enhance the beauty of buildings, gardens and fields.

Materials and methods of constructing fencing on farms reflect changes in technical development. Before the discovery of manufacturing methods for steel fencing, farmers built from materials readily available. Settlers of stony land cleared their fields of stone and erected fences by the expedient of piling stones about the field boundaries. Where stones were not abundant. timber, sod and living or quickset hedges formed fences. When properly trimmed, hedges make a permanent fence as attested by the English privet fence, the Osage orange and the multiflora rose of the United States. Hawthorn (*q.v.*) has been used in England since Roman times. Various species of cactus have long been used for living fences. especially in southern Mexico and Latin America and in Africa. Mud, adobe. brush and wattled fences have been widely employed in sparsely timbered areas; homesteaders in Kansas sometimes made fence posts from native limestone. Farmers with ample timberland chose to construct fences of wood.

In the United States in colonial days, five types of common wood fences were: split rail laid in a zigzag pattern, sometimes called worm; mortised and tenon; stake and bunk; jack pole or jack and pitch pole; and picket. In the mortise and tenon fence, rectangular holes were cut through the posts to support the straight rails, hewed to fit into the holes. The stake and bunk was constructed by placing rails in a straight line into a ladderlike structure of two posts with wooden spacers between them and mounted on a bunk or block. Jack pole and pitch pole fences were both built on X-shaped post structures. Poles to form the fence ran horizontally on the common jack pole fence, but were placed diagonally with one end resting on the ground in the pitch pole fence.

Farmers on the plains of Russia and the United States built earth fences of sod or turf since this material was readily available and low rainfall allowed them to stand over a period of years.

Wire for fencing was first used in the 1800s. Barbed wire and woven wire were developed between 1860 and 1883 when the first woven wire was produced for sale. The industry grew rapidly. In 1923 there were 552 styles of woven wire being produced and sold in 2,072 sizes of packages in the United States. The national bureau of standards of the United States worked to reduce this great variety. Five standard styles of barbed wire were developed, all of them packed in standard 80-rod rolls. Woven wire with rectangular mesh and hinged joints serves for most farm field use. Eight principal sizes are identified by number such as 939-6-11. This means that the wire has 9 horizontal line wires, is 39 in. tall, has vertical stay wires 6 in. apart, and the wires are 11-gauge, except the top and bottom line wires. All wire is galvanized for corrosion resistance, Hinged joint woven wire is packed with 20 rods in each roll.

Other forms of steel fencing include lightweight poultry netting from 12 to 72 in. tall, with 1- or 2-in. mesh; and heavy weight link fence as used by industry.

Post durability is an important factor in determining the life of a steel fence. Reinforced concrete, steel and wood are popular post materials. Although the heart woods of some species such as black locust. catalpa, cedar. cypress, juniper, mulberry and Osage orange have fairly good decay resistant properties, scarcity of these species created demands for preservative treated posts. Wood preservatives are classified as either oils such as coal-tar creosote and petroleum solutions of pentachlorophenol, or water-borne salts such as copper sulfate and sodium arsenate. These materials have been effective in prolonging post life when properly applied

Traditionally, posts were placed 1 rod ($16\frac{1}{2}$ ft.) on centre in the farm fence line, but later standards recommend a 14 ft. on centre spacing. Special bracing must be constructed at the corners and at 20-rod intervals along straight lines of woven wire. Tests conducted at Iowa State college showed that an effective brace system is composed of three well-set posts 8 ft. 6 in. on centre. Two horizontal compression braces are supported on dowels set 8 to 12 in. below the top of these posts. The two braced panels are tied with diagonal tension members made of four strands of smooth galvanized 9-gauge wire twisted tightly to pre-stress the assembly.

Electric fences are for temporary use where close confinement is not essential. Since they are not a physical barrier, but a symbol of electrical shock in the mind of livestock, they are seldom satisfactory as a permanent fence. (See RURAL ELECTRIFICATION.) When using impulsive electrical charge on fence wire, safety precautions such as outlined in the regulations of British Standard 1222, "Battery-operated electric fences." should be followed. Insulators on the wire should resist passage of current to the ground when submitted to a 1,000 volt potential. See also WIRE.

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FENCING. Modern fencing (Fr., *escrime;* Ital., *scherma*) is a world-wide sport derived from the ancient art of offense and defense with a sword. It is practised with three different weapons: the foil, épée (or dueling sword) and sabre. Each weapon has its own history, characteristics and rules; but the objective of all modern fencing is to score by touching the opponent's target and to avoid being touched.

In earlier days fencing was also practised with wooden weapons. such as the quarterstaff, singlestick and cane. Other obsolete forms include the Japanese game *kendo,* similar to quarterstafl but highly conventionalized as to ceremony and method of scoring; the German students' duels (*schläger-mensur*) designed as a test of courage rather than skill; and bayonet fencing, found in certain military establishments.

Modern fencing, from the point of view of the number of competitors and nations represented, has been a major Olympic sport since the games were revived in 1896. Its ruling body, the Fédération Internationale d'Escrime (F.I.E.), founded in 1913, comprises about 60 countries and conducts annual world championships except in Olympic years. The Amateur Fencers League of America is affiliated with the F.I.E. Fencing is predominantly a participant (rather than a spectator) sport than can be enjoyed competitively by a varied age group and by both men and women.

This article deals with the historical background and development of fencing as a sport, fencing weapons and equipment, rules and customs of fencing and fencing technique including footwork and fundamentals of foil, épée and sabre fencing.

Historical Background.— In the history of fencing; two great overlapping eras may be discerned. The first spans the period from ancient times to the 19th century, during which the art of swordsmanship was studied primarily for its practical utility (see SWORD). The second is the period of fencing as pure sport; in terms of the modern game, it dates roughly from the 18th century to the present day.

Although the sword was the chief weapon of battle until the introduction of gunpowder, relatively little is known about the technique of swordsmanship prior to 1400. The legendary skill of the heroes of Greek, Roman, Germanic and medieval epics seems to have been based mostly on strength and agility. During the golden age of chivalry the two-handed sword used by both knights and footmen was intended to crack heavy armour by powerful strokes with the edge. When, in the 15th century, the invention of firearms destroyed the effectiveness of heavy armour, the trend toward lighter, better-balanced weapons led to greater reliance on skill in the handling of the sword. Quick-firing weapons gradually rendered the sword obsolete in warfare, but the prevalence of dueling and brigandage required continued attention to the art of swordsmanship as a matter of personal safety. Guilds of professional fencing masters were organized and at times enjoyed great social prestige.

For a time fencing masters jealously guarded their knowledge, giving lessons behind closed doors, restricting practice to pupil and teacher, and forbidding disclosure of their "secret thrusts," or coups, which often cost fortunes to learn. Beginning in the 16th century, however, the publication of illustrated fencing treatise opened the way for testing the various theories and methods of swordsmanship. It seems clear that the secret thrusts of old Mere basic actions improved to a high degree of efficiency through long practice and concentration, with particular attention to the factors of surprise, timing and distance, which are still the keys to success in the sport of fencing.

From a technical viewpoint, the edge of the weapon seems to have been used exclusively until about 1500; thereafter preference was given to the one-handed rapier, and the faster and deadlier point thrust gained ascendancy. The rapier was used chiefly for offensive purposes; the defense was entrusted to the left hand, which carried a buckler or cloak and. eventually, a dagger for use at close quarters. Footwork at first was based on the elaborate geometic designs of Spanish masters, but was improved by the discovery of the effectiveness of the lunge during the second half of the 16th century. The next major advance was the use of a single weapon for both offense and defense. which led to the modern fencing position with the body in profile to offer the 'smallest target and to increase the reach of the lunge. With the development of the riposte or counteroffensive after the parry, the fundamental structure of modern swordplay with the thrusting weapon was completed, largely by Italian masters, by the beginning of the 17th century. Further refinements resulted from the introduction of the smallsword after 1650, the invention of the French foil about the same time. the evolution of the dueling sword with a rigid triangular blade and the development of a rough mask for practice in the 18th century.

Although the cutting weapon never disappeared, its technical development was much slower. The single-edged broadsword. or backsword. remained the "Englishman's traditional weapon" until the reign of Elizabeth I; it was used for offensive purposes, with a buckler for defense. A basket-hilt sabre was used in Germany for students' duels. The heavy cavalry sabre. which remained a weapon of war until modern times, featured wide circular movements from the wrist and parries made by countercuts. However, by modern standards. the handling of these weapons required only rudimentary skill. Technical advances were made chiefly by Italian masters in the 19th century, and resulted from the prevalence of sabre duels in Italy and eastern Europe under rules similar to those prevailing for combat with the thrusting weapon.

Even a brief history of fencing must refer to the symbolic importance of the sword in ceremony and social status over the centuries and to the ancient notion that the duel (*q.v*) was an acceptable method of settling disputes. Faith in divine judgment on the outcome characterizes the individual combats between Paris and Menelaus and between Ajax and Hector in the Iliad, the Germanic judicial institution of trial by battle and the chivalric tradition of the middle ages. Later, the duel was justified as a remedy for the deficiencies of the law in matters of personal honour. The duel had great impact upon the development of fencing as a sport. not only with respect to the technique of handling the weapons but also in the traditions of courtesy embodied in the punctilious dueling codes.

Development of Fencing as a Sport.—Foil Fencing.—The pivotal fencing bout (not a duel) in Hamlet indicates that friendly tests of skill in swordsmanship were well established by the year 1600. But fencing did not develop into a distinct game with its own rules for at least another century. The credit for this achievement is usually given to D. Angelo and G. Danet, who wrote treatises on fencing in the middle of the 18th century. The equipment for the new sport included the foil, originally designed as a practice weapon for the smallsword, and the metal practice mask with a horizontal eye slit. The rules were based on certain conventions of play originally adopted for safety reasons prior to the introduction of the mask. These conventions limited the target to the trunk of the body, and provided an orderly alternation of play between the contestants by specifying that the attack had the "right of way" until it was parried; then the defender's riposte had the right of way until it was parried, and so on. Following the invention of the wire-mesh mask around the year 1800, the new game made rapid strides. The rivalry of the French and Italian schools of foil fencing gave rise to the first great international tournaments. Emphasizing precision of movement, split-second timing. deception and counterdeception, fencing has been likened to a game of chess in the variety and intricacy of its actions; and its containment within the framework of the phrase d'armes or sequence of play turns the bout into a courteous but spirited argument Until the end of the 19th century, all the outstanding fencers were foil players An electrical scoring apparatus was adopted for international foil competitions in 1956.

Sabre Fencing dates from the middle of the 19th century, when the Italian masters introduced a light practice weapon and adapted the conventions of foil play to it. The limited target excluded the legs. and the orderly alternation of play was required. However. scoring could be done with both the point and the cutting edges. thus adding a new dimension to the diversity and complexity of the actions. Early in the 20th century, a number of masters in Hungary notably I. Santelli and L. Borsody, revolutionized the technique of sabre fencing by favouring a weapon no heavier than the foil and by emphasizing speed, co-ordination and other athletic aspects of the game. By the middle of the century, the popularity of the cut-and-thrust weapon rivaled, and in many countries surpassed. that of the classical foil.

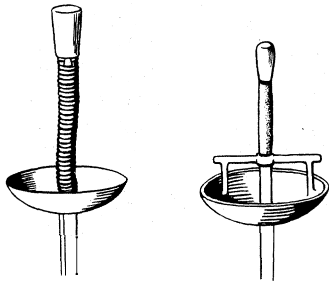


FIG. I — FRENCH (LEFT) AND ITALIAN (RIGHT) FOIL HANDLES

Épée Fencing began late in the 19th century as a reaction against the conventions of foil play and a tendency to score on "form" rather than effectiveness. A number of amateurs became interested in fencing outdoors for a single touch anywhere on the body with blunted dueling swords under rules that reproduced the prevailing conditions of the duel. The French term for the dueling sword, *épée* de terrain, indicates the original purpose of the new game exactly, but this realistic fencing soon followed the foil and sabre into the realm of pure sport. The special character of épée fencing was preserved through the elimination of conventions, although the number of touches per bout was increased to three in 1932 and to five in 1955. The decisive change came with the adoption of the electrical scoring apparatus in 1935, which led to an open game. with ample room for highly individualistic styles. that made CpCe fencing the most popular form of the sport in international competition. Épée fencing is one of the sports in the modern pentathlon, the others being running, swimming, riding and shooting.

Fencing Weapons and Equipment.—Because of the modern emphasis on speed. fencing weapons are usually lighter than the maximum weight permitted by the rules: 500 g. (17.637 oz.) for foil and sabre, 770 g. (27.16 oz.) for CpCe. The maximum overall length of foils and épées is 1.100 mm. (43.307 in); of sabres, 1.050 mm. (41.338 in.). Blades are made of finely tempered steel, with a maximum length of 900 mm. (35.433 in.) for foil and CpCe, and 880 mm. (34.646 in.) for sabre.

The foil is the only weapon used by both men and women. Its two principal forms are the French and Italian (fig. 1). The French favour a plain handle about eight inches long, slightly curved to fit the palm of the hand along the base of the thumb, with a pommel used chiefly for balance. The Italian handle is shorter and straight, with a crossbar about two inches from the guard; balance is obtained by a strap that binds the weapon to the wrist. In both types the weapon is held firmly with thumb and forefinger. while the other fingers control the movement of the point. With the Italian handle, the top joint of the middle finger hooks over the crossbar; this and the strap provide a somewhat stronger grip than the French handle (fig. 2). The latter, however, gives greater freedom of action to the fingers and wrist, particularly at close quarters. Other types of handles have been designed to combine the best features of the French and Italian styles, but have never attained the popularity of the older han-

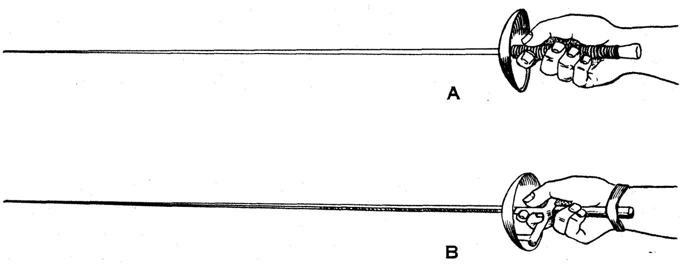
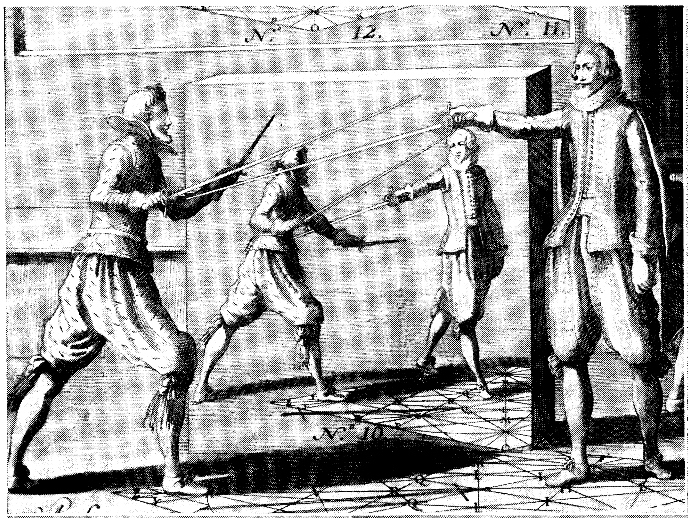
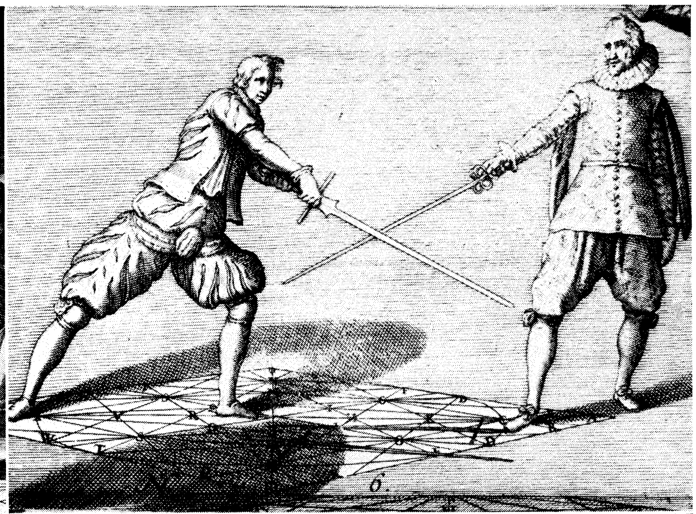
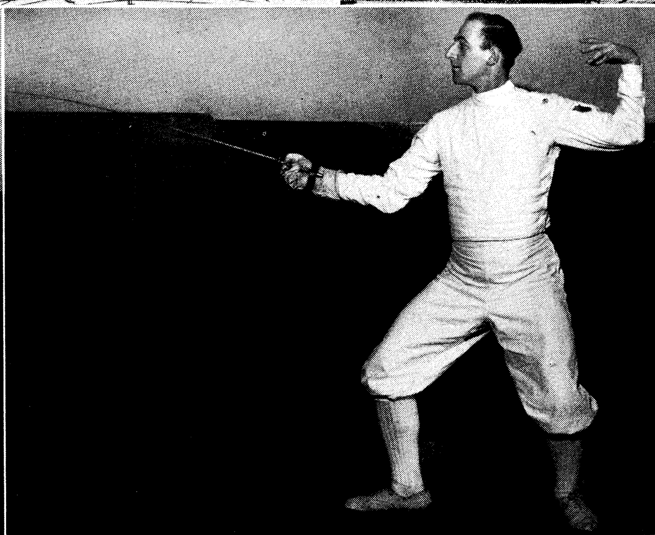
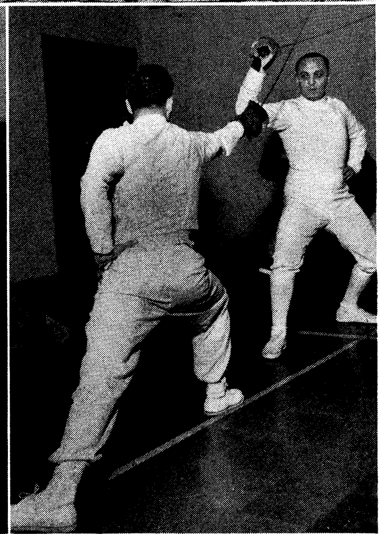


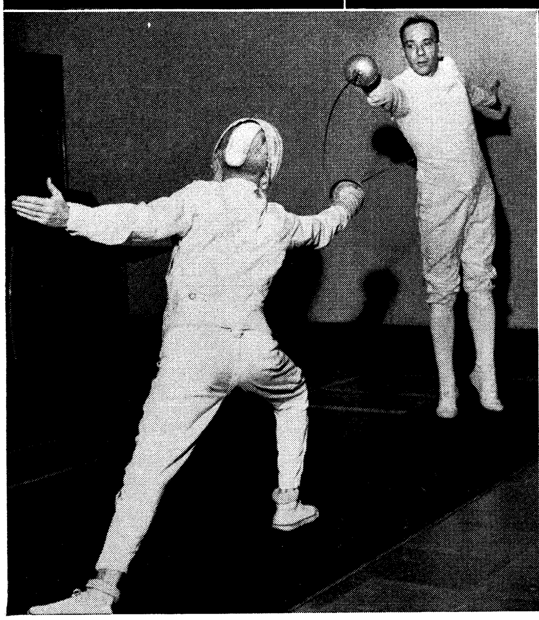
FIG. 2.— FRENCH(A) AND ITALIAN (B) FOIL GRIPS

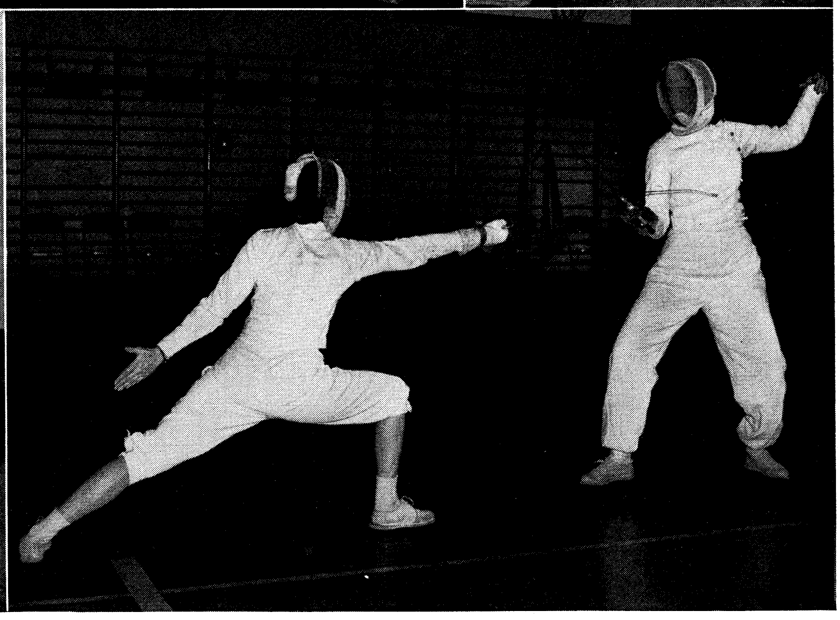












BY COURTESY OF (CENTRE ROW, BOTTOM ROW) AMATEUR FENCERS LEAGUE OF AMERICA, PHOTOS BY CARL VON HOFFMAN

FENCING, 16TH CENTURY AND MODERN

Top left: The long weapons and the geometrical designs of Spanish fencing masters of the 16th century. A circle was inscribed in a square intersected by chords, and pupils were instructed by this diagram

Top right: Two-handed sword against rapier in a match. The rapier, a straight two-edged sword used chiefly for thrusting, took the place of the espadon when the use of armour was discontinued and the heavier weapon was no longer required

Centre left: Beginning of salute at start of bout. The weapon is moved toward the person saluted and then is brought down sharply

Centre: The guard position with the Italian foil, which is strapped to the wrist

Centre right: Parrying with sabre (rear fencer) in fifth position against an opponent's cut to the head

Bottom left: Épée (dueling sword) fencer stop thrusts his opponent, who has started to attack, and catches him just above the wrist

Bottom right: Women's foil match showing a lunge in attack (left) being parried in fourth position

dles. Under the rules, disarmaments have no effect on the score, since touches after disarmament are not counted. The foil guard is normally circular, with a maximum diameter of 120 mm. (4.724 in.). The blade is rectangular in section. very flexible, tapering to a blunted tip; however, the electrical foil button is rounded and burred to insure registration of hits that land squarely on or off the target.

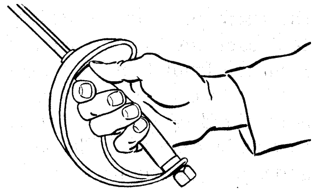


FIG. 3.— SABREGRIP

The construction of the CpCe is similar to that of the foil, but the Italian style of handle is not widely used. The guard is larger, 135 mm. (5.415 in.) in diameter, and sometimes mounted off-centre. The blade is triangular in section and fairly rigid; a special tip with three small prongs is used with nonelectric weapons to facilitate judging. In the electrical weapon, the tip is rounded and burred, and is fitted with a spring capable of resisting a pressure of 750 g. (26.455 oz.) before the apparatus registers a touch.

The sabre handle is plain and slightly curved. It is grasped so that it lies clear of the palm at the fleshy base of the fingers (fig. 3). The blade is V-shaped and narrow; it is rigid on the theoretical cutting edges, but quite flexible on the flat plane. The guard sweeps around the back of the hand to the pommel. so that it protects the knuckles against cuts; in size the guard must pass through a gauge 150 mm. (5.905 in.) by 140 mm. (5.512 in.). the flat of the blade being parallel to the 150 mm. sides.

All fencers wear a strong wire-mesh mask, a white suit made of closely woven canvass or gabardine, a glove with a cuff that overlaps the sleeve of the jacket and flat-soled shoes. Women must wear chest protectors. With the electrical CpCe and foil, the equipment includes a body cord that hooks up to the central apparatus; in foil fencing a metallic vest is also required. An elbow guard is optional in sabre fencing.

Rules and Customs of Fencing.—Since 1914, when the international rules were codified. the sole criterion for judging formal competitions has been the number of touches scored. Bouts are judged by five officials. The president of the jury starts and stops the play and awards the touches. Two judges watch each contest and announce, by raising a hand, when a hit has landed on or off the target. However, when the electrical apparatus is used for CpCe or foil, there is only one official. In informal bouts each fencer acknowledges the touches he receives.

In international events, bouts are held indoors on linoleum or cork strips about 2 m. (6 ft. $6\frac{3}{4}$ in.) wide and 18 m. (59 ft.) long. If a fencer retreats more than 4 m. (13 ft. $1\frac{1}{2}$ in.) in foil and 10 m. (32 ft. $9\frac{3}{4}$ in.) in CpCe and sabre, he is penalized one touch; if he steps off the side of the strip, he loses 1 m. (3 ft. $3\frac{3}{8}$ in.) in distance.

At the beginning of the bout, the contestants face each other in the centre of the strip and salute by raising their weapons (guard level with the chin) and bringing them smartly down. At the command "On Guard," the fencers put on their masks and take a guard position. The president then asks "Ready?" and. if neither fencer says "No," orders them to "Fence!" The contestants are free to fence as they please, each trying to touch his opponent and to avoid being touched, until "Halt!" is called.

In CpCe the entire body is valid target; in foil and sabre the target is limited (fig. 4) and hits on the invalid parts of the body stop the action. Since Jan. 1, 1960, the target for women (who participate in foil fencing only) has been the same as that for men and the target has been the same for the electrical and nonelectrical apparatus. If both contestants are hit, but with a sufficient time difference, only the first touch counts. If the hits are simultaneous, a touch is scored against both fencers in CpCe; but in foil and sabre the hit that has the conventional right of way prevails. After each score, the fencers go back to the centre and play is started again as before; if no touch is awarded, play is resumed at the point nhere it was halted.

Infighting is alloned, but as soon as there is a clinch (*corps-à-corps*), so that the fencers cannot use their weapons freely, the bout must be stopped. In CpCe a fencer is permitted to force the clinch without penalty, but in foil and sabre this is considered a violation of the conventions of play; the fencer is warned and then is penalized one touch for each offense. In all weapons dangerous play and unnecessary roughness are strictly forbidden.

Under F.I.E. rules bouts for men in all three weapons are fenced for five touches; women's foil bouts are for four touches. When one contestant has received the specified number of touches, each fencer salutes his opponent and the jury, and then shakes hands with and thanks his adversary.

Major individual competitions are held by the round-robin pool system. The entries are grouped into pools of six to ten contestants who fence one another, with the top one-third to one-half qualifying for the next round. The elimination process is repeated until only eight or nine fencers remain for a final round robin. Places are determined by the number of victories scored in the final round; ties for first are fenced off, but for other places ties are resolved in favour of the competitor who has received the fewest touches, and if a tie still exists the one who has scored the most touches gets the highest ranking. A number of national championships are conducted on this basis only up to the point where 16 or

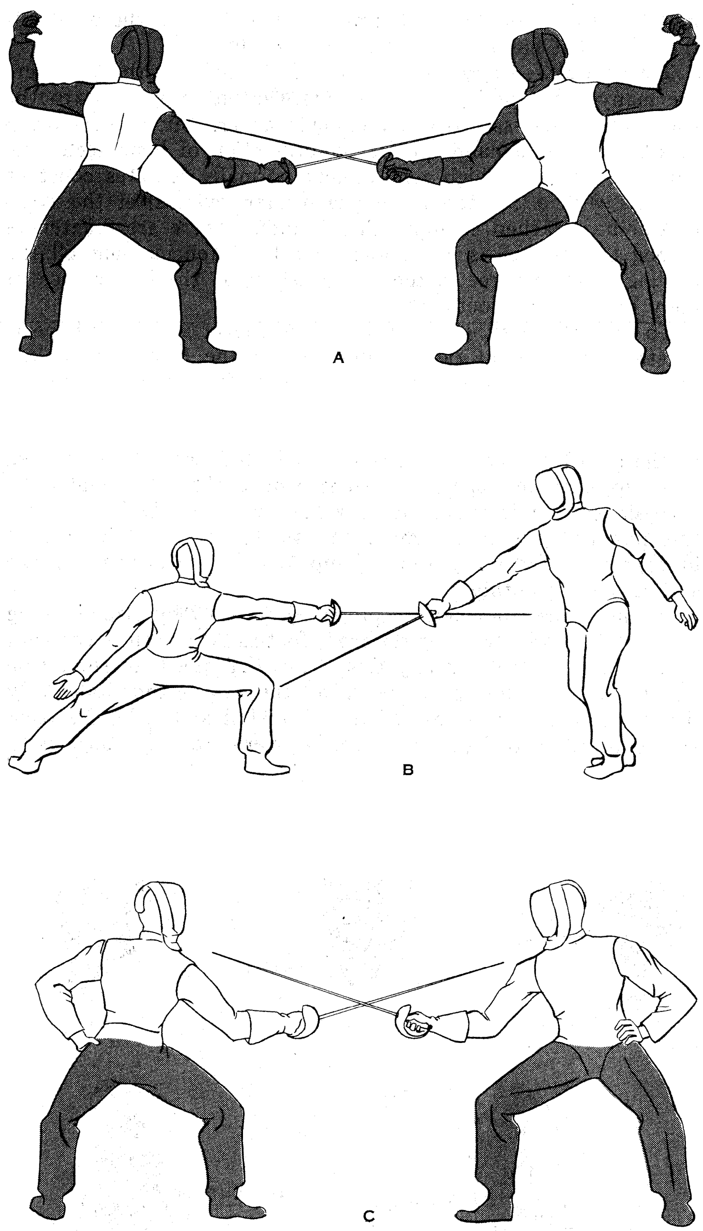


FIG. 4.— VALID TARGETS FOR (A) FOIL; (B) EPEE; (D) SABRE FENCING

Unshaded area indicates target. The target for women's foil is the same as that for men. The bib, no longer valid target in foil, must not extend below the collarbone. The lower limit of the sabre target is a horizontal line passing through the angle formed by the thighs and trunk of the fencer when in the guard position

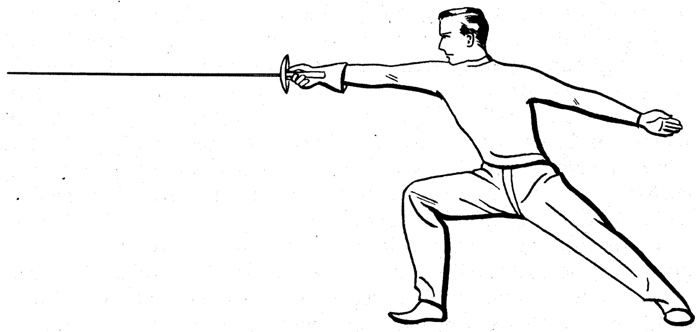


FIG. 5.—THE LUNGE IN FOIL AND ÉPÉE FENCING

32 contestants remain; then the competition proceeds on the basis of direct elimination, each match being fenced for the best two out of three bouts.

The pool system is also favoured for team events in the world and Olympic championships, with a final round of four teams. Each team consists of four fencers and two alternates, and each match is for 16 bouts. If the match ends at 8-all, the winner is the team that has received the fewer touches.

Technique. — Body Balance and Footwork. — Although there are many excellent books on fencing, the best way to learn the sport is to take lessons from a qualified teacher. Successful fencing in all weapons demands perfect co-ordination of hand technique and footwork, and high achievement normally requires constant training with a competent fencing master, even after the competitor has reached championship calibre. There are differences among the exponents of various schools of fencing, but all the leading masters agree in their emphasis upon the importance of body balance and footwork.

To take the basic guard position the fencer stands with heels together and feet at right angles so that the front foot points at the opponent; then he moves the front foot about $1\frac{1}{2}$ 'lengths forward, bends both knees distributing the weight evenly on the legs, and keeps the trunk erect. The sword arm is usually in one of the guard positions; the back arm in foil and CpCe is raised, palm up, shoulder high and then is bent at the elbow and wrist for balance, but in sabre the back hand rests on the hip. From this position, the fencer must be able to advance (front foot first), retreat (rear foot first), jump forward or backward, lunge and recover smoothly.

In the lunge, the body is propelled forward by straightening the back leg and advancing the front foot as far as consistent with balance and control; usually this means that the knee should be directly over the instep at the end of the lunge. Simultaneously the sword arm is fully extended and, in foil and CpCe, the back arm is also extended (fig. 5). The recovery from the lunge is to the guard position by flexing the rear leg and bringing the front foot back, or by advancing the rear foot to its normal distance from the front foot. Occasionally the *flèche* or running attack is used instead of, or as a continuation of, the lunge. This action is executed by bringing the back foot forward ahead of the front foot as in running. The *flèche* increases the reach of the fencer, and is particularly useful in CpCe and sabre, but it sacrifices balance and control of recovery and must be used judiciously.

Footwork is the key to the mastery of distance and timing; an otherwise perfectly executed attack will fail if the weapon cannot reach the target. or if the opponent can see the action coming in ample time to parry or retreat.

Fundamentals of Foil Fencing. — Facing his opponent, a fencer can see the "open lines, of attack" according to the position of the defensive hand. The four possibilities are high-outside, high-inside, low-outside. low-inside (fig. 6). There are two guards for each line: 3rd and 6th for high-outside, 1st and 4th for high-inside, 2nd and 8th for low-outside and 5th and 7th for low-inside. In the first-named guard for each line, the weapon is held with the fingernails down (pronation); most foilsmen, however, hold the weapon with the nails up (supination), and the preferred guards are 6th and 4th (fig. 7). When a fencer is in 6th, the elbow should be turned in so that it is six to nine inches in front of the flank, and the weapon should be held so that it forms a straight line from elbow to tip. The tip should be level with and slightly to the right of the opponent's mask.

The simplest attack is a straight thrust into an open line. If the blades are in contact (engaged) on a closed line, the attacker may pass his point into an open line by a small movement of the tip, or he may force an opening by a beat or by exerting pressure upon and gliding along the opponent's blade. When the weapon is held in supination, the point on reaching the target should cause the blade to form an upper arc.

The defender may avoid the attack by retreating or sidestepping, but the parry is preferred because it gains the right to riposte. Parries may be straight or circular (counterparries). The straight parry is made by a blocking movement or a sharp beat — usually executed without displacing the elbow — that meets the opponent's blade in the line of the attack. The counterparry consists of a small circle with the point that picks up the opponent's blade and carries it back to the guard position from which the parry was begun. Parries are numbered according to the guard positions where they block the opposing blade. The preferred foil parries in the high lines are 4th and 6th, and the corresponding counterparries; in the low lines, 7th and 8th. In the Italian school, the 7th parry is called the semicircle (*mezzocerchio*). Occasionally 2nd and 5th are used, but 1st and 3rd are practically obsolete.

To avoid the parry, the attacker may resort to timing, force or guile. He may attack so fast from close distance that the defender cannot react quickly enough to parry. He may control the opponent's blade by a bind or envelopment, catching the weak part of the defensive blade (the third nearest the point) with the strong part of his own (the third nearest the guard) in a semicircular or circular motion. He may make a feint and then deceive the defender's effort to parry; or he may make a false attack, intending that it be parried, in order to parry the defender's riposte and score on the counterriposte.

The defender after a successful parry has a similar choice of tactics on the riposte. In addition, if the attack is delayed or made in two or more movements, the defender may counterattack by a stop thrust, but if both contestants are hit, the stop to be valid must land before the final movement of the attack has begun. The same principle applies when the attacker makes a remise or counterattack against a delayed or composite riposte.

Fundamentals of *Épée* Fencing. — The basic analysis of the lines of attack, guards and parries is the same for CpCe as for foil, since both are thrusting weapons only. An impressive number of champion épéeists have based their game on the fundamentals of foil fencing, adapted to the larger target. The contestants tend to keep farther apart than in foil. and to take an intermediate guard position on the outside line, with the arm more or less extended and the weapon parallel to the ground (fig. 8). Attacks

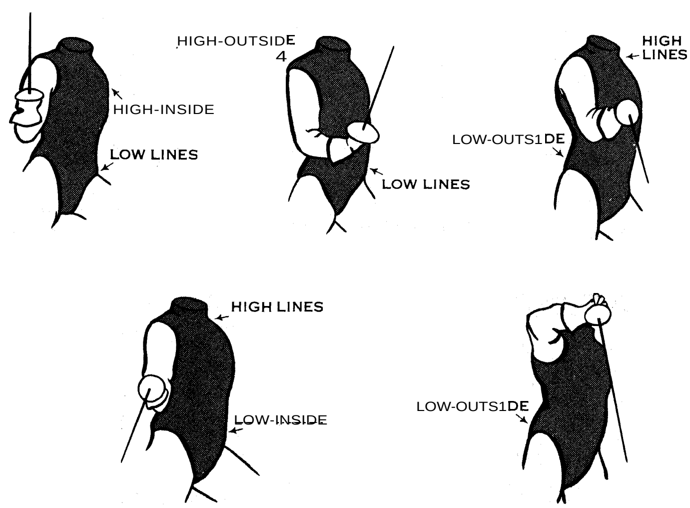
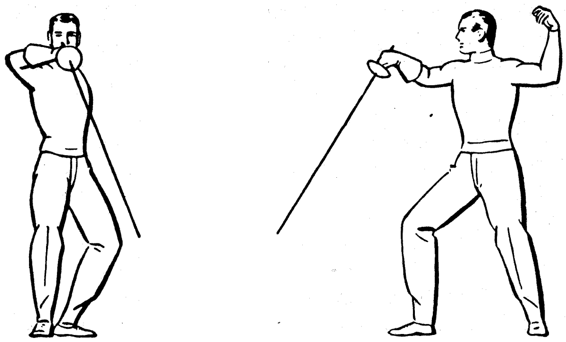
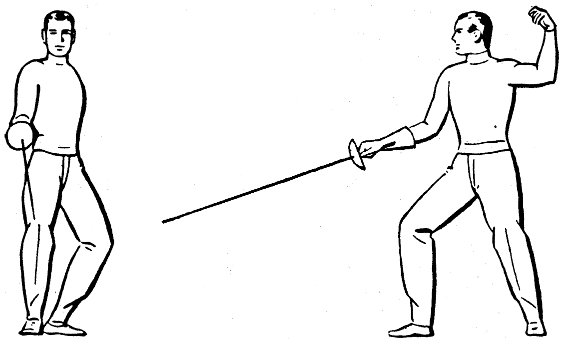


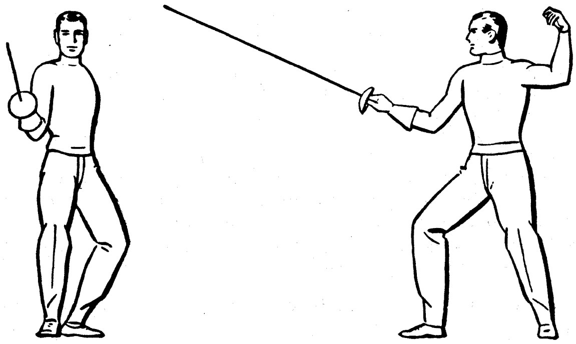
FIG. 6.— FOIL LINES OF ATTACK AS DETERMINED BY THE POSITION OF THE DEFENSIVE HAND



FIRST GUARD OR PARRY



SECOND GUARD OR PARRY



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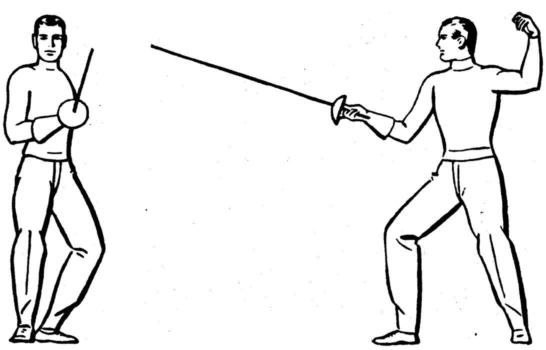
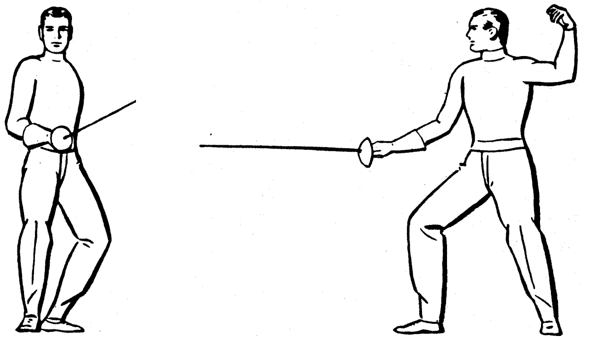
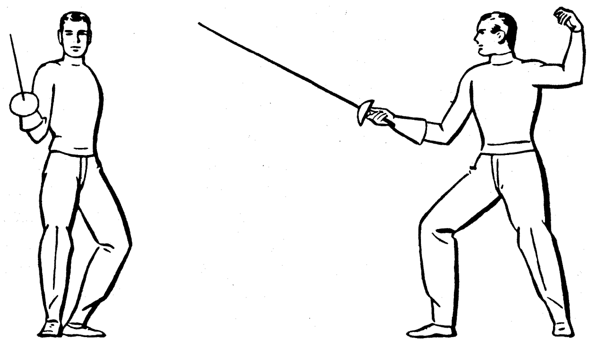


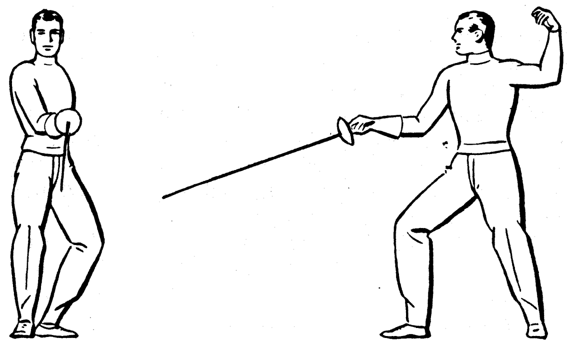
FOURTH GUARD OR PARRY



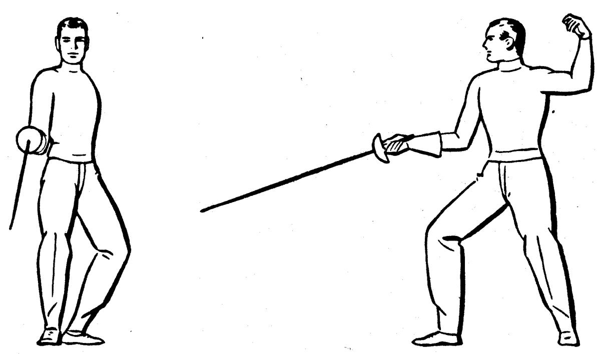
FIFTH GUARD OR PARRY



SIXTH GUARD OR PARRY



SEVENTH GUARD OR PARRY



EIGHTH GUARD OR PARRY

ADAPTED FROM J. MARTINEZ CASTELLO'S "THEORY AND PRACTICE OF FENCING"

FIG. 7.— FOIL AND ÉPÉE GUARDS AND PARRIES, SHOWING THE FRONT AND PROFILE VIEW OF POSITIONS OF THE HAND AND WEAPON

and ripostes are frequently aimed at the wrist and forearm, and occasionally the mask or knee. To reach the body it is usually necessary to combine an advance-or jump with the lunge, or to make a *flèche*. As far as possible, offensive actions are made in opposition, blocking the adversary's blade in order to prevent the stop thrust; and parries must be made with the strong part of the blade, raising or low-ering the hand to achieve the same result.

A number of outstanding épée fencers, however, avoid engagements of the blade and base their game on angled shots under and over the opposing arm both on attack and defense, relying on shifting distance, and accuracy of point in the stop thrust more than on parry and riposte. Tall men with long arms find this style particularly effective, especially with the electrical apparatus that registers only the first of two touches if it is one-twenty-fifth of a second ahead. A few strong fencers follow almost the opposite tactics. developing their game around the straight-arm guard, with the arm fully extended so that it and the weapon form a straight line from shoulder to point.

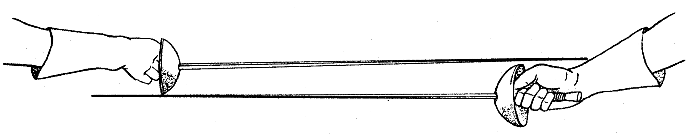
With the épée the fencer can attain a fair level of proficiency by capitalizing upon his individual resources more easily than with other weapons, and the less skillful fencer has a better chance to win any one bout than with foil or sabre. However, consistent victories are open only to the stronger and more complete fencers.

Fundamentals of Sabre Fencing. — The availability of the cutting edges as well as the point for scoring and the inclusion of the head in the target give the sabre all of the technical and tactical variations of the foil and a special brilliance of its o n. For proper control. the sabre must always be firmly grasped by the fingers and its direction must be guided precisely by the wrist and forearm. The upper arm and shoulder should be as relaxed as possible, in order to achieve lightness and speed. Hard-hitting results from a lack of proper blade control and is a discourtesy to the opponent.

Hits with the point are made in pronation, so that the blade bending against the target mill form an upper arc. Cuts with the front edge (the side away from the thumb) to the opponent's outside line — the sword arm, flank and right cheek — are delivered horizontally with the hand in pronation by a forward motion ending in a light tap on the target; the same motion is used in cuts to the head or the inside of the sword arm except that these are made vertically with the thumb uppermost Cuts to the left cheek and chest are usually made on the way back from a full extension of the arm, by a slicing motion with the hand in three-quarter supination; full supination is used only in horizontal cuts to the low inside areas of the target.

The basic guards and parries in sabre are five in number. 1st is for low-inside, 2nd for low-outside, 3rd for high-outside, 4th for high-inside, and 5th for the head (fig. 9). By far the commonest guard is 3rd. The elbow is close lo the body, the sword hand is level with the right hip, the wrist is cocked so that the sabre is almost vertical and turned so that the front edge will meet squarely a horizontal cut to the outside. The principle of meeting cuts with the front edge near the guard also applies to parries in all positions because of the slenderness of the sabre blade. Against cuts, straight blocking parries are preferred. Circular or counterparries are mainly used against point thrusts or to break up composite attacks.

The most important parries are 3rd, 4th and jth, because they offer the greatest opportunity for scoring on the riposte. Cuts to the low line will often be met by low 3rd and low 4th for that reason; but 2nd and 1st may be preferable in certain sequences of play. Thus, if the defender is in 2nd, he can more easily parry a chest cut with 1st than with 4th, and if he is in 5th he can more



ADAPTED FROM J MARTINEZ CASTELLO'S "THEORY AND PRACTICE OF FENCING

FIG. 8.—STOP-THRUST TO THE WRIST FROM THE STRAIGHT ARM OR INTERMEDIATE GUARD POSITION IN ÉPÉE FENCING

easily parry a flank cut with 2nd than with 3rd. The fastest riposte from 2nd is a horizontal cut to the upper arm or right cheek; the commonest riposte from 1st is a vertical cut to the head executed with a clocknise quarter turn of the wrist and forearm. The Italian school developed a 6th parry to protect the head, with the hand close to the left cheek, but the awkward position makes blade control and the riposte difficult, and for that reason the parry has become obsolete.

The complex range of possible actions with point and edge militates against static defense in sabre and enhances the value of the stop cut or thrust. The inclusion of the arm in the target, on the other hand, requires constant vigilance against the stop and favours the development of second intention attacks that draw the defender's stop in order to parry it and score on the riposte. The influence of the Hungarian school, however, has been in the direction of simplification. The fencers keep far enough apart so that it is difficult to reach the opponent by a simple lunge. Balance and mobility, timing and an exact sense of distance, decisive simple attacks on the *flèche,* direct or preceded by a sharp beat, and lightning ripostes are typical of modern sabre play.

For a list of Olympic champions, see OLYMPIC GAMES.

GLOSSARY

Attack. — A series of movements by which one tries to touch the opponent.

Beat. — A sharp tap made on the opponent's blade in order to deflect it.

Bind. — A pushing movement by which one contacts the opponent's blade and brings it from one'line into another.

Closing in, or corps *à* corps. — This occurs when the weapon guards or the fencers' bodies come together in such a way as to prevent the free use of the weapon by either fencer. Closing in is penalized in the conventional weapons (foil and sabre).

Conzposite attack. — An attack in more than one movement, *e.g.,* feint of straight thrust and disengage.

Composite parry. — A combination of defensive actions employed in meeting a composite attack.

Counter or circular *parry.*—A defensive movement executed by making a small circle with the point of the weapon around the opponent's blade, thereby deflecting it in the same line off the target.

Counter-riposte, — A riposte that follows the parry of the opponent's riposte.

Cutover or *coupé.*—An attack made by passing one's blade over the point of the adversary's blade by raising the point with a movement of fingers and hand and bending the arm very slightly, then extending to touch in the opposite line.

Disengage. — An attack made by passing the point into an open line with a small semicircular movement around the opponent's guard.

Envelopment.—A continuous binding movement executed so that the point of the weapon makes at least one complete circle.

False attack. — An attacking action meant to be parried so that the attacker may score on a redoublement, counter-riposte or stop thrust against the riposte.

Feint. — The semblance of an attack made to impel the defender to move his guard.

Flèche, or running attack. — A walking or running forward action.

Glide. — A sliding thrust along the opponent's blade usually with a slight pressure.

Jump. — An advance in which both feet move forward at same time.

Lunge.—A forward movement in which the back leg is straightened and the front foot advanced as far as consistent with balance. The sword arm is usually extended.

March. — An advance in which the forward foot is moved before the rear foot.

On guard, or en *garde.*—The position taken before the fencers begin combat.

Parry. — A defensive action with a direct or circular movement of the blade.

Redoublement.—A second attack after the first has been parried, but not followed immediately by a riposte.

Remise. — A stop thrust or cut on a riposte or counter-riposte.

Riposte. — The defender's counterattack following a parry.

Simple parry. — A direct blocking or beating movement of the defensive blade to deflect the attacking blade off the target.

Stop *thrust.*—A counterattack against the opponent's attack or riposte, intended to land with a sufficient time advantage over the opponent's action to score a touch.

Straight thrust or cut. — A simple attack made without contact of the blades or along the opposite blade if the opponent contacts one's blade without exerting pressure.

Time thrust or 'cut. — A counterattack that is both a parry and a riposte, by closing the line where the attack is to be completed.

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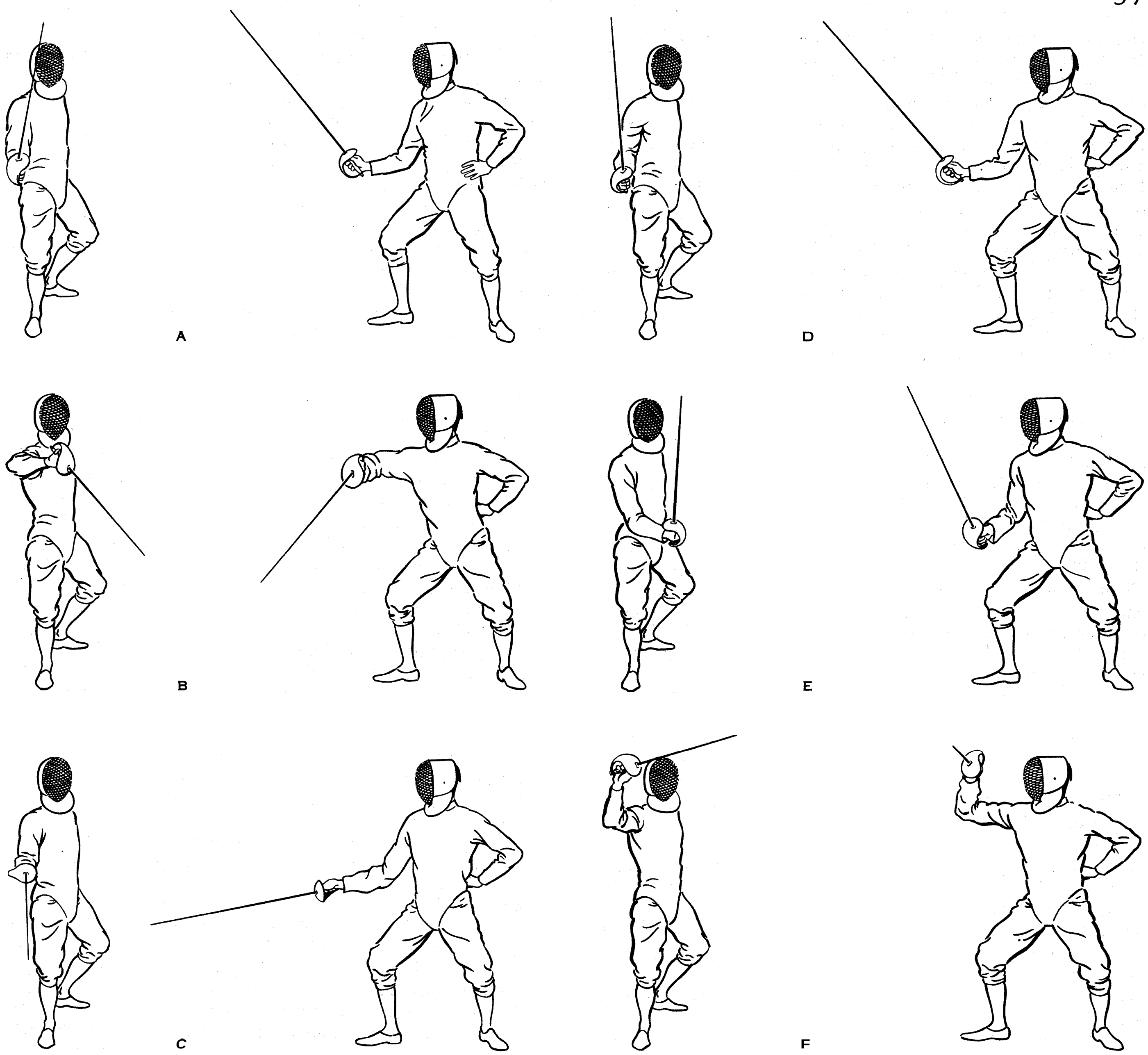

FIG. 9.— SABREGUARDS AND PARRIES SHOWING THE FRONT AND PROFILE VIEWS OF POSITIONS OF THE HAND AND WEAPON. THE GLOVE HAS BEEN OMITTED TO FACILITATE A VIEW OF THE GRIP
(A) On guard position of the Hungarian school; (B) first guard or parry; (C) second guard or parry; (D) third guard or parry; (E) fourth guard or parry; (F) Rfth guard or parry

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FÉNELON, FRANÇOIS DE SALIGNAC DE LA MOTHE (1651–1715), French writer and archbishop of Cambrai, was born at the château of Fénelon in Périgord on Aug. 6, 1651. His father, Pons, comte de Eknelon, was a country gentleman of ancient lineage, large family and small estate. He was educated at home and at the neighbouring University of Cahors. In 1666 he came to Paris, under charge of his father's brother, Antoine, marquis de Fénelon, and in 1669 he entered the college of St. Sulpice. He contemplated a missionary journey to the Levant. but the plan was vetoed, and he remained at St. Sulpice till 1679, when he was made "superior" of a "New Catholic" sisterhood in Paris—an institution devoted to the conversion of Huguenot ladies. In the winter of 1685, just after the revocation of the Edict of Nantes, Fénelon was put at the head of a mission to the Protestants of Saintonge. To Fénelon such employment was clearly uncongenial; but if he employed bribery and espionage among his proselytes. his general conduct was kindly and statesmanlike. But neither in his actions nor in his writings is there the least trace of that belief in liberty of conscience ascribed to him by 18th-century philosophers.

Meanwhile the marquis de Fénelon had introduced his nephew into the devout section of the court, dominated by Mme. de Maintenon. He became a favourite disciple of Bossuet, and at the bishop's instance undertook to refute certain metaphysical errors of Father Malebranche. In the philosophical *Treatise on the Existence of God,* which he wrote for the purpose, Fénelon rewrote Descartes in the spirit of St. Augustine. More important were his *Dialogues on Eloquence,* pleading for greater simplicity and naturalness in the pulpit and urging preachers to take the scriptural, natural style of Bossuet as their model, rather than the coldly analytic eloquence of his great rival. Bourdaloue. His *Treatise on the Education of Girls* was probably the most influential of all Fénelon's books: and guided French ideas on the question all through the 18th century. It holds a most judicious balance between the *pre'cieuses,* enthusiasts for the "higher" education of their sex, and the heavy Philistines. who thought that the less girls knew the better they were likely to be. Fénelon sums up in favour of the cultivated housewife; his first object was to persuade the mothers to take charge of their girls themselves, and bring them up to be suitable wives and mothers in their own generation.

The Royal Tutor.—In 1689 Fénelon was gazetted tutor to the duke of Burgundy, eldest son of the dauphin and eventual heir to the crown. The character of this strange prince has been drawn once for all by Saint-Simon. Brilliant, passionate to the point of mania, but utterly weak and unstable, he was capable of developing into a saint or a monster, but quite incapable of becoming an ordinary human being. Fénelon transformed him into a devotee, exceedingly affectionate, earnest and religious but woefully lacking in tact and common sense.

Fénelon's tutorship ended with his disgrace in 1697, before the pupil was 1j.

The abiding result of his tutorship is a code of carefully graduated moral lessons—the *Fables,* the *Dialogues of the Dead* (a series of imaginary conversations between departed heroes) and finally *Télémaque,* where the adventures of the son of Ulysses in search of a father are made into a political novel with a purpose. Not, indeed, that Fénelon meant his book to be the literal paper constitution some of his contemporaries thought it. Like other Utopias! it is an easygoing compromise between dreams and possibilities. Its object was to broaden Burgundy's mind and ever keep before his eyes the "great and holy maxim that kings exist for the sake of their subjects, not subjects for the sake of kings." Here and there Fénelon's work is prophetic of the age of Rousseau —in the fervid denunciation of war, the belief in nature and the fraternity of nations. He has a truly 18th-century belief in paternal government. Mentor proposes to "change the tastes and habits of the whole people, and build up again from the very foundations." Fénelon is on firmer ground when he leads a reaction against the mercantile system of Colbert, or insists on the importance of agriculture. Valuable and farsighted as were these ideas, they fitted but ill into the scheme of a romance. Seldom was Voltaire wider of the mark than when he called *Télémaque* a Greek poem in French prose. But although no single feature of the hook is Greek, there hangs round it a moral fragrance only to be called forth by one who had fulfilled the vow of his youth and learned to breathe, as purely as on "the double summit of Parnassus," the very essence of the antique.

Mme. **Guyon.**—*Télémaque* was published in 1699. Four years before. Fénelon had been appointed archbishop of Cambrai, one of the richest benefices in France. Soon afterward. however, came the great calamity of his life. In the early days of his tutorship he had met the Quietist apostle, Mme. Guyon (*q.v.*), and had been struck by her ideas. These he developed along lines of his own, where Christian Neoplatonism curiously mingles with theories of chivalry and disinterestedness, borrowed from the *pre'cieuses* of his own time. His mystical principles are set out at length in his *Maxims of the Saints,* published in 1697. Here he argues that the more love we have for ourselves, the less we can spare for our Maker. Perfection lies in getting rid of selfhood altogether—in never thinking of ourselves. or even of the relation in which God stands to us. The saint does not love Christ as his Redeemer, but only as the Redeemer of the human race. Bossuet (*q.v.*) attacked this position as inconsistent with Christianity. Fénelon promptly appealed to Rome. and after two years of bitter controversy his book was condemned by Innocent XII in 1699. One of the results of the quarrel was Fénelon's banishment from court, for Louis XIV had ardently taken Bossuet's side. Fénelon was exiled to his diocese, and during the last 18 years of his life he was only once allowed to leave it.

Even Saint-Simon allows that his episcopal duties at Cambrai were perfectly performed. His diocese was administered with great strictness, and yet on broad and liberal lines. Saint-Simon bears the same witness to his government of his palace. There he lived with all the piety of a true pastor. yet with all the dignity of a great nobleman. With all its luxuries, his house remained a true bishop's palace, breathing the strictest discipline and restraint. And of all this chastened dignity the archbishop was himself the ever-present, ever-inimitable model—in all that he did the perfect churchman. in all the high-bred noble, in all things, also, the author of *Télémaque.*

The blot on this ideal existence mas his persecution of the Jansenists (*see* JANSENISM). Fénelon's theories of life were different from theirs. and they had attacked his *Maxims* of *the Saints,* holding that visionary theories of perfection were ill-fitted for a world where even the holiest could scarce be saved. To suppress the Jansenists he was even ready to strike up an alliance with the Jesuits and force on a reluctant France the doctrine of papal infallibility. His time was much better employed in fitting his old pupil. Burgundy, for a kingship that never came. Louis XIV seldom allowed them to meet, but for years they corresponded, this exchange of letters became still more frequent in 1711, when the wretched dauphin died and left Burgundy heir apparent to the throne. Fénelon now wrote a series of memorable criticisms on the government of Louis XIV. Much more clearly than most men, he saw that the Bourbons were tottering to their fall.

In 1712 Burgundy died. and with him died all his tutor's hopes of reform. From this moment his health began to fail, though he mustered strength enough to write the *Lefter to the French Academy* (1714), a series of general reflections on the literary movement of his time. As in his political theories. the critical element is much stronger than the constructive. Fénelon was feeling his way away from the rigid standards of Boileau to "a Sublime so simple and familiar that all may understand it." But some of his methods were remarkably erratic; he was anxious, for instance, to abolish verse, as unsuited to the genius of the French. In other respects, however, he was far before his age. The 17th century had treated literature as it treated politics and religion; each of the three was cooped up in a watertight compartment by itself. Fénelon was one of the first to break down these partition walls and insist on viewing all three as products of a single spirit, seen at different angles.

A few weeks after the *Letter* was written, Fénelon met with a carriage accident. On Jan. 7. 171j, he died at the age of 63. Fénelon has been made by turns into a sentimentalist, a mystical saint, an 18th-century *philosophe,* an ultramontane churchman and a hysterical hypocrite. And each of these views, except the last, contains an element of truth. More than most men, Fénelon "wanders between two worlds--one dead, the other powerless to be born." He came at a time when the characteristic ideas of the 17th century—the ideas of Louis XIV, of Bossuet and Boileau—had lost their savour, and before another creed could arise to take their place. Hence, like most of those who break away from an established order, he seems by turns a revolutionist and a reactionary. Such a man expresses his ideas much better by word of mouth than in the cold formality of print; and Fénelon's contemporaries thought far more highly of his conversation than his books. Saint-Simon has left a portrait of Fénelon as he appeared about the time of his appointment to Cambrai—tall, thin, well built, exceedingly pale, with a great nose. eyes from which fire and genius poured in torrents, a face curious and unlike any other, yet so striking and attractive that, once seen, it could not be forgotten. There were to be found the most contradictory qualities in perfect agreement with each other—gravity and courtliness, earnestness and gaiety, the man of learning, the noble and the bishop. But all centred in an air of high-bred dignity, of graceful, polished seemliness and wit—it cost an effort to turn away one's eyes.

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FENESTELLA, Roman historian and encyclopaedic writer, flourished in the reign of Tiberius. If the notice in Jerome be correct, he lived from 52 B.C. to A.D. 19 (according to Pliny, *N.H.*, xxxiii, 35 B.C.–A.D. 36). Taking Varro for his model. Fenestella represented the new style of historical writing which discussed curious incidents and customs of political and social life and literary history. He was the author of an *Annales,* probably from the earliest times down to his own days. The fragments indicate the great variety of subjects discussed: the origin of the appeal to the people *(provocatio);* the use of elephants in the games; the wearing of gold rings; the introduction of the olive tree; the material for making the toga; the cultivation of the soil; details as to the lives of Cicero and Terence. The work was much used by Pliny the elder, Asconius Pedianus (the commentator on Cicero), Nonius, and the philologists.

Fragments in H. Peter, *Historicorum Romanorum fragmenta* (1883); *see* also monographs by L. Mercklin (1844) and J. Poeth (1849); M. Schanz, *Geschichte der rom. Litt.*, ed 2 (1901); Teuffel, *Hist. of Roman Literature,* p. 259. A work published under the name of L. Fenestella *(De magistratibus et sacerdotiis Romanorum,* 1510) is really by A. D. Fiocchi, canon and papal secretary, and was subsequently published as by him (under the latinized form of his name, Floccus), ed. by Aegidius Witsius (1561).

FENESTRATION, an architectural term applied to the arrangement and proportions of windows on the outside walls of a building. The structural nature of load bearing masonry walls usually limits the size, number, and placement of exterior windows. When curtain walls (nonload bearing) are used, the windows may be sized and placed in accordance with the needs of the plan. or exterior appearance.

When a building is sheathed completely in glass (*e.g.,* Lever house, New York city) the term applies to the size and proportions of the panes and supporting members as well as to the proportional relations between the various panes.

See also WINDOW. (H. MN.)

FENG HUANG, one of the four symbolical creatures which in Chinese mythology were believed to keep watch and ward over the Celestial empire. It was begotten by fire, was born in the Hill of the Sun's Halo, and its body bears inscribed on it the five cardinal virtues.

It has the breast of a goose, the hindquarters of a stag, a snake's neck, a fish's tail, a fowl's forehead. a duck's down, the marks of a dragon, the back of a tortoise, the face of a swallow, the beak of a cock, is about six cubits high and perches only on the wu-tung tree. Its appearance heralds an age of universal virtue. The name is Chinese for "phoenix."

FENGTIEN, province of Manchuria: *see* MANCHURIA.

FENG YÜ-HSIANG (1880–1948), Chinese military leader, was born in Chaohsien in the province of Anhwei, and was generally known as "the Christian general" from his early adoption of Christianity of a Baptist and Evangelical type. His education and training were purely military, and he saw active service under Chao Erh-feng in Tibet in 1909. In 1912 he was in Sian in the 20th division under the command of Lu Yung-hsiang. At the revolution he had attained the rank of major and uas at Shanhaikwan; from there he was promoted brigade commander in the army controlling Chihli and the capital. His acceptance of, and consistent adherence to, Republican principles dated from this period and formed a salient feature of his subsequent career. Under Wu Pei-fu he took part in the defeat of the Anfu group, and thereafter reorganized his famous 11th division.

General Feng obtained his first independent command early in 1921 when his division was dispatched into Shensi to restore order in that province, and in August, upon the death of the military governor, he was given the acting appointment. Both as *tuchun* of Shensi, and in Honan, Feng and his troops earned the highest encomiums. The complete suppression of banditry, the discouragement of poppy cultivation, extensive road construction works and an effort to re-establish honesty in public accounts were among the measures standing to his credit, while strict discipline and an active if somewhat Corybantic display of Christian practices in his army were evidence of his zeal for good administration.

Shortly afterward his division was transferred to Peking, where its disciplined efficiency and the strength of purpose of its commander made their influence felt. In the spring of 1923 Feng was appointed commissioner of frontier defense for the northwest, but because of the unstable political position in the capital he deferred taking up his new duties. With his assistance Li was driven from office in June by Tsao Kun, who then assumed the presidency. During the ensuing year he became convinced of Tsao Kun's inability to form a stable government and he opposed the resumption of the war against Chang Tso-lin. By a coup de main he descended upon Peking, causing the defeat and flight of Wu, and in co-operation with Chang he installed Tuan Chi-jui as "chief executive," thereafter leaving for the northwest. In Kalgan, Suiyuan and Paotowchen, his administrative gifts again found scope. Colonization plans for Mongolia and suppression of lawlessness marked his stay. Adhering to the Kuomintang, he co-operated with the Nationalist allies in 1927.

Feng was expelled from the Kuomintang in 1929 but reinstated in 1931. After the start of the Chinese-Japanese war he was commander of the "People's Allied Anti-Japanese army," and was a leading governmental and military figure during World War II.

At the close of the war, his growing opposition to the Chiang Kai-shek government resulted in his political exile to the United States, where he led an opposition movement aimed at removing Chiang from power. He was again expelled from the Kuomintang on Jan. 7, 1948.

He died in an accidental fire aboard a Russian vessel which left New York for Odessa on July 31, 1948.

FENIANS or FENIAN BROTHERHOOD, an Irish-American revolutionary secret society active 1863–70. The name was derived from *fiann, fkinne,* the legendary band of warriors in Ireland led by Finn Mac Cumhaill *(see* FINN MAC CUMHAILL). The society was founded in the United States in 1858 by John O'Mahony (1816–77), who had been concerned in William Smith O'Brien's rising in Ireland in 1848. James Stephens collaborated with him in Ireland. and founded the *Irish People,* a revolutionary journal, in Dublin in 1863. The Irish wing of the society was sometimes called the Irish Republican (or Revolutionary) Brotherhood, a name which continued to be used after Fenianism proper had virtually died out. Members bound themselves by an oath of "allegiance to the Irish Republic, now virtually established." The organization had ramifications in every part of the world, the Fenians being found in Australia, South America, Canada and above all the United States, as well as in centres of population in Great Britain such as London, Manchester and Glasgow. Fenianism, however, never gained much hold on the tenant farmers or agricultural labourers in Ireland. The movement was denounced by the priests of the Catholic Church.

The movement became more active after a convention held at Chicago, Ill., under O'Mahony's presidency in Nov. 1863. The close of the American Civil War in 1865 brought its greatest opportunity. Irishmen who had borne arms flocked to Ireland, and plans were made for a rising. The government, well served as usual by informers, now took action. In Sept. 1865 the *Irish People* was suppressed. Several prominent Fenians received prison terms; Stephens, however, succeeded in escaping to France. The Habeas Corpus act was suspended in 1866, a considerable number of persons were arrested and some small disturbances were put down by the police.

In 1867 there were minor risings in Kerry and elsewhere in Ireland and an intended attack on Chester castle was frustrated. On Sept. 18, 1867, when two Fenian prisoners were being conveyed through Blanchester, the prison van was attacked and a police sergeant killed. For this three men named Allen, Larkin and O'Brien were hanged on Nov. 23; they are frequently called the "Manchester martyrs." On Dec. 13, 1867, in an unsuccessful attempt to rescue Fenian prisoners in Clerkenwell prison, London, the prison wall was blown down with gunpowder, causing the death of 12 persons and the maiming of about 120 others.

Late in 1865 the brotherhood in the U.S. had split, one wing under O'Mahony (and later John Savage) advocating action in Ireland, the other under William Randall Roberts (1830–97) desiring to attack Canada. The Roberts wing attempted the Canadian invasion at the end of May 1866. John O'Neill (1834–78) crossed the Niagara with perhaps 600 men. He defeated a detached column of Canadian volunteers at Ridgeway (June 2) and escaped from Canada that night before other troops could close in on him. The returning Fenians were arrested by U.S. patrols but soon released.

The Roberts Fenians continued their threats and repeatedly obliged the Canadian government to make defensive preparations. O'Neill succeeded Roberts in Jan. 1868. In May 1870 another raid, on the Vermont border, was defeated by Canadian forces and O'Neill again was arrested by U.S. authorities. His final enterprise, against Manitoba in 1871, was frustrated by U.S. troops. Canada sought, but did not obtain, compensation from the United States for damage done by these expeditions organized on U.S. soil. In Ireland in 1870 Michael Davitt (*q.v.*) was sentenced to prison for Fenian activity; before his release in 1878 the name Fenian was becoming obsolete.

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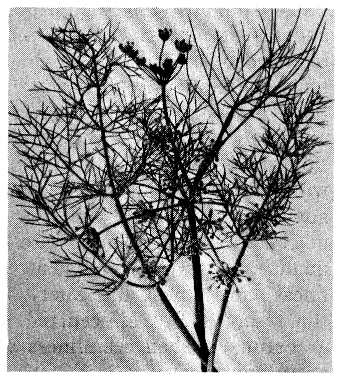
FENNEC, the name applied to several desert-dwelling species of fox, characterized by the great length of the ears and small size. The true fennec (Vulpes zerda) inhabits north Africa and is pale in colour with a short, black-tipped tail. South of the Zambezi the group reappears, being represented by the ass fox (*V. cama*), a dark-coloured, long-tailed species. The northern fennec (V. famelicus) is intermediate between the fennecs and typical foxes. See FOX.

FENNEL, Foeniculum *vulgare,* a perennial plant of the family Umbelliferae (*q.v.*), from two to three or (when cultivated) four feet in height, having leaves three or four times pinnate, with numerous linear or awl-shaped segments, and glaucous compound umbels of about 15 or 20 rays, with no involucres, and small yellow flowers, the petals incurved at the tip. The fruit is laterally compressed, five ridged, and has a large single resin canal or vitta under each furrow.

The plant appears to be of south European origin, but is naturalized in the eastern U.S. and is met in various parts of Britain and temperate Eurasia. The dried fruits of cultivated plants have an aromatic taste and odour and are used for the preparation of fennel water, valued for its carminative properties. The blanched shoots are eaten and the seeds are used for flavouring.

Giant fennel is Ferula *communis,* a member of the same family, often cultivated, and native to the Mediterranean region, where the pith of the stem, which grows from 8 ft. to 12 ft. high, is used for tinder. Hog's fennel or brimstonewort (*Peucedanum officinale*) is another member of the Umbelliferae.



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FENNEL (FOENICULUM VULGARE)

FENNER, DUDLEY (c. 1558–1587), English puritan divine, was born in Kent and educated at Cambridge university but, becoming an adherent of the Presbyterian Thomas Cartwright (1535–1603), had to leave without taking his degree. He followed Cartwright to Antwerp and preached to the English congregation there. The leniency shown by Archbishop Edmund Grindal encouraged him to return to England, and he became curate of Cranbrook in 1583. In the same year, however, he was suspended and imprisoned for refusing to sign an acknowledgement of the queen's supremacy and of the authority of the Prayer Book and articles.

After his release he became chaplain in the Reformed church at Middleburgh, where he died in 1587.

Fenner's works rank among the best expositions of the principles of puritanism; see list in Cooper's Athenae Cantabrigienses (Cambridge. 1858–61).

FENNY STRATFORD: see BLETCHLEY.

FENRIR or FENRIS, in Scandinavian mythology a water demon in the shape of a huge wolf, was the offspring of Loki and the giantess Angurboda. He grew so large that the gods, in fear, had him chained up. He broke the first two chains. The third, a magic bond made of the sound of a cat's footsteps, a woman's beard, the roots of a mountain. a fish's breath and a bird's spittle, held him until Ragnarok (Judgment day), when he escaped and swallowed Odin but was slain by Vidar, the latter's son.

FENS, a district in the east of England possessing peculiar characteristics and a distinctive history. It lies largely south and west of the Wash, in Lincolnshire. Huntingdonshire, Cambridgeshire and Norfolk. Its extreme length from Lincoln to Cambridge is about 73 mi.; its extreme breadth from Peterborough to Brandon is about 36 mi. Across its surface. the Witham, Welland, Nene and Great Ouse rivers flow into the Wash, but the original drainage of the area has been largely replaced by artificial channels.

In origin the fenland is essentially a flooded Jurassic clay plain which had for its limits the harder rocks around—chalk to the north and south, and resistant Jurassic rocks to the west. The surface of this Jurassic plain was uneven, and its higher portions projected above the general level of the surface to become the "islands" of the historical period, Ely, March and so on. The whole region emerged from the complicated events of the various phases of the Ice Age with its islands capped uith boulder clay but with its basin character unchanged. All subsequent time has aitnessed the filling up of this basin by the various agents of sedimentation. leaving the Wash of the present day as the remnant of a much larger indentation of the sea.

The postglacial deposits are of tno kinds. To the north, on the seaward side around the Wash, are marine silts and clays, while south of this belt of silt, an expanse of black peat covers the whole area except where the islands protrude above the surface. The thickness of the peat now varies from a few inches to ten ft. and more, but before the drainage took place the peat was very much thicker (see below). It was this peat area that the cartographers of the 17th century described as regiones *inundatae,* and in that area lay the main effort of draining from the 17th century onward. Except for some outlying peat areas and for the seaward margins, the silt zone was not in need of such extensive draining. The main emphasis of any history of fenland draining must therefore be upon the southern peat area.

EARLY ATTEMPTS AT DRAINING

The condition of the Fens during Roman times has aroused considerable speculation from time to time, but aerial photography has shown that in Romano-British times (50 B.C.–A.D. 450) some of the area, especially on the siltlands and on certain islands, was occupied by cultivators who tilled the soil in small rectangular or irregularly shaped fields upon a system of agriculture which is associated with the Celtic fringe of Britain and which was quite unlike the open-field system of the Anglo-Saxon invaders. All this stands in great contrast with later conditions in the Fenland. To explain the transition is one of the major problems that await solution. The alternative answers are: (1) that the Romans, with their highly developed political organization and engineering skill, practised artificial drainage with conspicuous success and that their works fell out of repair after the occupation was over; (2) that the deterioration was the result of natural agencies, a silting up of watercourses, or a basic land subsidence in post-Roman times. Both answers may be correct. In the state of knowledge in the mid-1950s it is unsafe to be dogmatic because too many associated problems await investigation.

Whatever the cause of the transformation, by Anglo-Saxon times the region had become marshy country but thinly settled, for a time forming a frontier area between the Anglo-Saxon states of East Anglia and Mercia. On the islands in the midst of the marsh many religious houses mere founded during the 7th and 8th centuries, at Crowland. Thorney, Ely and elsewhere, and these continued despite the raids of the Danes from the 9th century to the 11th. The Domesday survey of 1086 shows that villages were limited to the silt area in the north and to the islands; settlement was impossible on the peat area because there the soil provided no stable foundations on which to build. Normal arable agriculture seems to have been restricted to the islands and to the silt belt. Fishing and the gathering of reeds and rushes were important occupations, especially in the peat area.

The whole of fen life during the middle ages was dominated by the necessity of maintaining the banks and channels to prevent flooding, and it is clear that a number of practices established "time out of memory" had grown up to regulate the management of the Fenland streams. From the middle of the 13th century there began a series of commissions of sewers appointed by the crown to enforce repair and to settle disputes about the maintenance of banks. There was no sign of any large-scale project of reclamation, but there was a continuous piecemeal encroachment upon the edges of many fens and this seems to have been very general. Contemporary references to occasional enclosures and local "raising from the fen" are many. and they resulted in new meadow and pasture and even in arable land. The process of improvement seems to have been particularly active on the silt areas, and a comparison of 14th-century statistics with those of the Domesday Book brings out the fact that the siltlands of Lincolnshire and Norfolk had been improved so much that they were many times as wealthy as the uplands around. The peatlands remained a poor country, still sparsely populated.

The economic life of the area was. however, disturbed four times by local campaigns: in 1070–71 when Hereward the Wake defied the Normans; in 1139 and 1142 during the anarchy of Stephen's reign; in 1216 when some barons held out against King John; and in 1265 during the reign of Henry III. On each occasion, a group of people seized the Isle of Ely and fortified it. A period of amphibious guerrilla warfare followed until the forces of the king mere able to gain an entrance across the marsh. But long after the last defense of the island was over the tradition of Ely as a camp of refuge continued.

Shortly before the end of the 15th century a hint of changes to come was provided by the work of Bishop John Morton, who seems to have been the first person to carry out a large design for draining. He made a straight cut, about 12 mi, long, from Stanground near Peterborough to Guyhirne, in order to convey the waters of the Nene in a direct line to Wisbech; it is still known as Moreton's Leam. Coming at the close of the middle ages, it pointed the way forward to a new regime.

During the 16th century, complaints about the maintenance of banks and channels continued. The upkeep of any channel involved many interlocking interests, and the dissolution of the monasteries in 1536–39 served only to increase the confusion of divided responsibilities. The commissioners of sewers were finding it increasingly difficult to maintain the "ancient custom" of the fen. But, as Samuel Hartlib wrote, "in Queen Elizabeth's dayes, Ingenuities. Curiosities, and Good Husbandry, began to take place." During the later years of the 16th century various schemes and experiments prepared the way. At last, in 1600 came "An Act for the recovering of many hundred thousand Acres of marshes." Of the many stretches of marsh in the kingdom, that of the great Fenland itself provided the most spectacular opportunities for draining.

17TH-CENTURY DRAINING

The passing of the act in 1600 did not mean, however, that difficulties were over. Common pasture rights were a most important feature of predrainage economy, and the fenmen, living largely on the perquisites of the commons, resented any suggestion of interference with their traditional livelihood. There was, moreover, much debate about ways and means, and nothing effective was done for another generation. At length, some fenmen approached Francis, 4th earl of Bedford, the owner of 20,000 ac. near Thorney and Whittlesey, who contracted to drain within six years all the expanse of peat in the southern Fenland later known as the Bedford level. An agreement was drawn up in 1630. In the following year, 13 coadventurers (so called because they "adventured" their capital) associated themselves with the earl, and in 1634 they were granted a charter of incorporation. Their hope was to turn this expanse of "great waters and a few reeds" into "pleasant pastures of cattle and kyne"; and they secured the services of the Dutch engineer Cornelius Vermuyden (1590–1677), who had been at work upon the reclamation of the Axholme marshes. Under his direction, drains and sluices were made. Chief among these was the Old Bedford river extending from Earith to Salter's Lode, 70 ft. wide and 21 mi. in length. In 1637 the level was judged to have been drained according to the agreement of 1630.

But complaints and petitions showered upon the privy council, and royal feeling turned against the corporation. The inner history of this change in royal favour is obscure; at any rate, in the following year the award was set aside, and the king himself undertook to complete the draining; the services of Vermuyden were retained. Soon, however, the fen difficulties mere overshadowed by greater troubles, for the Civil War broke out in England.

During the Civil War (1642–49) the draining was in abeyance, but the project had not been forgotten. After much negotiation, an "Act for the draining of the Great Level of the Fens" was passed in May 1649; and the jth earl of Bedford and his associates were "declared to be the undertakers of the said work." Despite the continued hostility of the fenmen, activity was restarted in the Fens. The earlier works were restored; banks were made, sluices built and channels scoured. In particular, the New Bedford or Hundred Foot river was cut, running parallel to the Old Bedford river, about half a mile to the east. Between the two rivers a strip of land was left open, partly to provide a reservoir for surplus water in time of flood, and partly to enable a heavy flood discharge to be carried with a small surface gradient, or, as Vermuyden put it. "so that the water in time of Extremity may goe in a large roome to keepe it from rising too high." This strip, called the Hundred Foot Washes, has continued to serve these purposes. Various other cuts and sluices were also made, and in March 1652 the level mas formally adjudged to be drained. It was divided into three portions—north, middle and south. In the decade that followed the organization for preserving the works of the drainers was completed until, in 1663, the General Drainage act was passed.

In the Northern Fenland there was nothing to compare with this great work. It is true that various arrangements were made for draining individual stretches of fen, but, taken as a whole, the northern effort was sporadic in character and small in achievement.

Generally speaking, the fen commoners of Lincolnshire remained in possession of their ancient privileges.

At first. great success followed upon the work of the drainers in the Bedford level. Cultivation was introduced on lands which, as far as record went, had never before known a plow. The crops grown on the newly reclaimed land were numerous and varied: wheat, oats, barley, turnips, beans, peas, coleseed, chicory, mustard, hemp and woad. As Thomas Fuller said in 1655, "the best argument to prove that a thing may be done, is actually to do it."

But despite many praises, it was soon evident that all was not well in the Bedford level. Some of the complaints were only to be expected, disputes about the allotment of the reclaimed land and about the management of the new drains. These were problems of routine administration and could be settled by negotiation and compromise. But there were other difficulties of a much more fundamental character; they nearly brought the work of the drainers to disaster, and they have remained important considerations ever since. They are of two kinds, connected respectively with the lowering of the peat surface and the condition of the tidal rivers that flow through the Fens.

LOWERING OF THE PEAT SURFACE

Neither Vermuyden nor any of his associates apparently foresaw, when they planned and executed their schemes, that as soon as they began to drain the Fens the surface of the peat would become rapidly lower in level. This lowering was attributable in part to the shrinkage of the peat and in part to the wasting away of the peat surface as a result of bacterial action and cultivation. As a result, the surface of the peat soon became lower than the level of the rivers into which it drained. This difference in height can be seen along many of the fen channels; they are at a higher level than the land through which they flow. There soon came a time when the water of the small drains right in the heart of the peat area could no longer flow into the main channels. The amount of lowering varies from place to place, but even a very small rate of lowering becomes critically important over a period of years. The surface of the undrained peat must have stood at about 10 or 12 ft. or so above Ordnance Datum. By the 1950s the surface of much of the drained peat stands at about Ordnance Datum, or just below. It must also be remembered that a basic subsidence of land relative to the sea has been postulated, and this may have been upward of three feet since the 17th century.

Windmill Drainage. — What had seemed a promising enterprise in 1652 had become a tragedy by 1700. There was but one way to save the situation, the substitution of an artificial for the natural drainage by gravity. Water was pumped from small dike to drain and from drain to river. It was this introduction of windmills for pumping purposes that saved most of the drained fens from being reinundated. As the 17th century passed into the 18th century, windmill drainage became more and more frequent, and the windmills imparted a distinctive character to the landscape.

But the windmill was far from being a perfect engine. It was at the mercy of gale and frost and calm. It was never very powerful, and it soon ceased to provide a satisfactory solution to the problem of clearing water from the drains. For, as the surface of the peatlands continued to subside, the windmill became increasingly ineffective. The paradox was that the more the evils of lowering were combated by more effective draining, the more rapidly the peat surface continued to sink. Thus it was that the works of one generation became inadequate for the needs of the next. Inundations grew frequent. By the end of the 18th century, according to Arthur Young, there were many fens "all waste and water," where 20 years previously there had been "buildings, farmers and cultivation." He could only be "shocked at the sight of this desolation," and even went so far as to say that "the total ruin of the whole flat district must ensue." Other evidence bears out his impression of desolation. Moreover, not only were there large stretches of the Bedford level relapsing into "waste and water," but there were still some tracts that had never been drained at all; in the west, in Huntingdonshire, were the large reed-bordered lakes of Whittlesey mere and Ramsey mere. Fishing and fowling continued to be characteristic Fenland occupations. The large copper butterfly, Lycaena *dispar*, too, was not yet extinct in the area, nor was the ague against which the fenmen indulged in brandy drinking.

Outside the Bedford level, in the Northern Fens, the work of draining had been taken up again in the 18th century. There, effort was more divided than in the Bedford level, for the arrangement of upland and coast disposed the area into a number of separate tracts. Conditions varied from place to place; several districts had been brought into cultivation, but, as in the Southern Fens, complaints about inundation were frequent. In many of these northern districts, too, stretches of original fen lingered on, nursing the old economy based on fishing, fowling, reed cutting and the like. In wintertime, the East fen, the West fen and Wildmore fen (lying north of Boston, Lincolnshire) consisted of a mass of lakes connected by "narrow reedy straits"; even in dry summers the East fen "deeps" were covered on an average by about two feet of water.

The Steam Engine. — But before the first quarter of the 19th century was over a great change for the better had come over the whole area. There were still floods bringing with them a reminder of former conditions, but improvement was making itself felt decade by decade, indeed "almost annually." As one traveller in 1828 put it, "swampy land, . . . but drained more and made more cultivable every year." The main factor responsible for this transformation early in the 19th century was the introduction of the steam engine for pumping. At first there was delay and hesitation, and not until 1819–20 was the first steam-driven pump set up. Many others soon followed, and the Fenland was greatly relieved from the threat that had hovered over it at the end of the 18th century. So effective were the new engines that one of the most characteristic elements of the landscape of the fen for more than 100 years was doomed to disappear. Windmills fell into disuse and were replaced by pumping stations, though here and there some windmills still lingered on into the 20th century. There were other changes also, for the great scoop wheels that had been in use since the 17th century were replaced after 1850 by the more effective centrifugal pumps. It was an Appold centrifugal pump that, in 1851, was used to drain Whittlesey mere, the last remaining large stretch of water in the Fenland. From then on, the area benefited by the increasing technical improvements of the age. To overcome the continued lowering of the peat surface increasingly powerful pumping units were frequently installed.

The Diesel Engine. — After about 1913 diesel engines were used to supplement the steam engines, and today the latter have been almost entirely superseded. Diesel engines have the great advantage that they can be started up quickly at short notice, and they are much more suitable for intermittent running than steam engines.

The Care of Banks. — But the advent of improved pumping facilities did not solve all the problems produced by the lowering of the peat surface. The miles of banks brought into being in the 17th century, and increased in later times, need constant care. Many of these banks were originally constructed or repaired with poor materials and in great haste. The continued lowering of the adjoining surface increases the weakness of the banks, and they strain unevenly toward the fen to reveal unsuspected weaknesses in time of flood. The danger is not only that of overflowing but also of seepage. No matter how good the repair of the upper portion of a bank has been, it must frequently rest upon foundations that are not so good in many places. There is risk, therefore, of the upper portion of a bank slipping over the lower portion when subject to a great head of water. A number of crises emphasized the danger presented by the banks. In the spring floods of 1937 and 1939, for example, breaches in one of the smaller banks caused flooding near Soham, and in 1937 it was feared that the western barrier bank of the two Bedford rivers might give way at one point, thus allowing the great mass of water in the washes to pour over the surrounding countryside. The alarms of these and other years culminated dramatically in the great floods of March 1947, when several banks were breached, and large stretches of cultivated land were inundated. The breaches were repaired and the summer was spent in rehabilitation aided by government grants.

THE TIDAL RIVERS

As a result of the lowering of the peat surface, two water-level systems came into being: one, the low-level system of the internal drains of the Fens .themselves; the other, the high-level system of the large rivers that flow through the Fens from the uplands down to the sea. The problem of disposing of the water of the low-level drains was solved by pumping, but that of protecting the drained lands from the high-riding rivers, especially in time of flood, remained. The real difficulty is that of securing a quick discharge of floodwater.

After the early days of the draining much attention was concentrated on the condition of the outfalls of the fen rivers into the Wash. In a normal river the current of water is strong enough to force its way out to sea and so keep both channel and estuary clear. But the Fenland rivers are far from normal. The downward force of the fresh waters in the gently graded streams is no match, especially in summer, for the strong tidal flow each day. The incoming tide, moreover, brings large quantities of silt from the Wash. With swift flood tides and weak ebb tides deposition is inevitable, and the fresh-water discharge is able to maintain a channel of only limited capacity. The result is that in very wet weather, with large quantities of water pouring down from the uplands, high water levels are inevitable in the great Fenland rivers. The great fen controversies of the 18th and 19th centuries were largely outfall controversies concerned with topics such as the mechanics of silting. the formation of sandbanks and the disposition of sluices. In the early part of the 19th century the Ouse reached the sea through a channel of varying width, filled with shifting sandbanks; in the Nene, "ships of large burden could no longer reach" Wisbech; the Welland estuary, too. was full of shoals; that of the Witham was in no better plight. There was much conflict of opinion and interest about all these matters. Nor were the controversies ended even in the 1950s. But the increasing technical equipment of the 19th and 20th centuries enabled some improvements to be made in the outfalls of the Ouse, the Nene, the Welland and the Witham. New and straight channels were made to cut off bends in their estuaries; training walls were built out to sea; and various measures were taken to improve the conditions of the channels generally. But despite much effort the results in many cases were not as great as were hoped for.

An important feature of the tidal rivers are the sluices necessary to prevent the tidal waters from passing up some of the rivers and cuts. On the Witham are the Grand sluice and the Black sluice; on the Nene, the North level sluice; on the Ouse, the St. Germans sluice and Denver sluice. Upon Denver sluice depends the safety of the southern part of the Bedford level, and it has become the most famous of the Fenland sluices. Immediately below the sluice the waters of the Hundred Foot river fall directly into the Ouse. Consequently when there is a great volume of upland water passing down the Hundred Foot river, the level of water on the seaward side of the sluices never falls sufficiently low for the sluice gates to be opened long enough to provide an adequate runoff for the waters of the South level. These waters can only accumulate within the straining banks of their rivers and drains. A crisis is therefore always liable to be produced by a combination of (1) heavy land floods, (2) a high spring tide and (3) adverse wind conditions. A new feature in fen investigation was the experimental model set up at Cambridge in 1935 by the Great Ouse Catchment board, with the object of providing data for the study of tidal and silting conditions both in the Wash and in the river itself.

But no amount of work in the outfalls can much alter the low tide, and particularly the high tide, levels of the sea; nor can it appreciably alter the surface gradient of the river water upstream. Yet it is upon this surface gradient, as much as anything, that the discharge of a river depends. Alterations at the river outfalls, while producing local and temporary results, have had insufficient effect in lowering water levels higher up the rivers. Moreover, with the lowering of the peat areas, the high flood gradients of these rivers have been greatly increased because the flood discharge is unable to spread far beyond the normal river channels because of the high banks needed to protect the low-lying country around. Opinion in the South level has, therefore, shiited the emphasis from attempts at outfall improvements to other measures for lowering the surface gradients of the high-level rivers during flood.

Following the severe crisis of 1939, new proposals for lowering the flood levels in the Great Ouse were evolved after much discussion. Two main groups of works were envisaged, together with their associated sluices: (1) a "cutoff channel" along the eastern margin of the Fenland to intercept the upper waters of the Lark, Little Ouse and Wissey and convey them to a point near Denver; (2) a relief channel from Denver, running northward for about 10½ mi to enter the estuary above King's Lynn, and accompanied by a small flood reservoir near Denver. Work on this Flood Prutection scheme was in progress in 1956.

DRAINAGE ADMINISTRATION

Looming above all technical questions connected with the lowering of the peat surface and the condition of the tidal rivers, there was the great problem of administration. The outstanding difficulty lay in the lack of any single authority along the course of a river and in the absence of adequate co-operation among existing authorities. The responsibilities of the Bedford Level corporation did not extend beyond the maintenance of the major rivers. In order, therefore, to meet the new situation produced by the lowering of the peat, groups of landowners were forced to supplement the larger drainage scheme by local district enterprise. The first drainage district was formed by act of parliament at Haddenham near Ely in 1727, and it created a principle that was soon followed at frequent intervals. The whole of the Fens came to consist almost entirely of small districts, each dependent for its internal drainage upon small cuts leading to a main drain which in turn discharged its water by pumping into one of the major rivers. Each of the statutory districts had its own authority with full control over the internal drainage of its area, with wide powers of local taxation and with powers of negotiation with adjacent bodies over matters of common concern.

The necessity for co-operation was repeatedly urged, and many advocated the establishment of authorities responsible for the whole length of each main river. Bills were introduced into parliament in 1877, 1878, 1879 and 1881 with the idea of setting up conservancy boards, but difficulties of rating were among the main reasons that prevented their success. The tangle of authorities, working with antiquated powers and inadequate resources, remained for another 50 years. At last, in 1927, a royal commission was set up to examine the working of the 361 drainage authorities in England and Wales. The remedy it suggested was the same as that advocated in 1877, the establishment of conservancy boards, each with exclusive control over a main river and "clothed with supervisory powers (in order to secure co-ordination of effort) over the internal drainage authorities." It suggested, too, that the ancient formula of benefit should be abolished and that the new authorities should be empowered to levy rates over the whole of their respective catchment areas, recognizing a distinction between uplands and lowlands. This report formed the basis for the Land Drainage act of 1930. Thus there came into existence the catchment boards of the Great Ouse, the Nene, the Welland and the Witham (and Steeping). By another act of 1948, these catchment boards were replaced by river boards with somewhat enlarged pouers.

MODERN FENLAND AGRICULTURE

The improvements in draining that marked the 19th century were paralleled by agricultural changes. Indeed, only a fertile soil could have supported the heavy drainage rates that the improvements involved. One great innovation about 1830 was the introduction of the practice of "claying the land;" *i.e.,* digging up clay from below the peat and spreading it over the surface. Everywhere there were signs of prosperity, and a survey of 1848 could speak of the rich pastures and luxuriant crops of the district. Despite this prosperity the Fenland shared in the general ebb that marked English agriculture from the '70s onward, and conditions were bad locally. But in many ways the Fenland did not suffer as much as the upland around. The introduction of new crops helped to save the situation. Potatoes proved the "mainstay of the fen farmer" according to one report; vegetables and fruit, too, were becoming important. The first orchard had been planted in the Wisbech area as early as the '50s. In the '80s and '90s many farmers were forced to adopt a fresh form of husbandry, and so turned to market gardening and fruit farming. Flowers, too, spread, and Lincolnshire bulbs became famous. Thus, from the agricultural depression of the 19th century, the 20th century inherited the foundations of prosperity, and the Fenland became one of the richest arable areas in England, supporting the traditional crops such as wheat, but characterized by potatoes, flowers, small fruits and market garden crops; a newcomer on the southern peats was the sugar beet. But when World War II broke out there were still some patches of ill-drained derelict land. In the national endeavour to increase food production their black peat soil was made to yield its richness as elsewhere in the Fenland.

A few isolated stretches of peat fen have survived, and are of special interest from a botanical and entomological point of view. Along the western edge of the Fens; for example, is Wood Walton fen to the north of Huntingdon. Along the eastern edge are Chippenham fen and Wicken fen not far from Newmarket. The latter belongs to the National Trust and has been the scene of much investigation. It is about a square mile in extent and its waterlogged surface stands several feet higher than that of the adjoining peatlands. It is not strictly "natural," because the water levels are manipulated, the channels are kept open, and the fen is periodically cut over. Left to itself, most of its surface would become covered with bushes, and the fen species of plants and animals would he reduced or exterminated. Carefully controlled, Wicken fen gives an idea of what the "vast and deep fen" as a whole was like before Vermuyden's day.

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FENTON, EDWARD (d. 1603), English navigator. son of Henry Fenton and brother of Sir Geoffrey Fenton (*q.v.*), was born in Nottinghamshire. In 1577 he sailed in command of the "Gabriel," with Martin Frobisher's second expedition for the discovery of the northwest passage. and in 1578 he was second in command in Frobisher's third expedition, in the "Judith." In 1582 he was put in charge of an expedition which was to sail round the Cape of Good Hope to the Moluccas and China, and to obtain any knowledge of the northwest passage that was possible without hindrance to his trade. The voyage was a failure. He spent his time quarrelling with his officers, and only reached Brazil. In 1588 he had command of the "Mary Rose," one of the ships of the fleet that was formed to oppose the Armada. He died 15 years later.

See Richard Hakluyt, *Voyages,* vol. iv.

FENTON, ELIJAH (1683–1730), English poet, was born at Shelton. near Newcastle-under-Lyme. He graduated from Jesus college, Cambridge, in 1704, and became a schoolmaster.

Fenton was the coadjutor of Alexander Pope in his translation of the Odyssey. He was responsible for the 1st, 4th, 19th and 20th books. He produced an edition of John Milton, with a life (1725), which went through an amazing number of editions; also one of Edmund Waller (1729). Other works were two collections of poems (1708 and 1717) and *Mariamne,* a tragedy (1723). He died at East Hampstead. Berkshire, in July 1730. His epitaph in the parish church was written by Pope.

See S. Johnson, *Lives of the English Poets,* ed. by G. Birkbeck Hill, vol. ii (Oxford, 1905); W. W. Lloyd, *Elijah Fenton, His Poetry and Friends* (Hanley, 1894); E. Harlan, *Elijah Fenton, 1683–1730* (Philadelphia, 1937).

FENTON, SIR GEOFFREY (c. 1539–1608), English writer and politician, was the son of Henry Fenton of Nottinghamshire and brother of Edward Fenton the navigator. He is said to have visited Spain and Italy in his youth; possibly he went to Paris in Sir Thomas Hoby's train in 1566, for he was living there in 1567, when he wrote *Certaine tragicall* discourses *written oute of Frenche and Latin,* a free translation of François de Belleforest's French rendering of Matteo Bandello's *Novelle.* Fenton's other works are as follows: *Monophylo* (1572), *Golden* Epistles gathered out of Guevarae's workes as other authors . . . (1575), Historie of *Guicciardini,* translated out of French by *G. F.* (1579) and a number of Protestant tracts. Through Lord Burghley he obtained, in 1580, the post of secretary to the new lord deputy of Ireland, Lord Grey de Wilton. He held the secretaryship until the end of his life by the favour of Elizabeth, whom he kept informed of the activities of her other servants in Ireland. Under James I he shared the post with Sir Richard Coke. Fenton died in Dublin on Oct. 19, 1608, and was buried in St. Patrick's cathedral. He had two children, a son, Sir William Fenton, and a daughter, Catherine. who in 1603 married Richard Boyle, 1st earl of Cork.

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FENTON, LAVINIA, afterward Duchess of Bolton (1708–1760), English actress, the original Polly Peachum of John Gay's Beggar's Opera, was probably the daughter of a naval lieutenant named Beswick, but she bore the name of her mother's husband. Her first appearance was as Monimia in Thomas Otway's *Orphans* in 1726 at the Haymarket theatre, London. She then joined the company of players at the theatre in Lincoln's Inn Fields. Miss Fenton made her greatest success in 1728 as Polly Peachum, and a famous painting by William Hogarth shows her in one of the Beggar's Opera scenes. She ran away with Charles Paulet, 3rd duke of Bolton, a man much older than herself, who married her after the death of his wife in 1751. She died at Greenwich on Jan. 24, 1760.

See C. E. Pearce, *Polly Peachum* (1913).

FENTON, former civil parish. Staffordshire, Eng., which after 1922 formed three wards in Stoke-on-Trent (*q.v.*). Originally known as Lane Delph, it is a purely industrial district. China and earthenware are manufactured.

FENUGREEK (Trigonella *foenum-graecum*) is a slender, pubescent annual of the legume family, native to the Mediterranean region. The plants are erect, loosely branched, 20 to 30 inches tall with trifoliate leaves and yellowish-white flowers. The slender pods are 3 to 6 inches long, curved, and distinctly beaked. It is cultivated in parts of central and southeastern Europe, western Asia, the India subcontinent and North Africa. The seeds are used externally in poultices for boils, abscesses, carbuncles, etc., and internally as an emollient for inflammation of the digestive tract. They have long been used as the principal ingredient of "condition powders" for cattle and horses. Fenugreek seeds are also used in various ways for human food—mixed with flour for bread. eaten raw or boiled, and as a constituent in curry powders. In India the young plants are used as a pot herb and in North Africa the crop is utilized for hay. A small acreage is grown in California, largely as a green-manure crop. (Q. J.)

FENWICK, ETHEL GORDON (1857–1947), British nurse and journalist, was born at Spynie House, Morayshire, on Jan. 26, 1857, the daughter of David Davidson Manson. In 1881 she was appointed matron of St. Bartholomew's hospital, London. She married in 1887 a gynaecologist, Bedford Fenwick, and devoted herself to the work of organizing the nursing profession and raising its status by state registration. An act of parliament for this purpose was passed in 1919. Mrs. Fenwick became, in 1893, honorary editor of The British Journal of Nursing. She was founder of the Royal British Nurses association in 1887, the International Council of Nurses in 1899, the National Council of Nurses in 1904 and the British College of Nurses Ltd. in 1926, and was president of the last three associations. She died on March 13, 1947.

FENWICK, SIR JOHN (*c.* 1645–1697), English conspirator, came of an old Northumberland family. He had a successful military career, 1667–88, and was M.P. for Northumberland, 1677–85. He was a partisan of James II, and after the Revolution at once began to plot against William III, for which he underwent a short imprisonment in 1689. He publicly insulted Queen Mary in 1691, and it is practically certain that he was implicated in the schemes for assassinating William which came to light in 1695 and 1696. After the seizure of his fellow conspirators, Robert Charnock and others, he went into hiding, but was arrested in June 1696. To save himself he offered to reveal all he knew about the Jacobite conspiracies; but his confession was damaging but not conclusive, being confined to charges against leading Whig noblemen. Sufficient evidence of treason was doubtful, but the Whigs secured the passage of a bill of attainder. Fenwick was beheaded in London on Jan. 28, 1697.

FEODOROVNA, MARIE: see Marie Feodorovna.

FEOFFMENT, in English law, during the feudal period, the usual method of granting or conveying a freehold or fee (see Fief; Fee). The essential elements were livery of seisin (delivery of possession), which consisted in formally giving to the feoffee on the land a clod or turf or growing twig as symbol of the transfer of land, and words by the feoffer declaratory of his intent to deliver possession to the feoffee with a "limitation" of the estate intended to be transferred. This was called livery in deed. Livery in law was made not on but in sight of this land, the feoffer saying to the feoffee: "I give you that land; enter and take possession." Livery in law, in order to pass the estate, had to be perfected by entry by the feoffee during the joint lives of himself and the feoffor. It was usual to evidence the feoffment by writing in a charter or deed of feoffment; but writing was not essential until the Statute of Frauds. By the Real Property act, 1845, all corporeal hereditaments were declared to be in grant as well as livery; *i.e.,* they could be granted by deed without livery. (See Laws of Real Property and Conveyancing.)

FER-DE-LANCE (Trimeresurus atrox), a poisonous American pit viper. Reaching a length of 7 ft. it resembles a rattlesnake (*q.v.*) in appearance, but without the "rattle" of the latter, and is found almost throughout Central and South America. Its bite is often fatal. The fer-de-lance feeds on rats and other small animals.

FERDINAND, a name borne at various times by European sovereigns and princes (Span. Fernando or Hernando; Ital. *Ferdinando* or Ferrante; in O.H G. Herinand, "brave in the host").

FERDINAND (1577–1650), elector and archbishop of Cologne, son of William V., duke of Bavaria, was born on Oct. 7, 1577. He was educated by the Jesuits at the university of Ingolstadt, and in 1595 became coadjutor archbishop of Cologne. He became elector and archbishop in 1612 on the death of his uncle Ernest, whom he also succeeded as bishop of Liége, Munster and Hildesheim. He supported the league founded by his brother Maximilian I., duke of Bavaria, and wished to involve the leaguers in a general attack on the Protestants of north Germany. The duke refused to accede to his brother's wish; but, in spite of these temporary differences, Ferdinand sent troops and money to the assistance of the league when the Thirty Years' War broke out in 1619. In 1647 he joined his brother Maximilian in concluding an armistice with France and Sweden at Ulm. Ferdinand came into conflict with the citizens of Liége; and when the peace of Westphalia freed him from his enemies, he was able to crush the citizens and deprive them of many privileges. Ferdinand died at Arnsberg on Sept. 13, 1650, and was buried in the cathedral at Cologne.

FERDINAND I. (1793–187j), emperor of Austria, eldest son of Francis I. and of Maria Theresa of Naples, was born at Vienna on April 19, 1793. In his boyhood he suffered from epileptic fits, but as his health improved he was not excluded from the succession. In 1830 his father caused him to be crowned king of Hungary. In 1831 he was married to Anna, daughter of Victor Emmanuel I. of Sardinia. The marriage was barren. When Francis I. died on the 2nd of March 183j, Ferdinand was recognized as his successor, but his incapacity was so notorious that the conduct of affairs was entrusted to a council of state, consisting of Prince Metternich (*q.v.*) with other ministers, and two archdukes, Louis and Francis Charles. They composed the *Staatsconferenz,* the ill-constructed and informal regency which led the Austrian dominions to the revolutionary outbreaks of 1846–49. (See AUSTRIA, EMPIRE OF) The emperor, who was subject to fits of actual insanity, and in his lucid intervals was weak and confused in mind, was a political nullity. His popular name of Der Gutige (the kindly man) expressed as much derision as affection. Ferdinand had artistic and musical taste. In the presence of the revolutionary troubles, which began with agrarian riots in Galicia in 1846, and then spread over the whole empire, he was helpless. He was compelled to escape from the disorders of Vienna to Innsbruck on May 17, 1848. He came back on the invitation of the diet on Aug. 12, but soon had to escape once more from the mob of students and workmen who were in possession of the city. On Dec. 2 he abdicated at Olmutz in favour of his nephew, Francis Joseph. He lived under the supervision of doctors and guardians at Prague till his death on June 29, 1875.

See Krones van Marchland, Grundriss der oesterreichischen *Geschichte* (Vienna, 1882), which gives an ample bibliography.

FERDINAND I. (1503–1564), Roman emperor, was born at Alcalá de Henares on March 10, 1503, his father being Philip the Handsome, son of the emperor Maximilian I., and his mother Joanna, princess of Castile and Aragon. In April 1521 the emperor granted to him the archduchies and duchies of upper and lower Austria, Carinthia, Styria and Carniola, adding soon afterwards the county of Tirol and the hereditary possessions of the Habsburgs in south-western Germany. About the same time Ferdinand was appointed to govern the duchy of Wurttemberg, which had come into the possession of Charles V.; and in May 1521 he was married at Linz to Anna (d. 1547), a daughter of Ladislaus, king of Hungary and Bohemia. In 1521 also he was made president of the council of regency (Reiclzs-regiment), appointed to govern Germany during the emperor's absences, and the next five years were occupied with imperial business, in which he acted as his brother's representative, and in the government of the Austrian lands.

In Austria and the neighbouring duchies Ferdinand sought at first to suppress the reformers and their teaching, a policy which increased his difficulties in quelling risings in the districts under his rule after the Peasant's War broke out in 1524. In August 1526 his childless brother-in-law, Louis II., king of Hungary and Bohemia, was killed at the battle of Mohacs, and the archduke at once claimed both kingdoms, both by treaty and by right of his wife. He was chosen king of Bohemia in October 1526, and crowned at Prague in the following February. But in Hungary John Zapolya, supported by the national party and soon afterwards by the Turks, offered a sturdy resistance. Although Ferdinand was chosen king at Pressburg in December 1526, and after defeating Zapolya at Tokay was crowned at Stuhlweissenburg in November 1527, he was unable to take possession of the kingdom. The Bavarian Wittelsbachs, incensed at not securing the Bohemian throne, were secretly intriguing with his foes; the French, after assisting spasmodically, made a formal alliance with Turkey in 153j; and Zapolya was a very useful centre for the enemies of the Habsburgs. A truce made in 1j33 was soon broken, and the war dragged on until 1538, when by the treaty of Grosswardein, Hungary was divided between the claimants. The kingly title was given to Zapolya, but Ferdinand was to succeed. Meanwhile, in January 1531, he had been chosen king of the Romans, or German king, at Cologne. He had earned this honour by his loyalty to his brother, Charles V., whom he had represented at several diets. In religious matters the king was now inclined to steer **a** middle course, and in 1532 he agreed to the religious peace of Nuremberg, receiving in return from the Protestants some assistance for the war against the Turks. In 1534, however, Philip, landgrave of Hesse, and his associates had succeeded in conquering Wiirttemberg (*q.v*) on behalf of its exiled duke, Ulrich, and neither Charles nor Ferdinand could send much help to their lieutenants. They were consequently obliged to consent to the treaty of Cadan, made in June 1534, by which the German king recognized Ulrich as duke of Wiirttemberg though under Austrian suzerainty.

In Hungary the peace of 1538 was not permanent. When Zapolya died in July 1540 a powerful faction refused to admit Ferdinand's right of succession, and put forward Zapolya's young son John Sigismund as a candidate. The cause of John Sigismund was espoused by the Turks and by Ferdinanti's other enemies. The king repeatedly sought to make peace with the sultan, but his envoys were haughtily repulsed. In 1544, however, a short truce was made. This was followed by others, and in 1j47 one was concluded for five years, but only on condition that Ferdinand paid tribute for the small part of Hungary which remained in his hands. The struggle was renewed in 1j51 and was continued in the same desultory fashion until 1562, when a truce was made which lasted during the remainder of Ferdinand's lifetime. During the war of the league of Schmalkalden in 1546 and 1547 the king had taken the field primarily to protect Bohemia, and after the conclusion of the war he put down a rising in this country with some rigour. About 1546 he began to take up a more independent position in imperial politics. Although Charles had crushed the league of Schmalkalden he had refused to restore Württemberg to Ferdinand; and he gave further offence by seeking to secure the succession of his son Philip, afterwards king of Spain, to the imperial throne. In 1551 Ferdinand agreed that Philip should be his own successor. Events caused these plans to be dropped, but there was a rift between the brothers. During the short war between the emperor and Maurice, elector of Saxony, in 1552 Ferdinand's attitude was lukewarm. He negotiated the treaty of Passau with Maurice in 1552, and in 1555 after the conduct of imperial business had virtually been made over to him, and harmony had been. restored between the brothers, he was responsible for the religious peace of Augsburg. Early in 1556 Charles abdicated and on March 24. Ferdinand was crowned at Frankfort. The emperor's short reign was mainly spent in seeking to settle the religious differences of Germany, and-in efforts to prosecute the Turkish **war** more vigorously. Although he held firmly to the Roman Catholic Church he sought to obtain tangible concessions to her opponents; but he refused to conciliate the Protestants by abrogating the clause concerning ecclesiastical reservation in the peace of Augsburg, and all his efforts to bring about reunion were futile, though he secured the privilege of communion in both kinds from Pius IV. for the laity in Bohemia and in various parts of Germany. In November 1562 he obtained the election of his son Maximilian as king of the Romans, and died in Vienna on July 2j, 1564. His family had consisted of six sons and nine daughters.

Ferdinand sought to consolidate his Austrian lands, reformed the monetary system in Germany, and reorganized the Aulic council (*Reichshofrat*). Less masteriul but more popular than his brother, whose character overshadows his own, he was just and tolerant, a good Catholic and a conscientious ruler.

See the article on CHARLES V. and its bibliography; also HUNGARY. F. B. von Bucholtz, *Geschichte der Regierung Ferdinands dcs Ersten* (Vienna, 1831–1838); K. Oberleitner, *Österreichs Finanzen und Kriegswesen unter Ferdinand I.* (Vienna, 1859); E. Rosenthal. *Die Behördenorganisation Kaiser Ferdinands, I.* (Vienna, 1887); and W. Bauer, *Die Anfänge Ferdinands I.* (Vienna, 1907).

FERDINAND II. (1578–1637), Roman emperor, was the eldest son of Charles, archduke of Styria (d. 1590), and a grandson of the emperor Ferdinand I. Born at Gratz on July 9, 1578, he was trained by the Jesuits, finishing his education at the university of Ingolstadt, and became the pattern prince of the counter-reformation. In 1596 he undertook the government of Styria, Carinthia and Carniola, and after a visit to Italy began an organized attack on Protestantism which under his father's rule had made great progress in these archduchies. About 1615 it was agreed that Ferdinand, who already had two sons by his marriage with his cousin Maria Anna (d. 1616), daughter of William V., duke of Bavaria, should succeed Matthias in the elective kingdoms of Hungary and Bohemia and should be the next German emperor. (See HABSBURG: Genealogy.) The elder archdukes renounced their rights in the succession; the claims of Philip III and the Spanish Habsburgs were bought off by a promise of Alsace; and the emperor consented to his supersession during his lifetime in Hungary and Bohemia. In 1617 Ferdinand, who was just concluding a war with Venice, was chosen king of Bohemia, and in 1618 king of Hungary; but his election as German king, or king of the Romans, delayed owing to the anxiety of Melchior Klesl (*q v*) to conciliate the Protestant princes, had not been accomplished when Matthias died in March 1619. Before this event, however, an important movement had begun in Bohemia. The Bohemian Protestants suddenly realized that their religious, and possibly their civil liberties, were seriously menaced by the choice of Ferdinand as king. They declared Ferdinand deposed, and elected the elector palatine of the Rhine, Frederick V., in his stead; and the struggle between the rivals was the beginning of the Thirty Years' War. At the same time Gabriel Bethlen, prince of Transylvania, invaded Hungary, while the Austrians rose and joined the Bohemians; but having seen his foes retreat from Vienna, Ferdinand hurried to Frankfort, where he was chosen emperor on Aug. 28, 1619.

To deal with the elector palatine and his allies the new emperor allied himself with Maximilian I., duke of Bavaria, and the Catholic League, who drove Frederick from Bohemia in 1620, while Ferdinand's Spanish allies devastated the Palatinate. Peace having been made with Gabriel Bethlen in December 1621, the emperor could turn his attention to crushing the Protestants. In 1623 the Protestant clergy were expelled from Bohemia; in 1624 all worship save that of the Roman Catholic church was forbidden; and in 1627 an order of banishment against all Protestants was issued. A new constitution made the kingdom hereditary in the house of Habsburg, gave larger powers to the sovereign, and aimed at destroying Bohemian nationality. A fresh rising in Austria was put down by the aid of the Bavarians in 1627, and Ferdinand could fairly claim that in his hereditary lands at least he had rendered Protestantism innocuous.

The renewal of the Thirty Years' War in 1625 was caused mainly by the emperor's vigorous championship of the cause of the counter-reformation in northern and north-eastern Germany. (See THIRTY YEARS' WAR.) In March 1629 Ferdinand and his ad. visers felt themselves strong enough to take the important step towards which their policy in the Empire had been steadily tending. Issuing the famous edict of restitution, the emperor ordered that all lands which had been secularized since 1552, the date of the peace of Passau, should be restored to the church, and prompt measures were taken to enforce this decree. The result mas the outbreak of the third period of the war. The comparative failure of the imperial arms was due, in the initial stages of the campaign, to Ferdinand's weakness in assenting in 1630 to the demand of Maximilian of Bavaria that Wallenstein should be deprived of his command; and also to the genius of Gustavus Adolphus; and in its later stages to his insistence on the second removal of Wallenstein, and to his complicity in the assassination of the general (see WALLENSTEIN, ALBRECHT WENZEL EUSEBIUS VON). The peace of Prague, concluded in 1635, marks the definite failure of Ferdinand to crush Protestantism in the Empire, as he had already done in Austria and Bohemia. The emperor, however, refused to allow the inhabitants of his hereditary dominions to share in the benefits of the peace. During these years Ferdinand had also been menaced by the secret or open hostility of France. The last important act of the emperor was to secure in 1636 the election of his son Ferdinand as king of the Romans. A few weeks afterwards, on Feb. 15, 1637, the emperor died at Vienna, leaving, in addition to the king of the Romans, a son Leopold William (1614–1662), bishop of Passau and Strasbourg.

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FERDINAND III. (1608–1657), Roman emperor, was the elder son of the emperor Ferdinand II., and was born at Gratz on July 13, 1608. Educated by the Jesuits, he was crowned king of Hungary in December 1625, and king of Bohemia two years later, and soon began to take part in imperial business. Wallenstein, however, refused to allow him to hold a command in the imperial army. The young king was appointed the successor of the famous general when he was deposed in 1634; and as commander-in-chief of the imperial troops, he was nominally responsible for the capture of Regensburg and Donauworth, and the defeat of the Swedes at Nördlingen. Having been elected king of the Romans, or German king, at Regensburg in Dec. 1636, Ferdinand became emperor on his father's death in the following February, and showed himself anxious to put an end to the Thirty Years' War. But he was reluctant to grant religious liberty to the Protestants, and anxious to act in unison with Spain. In 1640 he had refused to entertain the idea of a general amnesty suggested by the diet at Regensburg; but in 1648 he assented to the treaty of Westphalia (*q.v.*). Owing to Ferdinand's insistence the Protestants in his hereditary dominions did not obtain religious liberty at this settlement. After 1648 the emperor was engaged in carrying out the terms of the treaty and ridding Germany of the foreign soldiery. In 1656 he sent an army into Italy to assist Spain in her struggle with France, and he had just concluded an alliance with Poland to check the aggressions of Charles X. of Sweden when he died on April 2, 1657. Ferdinand was a scholarly and cultured man, an excellent linguist and a composer of music. His first wife was Maria Anna (d. 1646), daughter of Philip III. of Spain, by whom he had three sons: Ferdinand, who was chosen king of the Romans in 1653, and who died in the following year; Leopold, who succeeded his father on the imperial throne; and Charles Joseph (d. 1664), bishop of Passau and Breslau, and grand-master of the Teutonic order. The emperor's second wife was his cousin Maria (d. 1649), daughter of the archduke Leopold; and his third wife was Eleanora of Mantua (d. 1686). His musical works, together with those of the emperors Leopold I. and Joseph I., have been published by G. Adler (Vienna, 1892–1893).

See M. Koch, *Geschichte des deutschen Reiches unter der Regierung Ferdinands III.* (Vienna, a vols., 1865–66).

FERDINAND I. (1373–1416), king of Aragon, called "of Antequera," was the son of John I. of Castile by his wife Eleanor, daughter of the third marriage of Peter IV. of Aragon. As infante of Castile Ferdinand had played an honourable part. When his brother Henry III. died at Toledo, in 1406, the cortes was sitting, and the nobles offered to make him king in preference to his nephew John. Ferdinand declined. As co-regent of the kingdom with Catherine, widow of Henry III. and daughter of John of Gaunt by his marriage mith Constance, daughter of Peter the Cruel, Ferdinand proved a good ruler. As king of Aragon his short reign of two years left him little time to make his mark. Having been bred in Castile, where the royal authority was, at least in theory, absolute, he showed himself impatient under the checks imposed on him by the *fueros*, the chartered rights of Aragon and Catalonia. His most signal act as king was to aid in closing the Great Schism in the Church by agreeing to the deposition of the antipope Benedict XIV., an Aragonese. He died at Ygualada in Catalonia on April 2, 1416.

FERDINAND, MAXIMILIAN KARL LEOPOLD MARIA (1861–1948), king of Bulgaria, fifth and youngest son of Prince Augustus of Saxe-Coburg and Gotha, was born on Feb. 26, 1861. In 1879 he travelled with his brother Augustus to Brazil, and the results of their botanical observations were published at Vienna, 1883–88, under the title of *Itinera Principum S. Coburgi*. Ferdinand was a lieutenant in an Austrian hussar regiment when he was elected prince of Bulgaria, on July 7, 1887, in succession to Prince Alexander, who had abdicated in 1886. He assumed the government on Aug. 14, 1887, but Russia for a long time refused to acknowledge the election, and he was accordingly exposed to frequent military conspiracies connived at by the Russian government. The firmness and vigour with uhich he met all attempts at revolution were at length rewarded, and his election was confirmed in March 1896 by the Porte and the Great Powers. On April 20, 1893, he married Marie Louise (1870–99), eldest daughter of Duke Robert of Parma. The prince adhered to the Roman Catholic faith in which he had been brought up, but his son and heir, the young Prince Boris, was received into the Orthodox Greek Church on Feb. 14, 1896, with the Tsar, Nicholas II, as godfather. This event marked a real rapprochement with Russia. In 1908 Ferdinand married Eleanor (1860–1917), a princess of the house of Reuss. Later in the year, in connection with the Austrian annexation of Bosnia-Herzegovina and the crisis with Turkey, he proclaimed the independence of Bulgaria and took the title of king or tsar. (See BULGARIA and EUROPE: *History.)*

King Ferdinand in 1911 was the instigator of the Balkan league between Bulgaria, Serbia, Greece and Montenegro, which was formed in 1912 and enabled these four states to declare war against Turkey that same year. This pact provided for the future division of the Balkan peninsula, reserving to the arbitration of the emperor of Russia the solution of any doubtful claims. The war started in Oct. 1912, before the conclusion of the Treaty of Ouchy, which put an end to the Italo-Turkish War (Oct. 15). Under the command of King Ferdinand, the Bulgarian army dealt' the most rapid and decisive blows to the enemy; victorious on the battlefields of Kirk Kilisse and Lule Burgas, and having conquered most of Macedonia and Thrace, it started on the open road to Constantinople. Europe grew alarmed; the Great Powers brought about the armistice of Dec. 3, 1912, and the London conference, which started on Dec. 13.

These discussions, however, ceased abruptly, and military operations were resumed on Feb. 3, 1913. The Bulgarian armies attacked at Gallipoli and Chatalja, and after a gallant siege entered Adrianople on March 26, 1913. However, the Treaty of London which followed did not sanction these victories, and its decisions instead of inaugurating peace, provoked a war between the Balkan States, which began on June 30, 1913, by a simultaneous attack of the Serbs and Bulgarians. The former allies became bitter rivals, Rumania and Turkey joining Montenegro, Greece and Serbia against Bulgaria, who, finding herself closed in by four enemies at once, was forced after a few weeks of brave but useless resistance, to submit unconditionally to the victors' terms. The Treaty of Bucharest, signed on Aug. 10, 1913, annihilated in one stroke the brilliant results obtained through the heroism of the Bulgarian armies in 1912–3. It deprived Bulgaria of all her conquests including the town of Silistra and part of the Dobruja and gave to the Serbians and Greeks the province of Macedonia for which Bulgaria had made all the sacrifices of the first Balkan War. This treaty was the principal cause of Bulgaria's participation in the World War on the side of Germany. It explains the resentment of King Ferdinand and his government against the other Balkan States. Had the Allied Powers in 1914 guaranteed the revision of the Treaty of Bucharest, Bulgaria would have co-operated with them; but as they failed to do so, Germany was able, by illusory promises, to induce Bulgaria, who felt she had been unjustly treated, to fight for the German cause. These German manoeuvres did not succeed at once, for King Ferdinand began by proclaiming the neutrality of Bulgaria in Nov. 1914.

During May 1915 the Bulgarian Government sounded the four Great Powers, with regard to the fulfilment of Bulgaria's legitimate claims in Macedonia. As no concrete answer was returned, King Ferdinand turned to Germany, where his application was received with great cordiality. Berlin made lavish promises at once. German envoys hurried to Bulgaria, with a view to persuading the King and the Government to conclude a military alliance with Germany. The desire for revenge against Serbia, Greece and Rumania inspired Ferdinand to bind Bulgaria to the Central Powers. On Sept. 21, 1915 he gave the order for general mobilisation, though his Government advised armed neutrality. In view of this equivocal situation Russia sent an ultimatum to Bulgaria on Oct. 4, 1915, which was succeeded by formal declarations of war against Bulgaria on the part of Serbia, France, Great Britain and Italy, Bulgaria was definitely in the German camp; under General Gekoff, commander-in-chief, her armies were victorious on most of the battlefields of Macedonia, Thrace and Rumania, in 1915, 1916 and 1917, against the Serbs, and against the Rumanians. The Kaiser, the king of Saxony and the king of Württemberg all paid official visits to King Ferdinand at Sofia. However, in Sept. 1918, the Bulgarian army, discouraged by innumerable hardships, was defeated at Dobropole, Macedonia, by the Allied troops. This was the sign for a general retreat. An armistice was signed at Salonika on Sept. 30 which ended the war between Bulgaria and the Allies. After this catastrophe King Ferdinand abdicated in favour of his son Boris on Oct. 4. 1918, and left Sofia the same evening for Coburg, Germany. He died there on Sept. 10, 1948. (A. ST.)

FERDINAND I. (1423–1494), also called Don Ferrante, king of Naples, the natural son of Alphonso V. of Aragon and I. of Sicily and Naples, was born in 1423. He succeeded his father on the throne of Naples in 1458, but Pope Calixtus III. declared the line of Aragon extinct and the kingdom a fief of the church. The new pope, Pius II., recognized Ferdinand, but John of Anjou decided to try to regain the throne conquered by his ancestors, and invaded Naples. Ferdinand was severely defeated by the Angevins and the rebels at Sarno in July 1460, but with the help of Alessandro Sforza and of the Albanian chief, Skanderbeg, he re-established (1464) his authority in the kingdom. In 1480 the Turks captured and sacked Otranto, but in the following year it was retaken by Ferdinand's son Alphonso, duke of Calabria. An attempt at revolt on the part of the nobles in 1485 was crushed; many of the nobles, notwithstanding Ferdinand's promise of a general amnesty, were afterwards treacherously murdered at his express command. He died in Jan. 1494.

AUTHORITIES.—*Codice Aragonese,* ed., F. Trinchera (Naples, 1866–74); P. Giannone, *Istoria Civile del Regno di Napoli* (1847); J. Alvini, De *gestis regum Neapol. ab Aragonia* (Naples, 1588); S. de Sismondi, *Histoire des républiques italzennes,* vols. v. and vi. (Brussels, 1838); P. Villari, *Machiavelli,* pp. 60–64 (Eng. transl., 1892); for the revolt of the nobles in 1485 *see* Camillo Porzio, *La Congiura dei Baroni* (first published Rome, 1565; many subsequent editions), written in the Royalist interest.

FERDINAND II. (1469–1496), king of Naples, was the grandson of the preceding, and son of Alphonso II. Alphonso abdicated in his son's favour in 1495, on the approach of Charles

VIII. of France. Ferdinand was unable to defend the city, where there was a strong party hostile to the dynasty. He fled to Ischia; but when the French king left Naples with most of his army, in consequence of the formation of an Italian league against him, he returned and defeated the French garrisons; and the Neapolitans, irritated by the conduct of the French occupation, received him back with enthusiasm. With the aid of the great Spanish general, Gonzalo de Cordova, he drove out the invaders. He died on Sept. 7, 1496.

For authorities *see* under FERDINAND *I.* of Naples; for the exploits of Gonzalo de Cordova *see* H. P. del Pulgar, *Crónica del gran capitano don Gonzalo de Cordoba* (new ed., Madrid, 1834).

FERDINAND IV. (III. of Sicily, and I. of the Two Sicilies) (1751–1825), king of Naples, third son of Don Carlos of Bourbon (afterwards Charles III. of Spain), king of Naples and Sicily, was born in Naples on Jan. 12, 1751. When his father ascended the Spanish throne in 1759, Ferdinand, in accordance with the treaties forbidding the union of the two crowns, succeeded him as king of n'aples, under a regency presided over by the Tuscan Bernardo Tanucci, who neglected the young king's education, and left him to indulge in his liking for low life. Ferdinand's minority ended in 1767, and his first act was the expulsion of the Jesuits. In 1768 he married Maria Carolina, daughter of the empress Maria Theresa. The queen secured the dismissal of Tanucci, and with the help of Sir John Acton (*q.v.*), who eventually became prime minister, sought independence of the Spanish connection and a *rapprochement* with England and Austria. From the day of the execution of her sister Marie Antoinette, the queen lived in terror of revolution and Naples joined the coalition against France in 1793. For the history of Ferdinand's intervention in the revolutionary war, the establishment of the Parthenopean republic at Naples, and the savage reaction after the recapture of Naples by the army of brigands and gaol-birds under Cardinal Ruffo, see NAPLES. KINGDOM OF. Ferdinand had to flee to Sicily in 1806, where he reigned under British protection while Joseph Bonaparte ruled in Naples. Lord Bentinck, the British resident in Sicily, procured the queen's exile to Austria, and Ferdinand allowed his son Francis (afterwards Francis I. of the Two Sicilies) to act as regent in Sicily.

He returned to Naples after the fall of Napoleon, and proclaimed the kingdom of the Two Sicilies. He was now completely subservient to Italy. Ruthless repression of all Liberal opinion favoured the spread of the secret society of the Carbonari (*q.v.*). After the revolt of Gen. Pepe (1820) Ferdinand granted a paper constitution, thus securing the help of his Neapolitan subjects in quelling an insurrection in Sicily. The success of the military revolution in Naples alarmed the Powers of the Holy Alliance. Ferdinand was invited to the congress of Laibach (*q.v.*) to explain the situation. His cynical repudiation at Laibach of the constitution he had granted made conciliation in Naples hopeless. An Austrian army occupied Naples, and Pepe was defeated. The parliament was now dismissed, and Ferdinand inaugurated an era of savage persecution, supported by spies and informers, against the Liberals and Carbonari, the Austrian commandant in vain protesting against the savagery which his presence alone rendered possible.

Ferdinand died on Jan. 4, 1825. Few sovereigns have left behind so odious a memory. His whole career is one long record of perjury, vengeance and meanness, unredeemed by a single generous act, and his wife was a worthy helpmeet and actively co-operated in his tyranny.

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FERDINAND I. (1345–1383), king of Portugal, sometimes referred to as el *Gentil* (the Gentleman), son of Pedro I. of Portugal, was born on Oct. 31, 1345, at Coimbra and succeeded his father in 1367. On the death of Pedro of Castile in 1369, Ferdinand, as great-grandson of Sancho IV. by the female line, became one of the claimants for the throne of Castile (see SPAIN: *History*), thus involving himself in disastrous wars between 1370 and 1382, when peace was made at Badajoz, it being stipulated that Beatrix, the heiress of Ferdinand, should marry King John of Castile, and thus secure the ultimate union of the crowns. Ferdinand left no male issue when he died at Lisbon on Oct. 22, 1383, and the direct Burgundian line, which had been in possession of the throne since Count Henry (about 1112), became extinct.

FERDINAND I. (1865–1927), KING OF RUMANIA, was born Aug. 24, 1865 at Sigmaringen, Prussia, the second son of Prince Leopold of Hohenzollern-Sigmaringen. As Charles I. had no son it was decided that the succession should be continued in the family of Prince Leopold, and Prince Ferdinand, Charles's nephew, became Crown Prince of Rumania and heir presumptive to the Rumanian throne in March, 1889. Prince Ferdinand took a great interest in military questions and organized the Rumanian Army on modern lines. He was commander-in-chief of the Rumanian armies during the Bulgarian campaign of 1913. On Jan. 10, 1893 he married Princess Marie, eldest daughter of the duke of Edinburgh, duke of Saxe-Coburg-Gotha. Six children were born of the marriage.

When Ferdinand ascended the throne on Oct. 11, 1914, he realized that an armed intervention in the cause of Rumania's national unity was unavoidable. A Hohenzollern by birth, he in due course declared war on his native country. As a consequence he was disowned by the Hohenzollern family. When Bucharest was occupied by General Mackensen, King Ferdinand and the Royal family withdrew with the Government and the army into Moldavia. There he endured with the rest of the population a most appalling period of anxiety, sickness and want. The Bolshevist revolution and the collapse of the Russian armies came as a crowning misery. But the Rumanian Army, headed by King Ferdinand, repulsed the German attack at Mărășești, thus saving the rest of the country from invasion. In 1918 the provinces of Bessarabia, Bucowina, Transylvania and the Banat had become united with Rumania, and on Oct. 15, 1922 King Ferdinand was crowned, at Alba Julia, king of all Rumanians.

Two most important reforms, the agrarian reform and the inauguration of universal suffrage, were enacted under Ferdinand's reign. The expropriation of large estates and their conversion into small holdings did much to guarantee the peaceful development of an agricultural country such as Rumania King Ferdinand was the first landlord to hand over his estates to his peasant-soldiers. It was also due to his initiative that the thorny Jewish question was solved by the grant of full civil and military rights to the Rumanian-born Jews. In Dec. 1925 Ferdinand's eldest son, Charles, renounced his claims to the throne, and Charles's son, Michael, became heir apparent. Ferdinand died on July 20, 1927 (see also RUMANIA).

FERDINAND I. (d. 1065), El *Magno* or "the Great," king of Castile, son of Sancho III. of Navarre, was put in possession of Castile in 1028, on the murder of the last count, as the heir of his mother Elvira, daughter of a previous count of Castile. He married Sancha, sister and heiress of Bermudo, king of Leon, and on the latter's death in battle at Tamaron (1038) took possession of Leon by right of his wife. He was recognized in Spain as emperor in 1056. The use of the title was resented by the emperor Henry IV. and by Pope Victor II., as implying a claim to the headship of Christendom, and as a usurpation on the Holy Roman empire. It did not, however, mean more than that Spain was independent of the empire, and that the sovereign of Leon was the chief of the princes of the peninsula. Although Ferdinand had grown in power by a fratricidal strife with Bermudo of Leon, and though in 1054 he defeated and killed his brother Garcia of Navarre at Atapuerca, he was counted a pious king. on account of his victories over the Mohammedans, with which he began the period of the great reconquest. Ferdlnand died on June 24, 1065, in Leon,—having laid aside his crown and royal mantle, dressed in the frock of a monk and lying on a bier, covered with ashes, which was placed before the altar of the church of Saint Isidore He left three sons, Sancho, Alphonso and Garcia, who divided the kingdom until the murder of Sancho and the imprisonment of Garcia, when Alphonso reigned over the uhole as Alphonso VI.

FERDINAND II., king of Leon only (d. 1188), was the second son of Alphonso VII. and of Berenguela, of the house of the counts of Barcelona. On the division of the kingdoms which had obeyed his father (1157), he received Leon, which he ruled for 30 years. During the minority of his nephew Alphonso VIII. of Castile he endeavoured to impose himself on the kingdom as regent On the west he was in more or less constant strife with Portugal, which was in process of becoming an independent kingdom. He extended his dominions southward in Estremadura at the expense of the Moors.

FERDINAND III. (1199–1252), El *Santo,* or "the Saint," king of Castile, son of Alphonso IX. of Leon, and of Berengaria, daughter of Alphonso VIII. of Castile, ranks among the greatest of the Spanish kings. The marriage of his parents, who were second cousins, was dissolved as unlawful by the pope, but the legitimacy of the children was recognized Till 1217 he lived with his father in Leon. In that year the young king of Castile, Henry, was killed by accident. Berengaria renounced the crown in her son's favour. Alphonso of Leon considered himself tricked, and the young king had to begin his reign by a war against his father and a faction of the Castilian nobles. His own ability and the remarkable capacity of his mother proved too much for the king of Leon and his Castilian allies. Ferdinand married Beatrice, daughter of the emperor Philip (of Hohenstaufen), and followed her advice both in prosecuting the war against the Moors and in the steps which she took to secure his peaceful succession to Leon on the death of his father in 1231. After the union of Castile and Leon by law in that year he began the series of campaigns which ended by reducing the Mohammedan dominions in Spain to Granada. Cordova fell in 1236, and Seville in 1248. The king of Granada did homage to Ferdinand, and undertook to attend the cortes when summoned. The king was a severe persecutor of the Albigenses, and his formal canonization by Pope Clement X in 1671 was due as much to his orthodoxy as to his crusading. He revived the university first founded by his grandfather Xlphonso VIII., and placed it at Salamanca. By his second marriage with Joan (d. 1279), daughter of Simon, of Dammartin, count of Ponthieu, by right of his wife Marie, Ferdinand was the father of Eleanor, the uife of Edward I. of England.

FERDINAND IV., EL *Emplazado* or "the Summoned," king of Castile (d. 1312), son of Sancho IV., El Bravo, and his wife Maria de Molina, succeeded to the throne when a boy of six. His minority was a time of anarchy. He owed his escape from the violence of competitors and nobles, partly to the tact and courage of his mother, and partly to the citizens of Avila, who gave him refuge within their walls. He died suddenly in his tent at Jaen when preparing for a raid into the Moorish territory of Granada, on Sept 7, 1312. His only son succeeded him as Alphonso XI.

FERDINAND V. of Castile and Leon, and II. of Aragon ("the Catholic") (1452–1516), was the son of John II. of Aragon by his second marriage with Joanna Henriquez, of the family of the hereditary grand admirals of Castile, and was born at Sos in Aragon on March 10, 1452. His marriage in 1469 to his cousin Isabella of Castile (heiress of Henry IV. of Castile) was dictated by the desire to unite his own claims to the crown with hers. When the king died in 1474 he made an attempt to procure his own proclamation as king without recognition of the rights of his wife. Isabella asserted her claims firmly, and at all times insisted on a voice in the government of Castile. But though Ferdlnand had sought a selfish political advantage at his wife's expense, he was well aware of her ability and high character, and their views in government were identical. The king cared for nothing but dominion and political power, and he played a great part in Europe. His share in establishing the royal authority in all parts of Spain, in expelling the Moors from Granada, in the conquest of Navarre, in forwarding the voyages of Columbus, and in contending with France for the supremacy in Italy, is dealt with elsewhere (*see* SPAIN: *History).* His character explains the most ungracious acts of his life, such as his breach of his promises to Columbus, his distrust of Ximenez and of the Great Captain He feared that Ximenez and the Great Captain would become too independent, and watched them in the interest of the royal authority. He is said to have boasted that he had deceived Louis XII. of France twelve times; it is, in any case, certain that wnen Ferdinand made a treaty, or came to an understanding with any one, the contract was generally found to contain implied meanings favourable to himself which the other contracting party had not expected. The worst of his character was prominently shown after the death of Isabella in 1504. He claimed the regency of Castile in the name of his insane daughter Joanna, without regard to the claims of her husband Philip of Habsburg. The hostility of the Castilian nobles baffled him for a time, but on Philip's death (1506) he reasserted his authority. His second marriage with Germaine of Foix in 1joj had apparently keen contracted in the hope that by securing an heir male he might punish his Hahsburg son-in-law. Aragon did not recognize the right of women to reign, and would have been detached together with Catalonia, Valencia and the Italian states if he had had a son. On this occasion Ferdinand alloued passion to obscure his political sense, and lead him into acts which tended to undo his work of national unification. As king of Aragon he abstained from inroads on the liberties of his subjects which might have provoked rebellion. A few acts of illegal violence are recorded of him—as when he caused a notorious demagogue of Saragossa to be executed without form of trial. His arrangement of the convention of Guadalupe, which ended the fierce Agrarian conflicts of Catalonia, was wise and profitable to the country, though it was probably dictated by a wish to weaken the landowners by taking away their feudal rights. Ferdinand died at Madrigalejo in Estremaclura on Feb 23, 1516.

The lives of the kings of this name before Ferdinand V. are contained in the chronicles, and in the *Anales de Aragon* of Zurita, and the *History of Spazn by* Mariana. Both deal at length with the life of Ferdlnand V.

See W H. Prescott, *History of the Reign of Ferdinand and Isabella* (1887); J. H. Mariéjol, *L'Espagne sous Ferdznand et Isabelle* (Paris, 1892).

FERDINAND VI., king of Spain (1713–1759), second son of Philip V., founder of the Bourbon dynasty, by his first marriage with Maria Luisa of Savoy, was born at Madrid on Sept. 23, 1713, and succeeded his father in 1746. His father's second wife, Elizabeth Farnese, looked upon her stepson as an obstacle to the fortunes of her own children. The hypochondria of his father left Elizabeth mistress of the palace. Ferdinand was married in 1729 to Maria hlagdalena Barbara, daughter of John V. of Portugal. For the events of his reign see SPAIN: *History,* and ENSENADA CENON DE SOMODEVILLA The death of his wife Barbara broke his heart. Betneen the date of her death in 1758 and his own on Aug. 10, 1759, he fell into a state of melancholy bordering on madness.

See William Coxe, *Memoirs of the Kings of Spain of the House of Bourbon,* vol iv. (1815); Count of Fernan Nuñez, *Vida de Carlos III.* ed. Morel Fatio and Don A. Paz y Melia (1898).

FERDINAND VII., king of Spain (1784–1833), eldest son of Charles IV., king of Spain, and of his wife Maria Luisa of Parma, was born at the palace of San Ildefonso near Balsain in the Somosierra hills, on Oct. 14, 1784. On March 17, 1808 he succeeded to the throne by the forced abdication of his father, but was shortly afterwards taken prisoner by Napoleon. He was released in 1814 (see SPAIN: *History*) and returned to find that while Spain was fighting for independence in his name a new world had been born of foreign invasion and domestic revolution. He came back to assert the ancient doctrine that the sovereign authority resided in his person only, and repudiated the impracticable constitution made by the cortes in 1814 without his consent. He proved himself, however, incapable of governing or of choosing reliable advisers, and was influenced by the lowest intriguers. The autocratic powers of the Grand Alliance, though forced to support him as the representative of legitimacy in Spain. watched his proceedings with disgust and alarm. When the inevitable revolt came in 1820 he grovelled to the insurgents as he had done to his parents and was imprisoned by them until 1823 On the invasion by France in that year the revolutionary party carried Ferdinand to Cadiz, and he continued to make promises of amendment till he was free. Then, in violation of his oath to grant an amnesty, he revenged himself for three years of coercion by killing on a scale which revolted his "rescuers" and against which the duke of Angoulême, powerless to interfere. protested by refusing the Spanish decorations offered him for his services. During his declining years Ferdinand's energy abated After his fourth marriage in 1829 with Maria Christina of Naples by whom he had two daughters, he was persuaded by his wife to confirm Charles IV.'s revocation of the Salic Law of Philip V., which gave a preference to all the males of the family in Spain When Ferdinand died at Madrid on Sept. 29, 1833, his daughter Isabella II. was proclaimed queen, and her mother acted as regent.

Ring Ferdinand VII. kept a diary during the troubled years 1820–23, which has been published by the count de Casa Valencia

See D E. de K. Vays, *Historia de la vida y reinado de Ferdinand VII.* 3 vols. (1842) Miñano, *Histoire de la Révolution d'Espagne, 1820–23* (2 vols., 1824); P. Zancada, *El Sentido Social de la revolución de 1820. Revista contemporénea* (1903).

FERDINAND II. (1810–1859), nicknamed King Bomba, king of the Two Sicilies, son of Francis I., was born at Palermo on Jan. 12, 1810. In 1832 he married Cristina, daughter of Victor Emmanuel I., king of Sardinia, and shortly after her death in 1836 he took for a second wife Maria Theresa, daughter of the archduke Charles of Austria. After his Austrian alliance the bonds of despotism were more closely tightened; there were various abortive attempts at insurrection; in 1837 there was a rising in Sicily in consequence of the outbreak of cholera, and in 1843 the Young Italy Society organized a series of isolated outbreaks. The expedition of the Bandiera brothers (*q.v*) in 1844, was followed by cruel sentences on the rebels. In Jan. 1848 a rising in Sicily was the signal for revolutions all over Italy and Europe; it was followed by a movement in Naples, and the king granted a constitution which he swore to observe. Serious disturbances broke out in the streets of Naples on May 15; the king withdrew his promise and dissolved the national parliament on March 13, 1849. He retired to Gaeta to confer with various deposed despots. and the Austrian victory at Novara (March 1849) strengthened his determination to return to a reactionary policy. Sicily was subjugated by General Filangieri, and the chief cities were bombarded. an expedient which won for Ferdinand the epithet of "King Bomba." In 1851 the political prisoners of Naples were calculated by Mr. Gladstone in his letters to Lord Aberdeen (1851) to number 15,000 (probably the real figure was nearer 40,000), and the scandalous reign of terror, and the abominable treatment of the prisoners led France and England to make diplomatic representations to the king, but without success. An attempt was made by a soldier to assassinate Ferdinand in 1856. He died on May 22, 1859, just after the declaration of war by France and Piedmont against Austria, which was to result in the collapse of his kingdom and his dynasty. He was bigoted, cruel, mean, treacherous, though not without a certain bonhomie.

BIBLIOGRAPHY.—See *Correspondence respecting the Affairs of Naples and Sicily, 1848–1849, presented to both Houses of Parliament by Command of Her Majesty*, May 4, 1849; *Two Letters to the Earl of Aberdeen*, by the Right Hon. W. E. Gladstone, 1st ed., 1851 (an edition published in 1852 and the subsequent editions contain an *Examination of the Official Reply of the Neapolitan Government*); N. Nisco, *Ferdinando II. il suo regno* (Naples, 1884); H. Remsen Whitehouse, *The Collapse of the Kingdom of Naples* (1899); R. de Cesare, *La Caduta d' un Regno*, vol. i. (Città di Castello, 1900), which contains a great deal of fresh information, but is badly arranged and not always reliable. *See* also M. Schipa, *Il regno di Napoli al tempo di Carlo di Borbone* (1904).

FERDINAND III. (1769-1824), grand duke of Tuscany, and archduke of Austria, second son of the emperor Leopold II., was born on May 6, 1769. On his father becoming emperor in 1790, he succeeded him as grand duke of Tuscany. Ferdinand was one of the first sovereigns to enter into diplomatic relations with the French republic (1793); and although, a few months later, he was compelled by England and Russia to join the coalition against France, he concluded peace with that power in 1795, and by observing a strict neutrality saved his dominions from invasion by the French, except for a temporary occupation of Livorno, till 1799, when he was compelled to vacate his throne, and a provisional Republican government was established at Florence. Shortly afterwards the French arms suffered severe reverses in Italy, and Ferdinand was restored to his territories; but in 1801, by the peace of Lunéville, Tuscany was converted into the kingdom of Etruria, and he retired to Vienna. He obtained in 1802 the electorship of Salzburg, which he exchanged by the peace of Pressburg in 1805 for that of Würzburg. In 1806 he was admitted as grand duke of Würzburg to the confederation of the Rhine. He was restored to the throne of Tuscany after the abdication of Napoleon in 1814, but had again to vacate his capital for a short time in 181j, when Murat proclaimed war against Austria. After Waterloo he remained in undisturbed possession of his grand duchy. The restoration in Tuscany was not accompanied by the reactionary excesses which characterized it elsewhere, and a large part of the French legislation was retained. His prime minister was Count V. Fossombroni (*q.v.*). The mild rule of Ferdinand, his solicitude for the welfare of his subjects, his enlightened patronage of art and science, his encouragement of commerce, and his toleration render him an honourable exception to the generality of Italian princes of his time. He died in June 1824, and was succeeded by his son Leopold II. (*q.v.*).

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FERDINAND, duke of Brunswick (1721–1792), Prussian general field marshal, was the fourth son of Ferdinand Albert, duke of Brunswick, and was born at Wolfenbüttel on Jan. 12. 1721. In his twentieth year he was made chief of a newly-raised Brunswick regiment in the Pruscian service. He was present in the battles of Mollwitz and Chotusitz. In succession to Margrave Wilhelm of Brandenburg, killed at Prague (1744), Ferdinand received the command of Frederick the Great's Leibgarde battalion, and distinguished himself at Sohr (1745). During the ten years' peace he was in the closest touch with the military work of Frederick the Great, who sought to make the guards battalion a model of the whole Prussian army. Ferdinand became one of the king's most intimate friends. In the first campaign of the Seven Years' War Ferdinand commanded one of the Prussian columns which converged upon Dresden, and in the operations which led up to the surrender of the Saxon army at Pirna (1756), and at the battle of Lobositz. he led the right wing of the Prussian infantry. In 1757 he distinguished himself at Prague, and he served also in the campaign of Rossbach. Shortly after this he was appointed to command the allied forces which were being organized for the war in western Germany. He found this army dejected by a reverse and a capitulation, yet within a week of his taking up the command he assumed the offensive, and thus began the career of victory which made his European reputation as a soldier. His conduct-of the five campaigns which followed (see SEVEN YEARS' WAR) was naturally influenced by the teachings of Frederick, whose pupil the duke had been for so many years. Ferdinand, indeed, approximated more closely to Frederick in his method of making war than any other general of the time. Yet his task was in many respects far more difficult than that of the king. Frederick was the absolute master of his own homogeneous army, Ferdinand merely the commander of a group of contingents, and answerable to several princes for the troops placed under his control. In 1758 he fought and won the battle of Crefeld, several marches beyond the Rhine, but so advanced a position he could not well maintain, and he fell back to the

Lippe. He resumed a bold offensive in 1759, only to be repulsed at Bergen (near Frankfort-on-Main). On Aug. 1 of this year Ferdinand won the brilliant victory of Minden (*q.v.*). Vellinghausen, Wilhelmsthal, Warburg and other victories followed, and Frederick, hard pressed in the eastern theatre of war, owed much of his success in an almost hopeless task to the continued pressure exerted by Ferdinand in the west. He was promoted field marshal in November 1758.

Ferdinand exerted himself to compensate those who had suffered by the Seven Years' War, devoting to this purpose most of the small income he received from his various offices and the rewards given to him by the allied princes. The estrangement of Frederick and Ferdinand in 1766 led to the duke's retirement from Prussian service, but there was no open breach between the old friends, and Ferdinand visited the king in 1772, 1777, 1779 and 1782. After 1766 he passed the remainder of his life at his castle of Veschelde, where he became a patron of learning and art, and a great benefactor of the poor. He died on July 3, 1792.

See Von Westphalen, *Geschichte der Feldzüge des Herzogs Ferdinands von Braunschweig-Lüneburg* (5 vols., Berlin, 1859–1872); also authorities for SEVEN YEARS' WAR.

FERENTINO, a town and episcopal see of Italy, province of Frosinone (anc. *Ferentinum*, to be distinguished from Ferentum or Ferentinum in Etruria), 48 m. E.S.E. by rail from it. Pop. (1951) 7,522. It is picturesquely situated on a hill 1,290 ft. above sea-level, and still possesses considerable remains of ancient fortifications. The lower portion of the outer walls is built of roughly hewn blocks of limestone; above this in places is walling of rectangular blocks of tufa.

Two gates, the Porta Sanguinaria (with an arch with tufa voussoirs), and the Porta S. Maria, a double gate constructed entirely of rectangular blocks of tufa, are preserved. Outside this gate is the tomb of A. Quinctilius Priscus, a citizen of Ferentinum, with a long inscription cut in the rock.

The acropolis has massive retaining walls similar to those of the lower town. At the eastern corner, under the present episcopal palace, a projecting rectangular terrace is supported by walls of quadrilateral blocks of limestone arranged almost horizontally; while upon the level thus formed a building of rectangular blocks of local travertine was raised. A projecting cornice bears two inscriptions of the period of Sulla, recording its construction by two censors (local officials); and in the interior there is an inscription of the same censors over one of the doors, and another over a smaller external side door. The windows lighting these chambers come immediately above the cornice, and the wall continues above them again. The whole of this construction probably belongs to one period. The cathedral occupies a part of the level top of the ancient acropolis; it was reconstructed on the site of an older church in 1099–1118; the interior was restored to its original form in 1902. It contains a fine canopy in the "Cosmatesque" style. The Gothic church of S. Maria Maggiore, in the lower town (13th–14th century), has a very fine exterior. The Romans captured Ferentinum, the chief city of the Hernici, in 364 B.C. It took no part in the rising of 306 B.C. The inhabitants became Roman citizens after 195 B.C. It lay just above the Via Latina and, being a strong place, served for the detention of hostages. Horace praises its quietness, and it does not appear much in later history. (T. A.)

FERENTUM or FERENTIS, an ancient town of Etruria, about 6 mi. N. of Viterbo and $3\frac{1}{2}$ mi. E. of the Via Cassia. It was the birthplace (A.D. 32) of the emperor Salvius Otho, was destroyed in the 11th century, and is now entirely deserted. It occupied a ridge running from east to west, with deep ravines on three sides. There are some remains of the city walls, and of various Roman structures, including some baths, of which the most important is the theatre. The stage front is still standing; it is pierced by seven openings with flat arches. It has recently been well restored, and fitted for use for theatrical representation. The necropolis was on the hill called Talone on the north-east. A tomb of the Republican period with several sarcophagi of the gens Salvia, no doubt ancestors of the emperor Otho, has been found there.

FERGHANA (FERGANA), (1) A range of mountains in Asiatic Russia, branching off about lat. 41° N. and long. 75° E. from the Tien-Shan range, rising to altitudes of 13,000 ft. or more.

(2) The name given to the rich and fertile valley lying south of this range and north of the Alai mountains, and opening out toward the southwest. The climate is dry and warm, with an average temperature of 68° F. in March, rising rapidly to 95° through June, July and August. Snow and frost occur in December and January, when the temperature may fall to −4° F. No rain falls during the five months following April. and the valley owes its fertility to irrigation from the rivers Naryn and Kara-darya, which unite near Namangan to form the Syr-darya or Jaxartes river. On the right bank of the Syr-darya, from Namangan to Khojent, are vast expanses of barren shifting river sand, a menace to the fertile, irrigated areas, upon which they encroach under the influence of the southwest wind. The crops include cotton, wheat, millet. maize and rice. Fruits, especially apricots. are widely cultivated and there are numerous vineyards. Other industries include silkworm breeding, manufacturing, and food- and textile-processing industries. The extension of the Transcaspian railway into Ferghana (1899), and the opening of the Orenburg–Tashkent railway (1906) gave a great impetus to trade and helped to develop the cotton growing industry. In northern Ferghana a rubber-producing euphorbia and other medicinal and aromatic herbs are found. The Ferghana valley has had an eventful history; its fertility has always proved attractive and the Khojent pass made it vulnerable to invaders. It was overrun by Arabs in A.D. 719. In the 9th and 10th centuries it was ruled by the Persian Samanid dynasty. while in the 12th century, it became subject to Kara-Kitai, the fore-runner of Jenghiz Khan, who later conquered it. Tamerlane conquered it later on. In 1513 the Uzbeks expelled Baber, the last descendant of Tamerlane, and until about 1770 the separate cities and clans had each its own Bek. or ruler. From that time until its conquest by Russia. it was ruled by the Khans of Khokand. In 1876 it became part of a much larger unit called Ferghana, which was created as a province of Russian Turkistan, with New Marghelan (Ferghana) as its administrative centre. After the fall of the tsarist regime. the valley became part of the Uzbek S.S.R.. though for a time it was an independent Soviet province. *See* UZBEKISTAN.

(3) A town formerly known as New Marghelan or Skobelev (after the Russian general M. D. Skobelev *q.v.*). It is the administrative centre of an *Oblast* of the same name, in the Uzbek S.S.R., in lat. 40° 32' N. long. 71° 48' E.. in the south central Ferghana valley. It was built by the Russians, after their conquest of the Khanate of Khokand, ten miles southeast of the old town of Marghelan, and became the administrative centre for the Ferghana province of the former Russian Turkistan. A branch line links it with the Khokand-Andijan railway. Pop. (1959) 80.000.

FERGUSON, ADAM (1723–1816), Scottish man of letters respected as a philosopher. as a historian and as a patriot, was born the son of a Presbyterian minister at Logierait in Perthshire on June 20, 1723, and educated at St. Andrews university. Appointed deputy chaplain to the Black Watch regiment in 1745, he charged sword in hand with it at Fontenoy. Abandoning the clerical profession, he succeeded his friend David Hume as advocates' librarian at Edinburgh (1757) and eventually became professor at Edinburgh, first of natural philosophy (1759), then of mental and moral philosophy (1764). He interrupted his professorial work in 1774, when he went to Europe to supervise the young earl of Chesterfield, and in 1778. when he went to Philadelphia with a commission sent to negotiate with the Americans. Resigning his chair in 1785, he spent a few months in Germany and Italy in 1793. but thereafter lived in retirement till his death. at St. Andrews, on Feb. 22, 1816. Walter Scott composed his epitaph.

Ferguson's works include *The Morality of Stage Plays Seriously Considered* (1757), an anonymous pamphlet in defense of his friend John Home's *Douglas*; *The History of the Proceedings in the Case of Margaret, Commonly Called Peg, Only Lawful Sister of John Bull, Esq.* (1761), remonstrating for the establishment of a Scottish militia: *Essay on the History of Civil Society* (1767; 7th ed. 1814), largely inspired by Montesquieu; *Institutes of*

Moral Philosophy (1769); *Remarks* (1776) on Richard Price's *Observations on . . . Civil Liberty*, in which Ferguson proposed peace terms for the Americans; *History of the Progress and Termination of the Roman Republic*, 3 vol. (1783; new ed.. 5 vol., 1813); and *Principles of Moral and Political Science*, 2 vol. (1792).

FERGUSON, ROBERT (*c.* 1637–1714), British conspirator and pamphleteer, called the "Plotter," was a son of William Ferguson (d. 1699) of Badifurrow, Aberdeenshire. He became vicar of Godmersham, Kent, from which living he was expelled by the Act of Uniformity in 1662. In 1680 he wrote "A letter to a Person of Honour concerning the 'Black Box,' " in which he supported the claim of the duke of Monmouth to the crown against that of the duke of York; he also claimed the authorship of the pamphlet "No Protestant Plot" (1681), parts of which are usually ascribed to Shaftesbury. Ferguson was deeply implicated in the Rye House plot, and fled to Holland with Shaftesbury in 1682, returning to England early in 1683. For his share in another plot against Charles II he was outlawed. Ferguson took a leading part in organizing Monniouth's rising of 1685. He drew up the manifesto against James II, escaping to Holland after the battle of Sedgemoor. He landed in England with William of Orange in 1688, and received a sinecure appointment in the excise. Ferguson was soon in correspondence with the exiled Jacobites. He shared in all the plots against the life of William, but although he was several times arrested on suspicion, he was never brought to trial. He died in great poverty in 1714, leaving behind him a great and deserved reputation for treachery. It has been suggested that Ferguson was a spy. and that his frequent escapes from justice were due to official connivance.

See James Ferguson, *Robert Ferguson, the Plotter* (Edinburgh, 1887), which gives a favourable account of Ferpuson.

FERGUSON, SIR SAMUEL (1810–1886), Irish poet and antiquary, who was well known for such contributions to *Blackwood's Magazine* as "The Forging of the Anchor." a fine ballad, and the humorous prose extravaganza of "Father Tom and the Pope." He was born in Belfast and educated at Trinity college, Dublin, was called to the Irish bar in 1838 and was made Q.C. in 1859, but in 1867 retired from practice upon his appointment as deputy keeper of the lrish records. He was knighted in 1878. He published *Lays of the Western Gael* in 1865, *Poems* in 1880 and in 1872 *Congal,* an attempt to revivify the heroic age of Ireland in an epic poem. He died at Howth on Aug. 9, 1886. His most important antiquarian work, *Ogham Inscriptions in Ireland, Wales, and Scotland*, was published in 1887.

FERGUSSON, ROBERT (1750–1774), Scottish poet, one of the leading figures of the 18th-century revival of Scots vernacular Writing, and the chief forerunner of Robert Burns, was born in Edinburgh on Sept. 5, 1750. He was educated at Dundee grammar school and at St. Andrew's university, and became a copying clerk in a lawyer's office in Edinburgh. In 1771 he began to contribute poems to Ruddiman's *Weekly Magazine*. He was a member of the Cape club. which met at a tavern in Craig's Close) and was noted for the vivacity of temperament that is reflected in his verse. From 1773, however, his good spirits were encroached upon by fits of depression and religious guilt, and after being severely injured in the head by a fall he became insane, and died in the Edinburgh Bedlam on Oct. 1;, 1774.

Fergusson's poems were popular from their first appearance, and a collected volume came out in 1773. He wrote in both Scots and English, but the English verse has little value. His Scots poems, racy, realistic, wittily descriptive and humorous, had a stimulating effect on Burns, whose "Holy Fair" and "Cotter's Saturday Night" stein from Fergusson's "Leith Races" and "The Farmer's Ingle"; but vigorous poems like "The Daft-Days." "To the Tron-Kirk Bell" and the famous "Auld Reikie" prove how well Fergusson can stand as a poet in his own right.

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FERINGHI or FERINGHEE, an Asiatic term for a European originally used in a purely geographical sense (Arabic and Persian, *Farangi,* "Frank") but now generally carrying a hostile significance. The combatants on either side during the Indian mutiny called each other Feringhis and Pandies.

FERISHTAH (FIRISHTA), **MOHAMMED KASIM** (c. 1560–*c.* 1620), Indo-Persian historiographer. was the author of the famous *Tarikh-i-Firishta* ("Ferishtah's History"), an account of the Moslems in India from the 10th century. When captain of the guard to Murtaza Nizam Shah, ruler of Ahmadnagar (1565–1588), Ferishtah conceived the idea of writing a history of Indo-Moslem rulers and saints and he fulfilled his intention when he compiled the *Tarikh-i-Fiuishta* under the patronage of Ibrahim 'Adil Shah, ruler of Bijapur, whose service he entered in 1589. With the passage of time the *Tarikh-i-Firishta* has gradually lost its status as an authority for Indo-Moslem history before Ferishtah's own day, especially since independent copies of the Indo-Persian histories, on which it was based, have become available and historical criticism has developed. It is, however, a valuable source for the history of the Moslem Deccan where he served and a remarkable example of the Indo-Moslem genius for historical writing. (P. H.)

FERMANAGH, a county of Northern Ireland, bounded on the northeast by County Tyrone and west, south and east by the frontier of the Irish republic. Area, including water, 71j sq.mi. or 6j3 sq.mi. excluding water. Pop. (1951) 53,044. The county lies chiefly in the basin of the Erne river which divides it into two nearly equal sections. The surface is hilly and, especially round Lough Erne, picturesque. Upper and Lower Lough Erne stretch from southeast to northwest. These lakes are expansions of the Erne river. which enters the county from Cavan. flows through Upper Lough Erne. past Enniskillen and through Lower Lough Erne on its way to the Atlantic. At Belleek it forms a considerable waterfall and is notable there for good salmon fishing. Trout are taken in most of the loughs, and pike of great size in both Upper and Lower Lough Erne.

The southwest boundary of the county, which is also the frontier of Northern Ireland. takes in a small portion of Lough Melvin and of Lough Macnean Upper and most of Lough Macnean Lower. An area of high ground lies between Lower Lough Erne and Lough Macnean Upper, including Belmore mountain (1.316 ft.). On the southern frontier of Fermanagh there are hills of greater height. including Cuilcagh (2,188 ft.) and Tiltinbane (1,881 ft.).

The county includes in the north an area of gneiss extending from Donegal and an area of metamorphic rock extending from Tyrone. A fault divides the latter from the Old Red Sandstone which spreads south. Limestone forms fine scarps on the southern side of Lower Lough Erne. The scenery about Lough Macnean Upper and Lower rises in siniilarly scarped hills to the summit of Cuilcagh. The Marble Arch cave near Belcoo, with its emerging river, is a characteristic subterranean waterway in the limestone. Higher Carboniferous strata form highlands on both sides of Lower Lough Erne. As well as Marble Arch there are other caves, including those at Boho near Enniskillen and at Knockmore near Derrygonnelly. The fact that Fermanagh is a predominantly limestone county makes it hard to obtain water supplies in some areas in spite of its containing the lake district of Ulster.

There is evidence of prehistoric occupation, there being "horned cairns" at Aghanaglack (Giant's Grave) and Ballyreagh, as well as stone cairns. Fermanagh became in historic times the country of the Maguires. There are many monuments of early Celtic Christianity, particularly on islands in the loughs. On Devenish Island, Lower Lough Erne, is the site of an ancient abbey, and substantial ruins there date from the 6th century, with a round tower standing 81 ft. high and a standing cross. On White Island and Innismacsaint are other ecclesiastical antiquities. There are ancient carvings in Killadeas graveyard, north of Enniskillen.

The county was included in the scheme for the plantation of Ulster in the reign of James I. At Newtownbutler in 1689, the Enniskillen men severely defeated a superior army of James II and began the victorious tradition of the "Inniskillings," now represented in the British army by the Royal Inniskilling Fusiliers. Enniskillen (pop.: 1951, 6,322), strategically situated between

Upper and Lower Lough Erne, has long been the county town. It was once the site of a Maguire stronghold.

Ferrnanagh is chiefly a pastoral and agricultural county, but there are industries in a number of towns. At Enniskillen, nylon stockings and clothing are manufactured; pottery is made at Belleek and cotton thread at Lisnaskea.

As a result of agreement between the governments of Ireland and of Northern Ireland, the hydroelectric capacities of the Erne were being developed in the mid-1950s for use by consumers on both sides of the frontier.

Fermanagh sends three members to the Northern Ireland parliament and unites with South Tyrone to send one member to the United Kingdom parliament. (HU. S.)

FERMAT, PIERRE DE (1601?–1665), French mathematician, was the greatest number theorist between Diophantus and Leonhard Euler. He is reported to have been born at Beaumont-de-Lomagne on Aug. 17, 1601, and he died at Castres on Jan. 12, 1665; but his age at death is given on his tombstone as 57.

For Fermat, a punctilious counselor of the parliament of Toulouse and a lover of classical learning, mathematics was but an avocation. About the year 1629 he made, but did not publish. the remarkable discovery that an equation $f(x,y) = 0$ represents a curve in the xy-plane—the fundamental principle of analytic geometry, which first appeared in print in 1637 in the *Géométrie* of Descartes. At this time he also showed that relative maxima and minima of $f(x)$ are found from $\frac{f(x+h)-f(x)}{h}=0$ by allowing h to vanish. This is equivalent to the modern equation $f'(x)=0$, and Fermat has been acclaimed as the inventor of the differential calculus. (*See* CALCULUS, DIFFERENTIAL AND INTEGRAL: *History.*) By 1636 he had used this device to find tangents as limits of secants, a procedure that led Newton to the method of fluxions. Fermat also noted that the area under the curve $y = x^n$ from $x = 0$ to $x = a$ is $\frac{a^{n+1}}{n+1}$, but he failed to remark the fundamental inversion theorem relating areas and tangencies.

From correspondence. in 1654, between Fermat and B. Pascal the theory of probability largely arose (though developed earlier by G. Cardano, *q.v.*); and Fermat was one of several mathematicians who independently disclosed (1659) the rectification of an algebraic curve, $ay^2 = x^3$. But it was in the theory of numbers that the genius of Fermat was most apparent, and here two theorems bear his name: (1) the "lesser Fermat theorem," that if p is prime, then $a^p - a$ is divisible by p; and (2) "Fermat's last theorem," that no positive integers x,y,z satisfy $x^n+y^n = z^n$, where n is an integer greater than two. The "lesser theorem," first given in a letter of 1640, was proved by Leibniz before 1683 and a proof was published by Euler in 1738; the "last theorem" remains a celebrated unsolved problem (see FERMAT'S LAST THEOREM). For some of his theorems Fermat gave demonstrations by his method of "infinite descent"; but one conjecture—that $2^2 +1$ is prime if n is a positive integer—was shown to be false when Euler found $2^{2^3}+1$ to be composite.

Fermat was the greatest mathematician of his day, but his influence was circumscribed by a reluctance to publish. The two volumes of his *Opera mathematica*, edited by his son, appeared belatedly in 1670–79. The definitive edition of his work is the *Oeuvres* (4 vol. and supp., 1891–1922) ed. by Paul Tannery and Charles Henry. *See* also L'Abbé Genty, *L'Influence de Fermat sur son siècle* (1784); E. Brassine, *Précis des oeuvres mathématiques de Pierre Fermat* (1853); E. T. Bell, *Men of Mathematics* (1937). (C. B. BR.)

FERMAT'S LAST THEOREM, a statement which is famous in the history of mathematics, namely that there do not exist integers x, y and z, none of which being zero, which satisfy

$$x^n+y^n=z^n \qquad (1)$$

n being a given integer >2. It was first given by Pierre de Fermat who wrote, about the year 1637, upon the margin of his copy of the works of Diophantus, "I have discovered a truly remarkable proof which this margin is too small to contain." He did not publish his proof, however, and no complete demonstration has been discovered.

The theorem was proved by Fermat for $n=4$ and, in the year 1770 by Leonhard Euler for $n=3$. The latter proof was incomplete at one point, but the missing steps were supplied by later writers.

To prove it in general, it is then not difficult to see that it is sufficient to demonstrate the impossibility of

$$x^l+y^l+z^l=0 \qquad (2)$$

in nonzero integers x, y and z for any odd prime $l>3$. This was proved by Adrien M. Legendre in 1823 for $l=5$, and later by Henri L. Lebesgue for I= 7. These proofs excited great interest among the mathematicians of the time and many efforts were made to extend them to other values of I, a number of them resulting in errors. For example. the celebrated mathematicians Gabriel Lamé and Augustin L. Cauchy published many results concerning (2) which were based on assumptions later proved false. The discussion and study of these mistakes led to the formulation, by Ernst E. Kummer, of one of the most powerful and fruitful concepts which has ever been introduced into mathematics; *i.e.,* the notion of ideal numbers. By means of this idea Kummer was able to prove (in 1850) that (2) is impossible in integers 2, y and z, none zero, for all primes l for which none of the numerators of the Bernoulli numbers (*q.v.*) B„ $a=1, 2, \ldots, (l-3)/2$, is divisible by I, where $B_1=1/6$, $B_2=1/30$, etc. Primes 1 of this character are called regular. By extensive numerical computations he found that the only primes less than 100 which are not regular are 37, 59 and 67, and in a later article published in 1874 he obtained results from which it may be inferred that the only primes which are not regular between the limits 100 and 166 are 101, 103, 131, 149 and 157. In the year 1857 Kummer published another memoir in which he concluded after a long and complicated procedure that (2) is impossible under three assumptions concerning the nature of the algebraic field defined by ζ where $\zeta=e^{2i\pi/l}$. He finds, again by the use of extensive numerical computations, that these three assumptions are satisfied for $l=37$, 59 and 67, and hence that (2) is impossible for all primes $1<100$.

Using, in the main, extensions of methods due to Kummer, Harry S. Vandiver, in the year 1929, obtained a number of conditions that must hold in case the relation (2) is satisfied. These conditions were applied by several of his collaborators, principally M. M. Abernathy, Derrick H. Lehmer and M. E. Tittle, who carried out the necessary computations and found that (2) is impossible for all primes $l<619$. These results were contained in several papers published by Vandiver between 1929 and 1939.

For the statement of later results the discussion is divided into two cases. If in (2), x, y and z are prime to each other and to 1, this condition will be referred to as case I of Fermat's last theorem; if x, y and z are prime to each other and one of them is divisible by I, the condition will be called case II of the theorem. All further statements in this article concerning (2) will refer to case I only unless otherwise noted, and only those criteria which do not involve in their enunciation the theory of algebraic numbers will be mentioned.

Legendre published in 1823 the following theorem due to Germain: If there exists an odd prime p such that the congruence

$$u^l+v^l+w^l\equiv 0 \pmod{p} \qquad (3)$$

has no set of integral solutions u, v and w, each not divisible by p, and such that l is not the residue of the lth power of any integer modulo p, then (2) has no solutions x, y and z, each prime to l. By means of this result, Sophie Germain proved that (2) is impossible in case I for all primes $l<100$.

In 1857, Kummer proved that certain congruences had to hold in order that (2) be satisfied. D. Mirimanoff in the year 1905 showed that these congruences could be reduced to the following form:

$$B, \ f_i\ (t)\equiv 0 \pmod{l}$$
$$n=(l-i)/2;$$

where the B's are the Bernoulli numbers as before:

$$i=3, 5, \dots, l-2; \quad -t=x/y, y/x, x/z, z/x, y/z, z/y;$$

$$f_i(t)=\sum_{k=1}^{l-1} k^{i-1}\, t^k \qquad (4)$$

He also added the criterion

$$f_{l-1}(t) \equiv 0 \pmod{l} \qquad (4a)$$

for the solution of (2) in case I. The criteria (4) and (4a) are generally referred to as the Kummer criteria.

In 1908 Leonard E. Dickson, using Germain's theorem, proved that (2) is impossible in case I for all primes $l<7{,}000$. A. Wieferich, in 1909, by the use of (4) and (4a) proved that, if (2) is possible in case I, then $2^{l-1}\equiv 1 \pmod{l^2}$, and in 1910, Mirimanoff obtained on the same assumption, $3^{l-1}\equiv 1 \pmod{l^2}$. The criterion, $5^{l-1}\equiv 1 \pmod{l^2}$, was derived by Vandiver in 1912 for case I. P. Furtwangler, in 1912, proved that, if (2) is satisfied in case I and r is a factor of x or of $x^2-y^2\equiv 0 \pmod{l}$, then $r^{l-1}\equiv 1 \pmod{l^2}$. This result includes those of Wieferich and Mirimanoff just referred to. In the year 1925, N. G. W. H. Beeger found that the only primes $l<14{,}000$ for which $2^{l-1}\equiv 1 \pmod{l^2}$ are $l=1{,}093$ and $l=3{,}511$, the case $l=1{,}093$ having been previously noted by Meissner. Using these results with those of Dickson, he concludes that (2) is impossible in integers x, y and z prime to l, for all primes $l<14{,}000$. He later extended this limit to 16,000. Vandiver obtained, in 1926, the theorem that if there exists an odd prime $p=1+ml$, such that $m<10l$ and

$$u^l+v^l+w^l\equiv 0 \pmod{p}$$

has no set of integral solutions u, v, w, each not divisible by p, then (2) has no solution in case I. He also proved (1925) that if (2) is satisfied in case I, then

$$f_i(t)\, f_{l-i}(1-t)\equiv 0 \pmod{l}$$

F. Pollaczek, using the Kummer criteria, proved, in 1917, that if (2) is satisfied in case I then

$$m^{p-1}\equiv 1 \pmod{p^2}$$

holds for $m\leqq 31$ except for a finite number of primes p. T. Morishima removed the exception in this statement in 1931. B. Rosser in 1939–41 pushed the limit to $m\leqq 43$ and interpreting these results by means of a new analytic method, showed that (2) does not hold for any $l<41{,}000{,}000$ in case I. Derrick H. and Emma Lehmer carried this result to $l<253{,}747{,}889$.

Based mainly on an idea due to Howard H. Mitchell, Vandiver proved, in 1944, that if c is a given even integer not divisible by 3 and it is possible to define two primes l and p such that $p=1+cl$; $l>c$; and $p>3^{\varphi(c)}$; then (2) is impossible in integers with x, y and z prime to l. Here $\varphi(c)$ is the number of positive integers $<c$ and prime to it.

As may be inferred from the above account, little has been discovered concerning case II of the theorem. Some mathematicians think that (2) may be satisfied when one of the integers x, y or z is divisible by l.

In case I, however, everything indicates that Fermat's Last Theorem is true, although it has not been proved. That it has not been proved for this case is one of the most amazing facts in mathematics; and for this reason alone, the great celebrity of the theorem is perhaps justified. Also the many attempts to solve it by competent mathematicians have led to a number of remarkable developments in number theory, including very abstract conceptions and profound results, arrived at only after long chains of reasoning.

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(H. S. V.)

FERMENTATION. In industrial practice the word fermentation refers to processes by which raw materials (usually agricultural products such as grain, or industrial by-products such as molasses) are transformed by the controlled action of carefully selected strains of microorganisms (fungi, yeasts or bacteria) into definite products. Fermentation, in this connection, denotes the key operation in manufacturing processes which, by virtue of their increasing importance and specialized techniques, can fairly claim consideration as a separate branch of applied science. Louis Pasteur used the term in a narrower sense to describe changes brought about by microorganisms growing in the absence of air. In the modern biochemical laboratory, general terms such as "fermentation" tend to be replaced by a scientific terminology describing the individual enzymes or associated groups of them (see ENZYMES).

The great advances in understanding of living organisms achieved by the century-old sciences of bacteriology and biochemistry have created the newer fermentation industries. Side by side with these exist the old-established industries of brewing, wine making, tobacco curing and so on, from which science increasingly eliminates the factor of chance, if not that of art. It is recorded that when Michael Combrune, in 1762, wished to control the temperature at which grain was mashed, he was forced to hide his thermometer from his father, who objected to experimental innovations. On the other hand, among the first specialized technical journals to appear were those devoted to brewing; while many fundamental biochemical discoveries have come from laboratories supported by the industry. (See also BREWING.)

Early History of Fermentation.—Fermentations involving (as is now known) one of the many strains of yeast—*e.g.*, brewing of beer, wine making, raising of dough in breadmaking—were practised long before the beginning of recorded history. The word fermentation itself (Lat. fervere, "to boil") is a reminder of a time when chemical knowledge was so meagre that the bubbling and foaming of fermenting liquors could only be compared with boiling. That this appearance was due to the evolution of a gas (carbon dioxide) could not, of course, be understood until the existence of gases was recognized in the 17th century. Alcohol, which had been prepared long before, was the first pure organic compound known, and the process of distillation by which it was obtained from wine played an important role in the development of chemistry. Acetic acid (vinegar, *q.v.*), made by the souring of wine (a fermentation process dependent on the action of the bacterium Acetobacter), was the first acid to be made. From early times it was widely used, not only in preparing food but also in medicine and industrial arts, such as the manufacture of lead pigments.

When yeast (*q.v.*) grows in sugary solutions in the virtual absence of air, most of the sugar is converted into alcohol and carbon dioxide. Only a fraction is used by the yeast to build up new cell material. It was therefore possible, without great error, to disregard the part played by the yeast and to study the over-all change by purely chemical methods. This was done notably by Antoine Lavoisier who, after establishing that organic compounds contain carbon, hydrogen and oxygen, applied his new technique of analysis to the products of alcoholic fermentation. His figures showed that the alcohol and carbon dioxide formed equaled, in total weight and in amount of carbon, oxygen and hydrogen, the sugar consumed. Fermentation therefore obeyed the law of the conservation of matter as did more conventional chemical reactions. The sugar, he considered, split into two parts, one of which oxidized the other to carbon dioxide and was itself reduced to alcohol. Ironically, Lavoisier's analytical figures (*e.g.*, for the composition of sugar) were grossly in error, though his conclusions were nearly correct, as shown by J. L. Gay-Lussac (1810) who summarized the process of fermentation by the equation

$$\underset{\text{sugar}}{C_6H_{12}O_6} \longrightarrow \underset{\text{carbon dioxide}}{2CO_2} + \underset{\text{alcohol}}{2C_2H_6O}$$

Fermentation was thus to be considered as a chemical reaction. Yeast, which was not even classified as a definite substance (let alone an organism with remarkable powers of chemical synthesis and degradation), was thought to play a physical rather than a chemical part, an idea dating back to the time of Georg Stahl

(1697). The molecular vibrations of decomposing complex organic matter, it was held, could initiate the chemical reaction of fermentation in much the same way as a spark could cause the combination of hydrogen and oxygen. This attitude gained powerful reinforcement as new examples came to light of catalysis (*q.v.*), the name given to the action of certain substances of diverse character—*e.g.*, finely divided metals, acids and bases—which were found to accelerate the rate of a chemical reaction without themselves being materially altered. In 1817 it was found possible to oxidize a mixture of alcohol vapour and air to acetic acid by catalysis, using platinum as the catalyst. This apparently duplicated the action of the acetic acid ferment upon wine.

Moreover, about this time complex organic catalysts (then called ferments, now enzymes) began to be prepared from plants and from animal tissues and secretions: the starting material admittedly living, the enzyme preparations themselves equally obviously not. Among these were some which played a role in alcoholic fermentation. Yeast will not ferment starch, the molecule of which is made up of a large number of units of the simple sugar glucose linked together, because the large molecule cannot pass through the cell wall of yeast. Malt (sprouted barley) contains enzymes that split starch to the sugar maltose, made up of only two glucose units. which is fermentable. The conversion occurs during the mashing process of brewing. The agent responsible for this process, diastase (now known to be a mixture of enzymes), was prepared in 1833 by A. Payen and J. F. Persoz. Later, in 1860, P. E. M. Berthelot was to prepare from yeast itself the enzyme invertase, that splits sucrose (ordinary domestic sugar) into the simple sugars glucose and fructose.

Could not yeast, then, be simply considered as a catalyst? This is so close to the modern position as to make one wonder, at first, at the bitterness and fury with which the controversy over the mechanism of fermentation was conducted in the last half of the 19th century. It is now considered that the complex chemical changes of life are brought about by enzymes, each highly specialized in its catalytic action and responsible for one small step in such apparently simple reactions as the transformation of sugar to alcohol. However, enzymes themselves are produced only by living organisms, and if these marvelously active and specialized catalysts are to be used in a controlled way, it is the organism that must first be controlled. It was in insisting upon the importance, the primacy. of the living organism that Pasteur was right and his opponents wrong.

Pasteur: Fermentation as *La vie sans air* ("Life Without Air").—Establishing fermentation as a vital activity was not an exercise in experimental skill and logic; it was a triumph of the human spirit. And the 50-year-long fight to prove that it was the activity of a living organism was to lead to the germ theory of disease with its immeasurable consequences. Patient experimentation and intuition, rational argument and rhetoric, personal, national and professional pride. sheer chance. all played their part. Evidence of the living nature of yeast existed before Pasteur commenced work on the problem (1855). In 1837–38 three publications appeared, by C. Cagniard de la Tour, T. Schwann and F. Kiitzing respectively. all of whom as a result of microscopic observations concluded that yeast was a living organism that reproduced by budding. Schwann gave to it the name *Zuckerpilz* ("sugar fungus," whence comes the generic name *Saccharomyces* applied to types of yeast commonly used in baking and brewing) and explained alcoholic fermentation as "the decomposition brought about by this sugar fungus removing from the sugar and a nitrogenous substance the materials necessary for its growth and nourishment."

These views immediately aroused savage resentment and bitter scorn. Scientific innovators, for example Galileo, have often had to meet attacks from entrenched interests outside science; this time the attack came from organized science itself. with J. J. Berzelius. F. Wöhler, J. von Liebig (*qq.v.*) and other leaders of the chemical norld in the van. It is worthwhile to consider why this should have been so. For science, the 19th century was a period of transition. Shortly before its outset. Lavoisier had gone to the guillotine: "the Republic has no need of scientists." At its close, science had become the fount of industrial power, the scientist no longer an eccentric amateur but a dignified professional. Karl Marx's famous remark "the philosophers have only interpreted the world in various ways: the point, however, is to change it" would have found an echo in the hearts of many men of science of the time. Organic chemistry, in particular, had discarded the idea that substances of natural origin had anything essentially mysterious about them and was becoming established as the chemistry of carbon compounds. To reintroduce any concept which smacked of vitalism must have appeared as a dangerous and retrograde step.

In the succeeding 20 years the recognition of yeast as a living organism became more widespread, but its exact function in alcoholic fermentation remained a matter of controversy. It was still maintained that fermentation was due to catalytic action at the surface of the yeast cell, or to the transmission of molecular vibration from decomposing organic matter arising from the death of the cells. Nevertheless, when Pasteur was asked to investigate the difficulties a manufacturer was having with his fermentation process, he was already predisposed to take up a biological point of view. This was not apparently due to the publications of Cagniard de la Tour and others, but arose from his own researches in a purely chemical field.

In studying the optical activity of organic ccmpounds, which he correctly related to their molecular asymmetry, Pasteur had become convinced that optically active substances could not be synthesized by chemical methods. This is actually not the case, since the optical inactivity of synthetic products is sometimes due to their being mixtures of two forms of equal and opposite rotation. Nevertheless, his assertion that molecular asymmetry was correlated with life is, broadly speaking, correct. In alcoholic fermentation a certain amount of an optically active amyl alcohol was known to be produced. and this appeared to Pasteur to be possible only through some vital process.

In 1857 Pasteur showed that the malfunctioning of the fermentation process he was investigating was due to a new "ferment"—a minute organism which converted sugar into lactic acid. At this time there was no suspicion that lactic acid fermentation. for example of milk, involved anything other than a chemical change. Pasteur went on to study alcoholic fermentation itself and completely disproved the views of Liebig. His crucial experiment was to produce yeast by growing it in a liquid medium containing simple substances of known composition, sugar, ammonium tartrate and inorganic salts. Fermentation paralleled multiplication of the yeast. In this experiment he was to some extent fortunate for, as was shown later, yeast will not grow in such a simple medium from a very small seeding if the materials have been carefully purified, a finding which was to lead to the discovery that yeast and many other microorganisms require traces of vitamins for growth, as do higher forms of life. In a famous passage in *Études sur la bière* (1876), Pasteur was to summarize fermentation as *la vie sans air.* An abundant supply of air was found to suppress alcohol formation by yeast. Under such conditions, however, the organism grew more rapidly and was able to incorporate into its cell substance a far greater proportion of the sugar which had been transformed, a discovery which forms the basis of the modern pressed-yeast industry.

Buchner: Cell-Free Fermentation.—Fermentation was now established as a chemical change that occurred inside the cells of microorganisms, which were then called organized ferments, to distinguish them from unorganized ferments, of which diastase of malt had provided an early example. A relation between the two types of ferment was suspected by many. and in 1858 M. Traube had put forward the theory that all fermentations were due to ferments, definite chemical substances he regarded as related to the proteins and produced in the cells of the organism. Confusion between the two sorts of ferment was later to lead W. Kiihne to give the name enzymes to the substances then known as "unformed ferments."

Many investigators, including Pasteur, made unsuccessful attempts to liberate the fermentation enzyme from yeast. Success was not to come until 1897, and then almost fortuitously. Four years before, H. and E. Buchner had found that the cells of micro-organisms were disrupted when they were ground with sand. After yeast had been treated in this way, a yellow viscous liquid, free from cells, could be squeezed out with a hydraulic press. This was not intended for use in experiments on fermentation, but for pharmaceutical studies. As it kept badly, antiseptics were added; these proved unsuitable as the juice was being used in experiments with animals. Sugar was then tried as a preservative. The changes which occurred were recognized as fermentative — a feat of scientific imagination — by E. Buchner, who named the fermentation enzyme of yeast zymase. Zymase, it nas observed. differed in some respects from invertase, an enzyme from yeast known since 1860. It was less stable to heat. and catalyzed a reaction of greater complexity. That Buchner succeeded where so many others had failed seems to have been due partly to his fortunate choice of yeast, only a few types of which are suitable.

The Complexity of Zymase. — The complexity of alcoholic fermentation by living yeast was almost an article of faith with Pasteur, and in consequence it was realized from the outset that the production of alcohol and carbon dioxide from sugar by yeast juice probably occurred in a stepwise fashion, and that zymase was merely a convenient term for a mixture of an unknown number of enzymes. Cnraveling the whole story was to take nearly 40 years.

Three general methods were used in the attack on the zymase problem: (1) Suspected intermediates were added to yeast juice to see if they could be fermented. (2) The fermentation system was altered, either by removing some essential factor (such as a coenzyme, see below) or by interfering with certain steps by the addition of selective poisons (now called enzyme inhibitors). and the nature of the products of the modified process investigated. The use of inhibitors may be understood by considering a complex of enzymes which first convert a substance A to B then B to C and so on. If the conversion of B to C is interfered with. then B will accumulate instead of the usual end product and this increase in the concentration of B enormously facilitates its isolation and identification. (3) Individual enzymes themselves were separated from zymase and purified, and the intermediate reactions studied in isolation.

Of these methods, the second proved initially the most powerful. The first method often had value merely as confirmation, since it proved difficult. from a knowledge of synthetic organic chemistry. to predict the nature of the chemical intermediates involved in biochemical transformations. The third method, in essence the most decisive: had to wait until the technical problems of enzyme purification were solved. Enzymes, it must be realized. are chemically so complex that they can even now only be recognized by their action and not by chemical analysis. In the early days of enzymology chemists had no means of knowing how pure their preparations were. The unrecognized enormous potency of enzymes often led them to underestimate the degree of impurity of their preparation; in consequence, there was considerable controversy about the chemical nature of enzymes. The problem was further bedeviled by the fact that invertase, with which much early work was done, was in many ways atypical in its chemical properties. Finally, in 1926, J. B. Sumner succeeded in preparing an enzyme (from jack bean) in crystalline form, a cogent argument for its purity, and showed it to be a protein. This enzyme, urease. was extremely active and decomposed its own weight of urea in just over one second. It is now generally accepted that enzymes are proteins, and techniques for their isolation are well established. Many of those concerned in fermentation have been crystallized. Some are even available, in small quantities, commercially. One fermentation enzyme has found application in forensic medicine to estimate alcohol in the blood of motorists suspected of drunkenness.

Zymase itself in a sense constitutes an altered enzyme system. As shown by Sir A. Harden and W. J. Young in 1905, fermentation by yeast juice proceeds rapidly only when salts of phosphoric acid are added. For each molecule of sugar split to alcohol, one is esterified to form a sugar phosphate, fructose diphosphate, called the "Harden-Young ester." (In the living cell, other reactions outside the fermentation system reform free phosphate and prevent the accumulation of sugar phosphates.) Harden and Young made another fundamental advance when they found that the fermentative action of yeast juice depended not only upon enzymes, which have large complex molecules, but also upon a simpler substance which could be separated by ultrafiltration and which was to be classified as a coenzyme. (Coenzymes are agents not themselves enzymes, but necessary for the action of enzymes.)

At first the role of phosphorylation in the initial steps of the fermentation process gave rise to much controversy. Meanwhile a clue as to the nature of one of the later steps was provided by C. Neuberg's discovery (1911) of carboxylase in yeast and yeast juice. This enzyme splits pyruvic acid (*q.v.*) into acetaldehyde and 'carbon dioxide, and is now known to be responsible for the evolution of gas in alcoholic fermentation. A further important advance was made by G. Embden three years later, when he showed that fructose diphosphate was transformed to lactic acid by enzymes present in muscle preparations. It soon became evident that the characteristic fermentation process of animal tissue, glycolysis, the splitting of sugar into two molecules of lactic acid, showed striking similarities to alcoholic fermentation. From this time on, the nature of the intermediate steps in sugar breakdown was worked out sometimes with one system, sometimes with the other. The differences between the fermentation systems of different types of organism, which Pasteur found so striking, are less impressive than the similarities, when these systems have been analyzed into their component enzyme-catalyzed steps.

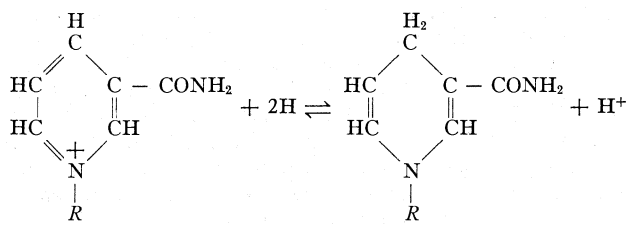
The Modern Position. — By 1939, as a result of the work of Embden. O. Meyerhof and others. knowledge of the intermediate steps in alcoholic fermentation and glycolysis was complete. In the course of its breakdown. the sugar molecule goes through about a dozen intermediate stages. The same number of enzymes, each highly specialized in the catalysis of a single step, is involved. As forecast by Lavoisier, Schwann and others, an oxidation-reduction process occurs, hydrogen being taken from one of the intermediates in an early step and transferred to one of the later intermediates. This is not a direct process. Hydrogen is first transferred to a carrier substance (diphosphopyridine nucleotide or cozymase), which is an example of a coenzyme (the one discovered by Harden and Young).. Another carrier molecule, or coenzyme. is involved in phosphate transfer. These coenzymes may be likened to the conveyer belts linking the machines (enzymes) in a factory assembly line. They are not so specialized as are the enzymes themselves, and they interact with many different enzymes concerned with processes other than fermentation. In so doing, they provide one means by which fermentation is integrated into the life of the cell as a whole.

In the 1930s cozymase was shown to contain nicotinamide, shortly afterward found to be the vitamin whose deficiency in human beings induces pellagra. Another fermentation coenzyme (cocarboxylase. concerned in the splitting of the intermediate pyruvic acid) was found to be related to thiamine: also a B group vitamin. This elucidation of the biochemical function of vitamins exemplifies the repercussions, in all fields of biochemical research, of the nork on fermentation.

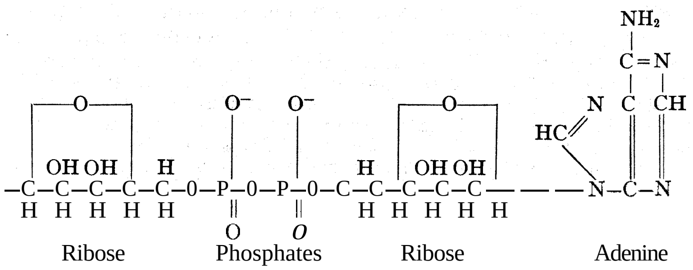
Diphosphopyridine nucleotide, the hydrogen-transferring coenzyme, has a complicated structure. It may be degraded chemically into a number of less complex substances, so that the coenzyme may be represented in terms of these units as

nicotinamide — ribose — phosphate — phosphate — ribose — adenine

Oxidation and reduction during fermentation affect only the nicotinamide part of the molecule, as shown by the equation:



Here R stands for the remainder of the molecule, namely:



The phosphate-transferring coenzyme; adenosine triphosphate, has the structure

adenine—ribose—phosphate—phosphate—phosphate

and the biochemical reaction of transfer involves only the terminal phosphate grouping. The function of the complex nonactive part of these molecules is to ensure that the coenzymes combine with the appropriate enzyme, with the active groups of atoms correctly positioned. It is generally found that biologically active molecules contain only a small "active centre." the remainder of the molecule conferring specificity in much the same way as the wards of a key adapt it to open one lock, or at most only a few. Different "keys" are constructed from simple units, such as adenine and other purine bases, sugars such as ribose, or amino acids, and the arrangement as well as the nature of these units determines the specificity of the biologically important molecule.

Yeast will ferment any one of three simple sugars: glucose, fructose and mannose. They differ only slightly in the arrangement of atoms in the molecule and can be converted one to the other by the action of dilute alkalies. The first step in fermentation is the addition to the sugar molecule of a phosphate group (transferred from a coenzyme). The three sugar monophosphates are interconvertible by enzymes which thus reproduce the catalytic action of alkali on the free sugars. From the trio of monophosphates one, fructose monophosphate, is selected for further transformation. A second phosphate group is accepted from the coenzyme to give fructose diphosphate. This molecule is split into halves. each retaining one phosphate group. The two substances so formed also belong to the class of (phosphorylated) sugars known as trioses. since the molecule contains only three carbon atoms; sugars such as glucose are termed hexoses, as their molecules have six carbon atoms. The two triose phosphates differ in the structure of their molecules in the same way as glucose monophosphate differs from fructose monophosphate, and are likewise interconvertible by a specialized enzyme. The action of the splitting enzyme, in reverse. can be imitated in the chemical laboratory; the free triose sugars can be made to combine to give fructose. by the catalytic action of alkalies.

In the next stage, the key to the whole process, one of the triose phosphates is oxidized, hydrogen being transferred to the carrier cozymase. The product remains attached to the enzyme, however, until a molecule of free inorganic phosphate (not phosphate bound to the phosphate-transferring coenzyme) is encountered, when the final step occurs by which phosphate is incorporated to form an intermediate containing two phosphate groups per molecule (diphosphoglyceric acid). This then undergoes, several intramolecular rearrangements, each catalyzed by its specific enzyme. The two phosphate groups are split off and bound to the phosphate-transferring coenzyme, and eventually pyruvic acid is formed. The net result is

$$\left\{\begin{array}{l}\text{glucose} \longrightarrow 2 \text{ pyruvic acid}\\ 2 \text{ cozymase} \longrightarrow 2 \text{ reduced cozymase}\\ 2 \text{ phosphoric acid} \longrightarrow \text{bound to coenzyme}\end{array}\right.$$

This series of enzyme reactions is common to sugar transformation in muscle and yeast. as well as some bacteria and plants. It is only the subsequent fate of the pyruvic acid that is different. In muscle, hydrogen is taken from reduced cozymase (which is thus restored to its original form) to give lactic acid. In yeast, pyruvate is first split to carbon dioxide and acetaldehyde; the latter accepts hydrogen to form alcohol. (Alcohol, however, is not formed when the yeast cell is abundantly supplied with air; in this case another complex system of enzymes converts pyruvic acid to carbon dioxide and water).

Especially as a result of studies of the bacterium Pseudomonas *fluorescens*, it has been realized that modifications of this scheme of carbohydrate breakdown occur in different organisms. In the one mentioned, glucose is first oxidized to gluconic acid. The similarities are. however, still more striking than the differences.

In the living yeast cell, the enzymes of the zymase system are enclosed within a membrane through which the phosphorylated intermediates cannot diffuse; as, normally, the cells occupy only a small proportion of the total volume, very little of the total sugar fermented is at any time present in the form of these intermediates. For this reason they escaped detection until the Buchners succeeded in liberating the enzyme complex from the cell.

The importance of phosphate, in its various forms, is clear from this summary of the chemical changes of alcoholic fermentation. In seeking further understanding of this point, it is necessary to refer to one of the most fruitful concepts of modern biochemistry, that combined phosphate is the form in which energy released by the degradation of the sugar molecule is preserved and subsequently transferred to all parts of the living cell. This energy is available for chemical synthesis, as in growth. In muscle it is converted to mechanical work, or it may appear in other forms, for example light, as in fireflies and luminescent bacteria, such as those responsible for the phosphorescent glow of rotting fish. The complexity of the fermentation process therefore becomes understandable if it is remembered that' its function is to enable the yeast cell to grow, *i.e.*, to synthesize new cell material. Zymase may be likened to an oil refinery producing both fuel oil (phosphorylated coenzyme) and raw materials for chemical processing (the intermediates of fermentation). The growth process of the yeast cell finds a counterpart in the manufacturer specializing, for example. in plastics production who requires a particular raw material and also oil to drive his machines. Also, he may require raw materials from other sources. in the same way as the yeast cell requires ammonium salts, for example, before it can construct protein molecules.

When yeast grows in the absence of air, part of the sugar transformed is incorporated as new cell substance, but a far greater part is excreted as alcohol. This apparent waste may be a means of rendering the sugar unavailable to other organisms and therefore valuable to the survival of the species. In air, more phosphorylated coenzyme is formed by enzymes outside the fermentation system and a greater proportion of the sugar can be used in building cell material.

Modern research on the biochemistry of fermentation falls into three broad classes: (1) the enzymes and reactions described are being studied in an increasing variety of organisms; (2) the individual enzymes are being examined in fine detail, in an effort to understand catalysis in terms of the molecular forces involved; (3) enzymes and their action are being investigated in situ in the living cell.

Industrial Fermentation Processes.—These start with the selection of a suitable microorganism. Each main type (*e.g.*, yeast or lactic acid bacteria) exists in a bewildering number of strains, and selection of the best one is of key importance. Fermentation conditions such as acidity, air supply and concentration of nutrients must be carefully adjusted in the light of the result aimed at.

Products may be of many types. In some cases. a major part of the raw material (usually sugar in some form) is transformed into the desired product. Examples are: alcohol. glycerol, carbon dioxide (marketed as dry ice) from yeast fermentations; butyl alcohol and acetone, lactic acid. acetic acid from fermentation by one or another type of bacterium; citric acid, gluconic acid from mold fermentations. Fermentation alcohol and acetone are being partially displaced by cheaper synthetic products. A notable product of bacterial fermentation is dextran. a gummy material. The bacteria responsible for this are well-known troublemakers in sugar refineries, but the product of their action under controlled conditions finds occasional application as a blood extender, to replace blood plasma transfusions.

A later development is the manufacture by fermentation of amino acids. an advantage over chemical synthesis being that only one of two possible optically active forms is produced. Japanese scientists devised a bacterial fermentation process to make L-glutamic acid. a widely used flavouring agent. L-lysine, a substance of great importance in human and animal nutrition, is manufactured in the U.S. The fermentation process is ingenious, in that it uses a mutant strain of a coliform organism; *i* e., an organism "created" in the laboratory by the action of ultra-violet radiation on the natural strain. This mutant is incapable of making the lysine it needs for its own growth and has to be supplied with this amino acid before it can be cultivated. But in exchange it forms in the course of fermentation a much greater amount of a precursor substance. which is then converted into lysine itself in a second stage of the process.

Other substances are produced in relatively small amount, so that their extraction and purification are more complicated. Predominant among these are the various antibiotics. These are made by mold fermentation, as are the antianemia factor vitamin B_{12} and the vitamin riboflavin. Antibiotics. and vitamin B_{12}. find increasing use outside medicine as supplements to poultry and animal foodstuffs.

In the manufacture of baker's yeast the organism itself is .the desired product. Enzymes extracted irom various microorganisms. usually in rather crude form. are also valuable. Invertase, from yeast, is used to prevent the crystalization of sugar in the manufacture of soft-centred chocolates. In the textile industry. bacterial and fungal amylases find application in removing starch sizing from cloth. Among other enzymes. an interesting one is glucose oxidase, used to destroy glucose which otherwise would cause browning and deterioration of dried eggs. Yeast fermentation has been employed as an adjunct to synthetic methods in pharmaceutical manufacture. Here what is sought is not a product of the fermentation itself, but a change (usually reduction) of some chemical added to the fermentation. Benzaldehyde in this way yields a product which can be further converted, by purely chemical methods, to ephedrine. Phytochemical reduction is also being applied in the synthesis of steroids related to cortisone. These methods have the advantage of producing only one of two possible optically active forms, an interesting echo of Pasteur's insistence on the connection between molecular asymmetry and life. See also BIOCHEMISTRY: *Glycolysis and Fermentation.*

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FERMI, ENRICO (1901–1954), Italian-U.S. physicist. Nobel prize winner (1938) for research on artificial radioactive substances. directed the first controlled nuclear chain reaction (*see* ATOMIC ENERGY: *Achievement of a Chain Reaction*) at The University of Chicago, Dec. 2, 1942. and was first winner of the special award, which now bears his name, of $50.000 for work on the atom. Born in Rome, Sept. 29, 1901. he received a doctorate irom the University oi Pisa in 1922. He was lecturer at the University of Florence, 1924–26, and professor of theoretical physics at the University oi Rome, 1927–38. In 1934 Fermi demonstrated that nuclear transformation occurs in nearly every element subjected to neutron bombardment (*see* NEUTRON). To escape Mussolini's iascist decrees, Fermi went to the U.S., where he became professor of physics at Columbia university in 1939; he was later associated with The University oi Chicago and Los Alamos, N.M., atomic energy research programs. In 1945 he became a U.S. citizen and was appointed proiessor in the Institute ior Nuclear Studies of The University of Chicago, where he remained until his death on Nov. 28, 1954.

See Laura Fermi, *Atoms in the Family—My Life With Enrico Fermi* (1954).

FERMIUM. The synthetic element fermium has the chemical symbol Fm and the atomic number 100. It occupies a position in the periodic system of the elements as the 11th member of a rare-earthlike transition series. the actinide series. which includes the heaviest known elements and in which an inner electronic shell (the 5f shell) is being filled. The eighth transuranium element to be discovered. it was first identified by A. Ghiorso and coworkers. For a discussion of its discovery, see TRANSURANIUM ELEMENTS.

As in the case of a number of the other actinide elements, there is no completely logical assignment of atomic weight because the isotopic composition is variable, depending on the source. If there is a formal requirement for this quantity the use of the mass number of the longest-lived isotope might be considered. Since the longest-lived fermium isotope known in the early 1960s was Fm^{253}. it seemed unlikely that this element could be isolated in weighable amount. Its chemical properties have been studied on a tracer scale. and in aqueous solution only the III oxidation state appears to exist. Most of the chemical studies have been concerned with the determination of its ion exchange properties.

Isotopes of Fermium

Isotope	Half life	Type* and energy of radiation (Mev)	Isotope	Half life	Type* and energy of radiation (Mev)
$Fm^{248, 249}$	short	a	Fm^{253}	4.5 days	EC, a 6.94
Fm^{250}	—0.5 hr.	a 7.43	Fm^{254}	3.24 hr.	α 7.20
Fm^{251}	7 hr.	EC a (1%) 6.89	Fm^{255}	22 hr.	a 7.1
Fm^{252}	23 hr.	α 7.04	Fm^{256}	3 hr.	SF

*EC = electron capture; a = alpha particle; SF = spontaneous fission.

Fermium can be separated from the other tripositive actinide elements by adsorption and elution from columns packed with ion exchange resins. Separation from the rare-earth elements can be effected by the use of eluting agents such as concentrated hydrochloric acid, which forms complex ions with the actinide elements which are much more stable than the corresponding ions formed with the rare-earth elements. Since fermium is the 11th member of the actinide transition series it seemed probable that the chemistry of the tripositive ion would be similar to that of the corresponding ions of other members of the series.

The isotope Fm^{254} and heavier fermium isotopes can be produced by intense neutron bombardment of elements of lower atomic number. such as plutonium, by a process of successive neutron capture reactions interspersed with beta particle decays until atomic number 100 and these mass numbers are attained.

See J. J. Katz and G. T. Seaborg, *The Chemistry of the Actinide Elements* (1957); G. T. Seaborg, *The Transuranium Elements* (1958). (G. T. SG.)

FERMO, a town and archiepiscopal see of the Marches, Italy (anc. Firmum Picenum), province of Ascoli Piceno, on a hill 1.046 ft. above sea level. Pop. (1957 est.) 28.267 (commune). The summit of the hill was occupied by the citadel until 1446. It is crowned by the cathedral. reconstructed in 1227. Against the side of the hill was built the Roman theatre; scanty traces of an amphitheatre also exist. Remains of the city wall may be seen.

The church of S. Francesco has a tower and choir in brickwork of 1240. Under the Dominican monastery is a large Roman reservoir in two stories. The piazza contains the Palazzo Comunale, restored in 1446, with a statue of Pope Sixtus V in front. Porto S. Giorgio has a fine castle of 1269, blocking the valley which leads to Fermo.

The ancient Firmum Picenum was founded as a Latin colony in 264 B.C., after the conquest of the Picenes, as the local headquarters of the Roman power, to which it remained faithful. It was originally governed by five quaestors. It was made a colony with full rights after the battle of Philippi, the 4th legion being settled there. It lay at the junction of roads to Pausulae, Urbs Salvia and Asculum, being connected with the coast road by a short branch road from Castellum Firmanum (Porto S. Giorgio). In the 10th century it became the capital of the Marchia Firmana. In 1199 it became a free city and remained independent until 1550, when it became subject to the papacy

FERN, a name often used to denote the whole botanical class of Pteridophyta, including both the true ferns, Filicales, by far the largest group of this class in the existing flora, and the fern allies, Equisetales, Lycopodiales, etc. *(see* BRYOPHYTA; PTERIDOPHYTA).

FERNALD, MERRITT LYNDON (1873–1950), U.S. botanist noted for his publications in plant systematics and plant geography. was born in Orono, Me., Oct. j, 1873. Fernald published works extending over a 60-year period beginning with his first published paper in 1890. He was educated and spent his entire professional career at Harvard university, ultimately becoming (191j) Fisher professor of natural history and director of the Gray herbarium (1937). He was the recognized authority on the vegetation of eastern North America and propounded the so-called nunatak hypothesis to explain the persistence of plants through the ice age in areas largely covered by glaciers. His principal books are. the 7th edition of *Gray's Manual of Botany;* (with Benjamin L Robinson), (1908); *Persistence of Plants in L'nglaciated Areas of Boreal America* (1925); and *Edible Wild Plants of Eastern North America* (aith Alfred C. Rinsey) (1943); 8th (centennial) edition of Gray's *Manual of Botany* (1950). (R. C. R.)

FERNANDES, ÁLVARO (fl. 15th cent.), the most successful Portuguese captain of the earlier 1jth century, was sent southward by Prince Henry the Navigator to explore the west African coast. Most of the Portuguese made little progress beyond Arguin, and were only concerned uith slave raiding. When Prince Henry's expedition of 1445 sailed for Arguin, Fernandes was entrusted by his uncle, Gonçalves Zarco, discoverer of Madeira, with a caravel, under injunctions to devote himself to discovery. After visiting the mouth of the Senegal and rounding Cape Verde he continued to the "Cape of the Masts," 50 leagues beyond Cape Verde. In 1446 he returned to west Africa and coasted on to a bay 110 leagues beyond Cape Verde, little short of Sierra Leone. This was the farthest reached by Portuguese exploration during Prince Henry's lifetime and was not surpassed until 1462. A wound from a poisoned arrow compelled Fernandes to return to Portugal. He made no further effort to explore the African coast, as Prince Henry was content to establish trade in slaves, ivory and gold dust with Guinea (the region of the Senegal and Gambia). (A. Ds.)

FERNANDES, JOÃO (fl. 1446), Portuguese traveler who stayed seven months with the nomads of Rio de Oro, played an important part in Portuguese expansion in Africa. In 1445 he went with a Portuguese trading ship to the Río de Oro, at a latitude of about 23° N. An elderly Moorish trader wished to go back in the ship to investigate trade possibilities in Portugal; and Fernandes, then a young squire, volunteered to stay with the Moorish family as hostage, having already learned Arabic when a captive in Morocco before this date. Jews, French and Italians had earlier accompanied trade caravans into the Sahara. and Fernandes was nelcomed by the nomads with their customary hospitality. The nomads had horses and lived by herding sheep, having to move every eight days in search of fresh pasture. They lived mainly on milk, mutton and dates, while grain from Morocco was exchanged for slaves and gold dust from the Sudan. They were Moslem but did not speak Arabic. Fernandes was taken south across the desert to visit an old patriarch who from time to time went to the Sudan to trade for slaves and gold dust. He found that the nomads got their slaves from Negro kings who raided other tribes. Fernandes re-embarked at about 19° N. and was able to give Prince Henry the Navigator detailed information of the western Sahara and the trade with Guinea. Until then the Portuguese had raided the coasts for slaves as far south as the Senegal, but this roused hostility, and the Negroes repelled Portuguese attacks with poisoned arrows. From 1448 Prince Henry stopped slave raiding and made exchange treaties with Moorish and Negro chiefs, a vastly more profitable policy that made further exploration along the coast unnecessary. In 1446 and 1447 Fernandes again visited Río de Oro to arrange trade agreements.

See Gomez Eannes de Azurara, *Chronica . . . de Guiné.* (A. Ds.)

FERNÁNDEZ, GREGORIO: *see* HERNÁNDEZ, GREGORIO.

FERNÁNDEZ, JUAN (1536?–1604?), a navigator in the service of Spain, in 1563 made a celebrated voyage from Callao to Chile which won him the title of *brujo* ("wizard"). By sailing out to the westward he avoided the southerly offshore winds and reached Valparaiso in only 30 days. He discovered the islands San Félix and San Ambrosio in 1574 (according to Sarmiento de Gamboa and Leonardo de Argensola); and at an uncertain date (probably sometime between 1563 and 1574) discovered the group of islands which bear his name, establishing a settlement there which included goats. On the failure of this settlement (1580) he resumed his work as a pilot and died in about 1604. The tradition that he had discovered the southern continent in latitude 40° S., to the west of Chile, originated in a memorial by Juan Luis Arias, written after 1614.

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FERNÁNDEZ, LUCAS (1474?–1542), Spanish dramatist and musician, whose plays are notable for their effective dialogue. simple humour and skillful use of interpolated songs and music. was born and educated at Salamanca. He was professor of music there from 1522. His six plays (1514) show clearly the influence of Encina *(q.v.)*, his rival as a musician. His most impressive work is the *Auto de la Pasión,* the others being short homely Christmas pieces and comic shepherd plays. His *Diálogo para cantar* (1514) is a shepherd duologue set to a popular tune and is the first example of a rudimentary zarzuela (a Spanish form of musical comedy). (J. Gs.)

FERNÁNDEZ NAVARRETE, JUAN (c. 1526–1579). Spanish painter of the Spanish Mannerist school, called EL MUDO (because he was mute), was born in Logroño. He is said by José de Sigiienza *(Historia de la Orden de San Jerónimo,* 1605) to have studied in Italy under Titian and others and to have been summoned back to Spain by Philip II. In 1568 he was appointed painter to the king. who chose him to play a major role in the decoration of the Escorial. near Madrid (1576), though he did not live to fulfill it; of the 32 altarpieces commissioned for the church only 8 were completed at the time of his death in Toledo on March 28, 1579.

El Mudo's eclectic style was based on that of the Italian Mannerists working in the Escorial; and he was strongly influenced by Titian, though there is no evidence that he was his pupil. In the "Burial of St. Lawrence" (Escorial), unfinished at his death, naturalism and chiaroscuro foreshadow later developments of the Spanish school. (E. Hs.; X.)

FERNANDO DE NORONHA, a Brazilian island in the South Atlantic ocean located some 225 mi. N.E. of Cape São Roque. The main island is 7 mi. long by $1\frac{1}{2}$ mi. wide. A neighbouring island has an area of $3\frac{1}{2}$ sq.mi., and there are several rocky islets. The islands are of volcanic origin and have steep, unprotected shore lines. The highest peak on the main island rises 1,089 ft. above sea level. The temperatures are always mild because of the island's latitude 3° 49' S. of the equator and its exposure to the full sweep of the southeast trade winds. The temperature ranges from an average of 78.8° F. in March to 75.2° in August. The rainy season is from February to June. During the long dry season there is often a serious shortage of water, although the average annual rainfall is 42.6 in. The population, (1950) 648, fluctuates considerably because most of the inhabitants are in the military garrison. The population in 1940 was 1,065. In the 18th century it was a penal colony, and some prisoners are still sent to the island.

The island was given to Fernando de Noronha, its discoverer, in 1504. Later it became a dependency of Pernambuco. In the 17th and 18th centuries it was attacked several times by naval powers, but the Portuguese successfully defended it. In 1942 the island was made a federal territory. Of little importance economically, its main products are salt and guano. However, Fernando de Noronha has considerable strategic importance because of its position off the bulge of Brazil. The island lies in the 5,500-mi. rocket-firing corridor between Cape Canaveral, Fla., and Ascension Island. An agreement was concluded on Jan. 21, 1957, between the U.S. and Brazil whereby a guided-missile tracking station was established under a five-year concession. (P. E. J.)

FERNANDO PO (or Poo), a Spanish island lying some 20 mi. off the Cameroon coast of west Africa. It is fi9 sq.mi. in area, volcanic and precipitous, but more fertile than most of west Africa. With the island of Annobón it constitutes an African province of Spain. *See* SPANISH GUINEA. (R. J. H. C.)

FERNDALE, a city of Oakland county, in southeastern Michigan, U.S., is one of Detroit's northern suburbs, about 2 mi. N. of Highland Park (*q.v.*). The Eight Mile road forms its southern boundary and the Ten Mile road its northern. Ferndale became a village in 1918. The increase in Ford car production along with the war industries of World War I brought many people to the area. The open farm lands in the north Woodward area provided homesites for these workers. It was incorporated as a village in 1919 and during the 1920s the area built up rapidly. In 1927 Ferndale was incorporated as a city. A council-manager form of government has been in effect since 1924. Ferndale is both residential and industrial. For comparative population figures *see* table in MICHIGAN: *Population.* (F. E. LE.)

FEROZEPUR (FIROZPUR), a municipal town, *tehsil* and district in the Punjab state. India. The town is about 4 mi. from the Sutlej. Population (1951) 40.703 (excluding the cantonment area with a population of 38,784).

British rule was first established at Ferozepur in 1835, when, on the failure of heirs to the Sikh family who possessed it, a small territory 86 mi. in extent became an escheat to the British government; the district was gradually formed around this nucleus. The strategic importance of Ferozepur was at that time very great: and when. in 1839, Capt. (afterward Sir) Henry Lawrence took charge of the station as political officer. it was the outpost of British India in the direction of the Sikh power. Ferozepur accordingly became the scene of operations during the first Sikh War. The Sikhs crossed the Sutlej in Dec. 1845 and were defeated successively at Mudki. Ferozeshah. Aliwal and Sobraon, after which they withdrew into their own territory, and peace was concluded at Lahore.

Ferozepur rapidly advanced in material prosperity to become a seat of commerce, trade being mainly in grain. It is the site of three colleges affiliated to the Panjab (India) university. Ferozepur *tehsil* (pop., 1951, 255,342) covers an area of 680 sq.mi.

FEROZEPUR DISTRICT comprises an area of 4,107 sq.mi. and had in 1961 a population of 1,620,389. The surface is level, with the exception of a few sand hills in the south and southeast. The country consists of two distinct tracts, that liable to annual fertilizing inundations from the Sutlej, and the upland tract. The only river is the Sutlej, which runs along the northwestern boundary. The principal crops are wheat, barley, millet, gram, pulses, oilseeds, cotton. tobacco, etc. The other important towns and seats of commerce are Moga (pop., 1951, 36,598), Fazilka (25,-934). Abohar (25.476) and Muktsar (22,097). The district is watered by the Sirhind canal and by canals from the Sutlej, the Bikaner. the Eastern and the Dipalpur canals.

FERRABOSCO or FERABOSCO, the name of a family of musicians of Italian origin who settled in England in the 16th century. The father, DOMENICO MARIA (1513–1574), was choirmaster at Bologna and at the Basilica Vaticana, Rome, and then a singer in the papal chapel. He wrote madrigals and motets.

His son ALFONSO (d. 1588), madrigalist, settled in England before 1567, when he received a pension from the queen and became intimate with William Byrd. He returned to Italy in later life and died at Turin. His madrigals were printed at Venice in 1587. He was highly esteemed in England, and Henry Peacham, in his *Compleat Gentleman,* says that "in judgment and depth of skill he was inferior unto none." Many of his madrigals and motets found their way into English collections, such as Yonge's *Musica Transalpina,* Leighton's *Teares or Lamentations.*

His son ALFONSO (d. 1628), lutanist and composer. was born and died at Greenwich. He was one of the king's musicians for the violin under James I. He wrote the music for five masques by his friend Ben Jonson between 1605 and 1609. He was music master to Prince Henry and then to Prince Charles (Charles I) and, mhen Charles came to the throne, became "composer of the king's music." He published a book of *Ayres* (1609). containing songs written for Jonson's masques, and *Lessons for 1, 2 and 3 Viols* (1609).

His son, also named ALFONSO (d. *c.* 1660), succeeded (1628) his father as a viol player in the king's band. He and his brother Henry jointly held the post of musician in ordinary to the king. Both the brothers died before July 4, 1661. John Ferrabosco. organist at Ely cathedral, who died in 1682, belonged to the same family.

FERRAR, NICHOLAS (1592–1637), English theologian, was born in London in 1592 and educated at Clare Hall. Cambridge. graduating in 1610. In 1618 he became actively connected with the Virginia company. When in 1623 it was deprived of its patent, he entered parliament; but, soon deciding to devote himself to a religious life, he purchased the manor of Little Gidding. Huntingdonshire, where he organized a small religious community. There. in 1626. Ferrar was ordained a deacon by Laud. and declining preferment, he lived an austere, almost monastic life of study and good works. He died on Dec. 4, 1637. and the house was despoiled and the community broken up ten years later. There are extant a number of "harmonies" of the Gospel. printed and bound by the community. two of them by Ferrar himself. One of the latter was made for Charles I on his request, after a visit in 1633 to see the "Arminian Nunnery at Little Gidding." Little Gidding is described in Shorthouse's *John Inglesant.*

FERRAR, ROBERT (*c.* 1500–1555), bishop of St. David's and martyr. born of a Yorkshire family, is said to have studied both at Cambridge and Oxford before he became a canon regular of St. Xugustine. As soon as the heresy laws were re-established under Mary, Ferrar was sent down to be tried by his successor at St. David's. He was burnt at the stake at Carmarthen on March 30. 1555.

See the article by T. F. Tout in the *Dict. Nat. Biog.*

FERRARA, a city and archiepiscopal see of Emilia–Romagna, Italy, capital of the province of Ferrara, 30 mi. S.N.E. of Bologna, situated on the Po di Vomano, a branch channel of the main stream of the Po. Pop. (1957 est.) 144,801 (commune). The town has broad streets and numerous palaces, which date from the 16th century, when it was the seat of the court of the house of Este.

The most prominent building is the square castle of the house of Este, a brick building surrounded by a moat, with four towers. It was built after 1385 and partly restored in 1554–70. The Palazzo del Municipio, rebuilt in the 18th century, was the earlier residence of the Este family. Close by is the cathedral of S. Giorgio, consecrated in 1135. It was built by Guglielmo degli Adelardi (d. 1146). Opposite the cathedral is the Gothic Palazzo della Ragione, in brick (1315–1326), now the law courts. A little nay off is the free university. It has faculties of law, medicine and natural science. The Palazzo de' Diamanti, contains the municipal picture gallery, with a large number of pictures of artists of the school of Ferrara.

The origin of Ferrara is uncertain, and probabilities are against the supposition that it occupies the site of the ancient Forum Alieni. It mas probably a settlement formed by the inhabitants of the lagoons at the mouth of the Po. It appears first in a document of Aistulf of 753 or 754 as a city in the exarchate of Ravenna. After 984 we find it a fief of Tedaldo, count of Modena and Canossa, nephew of the emperor Otho I. It afterward made itself independent, and in 1101 was taken by siege by the countess Matilda. At this time it was mainly dominated by several great families, among them the Adelardi. In 1146 the property of Guglielmo Adelardi passed, as the dowry of his niece Marchesella, to Azzolino d'Este. After considerable struggles Azzo Novello was nominated perpetual podestà in 1242; in 1259 he took Ezzelino of Verona prisoner in battle. His grandson, Obizzo II (1264–1293), succeeded him, and the pope nominated him captain-general and deiender of the states of the church; and the house of Este mas from henceforth settled in Ferrara. Rorso received the fiefs of Modena and Reggio irom the emperor Frederick III as first duke in 1452 (in which year Girolamo Savonarola was born there), and in 1470 mas made duke of Ferrara by Pope Paul II. Ercole I (1471–1505) and his son Alfonso I (m. Lucrezia Borgia) carried on war with Venice. In 1509 he was excommunicated by Julius II, and attacked the pontifical army in 1512 outside Ravenna, which he took. Gaston de Foix fell in the battle. With the succeeding popes Alfonso was able to make peace. He was the patron of Ariosto from 1518 onwards. His son Ercole II (duke, 1534–59) married Renata, daughter of Louis XII of France. His son Alfonso II married Barbara, sister of the emperor Maximilian II. He raised the glory of Ferrara to its highest point, and was the patron of Tasso and Guarini, iavouring, as the princes of his house had always done, the arts and sciences. For its majolica *see* POTTERY AND PORCELAIN. He had no legitimate male heir, and in 1597 Ferrara was claimed as a vacant fief by Pope Clement VIII. The town remained a part of the states of the church, the fortress being occupied by an Austrian garrison from 1832 until 1859, when it became part of the kingdom of Italy.

A considerable area within the walls of Ferrara is unoccupied by buildings, especially on the north, where the handsome Renaissance church of S. Cristoforo, with the cemetery, stands; but modern times have brought a renewal oi industrial activity. Knitted goods and shawls are made. Ferrara is on the main line from Bologna to Padua and Venice, and has branches to Ravenna, Poggio Rusco (fcr Suzzara), Cento and Comacchio. At Pontelagoscuro, which is within the commune of Ferrara, is a railway bridge over the Po and a large soap and candle factory.

See G. Agnelli, *Ferrara e Pomposa* (1902); E. G. Gardner, *Dukes and Poets oj Ferrara* (1904); K. Chledowski, *Der Hof von Fevrara* (1919); Arti Grafiche; G. Facchini, *La Storia di Ferrara* (1933).

FERRARA-FLORENCE, COUNCIL OF. The council of Ferrara and Florence was the culmination of a series of futile mediaeval attempts to reunite the Greek and Roman churches. The emperor, John VII Palaeologus, had been advised by his experienced father to avoid all serious negotiations, as they had invariably resulted in increased bitterness; but John, in view of the rapid dismemberment of his empire by the Turks, felt constrained to seek a union. The situation was, however, complicated by the strife which broke out between the pope (Eugenius IV) and the oecumenical council of Basel. Both sides sent embassies to the emperor at Constantinople, as both saw the importance of gaining the recognition and support of the east, for on this practically depended the victory in the struggle between papacy and council for the supreme jurisdiction over the church (*see* BASEL, COUNCIL OF). The Greeks, fearing the domination of the papacy, were at first more favourably inclined toward the conciliar party; but the astute diplomacy of the Roman representatives, who have been charged by certain Greek writers with the skilful use of money and of lies, won over the emperor. With a retinue of about 700 persons, entertained in Italy at the pope's expense, he reached Ferrara early in March 1438, and in the following month the Union Synod was solemnly inaugurated on April 9, 1438. After several months of negotiation, it seemed for several reasons advisable to transfer the council to Florence. There ensued long debates and negotiations on the *filioque*, in which Markos Eugenikos, archbishop of Ephesus, spoke for the irreconcilables; but the Greeks under the leadership of Bessarion, archbishop of Nicaea, and Isidor, metropolitan of Kiev, at length made a declaration on the *filioque* (June 4), to which all save Markos Eugenikos subscribed. On the next topic of importance, the primacy of the pope, the project of union nearly suffered shipwreck; but here a vague formula was finally constructed which, while acknowledging the pope's right to govern the church, attempted to safeguard as well the rights of the patriarchs. On the basis of the abovementioned agreements, as well as of minor discussions concerning purgatory and the Eucharist, the decree of union was drawn up in Latin and in Greek, and signed on July 5 by the pope. the Greek emperor and all the members of the synod save Eugenikos and one Greek bishop who had fled; and on the following day it was solemnly published in the cathedral of Florence.

The council, however, desirous of negotiating unions with the minor churches of the east, remained in session for several years, and seems never to have reached a formal adjournment. The decree for the Armenians was published on Nov. 22, 1439; they accepted the *filioque* and the Athanasian creed, rejected Monophysitism and Monothelitism, agreed to the developed scholastic doctrine concerning the seven sacraments and conformed their calendar to the western in certain points. On April 26, 1441, the pope announced that the synod would be transferred to the Lateran; but before leaving Florence a union was negotiated with the oriental Christians known as Jacobites. The *Decretum pro Jacobitis,* published on Feb. 4, 1442, is, like that for the Armenians, of high dogmatic interest, as it summarizes the doctrine of the great mediaeval scholastics on the points in controversy. The decree for the Syrians, published at the Lateran on Sept. 30, 1444, and those for the Chaldeans (Nestorians) and the. Maronites (Monothelites), published at the last known session of the council on Aug. 7, 1445, added nothing of doctrinal importance. Though the direct results of these unions were the restoration of prestige to the absolutist papacy and the bringing of Byzantine men of letters, like Bessarion, to the west, the outcome was on the whole disappointing. Of the complicated history of the "Uniate" churches of the east it suffices to say that Rome succeeded in securing but fragments, though important fragments, of the greater organizations. As for the Greeks, the union met with much opposition, particularly from the monks, and was rejected by three oriental patriarchs at a synod of Jerusalem in 1443; and after various ineffective attempts to enforce it, the fall of Constantinople in 1453 put an end to the endeavour. As Turkish interests demanded the isolation of the oriental Christians from their western brethren, and as the orthodox Greek nationalists feared Latinization more than Mohammedan rule, a patriarch hostile to the union was chosen, and a synod of Constantinople in 1472 formally rejected the decisions of Florence.

BIBLIOGRAPHY.—*See* article ORTHODOX EASTERN CHURCH; references to literature by Tschackert in Herzog-Hauck, *Realencyklopiidie,* vol. vi, 45 ff.; W. Norden, *Das Päpsttum und Byzanz* (1903); M. Creighton, *History of the Papacy during the Period of the Reformation,* vol. ii, 173 *sqq.* and the general church histories under reference to the Greek Church.

FERRARI, GAUDENZIO (1470/80–1546), Italian artist of the Lombard school and a painter of frescoes and altarpieces, was born at Valduggia in Piedmont. He was stated to be *annorum circa 75* when he died in Milan on Jan. 31, 1546, but he probably was born between 1475 and 1480. His earliest dated work is of 1507. The painter and writer G. P. Lomazzo, who was a pupil of one of Gaudenzio's pupils, says that he studied first under the obscure Stefano Scotto and then under Bernardino Luini; the latter's influence is visible in Gaudenzio's works, as is also that of the Milanese B. Suardi, called Bramantino. On the whole, however· Gaudenzio seems to belong to the older Lombard school, relatively little influenced by Leonardo da Vinci. He is perhaps not ranked as highly as he might be, largely because his major works are in remote churches, but Lomazzo placed him seventh among the painters of Italy.

His earliest works were done at Varallo (near the Swiss border), where he painted the frescoes in the chapel of S. Margherita in S. Maria delle Grazie in 1507, as well as an altarpiece (probably now in Turin, Galleria Sabauda) which was contracted for in 1508, and some frescoes in 1513. His major work, however, was the decoration of some of the chapels on the Sacro Monte at Varallo, a task that occupied many years. In this work he made an ambitious attempt to secure extreme realism by setting coloured terracotta figures against a frescoed background, but it is arguable that this waxworks effect defeats its own ends.

In 1510 and 1511 he painted an altarpiece for S. Maria at Arona; in 1514 he worked on the S. Gaudenzio altar at Novara, which established his fame and secured further commissions in the region. From 1jag to 1535 he is documented as living and working at Vercelli, but between 1534 and 1536 he painted the "Angelic Choir" in the dome of S. Maria dei Miracoli at Saronno. In 1539 he moved to Milan, where he spent the rest of his life and where he painted several frescoes in churches. There are other works by him in European galleries and in Sarasota, Fla.

See G. P. Lomazzo, *Trattato dell'Arte* (1584), *Idea del Tempio* (1590); E. Halsey, *Gaudenzio Ferrari* (1904) and the catalogue of the Vercelli exhibition, *Mostra di Gaudenzio Ferrari* (1956) with full bibliography. (P. J. My.)

FERRARI, GIUSEPPE (1812–1876), Italian philosopher, historian and politician, was born at Milan on March 7, 1812, and died in Rome on July 2, 1876. After studying law at Pavia, he edited the works of Vico, prefaced by an appreciation (1835). He then went to France and, in 1839, produced his *Vico et l'Italie,* followed by *La Nouvelle Religion de Campanella* and *La Theorie de l'erreur.* In 1840 he was made professor of philosophy at Rochefort, and in 1842 was transferred to Strasbourg. Owing to trouble with the clergy, he returned to Paris and published *Idées sur la politique de Platon et d'Aristote,* a defense of his theories. From 1849 to 1858 he devoted himself exclusively to writing, publishing *Les Philosophes Salariés, Mackiavel juge des révolutions de notre temps* (1849), *La Federazione repubblicana* (1851), *La Filosofia della rivoluzione* (1851), *L'Italia dopo il colpo di Stato* (1852), *Histoire des révolutions, ou Guelfes et Gibelins* (1858; Ital. trans., 1871–73). In 1859 he returned to Italy, opposed Cavour, and upheld federalism against the policy of a single Italian monarchy. He held chairs of philosophy at Turin, Milan and Rome, and was made senator in May 1876. His other works include *Histoire de la raison d'état, La China e l'Europa, Corso d' istoria degli scrittori politici italiuni.* A sceptic and phenomenalist in philosophy, a revolutionist in politics, Ferrari was admired as an orator and as a writer.

See Marro Macchi, *Annuario istorico italiano* (Milan, 1877); A. Mazzoleni, *Giuseppe Ferrari* (Milan, 1877); C. Werner, *Die ital. Philosophie des 19. Jahrh.* vol. 3 (Vienna, 1885), P. Nicoli, *La Mente di G. Ferrari* (1902); *Le Pid Belle Pagine di G. Ferrari* (Milan, 1927).

FERRARI, LODOVICO (1522–1565), Italian mathematician, is chiefly known for his solution of the biquadratic equation (an equation which contains the iourth power of the unknown quantity but no higher power). He was born in Bologna. Feb. 2, 1522. As a lad of 1j he came into the service of Girolamo Cardano (*q.v.*) in Milan, and most of the information about him can be found in Cardano's writings. He reputedly had a fiendish temper; when 17 he lost most of the fingers on the left hand in a brawl. Cardano taught him Latin, Greek and mathematics. In 1540 he became Cardano's successor as public mathematics lecturer in Milan after deieating Zuan da Coi, Brescian mathematician. At this time he iound the solution of the quartic equation, later published in Cardano's *Ars Magna.* He invented a mechanism for transforming circular into rectilinear motion, and considered geometric constructions with a fixed compass opening. The publication of the *Ars Magna* brought Ferrari into a celebrated scientific controversy with Niccolò Tartaglia in regard to the solution of the cubic equation. After six printed cartels and countercartels Ferrari was declared the winner in a public dispute in Milan on Aug. 10, 1548. Subsequently Ferrari was deluged with offers—from Rome, Venice. from Charles de Brissac. the French commander in chief, and even from the emperor Charles V to he tutor for his son. He accepted an offer from Ercole Cardinal Gonzaga, regent of Mantua, to become supervisor of tax assessments, a position which in a short time made him a wealthy man. Later. ill-health and a quarrel with the cardinal made him take a professorship in mathematics at the University of Bologna. He died shortly afterward, in Oct. 1565; Cardano suspected that Ferrari had been poisoned for the sake of his money by his sister Magdalena and her lover.

See E. Giordani. *I sei cartelli di matematica disfida di Lodovico Ferrari (1876);* O. Ore, *Cardano, the Gambling Scholar* (1953). (O. Oe.)

FERRE, CHARLES THEOPHILE (1845–1871), chief of police of the Paris commune, was until March 1871 one of the lesser known followers of L. A. Blanqui (*q.v.*). He was elected to the commune for the 18th arrondissement, polling the very. high figure of 13.784 votes. Together with Raoul Rigault, a man as young as himself, he was placed in charge of the police. Like Marat of the French Revolution, Ferré of the commune has been invested with the reputation of a monster of terrorism. The department of the police was not., indeed, very wisely run; arrests were made widely, haphazardly and clumsily. but the commune mas at least protected from internal trouble. Ferré always supported the most violent motions, in particular (after the shooting of Duval) a motion declaring that the hostages in the hands of the commune mould be executed if the government troops killed any more communard prisoners. This decree was not carried out until after the government troops had broken into Paris. when. ascertaining that they were again shooting communard prisoners: Ferré ordered the execution of the hostages. including Archbishop Darboy. At his trial before the court-martial he defended hi's action and defied the court. He was shot at Satory on Nov. 28, 1871.

See P. Larousse, *Dictionnaire du XIXe siècle, s.v.* "Ferré" (1872); G. Da Costa, *La Commune Vécue* (1901); R. W. Postgate, *Out of the Past* (1922); A. Dayct, *La Guerre, La Siège, La Commune d'après les peintures, gravures, photographies, sculptures, médailles, autographes, et objets du temps* (1901). (*See* also COMMUNE.)

FERREIRA, ANTONIO (1528–1569), Portuguese poet, was a native of Lisbon; his father was employed in the house of the duke of Coimbra at Setubal, and the poet was educated at the University of Coimbra, where he eventually became a professor. The sonnets forming the First Book in his collected works date from 1552 and contain the history of his early love for an unknown lady. The sonnets in the Second Book were inspired by D. Maria Pimentel, whom he afterwards married, and they are marked by that chastity of sentiment, seriousness and ardent patriotism which characterized the man and the writer. He was intimate with princes, nobles and the most distinguished literary men of the time, and became the foremost representative of the classical school. In Oct. 14, 1567, he became *Disembargador da Casa do Civel,* and had to leave the quiet of Coimbra for Lisbon. His verses tell how he disliked the change, and how the bustle of the capital, then a great commercial emporium, made him sad and almost tongue-tied for poetry. He died of plague in Lisbon on Nov. 29, 1569, having stayed there doing his duty when others fled.

Horace was his favourite poet and his admiration of the classics made him disdain the popular poetry of the Old School (*Escola Velha*) represented by Gil Vicente. His national feeling would not allow him to write in Latin or Spanish, like most of his contemporaries, but his Portuguese is as Latinized as he could make it, and he even calls his poetical works *Poemas Lusitanos.* Ferreira wrote the Terentian prose comedy. *Bristo,* at the age of 2j(1553), and dedicated it to Prince John in the name of the university. It is neither a comedy of character nor manners, but its *vis comica* lies in its plot and situations. The *Cioso,* a later product. may almost be called a comedy of character. *Castro* is Ferreira's most considerable work, and, in date, is the first tragedy in Portuguese, and the second in modern European literature.

The *Castro* was first printed in Lisbon in 1587, and it is included in Ferreira's *Poemas*, published in 1598 by his son. It has been translated by Musgrave (1825), and the chorus of Act I appeared again in English in the *Savoy* for July 1896. It has been done into French and German. The *Bristo* and *Cioso* first appeared with the comedies of Sá de Miranda in 1622. There is a good modem edition of the Complete Works of Ferreira (2 vols., Paris, 1865). *See* Castilho, *Antonio Ferreira* (3 vols., Rio, 1865), which contains a full biographical and critical study with extracts.

FERRERO, GUGLIELMO (1871–1942), Italian journalist and author, was born at Portici, near Naples, on July 31, 1871. At an early age he joined the staff of the Radical semi-republican *Secolo* of Milan. He travelled abroad considerably, and made a reputation by his books *L'Europa giovane* (1897) and *Il Militarismo* (1898; Engl. tr., 1902). Later he studied Roman history, and in 1902 published his *Grandezza e decadenza di Roma,* which established his fame as historian among the general public rather than among scholars. He was an ardent advocate of Italian intervention on the Allied side in World War I. After the war he published numerous articles and several books prophesying imminent catastrophe for Italy and the world. Among these are *Da Fiume a Roma* (1923), also published in English under the title *Four Years of Fascism* (1924), and *La Fin des Aventures* (Eng. ed., *War and Peace,* 1933). His Italian works were seized by the Italian government in 1935. Ferrero died in Geneva in 1942.

FERRERS, the nanie of a great Norman-English feudal house, derived from Ferrikres-St.-Hilaire, to the south of Bernay, in Normandy. Its ancestor Walkelin was slain in a feud during the Conqueror's minority, leaving a son Henry, who took part in the Conquest and held a great fief in the midlands. He established his chief seat at Tutbury Castle, Staffordshire, on the Derbyshire border, and founded there a Cluniac priory. His eldest son succeeded to Ferrikres, and, according to Stapleton, he was ancestor of the Oakham house of Ferrers, whose memory is preserved by the horseshoes hanging in the hall of their castle. Robert, a younger son of Henry, inherited his vast English fief, and, for his services at the battle of the Standard (1138), was created earl of Derby by Stephen. He appears to have died the next year.

The earls seem to have been styled indifferently earls of Derby or Nottingham (both counties then forming one shrievalty) or of Tutbury, or simply (de) Ferrers.

William, the 3rd earl, joined in the great revolt of 1173, when he fortified his castles of Tutbury and Duffield and plundered Nottingham, which was held for the king. On his subsequent submission his castles were razed. He died at the siege of Acre, 1190. His son William, the 4th earl, attacked Nottingham on Richard's behalf in 1194. He was confirmed by king John in the earldom of Derby, 1199. With his brother-in-law the earl of Chester, and with William Marshal, earl of Pembroke, whose daughter married his son, he acted in securing the succession of the young Henry, joining in the siege of Mountsorrel and the battle of Lincoln. In 1227 he was one of the earls who rose against Henry III. on behalf of his brother Richard and made him restore the forest charters, and in 1237 he was one of the three counsellors forced on the king by the barons. He died in 1247.

Robert, 6th and last earl, his grandson, succeeded as a minor in 1254. He was one of the five earls summoned to Simon de Montfort's parliament, though, on taking the earl of Gloucester's part, he was arrested by Simon. On the king's triumph, he was compelled to forfeit his castles and seven years' revenues. In 1266 he revolted on his own estates in Derbyshire, but was defeated at Chesterfield by Henry "of Almain," deprived of his earldom and lands and imprisoned. In 1269, he agreed to pay £50,000 for restoration, and to pledge all his lands save Chartley and Holbrook for its payment. As he was not able to find the money, the lands passed to the king's son, Edmund.

The earl's son John succeeded to Chartley, a Staffordshire estate long famous for the wild cattle in its chase, and was summoned as a baron in 1299, though he had joined the baronial opposition in 1297. On the death, in 1450, of the last Ferrers lord of Chartley, the barony passed with his daughter to the Devereux family and then to the Shirleys, one of whom was created Earl Ferrers in 1711. The barony has been in abeyance since 1855.

The line of Ferrers of Groby was founded by William, younger brother of the last earl, who inherited from his mother Margaret de Quinci her estate of Groby in Leicestershire, and some Ferrers manors from his father. On the death of William, Lord Ferrers of Groby, in 1445, the barony passed with his granddaughter to the Grey family and was forfeited with the dukedom of Suffolk in 1554. A younger son of William, the last lord, married the heiress of Tamworth Castle, and his line was seated at Tamworth till 1680, when an heiress carried it to a son of the first Earl Ferrers. From Sir Henry, a younger son of the first Ferrers of Tamworth, descended Ferrers of Baddesley Clinton, seated there in the male line till towards the end of the 19th century. The line of Ferrers of Wemme was founded by a younger son of Lord Ferrers of Chartley, who married the heiress of Wemme, Co. Salop, and was summoned as a baron in her right; but it ended with their son.

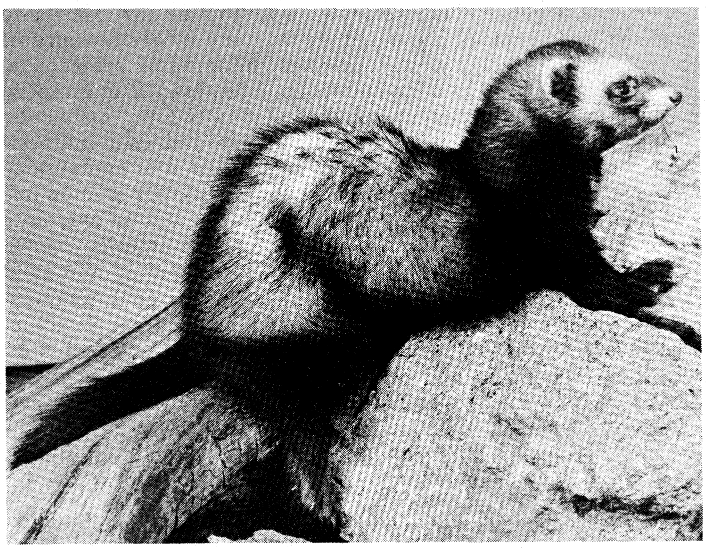
Higham Ferrers, Northants, and Woodham Ferrers, Essex, take their names from this family. It has been alleged that they bore horseshoes for their arms in allusion to Ferrikres (*i.e.,* iron-works); but when and why they were added to their coat is a moot point.

See Dugdale's *Baronage;* J. R. Planche's *The Conqueror and his Companions;* G. E. C(okayne)'s *Complete Peerage; Chronicles and Memorials* (Rolls Series); T. Stapleton's *Rotuli Scaccarii Normannie;* H. Norris, *Baddesley Clinton, with account of the family of Ferrers* (1897).

FERRERS, LAURENCE SHIRLEY, 4TH EARL (1720–1760), the last nobleman in England to suffer a felon's death, was born on Aug. 18, 1720. In 1758 his wife obtai'ed a separation from him for cruelty. The Ferrers estates were then vested in trustees, an old family steward, Johnson, being appointed receiver of rents. On Jan. 18, 1760, Johnson called at the earl's mansion at Staunton Harold, Leicestershire, when Lord Ferrers shot him. Ferrers was tried for murder by his peers in Westminster Hall. He pleaded insanity, but was found guilty. On May 5, 1760, dressed in a light-coloured suit, embroidered with silver, he was taken in his own carriage from the Tower of London to Tyburn and there hanged. It has been said that as a concession to his order the rope used was of silk.

See Peter Burke, *Celebrated Trials connected with the Aristocracy in the Relations of Private Life* (London, 1849); Edward Walford, *Tales of our Great Families* (London, 1877); Howell's *State Trials* (1816), xix. 885–980.

FERRET, a domesticated breed of the wild polecat (*Mustela putorius*), which it resembles in size, form and habits, and with which it interbreeds. It differs in the colour of its fur, which is usually yellowish-white, and of its eyes. which are pinky-red. The "polecat-ferret" is a brown breed, apparently the product of the above-mentioned cross. The ferret attains a length of about 14 in.. exclusive of the tail, which measures j in. It is employed in destroying rats and other vermin, and in driving rabbits from their burrows. The ferret is remarkably prolific, the female bringing forth two broods annually, each numbering from six to nine young. Pliny states it was employed in his time in rabbit hunting.



YLLA FROM RAPHO-GUILLUMETTE

THE COMMON FERRET

The ferret should be kept in dry, clean, well-ventilated hutches, and fed twice daily on bread, milk, and meat, such as rabbits' and fowls' livers. When used to hunt rabbits it is provided with a muzzle or with a cope. made by looping and knotting twine about the head and snout, in order to prevent it killing its quarry. As the ferret enters the hole, the rabbits flee before it. and are shot as they break ground. A ferret's hold on its quarry is as obstinate as that of a bulldog, but can easily be broken by pressure of the thumb just above the eyes. Only full-grown ferrets are "worked to" rats. Several are used at a time and without copes, as rats are fierce fighters.

See N Eveiitt. *Ferrets* (1897).

FERRI, CIRO (1634–1689), Roman painter. the chief disciple and successor of the painter and architect Pietro da Cortona, was born in Rome. When he was a little past 30 he completed the painting of the ceilings and other internal decorations begun by his instructor in the Pitti palace, Florence. He also co-operated in or finished several other works by Pietro, both in Florence and in Rome.

Of his own independent productions the chief is an extensive series of scriptural frescoes in the church of S. Maria Maggiore in Bergarno; also a painting (rated as Ferri's best work) of St. Ambrose healing an invalid. the principal altarpiece in the church of S. Ambrogio in Rome. He executed a large number of etchings and frontispieces for books.

Ferri was appointed-to direct the Florentine students in Rome: where Antonio Gabbiani was one of his leading pupils. He died in Rome on Sept. 13, 1689.

FERRIER, JAMES FREDERICK (1808–1864), Scottish metaphysician distinguished for his agnoiology or theory of ignorance, was born in Edinburgh on June 16, 1808. Educated at Edinburgh and Oxford, he qualified as a barrister in 1832, but came under the influence of Sir William Hamilton (who may have inspired his visit to Heidelberg in 1834 to study German idealist philosophy) and was appointed professor of civil history at Edinburgh (1842) and then of moral philosophy and political economy at St. Andrews (1845). He died at St. Andrews on June 11. 1864.

Ferrier's publications include a number of articles in *Blackwood's Magazine* (from 1838 onward). mainly on metaphysics though one dealt with "Some Plagiarisms of S. T. Coleridge" (1840); *Institutes of Metaphysic, the Theory of Knowing and Being* (1854), his major work; an edition of the works of John Wilson ("Christopher North"), his uncle and father-in-law, 12 vol. (1855–58); and *Scottish Philosophy, the Old and the* Yew (1856), in which he defended his *Institutes* and denounced the "philosophy of common-sense" that Hamilton had tried to combine with Kantianism. His *Lectures on Greek Philosophy and Other Philosophical Remains,* 2 vol. (1866), and *Philosophical Works,* 3 vol. (1875), appeared posthumously.

Ferrier's Hegelian epistemology (a word that he introduced into English) and ontology are based on the concept of the unity of the act of knowledge, which combines the knowing subject and the object known. The mind cannot apprehend anything except in conjunction with an apprehension of itself, and the distinction of subject and object is a source of error. Only minds in synthesis with what they know can be said to exist. and it is nonsense to speak of the mind's "ignorance" of what is allegedly unknowable (as the Kantian "thing-in-itself" was said to be), since ignorance must refer to what is still knowable though not actually known.

See E. S. Haldane, *James Frederick Ferrier (1899).*

FERRIER, PAUL (1843–1920), French dramatist, was born at Montpellier on March 29, 1843, and he died at Nouan-le-Fuzelier on Sept. 11, 1920. One of Ferrier's greatest triumphs was the produdtion with Fabrice Carré of *Joséphine vendue par ses soeurs* (1886). an *opéra bouffe* with music by Victor Roger. His opera libretti include *La Marocaine* (1879), music of J. Offenbach; *Le Chevalier d'Harmental* (1896) after the play of Dumas père, for the music of A. Messager; La *Fille de Tabarin* (1901), with Victorien Sardou, music of Gabriel Pierné.

FERRIER, SUSAN EDMONSTONE (1782–1854), Scottish novelist, born in Edinburgh on Sept. 7, 1782, was the daughter of James Ferrier, at one time one of the clerks of the court of session with Sir Walter Scott.

Susan Ferrier's first novel, *Marriage* (1818), was begun in concert with a friend, Miss Clavering, but this lady wrote only a few pages. It was followed in 1824 by *The Inheritance,* a better constructed and more mature work; and the last and perhaps best of her novels, *Destiny,* appeared in 1831. All these novels were published anonymously. With their clever portraiture of contemporary Scottish life and manners, and even recognizable caricatures of some social celebrities of the day, they could not fail to become popular north of the Tweed. Many were the conjectures as to the authorship of the novels. In the *Noctes Ambrosianae* (Nov. 1826) James Hogg is made to mention *The Inheritance,* and adds. "which I aye thought was written by Sir Walter, as weel's *Marriage,* till it spunked out that it was written by a leddy."

Scott himself gave Susan Ferrier a very high place indeed among the novelists of the day. In his *Tales of* My *Landlord* he calls her his "sister shadow," the still anonymous author of "the very lively work entitled *Marriage.*" Lively, indeed, all her works are, written in clear, brisk English, and with an inexhaustible fund of humour. Her books portray the society in which she lived, caricaturing with terrible exactness its hypocrisy, boastfulness, greed, affection and undue subservience to public opinion. Yet she wrote less to reform than to amuse. In this she is less like Maria Edgeworth than Jane Austen. Maria Edgeworth was more of a moralist; her wit is not so involuntary, her caricatures not always so good-natured. But Jane Xusten and Susan Ferrier were genuine humorists, and with the latter especially a keen sense of the ludicrous was always dominant. Her humorous characters are always her best. But if she was not a moralist, neither was she a cynic; and her wit, even where it is most caustic. is never uncharitable.

Susan Ferrier lived at Morningside House and in Edinburgh for more than 20 years after the publication of her last work. Lockhart describes her visit to Scott in May 1531. She died on Nov. 5, 1854, in Edinburgh.

She left among her papers a short unpublished article, entitled "Recollections of Visits to Ashestiel and Abbotsford." This is her own very interesting account of her long friendship with Sir Walter Scott. It contains some impromptu verses written by Scott in her album at Ashestiel.

See Sir G. B. S. Douglas, *The Blackwood Group,* "Famous Scots series," (1897).: *Memoir and Correspondence of Susan Ferrier,* collected by John Ferrier, ed. J. A. Doyle (1898).

FERROCONCRETE: *see* CONCRETE.

FERROL, EL (known as EL FERROL DEL CAUDILLO. since it was the birthplace of Gen. Francisco Franco Bahamonde), a city of northwestern Spain, in the province of Corunna; 41 mi. N.E. of the city of Corunna by rail. Pop. (1950) 56.332. Ferrol ranks with Cartagena and San Fernando, near Cadiz, as one of the principal Spanish naval stations. The town is on a north shore headland of the Bay of Ferrol and is concealed by rocky hills from view from the sea. Its natural harbour, the largest in Spain, except those of Vigo and Cartagena, is deep and safe; but the entrance is a narrow strait about 2 mi. long, which admits only one vessel at a time and is commanded by powerful modern batteries and forts on either side. Ferrol has shipbuilding yards and a large arsenal basin, with workshops and foundries, and two dry docks. Across a broad inlet west of the headland lies the submarine base of La Grana.

After the 1908 decree for bringing the Spanish navy up to date, much constructional work went on in the dockyards. Local industries are mainly connected with the building or refitting of naval vessels. Because of the competition of Corunna and also because of the lack, until 1904, of railway communication, El Ferrol is not a first-class commercial port. It is now connected by rail with Betanzos on the line from Corunna; but the exports are insignificant, consisting mainly of pit props, and the chief imports ordinarily are coal, cement, timber, iron and machinery, for use in the shipping industries.

El Ferrol was a mere fishing village until, in 1726, Philip V chose it as the site for a naval base, and Ferdinand VI (1746–1759) later set up shipbuilding yards there. Charles III developed it as a naval arsenal and erected strong fortifications between 1769 and 1774. In 1799 the British made a fruitless attempt to capture it, but on Nov. 4, 1805, they defeated the French fleet in front of the town, which they compelled to surrender. Delivered by treachery to the French on Jan. 27, 1809, it was vacated by them on July 22. When the French invaded Spain in 1823, the port withstood a month's blockade before surrendering on Aug. 27. Nationalists captured it early in the civil war of 1936–39.

FERROMAGNETISM is the kind of magnetism associated with iron. cobalt and nickel and some alloys and compounds containing one or more of these elements or manganese. It is characterized by the strong attraction of one magnetized body to another, a phenomenon known to the ancient world.

In contrast to other substances, ferromagnetic materials are magnetized easily. and in strong magnetic fields the magnetization approaches a definite limit called saturation. When a field is applied. and then removed. the magnetization does not return to its original value — this behaviour is referred to as hysteresis (*q.v.*). When heated to a certain temperature called the Curie point, different for each substance, ferromagnetic materials lose their characteristic properties and cease to be ferromagnetic; however, they become ferromagnetic again on cooling.

Ferromagnetic materials are essential parts of the machines of modern civilization, *e.g.*, electric motors and generators, transformers, telephones, loud-speakers and many others. Useful materials consist of two classes: those which are magnetized in weak fields and lose their magnetism easily (high permeability materials) and those requiring rather strong fields for magnetization but retaining their magnetism with tenacity (permanent magnets). *See* MAGNETISM. (R. M. B.)

FERRUCCIO or FERRUCCI, **FRANCESCO** (1489–1530), Florentine captain, who served in the *Bande Nere* in various parts of Italy, earning a reputation as a daring fighter and somewhat of a swashbuckler. When Pope Clement VII and the emperor Charles V decided to reinstate the Medici in Florence, they made war on the Florentine republic, and Ferruccio was appointed Florentine military commissioner at Empoli, where he showed great daring and resource by his rapid marches and sudden attacks on the Imperialists. Early in 1530 Volterra had thrown off Florentine allegiance and had been occupied by an Imperialist garrison. but Ferruccio surprised and recaptured the city. During his absence, however, the Imperialists captured Empoli by treachery, thus cutting off one of the chief avenues of approach to Florence. Ferruccio then attempted a diversion by attacking the Imperialists in the rear and started from Volterra for the Apennines. But at Pisa he was laid up for a month with a fever —a misfortune which enabled the enemy to get wind of his plan and to prepare for his attack. At the end of July Ferruccio left Pisa at the head of about 4,000 men, and although the besieged in Florence, knowing that a large part of the Imperialists under the prince of Orange had gone to meet Ferruccio, wished to cooperate with the latter by means of a sortie, they were prevented from doing so by their own traitorous commander in chief Malatesta Baglioni. Ferruccio was defeated on Aug. 3 at Gavinana; he himself was wounded and captured. Maramaldo out of personal spite dispatched the wounded man with his own hand. Nine days later Florence surrendered. Ferruccio was one of the great soldiers of the age, and his enterprise is the finest episode of the last days of the Florentine republic.

See also under FLORENCE and MEDICI.

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FERRY, JULES FRANÇOIS CAMILLE (1832–1893), French statesman, was born at Saint Dié (Vosges) on April 5, 1832. He studied law, was called to the bar at Paris, and contributed to the *Temps.* He attacked the empire with great violence, directing his opposition especially against Baron Haussmann, prefect of the Seine. Elected republican deputy for Paris in 1869, he protested against the declaration of war with Germany, and on Sept. 6, 1870 was appointed prefect of the Seine by the government of national defence. He administered Paris during the siege, and after the Commune was obliged to resign (June 5, 1871). From 1872–1873 he was minister in Athens, but returned to the chamber as deputy for the Vosges, and became one of the leaders of the republican party. He was a member of the first republican ministry formed under W. H. Waddington on Feb. 4, 1879, and continued in the ministry until March 30, 1885, except for two short interruptions, first as minister of education and then as minister of foreign affairs. He was twice premier (1880–81 and 1883–1885). Two important works are associated with his administration, the non-clerical organization of public education, and the beginning of the colonial expansion of France. He reorganized the committee of public education (law of Feb. 27, 1880), and proposed a regulation for the conferring of university degrees, which, though rejected, aroused violent polemics because the 7th article took away from the unauthorized religious orders the right to teach. He finally succeeded in passing the great law of March 28, 1882, which made primary education in France free, non-clerical and obligatory. In higher education the number of teachers doubled under his ministry. After the military defeat of France by Germany in 1870, he formed the idea of acquiring a great colonial empire, not to colonize it, but for the sake of economic exploitation. He directed the negotiations which led to the establishment of a French protectorate in Tunis (1881), prepared the treaty of Dec. 17, 1885 for the occupation of Madagascar; directed the exploration of the Congo and of the Niger region; and above all he organized the conquest of Indo-China. The excitement caused at Paris by an unimportant reverse of the French troops at Lang-son caused his downfall (March 30, 1885), but the treaty of peace with China (June 9, 1885) was his work. After the resignation of President Grévy (Dec. 2, 1887), he was a candidate for the presidency of the republic, but the radicals refused to support him, and he withdrew in favour of Sadi Carnot. The violent polemics directed against him caused a madman to attack him with a revolver, and he died from the wound on March 17, 1893. The chamber of deputies voted him a state funeral.

See Edg. Zevort, *Histoire de la troisième République; A.* Rambaud, *Jules Ferry* (Paris, 1903).

FERRY, a place where passengers, freight or vehicles are carried by boat across a river, lake, arm of the sea or other body of water. The term applies both to the place where the crossing is made and to the boat used for the purpose. By an extension of the original meaning, ferry also denotes short overwater fights by airplanes carrying passengers or freight. or the flying of planes from one point to another as a means of delivering them.

The term has a long history extending back to Greek mythology. It includes a wide variety of vessels, from the most primitive canoes or rafts to large motor-driven ferries capable of carrying large motor trucks and railway cars across many miles of water. It is frequently used in combination with other words, as in the expressions train ferry, car ierrv and channel ferry.

Ferries were of great importance in ancient and medieval history, and their importance continued well into the period of modern history. Before engineers learned to build permanent bridges over large bodies of water or construct tunnels under them. ferries offered the only means of crossing. In the early history of the United States the colonists found that the coasts of the new world n-ere broken by great bays and rivers, and that the interior of the continent was divided by rivers that defied bridging for many generations. Yet crossing these rivers and bays was a necessity. At first, small boats propelled by oars or poles were the most common form of ferry. They mere replaced later by large flatboats propelled by a form of long oar called a sweep. Sails were used when conditions were favourable and in some rivers the current itself provided the means of propulsion.

Horses mere used on some ferries to walk a treadmill geared to paddle wheels; in others, horses were driven in a circle around a capstan that hauled in ropes and towed the ferry along its route.

The first steam ferryboat in the United States was operated by John Fitch (*q.v.*) on the Delaware river in 1790 but it was not financially successful. The advent of steam power greatly improved ferryboats: they became larger, faster and more reliable, and began to take on a design different from other steamers. At cities which spanned a river and where hundreds of people and many horse-drawn wagons had to cross the river daily, the typical U.S. ferryboat took shape. It was a double-ended vessel with side paddle wheels and a rudder and pilothouse on both ends. The pilothouses n-ere on an upper deck. and the lower deck was arranged to hold as many vehicles as possible. A narrow passageway ran along each side of the lower deck with stairways to give passengers access to the upper deck. A narrow casing on the centre line housed the engine space. The engine was of the walking-beam type with the walking beam mounted on a pedestal so high that it was visible above the upper deck.

Terminals to accommodate such ferries were built at each end of their routes. In order to dock promptly and permit wheeled vehicles to move on and off quickly a floating bridge was sometimes provided. This was a platform with one end supported by a pivot on land and the other end supported by floats in the water. Such an arrangement adjusted for changes in the tide, and the bridge was always nearly flush with the deck of the ferry.

As roads improved and the use of automobiles and large motor trucks increased. ferries became larger and faster, but the hull arrangement remained the same. High-speed steam engines with propellers on both ends of the ferry were used. Steam engines gave way to diesel engines and to diesel-electric drive. Several states organized commissions which took over ferries from private ownership and operated them for the public; these commissions frequently also operated bridges, public roads and vehicular tunnels. Increase in the use of motor vehicles so overtaxed many ferries that they could not handle the load. As a result, more bridges and tunnels were built, and ferries began to disappear from U.S. coasts, but their use on some inland rivers and lakes still continues. A modern type of ferry service transports large motor trucks between the United States and islands of the West Indies. Big truck-trailer combinations are driven onto a wharf from which the loaded trailers (disconnected from the truck engines) are hoisted aboard ship and secured for sea travel. Ships large enough to carry more than two hundred 35-ft. trailers are engaged in this trade. On arrival at their destination the trailers are hoisted ashore so they can complete their journey on land.

(M. R. D.)

Channel **Ferries.**—A special type of cross-channel ferry between England and France was designed to meet the urgent need to supply the British armies in France and Belgium during World War I. A cross-channel barge route was started from Richborough, Kent. to Calais, where the barges continued up the canals to Vendroux Audruicq, Zeneghem and other points. The 255 steel barges so employed, each carrying about 200 tons of stores, ammunition. etc . were towed across the channel by tugs, of which 67 were available, and provided a reliable service; no barge was ever reported lost on the channel crossing.

However, this method did not suffice for all needs and was from 1917 to 1918 supplemented by three specially built train ferries which sailed from Richborough to Calais and Dunkirk, and from Southampton to Dieppe. Railway vehicles were propelled into the ferry at the stern. the two entry tracks spreading into four tracks on the deck of the vessel itself; the capacity in terms of four-wheeled freight cars was 54 per ferry. Rail-mounted guns and locomotives could be carried on the two centre tracks. About 1.000 locomotives were thus dispatched from Richborough to Audruicq shops, almost ready for instant service.

Nearly all these locomotives were returned to England in 1919 by these same train ferries, together with passenger coaches which had been employed on ambulance trains or leave and demobilization trains in France, Belgium, Germany and Italy. In 1919 the train ferries were adjusted to take motor vehicles instead of freight cars, if required.

After World War I the ferry services were discontinued but, after a few special voyages carrying British-built rolling stock for export to the continent, they were acquired by Great Eastern Train Ferries, Ltd., and placed in service between Harwich and Zeebrugge, where suitable aprons (in effect, hinged lifting bridges) uere constructed for loading and unloading purposes. The tidal range at Harwich is only 124 ft. and therefore the necessity of passing through locks was obviated at that port. This service was inaugurated in April 1924 and required the close co-operation of the London and North Eastern railway. The service acquired traffic in vegetables, cheese, eggs, fruit, machinery, silk and rolling stock.

In conjunction with Great Eastern Train Ferries was the Anglo-Belge Ferry Boat company, which owned many of the freight cars employed on the train ferry service. Later the three former wartime train ferries. operating between Harwich and Zeebrugge, became part of the London and North Eastern railway fleet.

Further train ferry developments across the channel were delayed by the proposal to build a channel tunnel, but that project was turned down by the British government in 1930.

The Harwich-Zeebrugge freight service permitted traffic to move without transshipment between all parts of England. Scotland and Wales and any station served by the standard-gauge railways of continental Europe, stretching from Narvik to Sicily and from the Spanish frontier to Istanbul. The success of the Harwich-Zeebrugge freight service led the Southern railway to start in Oct. 1936, in conjunction with the then Nord railway of France, a train ferry service from Dover to Dunkirk.

Three vessels. nith a gross tonnage of 2,989 each. mere specially built in Great Britain. the "Tnickenham Ferry." the ' Hampton Ferry" and the "Shepperton Ferry"; they mere designed to carry passenger coaches and sleeping cars as well as freight cars across the English channel.

Difficulties were experienced in the construction of the train ferry dock at Dover. because of faults in the chalk formation. but on completion a night ferry service for passengers nas started between London (Victoria) and Paris (Nord). as well as other services for freight traffic.

As a consequence of World War II the London and North Eastern railway train ferry was reduced. but the tno fleets, Harwich-Zeebrugge and Dover-Dunkirk, received nen vessels, a French one being employed on the latter.

The Dover-Dunkirk night ferry passenger service between London and Paris proved exceedingly popular. The Harwich route continued to cater for freight traffic only.

Other Train Ferry Services.—A famous example is the train ferry across the Great Belt in the Baltic sea, operated by the Danish State railways, which carries diesel trains, sleeping cars and passenger coaches on the Copenhagen-Paris and other international services.

In conjunction with the Swedish State railways, a ferry route is operated betneen Malmö and Copenhagen; another route is between Helsingør and Halsingborg. Before World War II a joint German-Swedish service ran between Sassnitz and Trelleborg and a Danish service between Gjedser and Warnemünde. Ger Developments after 1948 included a new route from Grossenbrode, Ger., to Gjedser Italian State railways operate fine motor vessels as train ferries across the strait between Reggio di Calabria and Messina in Sicily.

Outside Europe, Japanese National railways has a number of train ferries in service between the several islands. and in North America the Canadian National operates a train ferry to Prince Edward Island as does the Canadian Pacific to Vancouver Island. Train ferries provide services across Lake Michigan, betneen Ludington and Frankfort in Michigan and Milwaukee. Manitowoc and Kewaunee in Wisconsin; they are operated by the Chesapeake and Ohio and other railways including the Ann Arbor, controlled by the Wabash railway.

Railway equipment is regularly ferried across the harbours of New York and San Francisco, and a regular service of train ferries links Cuba to the United States. (C. E R S)

FERSEN, FREDRIK AXEL, COUNT VON (1719–1794), Swedish politician, entered the Swedish Life Guards in 1740, and from 1743 to 1748 was in the French service (*Royal-Suédois*), where he rose to the rank of brigadier. At the diet of 1755–56 he was elected *landtmarskalk,* or marshal of the diet, and from henceforth, till the revolution of 1772, led the Hat party (see SWEDEN: Hzstory). In 1756 he defeated the projects of the court for increasing the royal power; but. after the disasters of the Seven Years' War, gravitated toward the court again and contributed, by his energy and eloquence, to uphold the tottering Hats for several years. On the accession of the Caps to poner in 1766, Fersen assisted the court in its struggle with them by refusing to employ the Guards to keep order in the capital when King Adolphus Frederick, driven to desperation by the demands of the Caps, publicly abdicated, and a seven days' interregnum ensued.

At the ensuing diet of 1769, when the Hats returned to power, Fersen was again elected marshal of the diet; but he made no attempt to redeem his pledges to the crown prince Gustavus, as to a very necessary reform of the constitution, nhich he had made before the elections, and thus involuntarily contributed to the subsequent establishment of absolutism.

When Gustavus III ascended the throne in 1772, and attempted to reconcile the two factions by a composition which aimed at dividing all political power between them, Fersen consented to open negotiations with the Caps, and was the principal Hat representative on the abortive composition committee. During the revolution of Aug. 1772, Fersen remained a passive spectator of the overthrow of the constitution, and was one of the first whom Gustavus summoned to his side after his triumph. Yet his relations with the king were never cordial. There was a slight collision between them as early as the diet of 1778; but at the diet of 1786 Fersen boldly led the opposition against the king's financial measures *(see* GUSTAVUS III.) which were consequently rejected. At the diet of 1789 Fersen marshalled the nobility around him for a combat *à outrance* against the throne and that, too, at a time when Sweden was involved in two dangerous foreign wars, and national unity was absolutely indispensable. This tactical blunder materially assisted the secret operations of the king. He and 20 of his friends of the nobility were arrested (Feb. 17, 1789) and the opposition collapsed. Fersen was speedily released, but henceforth kept aloof from politics, surviving the king two years. His *Historiska Skrifter*, a record of Swedish history, mainly autobiographical, during the greater part of the 18th century, is excellent as literature, but somewhat unreliable as an historical document.

See C. G. Malmström, *Sveriges politiska Historia* (Stockholm, 1855-65); R. N. Bain, *Gustavus III.* (1895); C. T. Odhner, *Sveriges politiska Historia under Gustaf III.'s Regering* (Stockholm, 1885, etc.); F. A. Fersen, *Historiska Skrifter* (Stockholm, 1867–72).

FERSEN, HANS AXEL, COUNT VON (1755–1810), Swedish statesman, was educated at home, and at the military schools of Brunswick, Turin and Strasbourg. In 1779 he entered the French military service *(Royal-Bavière)*, accompanied General Rochambeau to America as his adjutant, distinguished himself during the war with England, notably at the siege of Yorktown, 1781, and in 1785 was promoted to be *colonel propriétaire* of the regiment *Royal-Suédois*. The queen, Marie Antoinette, was especially attracted by his grace and wit and it is possible that he would have passed his life at Versailles, but for a hint from his own sovereign, then at Pisa, that he desired him to join his suite. He accompanied Gustavus III. in his Italian tour and returned home with him in 1784. Fersen went with his regiment to Finland in 1788, but in the autumn of the same year returned to France, where Gustavus required an agent thoroughly in the confidence of the French royal family, and sufficiently able and audacious to help them in their desperate straits. Before the end of 1790 Fersen had to admit that the cause of the French monarchy was hopeless so long as the king and queen of France were captives in their own capital. Finding the requisite funds he made the arrangements for their flight to Varennes, and was the coachman of the *fiacre* which drove the royal family from the Carrousel to the Porte Saint-Martin.

In 1791, Fersen was sent to Vienna to induce the emperor Leopold to accede to a new coalition against revolutionary France, but he soon realized that the Austrian court meant to do nothing, and was transferred to Brussels, where he could be of more service. In Feb. 1792, he reached Paris with counterfeit credentials as minister plenipotentiary to Portugal. On Feb. 13, he had three interviews with the royal family, but returned to Brussels on the 27th, having accomplished nothing. In 1797 Fersen was sent to the congress of Rastatt as the Swedish delegate, but in consequence of a protest from the French government, was not permitted to take part in it.

During the regency of the duke of Sudermania (1792–96) Fersen, like all the other Gustavians, was in disgrace; but, on Gustavus IV. attaining his majority in 1796, he was reinstated in all his offices and dignities. In 1801 he was appointed *Riksmarskalk* (=earl-marshal). On the outbreak of the war with Napoleon, Fersen accompanied Gustavus IV. to Germany to assist him in gaining fresh allies. He prevented Gustavus from invading Prussia in revenge for the refusal of the king of Prussia to declare war against France, and during the rest of the reign was in semidisgrace, though generally a member of the government when the king was abroad.

Fersen stood aloof from the revolution of 1809. *(See* SWEDEN: *History.)* His sympathies were entirely with Prince Gustavus, son of the unfortunate Gustavus IV., and when the newly elected successor to the throne, prince Christian Augustus of Augustenburg, died suddenly in Skåne in May 1810, the report spread that he had been poisoned, and that Fersen and his sister, the countess Piper, were accessories. When the prince's body was conveyed to Stockholm on June 20, 1810, and Fersen, in his official capacity as *Riksmarskalk*, received it at the barrier and led the funeral cortège into the city, he was attacked by the mob. In order to save him, two officers volunteered to conduct him to the senate house and there place him in arrest. But when he appeared on the steps, the crowd rushed on him and kicked and trampled him to death, while the troops, drawn up in the Riddarhus Square, made no effort to rescue the Riksmarskalk.

See R. M. Klinckowström, *Le Comte de Fersen et la cour de France* (1877; Eng. ed. entitled, *Diary and Correspondence of Count Axel Fersen*, 1902); *R.* N. Bain, *Gustavus III.*, vol. ii. (1895); P. Gaulot, *Un Ami de la reine* (1892); F. F. Flach, *Grefve Hans Axel von Fersen* (Stockholm, 1896); E. Tegner, *Gustaf Mauritz Armfelt*, vol. iii. (Stockholm, 1883–87); O. G. de Heidenstam. *Marie-Antoinette, Fersen et Barnave; leur Correspondance* (1913, Eng. trs., 1926).

FERTILITY AND FECUNDITY. Fertility is the power to beget living offspring; fecundity that of the individual to produce functional gametes (marrying cells, sex cells, in the higher animals' ova and sperms). The reproductive rate of a mating or of a generation is determined both by the fecundity of the individuals composing it and by the fertility of their matings.

There is some meaning in viewing fecundity as what a species can do in terms of maximal reproduction, and fertility, as what a species actually does. Animals that live more exposed to rigorous environmental conditions usually have a high fecundity and those in more protected environments, frequently in part of their own making, a lower fecundity. This can be said differently: In a general way, fecundity is in direct relation to the chances of death; those species which have many enemies and face many hazards produce many eggs. There are numerous exceptions to this rule, however. It has been estimated that the Pacific herring of the Strait of Georgia has a population on four spawning grounds of 1,000,000 to 9,000,000 fishes. These produce annually something in the order of 8,000,000,000 to 75,000,000,000 eggs of which about 0.1% may reach maturity even though 95% may hatch. On the other hand, a mammal such as the human species has a low fecundity but a high degree of reproductive success in terms of reproductive effort.

Fecundity potentials can assume startlingly high proportions. An individual oyster can produce 55,000,000 to 114,000,000 eggs during its lifetime. It is estimated that the blue crab of the western Atlantic carries as many as 1,750,000 eggs at one time. A fish, the shad, is reputed to lay from 30,000 to 100,000 eggs per season; an adult cod about 4,400,000 eggs per year, and the carp from 2,000,000 to 4,000,000 eggs a year. An old speculation suggests that the tapeworm *Taenia* produces at least 8,800 eggs in a single proglottis and liberates as many as 13 or 14 proglottids each 24 hours.

Fecundity is affected by factors which determine or influence:

(1) *The number of gametes available at the time of fertilization.* In certain forms the female is monotocous (producing one young at a birth), only one ovum being extruded from the ovary and becoming available for fertilization at each period of "heat." In others she is polytocous, several or many extruded ova being available for synchronous fertilization by the abundant sperm. In both forms the ripening of the ova and the number extruded are conditioned by environmental factors. As a general rule, the average number of offspring in a litter in any species of mammals is inversely proportional to the average size of the animals of that species. In ungulates, twins are exceptional. The sow, however, is remarkable in having very large litters. In small mammals and rodents large litters are the rule, but the bats are exceptional, only one young ordinarily being produced at a time, doubtless to avoid extra weight when flying. Broadly speaking those species in which the gestation period exceeds six months produce but one young at a time and the number of teats is an approximate indication of the average size of the litter. The initial fecundity gradually waxes to a climax and thereafter gradually wanes. In polytocous animals the first litter as a rule is relatively smaller as are those which are born towards the end of the reproductive life of

the individual. In the fowl the greatest fecundity is exhibited during the first year and diminishes rapidly and progressively thereafter. It is probable that artificial selection is the cause of this antedating of the peak of fecundity in the fowl. Increased nourishment is followed by an increase in the number of ova shed in the polytocous forms, *e.g.*, the effects of "flushing" (special feeding) in sheep. Insufficient food and especially a deficiency of the accessory food substances, vitamins B and E (*see* VITAMMS) lead to an imperfect production or to the nonproduction of gametes by both male and female. The number of sperms is an important factor in efficient fertilization, for a certain concentration is required in the rabbit. Ordinarily, spermatozoa are present in amply sufficient numbers in the male ejaculate. Hammond (1925) found that in the case of the male rabbit repeated intercourse was followed by no reduction in fertility, though the periods between copulations became increased. Lloyd Jones and Haqs (1918), however, found that excessive intercourse led to a reduction both in pregnancies and in litter size.

(2) *The frequency of ovulation.* There are monoestrous forms in nhich the female has but a single oestrous cycle within one sexual season, and polyoestrous in which she has two or more. Since fertilization can only occur during the oestrous cycle the reproductive rate is limited by the frequency of these cycles. In most wild mammals the male experiences a sexual season as well as the female and generative activity is entirely restricted to such times. In man and most domesticated animals, however, the male is capable of sexual intercourse at all seasons, though an increased sexual activity may be evidenced at certain times of the year. Since in the human female there is no restricted sexual season fertilization can occur at all times throughout the year. Long continued lactation would seem commonly to exert an inhibitory influence on the oestrous cycle. In the pig, early weaning leads to a more frequent recurrence of oestrous cycles and an increased number of litters.

(3) *The length of life of tlze individual and tlze length of its reproductive phase.* Longevity is an hereditary character. Fecundity is exhibited during the period of life between puberty and senescence. The total number of opportunities for fertilization is influenced by hereditary and environmental factors which affect the time of attainment of puberty, the time of the onset of the climacteric, and the length of life. The protection and sanitation of domestication and civilization can prolong life and delay the decline of reproductive vigour.

(4) *The functional ability of the gametes.* The gametes of the mule and of other interspecific hybrids are in the great majority of cases inherently imperfect and incapable of fusing in proper fertilization. Commonly the sterility in these cases is due to irregularities in the mechanism of division of the germ cells and in some to the fact that the chromosome number and form of the two parental forms are widely different (*see* CYTOLOGY). Poisons, toxins and X-rays can render the gametes imperfect. The intra-abdominal undescended testis (*e.g.*, in so-called "rigs" in horses) cannot proceed to the elaboration of functional sperm for this cannot occur at a temperature as high as that within the body. Certain wild animals when removed from their natural habitat and kept in captivity become partially or completely sterile even though kept in a healthy condition and in their native countries. For reasons as yet unknown the generative system fails to discharge its functions: there is either an absence of sexual desire or an inability to elaborate functional gametes. Some normal stimulus to sexual activity, possibly a psychological one, is lacking.

Fertility.—The union of the gametes and the proper development of the resulting individual is embarrassed or prevented by factors which affect:

(1) *The act of sexual congress, e.g.*, homosexuality, intersexuality, and other structural, physiological and psychological anomalies.

(2) *The actual union of the ganzetes after efficient congress.* For reasons as yet unknown, certain individuals are infertile *inter se* but when mated with other individuals beget offspring. In human societies a differential fertility rate distinguishes the social grades. The average size of the family among the relatively socially unsuccessful is on the whole greater than that of the successful. Much of this difference is due to differences in the exercise of control, abstinence, and the use of contraceptives. It has not yet been demonstrated that any of it is due to a differential fecundity distinguishing the social grades.

(3) *The antenatal nurture of the offspring.* Hereditary and environmental factors can bring about the death of the embryo and foetus *in utero*. In polytocous forms the number of fertilized ova is frequently in excess of the nutrition available for them with the result that atrophy and absorption of the surplus embryos and foetuses occur. In other cases the death of the offspring is due to the action of hereditary *lethal* factors (*see* HEREDITY). An instance of such lethal factors is that which eliminates the homozygous yellow mouse. The mating yellow×yellow invariably yields yellows and grays in the ratio 2:1. Such yellows are constitutionally heterozygous: the homozygous yellow dies *in utero* as the result of the action of the hereditary factor for yellow present in duplicate. Haemophilic (bleeder) female children are comparatively rare: it is thought that the homozygous haemophilic usually dies early in pregnancy; only the female can carry the factor for this sex-linked character in duplicate (*see* HEREDITY). An examination of the sex ratio among new-born children, still-births and abortions, reveals the fact that during intrauterine life and parturition more males than females succumb. The male is constitutionally less able to withstand unfavourable conditions.

(4) *The postnatal viability of the individual.* The same hereditary and environmental factors as those which operate antenatally arc responsible for the fact that more males than females succumb during the antepubertal period. During the age group 10–15 years more females than males die, a reflection of the dangers that beset the onset of puberty in the female.

(*See* REPRODUCTION.)

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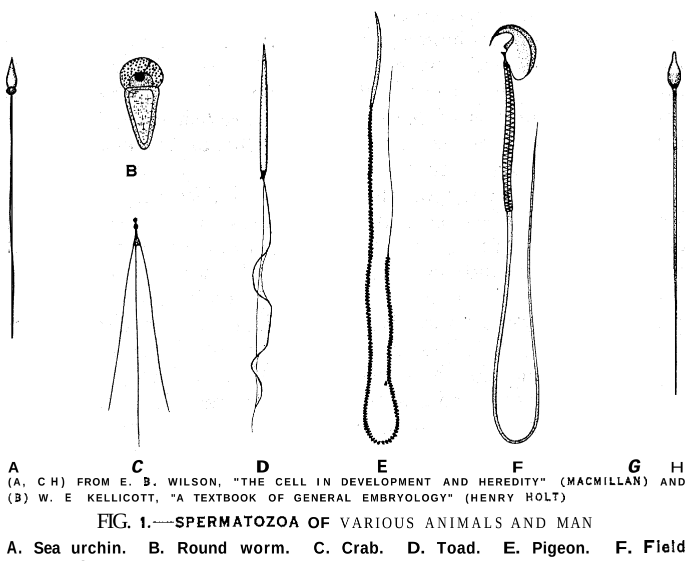
(F. A. E. C.; T. PK.)

FERTILIZATION. A new organism, animal or plant, usually arises from a fertilized egg. Fertilization is the union of an egg cell (ovum) from the female, with a sperm cell (spermatozoon) from the male. In the process of fertilization, two main functions are served: (1) the egg is activated to development by the spermatozoon and (2) the hereditary characters of both mother and father are combined in the new organism. The activation of the egg by the spermatozoon is in the nature of a chemical reaction and results in a change in the surface and in the substance (cytoplasm) of the egg cell. The combination of the hereditary characters is accomplished by the nuclei, small bodies within the cells, or more specifically by the chromosomes within the nuclei.

Egg cells are formed in the ovary and are typically large cells rather simple in appearance, each consisting of cytoplasm and a nucleus. The cytoplasm is enclosed in a cell membrane and consists of a liquid matrix or "ground substance" in which are embedded yolk and other granules of different sizes, weights and chemical composition. The nucleus is a small spherical body within the cytoplasm enclosed by a nuclear membrane and consisting of a liquid matrix (nucleoplasm) and the chromatin material which in certain stages is in the form of very definite bodies or chromosomes in which lie the genes which determine the hereditary characters. Each species of animals and plants has a definite number of chromosomes. In the fruit fly, *Drosophila melanogaster*, on which so much genetic work has been done, there are eight chromosomes in the body cells and early egg and sperm cells. The chromosome number in man, long thought to be 48, is now placed at 46.

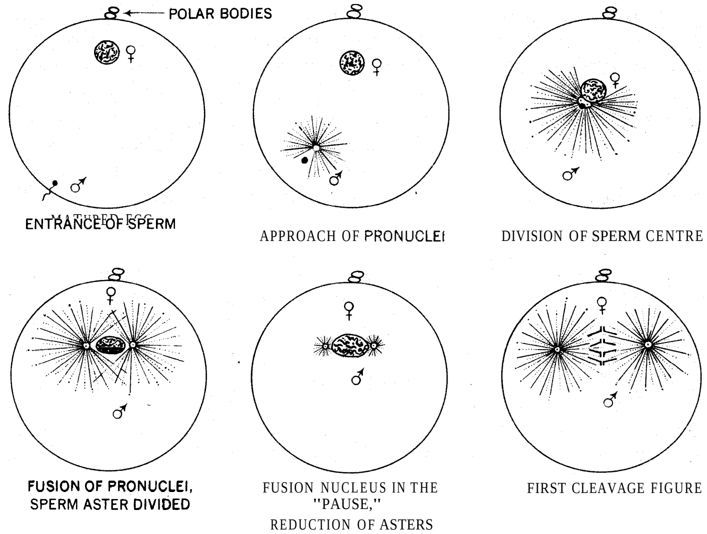
The spermatozoa are very specialized small cells adapted to their function of finding and attaching themselves to the egg. The spermatozoa develop in the testes from cells originally much like primitive egg cells. Whereas the egg cell increases greatly



(A, C H) FROM E. B. WILSON, "THE CELL IN DEVELOPMENT AND HEREDITY" (MACMILLAN) AND (B) W. E KELLICOTT, "A TEXTBOOK OF GENERAL EMBRYOLOGY" (HENRY HOLT)

FIG. 1.—SPERMATOZOA OF VARIOUS ANIMALS AND MAN

A. Sea urchin. B. Round worm. C. Crab. D. Toad. E. Pigeon. F. Field mouse. G. Man, face view. H. Man, side view



FROM E B WILSON, "THE CELL IN DEVELOPMENT AND HEREDITY" (MACMILLAN)

FIG. 2.— DIAGRAM OF SEA URCHIN TYPE OF FERTILIZATION (MAGNIFICATION 200 X)

in size without much change in form as it matures, the sperm cell actually becomes smaller and very complicated in structure. They differ in shape in different animals (*see* fig. 1). The most common type is a free-swimming form consisting of: (1) a head containing the chromosomes, now massed together. but of the same number as those in the mature egg cell; (2) a middle piece in which lie certain bodies, centrosomes, which probably function in the subsequent division of the egg; and (3) a long tail which is very motile and enables the sperm to swim.

The spermatozoa of some animals (*e.g.*, crabs and lobsters) have no tails. but several spinelike processes by which they move slowly to the egg.

Since, in fertilization. the chromosomes which come from both the male and the female are added together and would double in number in each generation, there is a special mechanism by nhich this is prevented. Just before the egg cell becomes mature' and ready for fertilization, the chromosomes become associated in pairs, so that apparently only half the number is present. Now the cell (oöcyte) divides twice, very unequally, into one large and one very small cell. These two small cells, known as polar bodies (fig. 2), are discarded. But in the process of throwing off the polar bodies, one-half of each paired chromosome is discarded also, so that the mature egg is left with one-half the number of chromosomes (haploid number) that are present in each of the body cells and early germ cells (diploid number). Likewise the sperm cell (spermatocyte), in maturing, divides twice but into equal cells, each with half the original number of chromosomes (now haploid number), and all four of these cells form spermatozoa. Thus when the egg and sperm unite in fertilization, the somatic (diploid) number characteristic of the species is restored.

Since all the cells of the body, including the germ cells, arise by division of the original fertilized egg cell. each cell has the same number of chromosomes.

The sex of an individual is determined at fertilization by the sperm in man and many other animals because half of the spermatozoa differ from the other half in one of the chromosomes In butterflies, moths and birds, the sperm are all alike but the eggs are of two slightly different types with regard to one chromosome and here the female determines the sex of the next generation at fertilization. (*See* CYTOLOGY; HEREDITY; GENE.)

Fertilization in the Sea **Urchin.**—Whereas it is difficult to obtain human eggs, certain marine eggs can be obtained in abundance and the actual process of fertilization, that is, the union of the egg and sperm, can be best studied here (see fig. 2). One can put the eggs of a sea urchin, Arbacia *punctulata,* in sea water in a small glass dish and add some sperm. Under a microscope one can watch the sperm cells collect around each egg. The meeting of the egg and sperm is generally believed to be by chance in animals, not by chemical attraction, but having reached the egg, the sperm are held there by the surrounding jelly (see EMBRYOLOGY, CHEMICAL). Though there may be thousands of sperm present, only one sperm enters the egg, and, in Arbacia (also in mammals), at any point on the surface. In some animals several sperm normally enter but only one takes part in the union with the egg nucleus (*e.g.,* in the hen's egg). Within two minutes, in Arbacia, a membrane, the fertilization membrane, is thrown off a small distance from the surface of the egg; it removes the unsuccessful sperm from the surface of the egg and probably protects the egg as it develops.

Some of the details of the succeeding events can be seen in the living egg but they are better seen in stained sections, that is, thin slices of the eggs which have been killed and stained and mounted on a glass slide. About five minutes after fertilization the sperm head is seen inside the egg, accompanied by a small star-shaped figure, the sperm aster. This is generally believed to arise from the centrosome brought in by the middle piece. In this case the tail of the sperm is left outside, though in some eggs (*e.g.,* the guinea pig) the tail also enters the egg. The head of the sperm becomes the male pronucleus, enlarging somewhat as it approaches the egg nucleus (female pronucleus), which itself moves slightly toward the male pronucleus.

The two pronuclei unite near the centre of the egg and the astral radiations extend throughout the cell; this is the monaster, readily visible in the living egg. In the fusion nucleus of Arbacia the male and female components become indistinguishable. Soon (about 30 min. after fertilization) the nuclear membrane breaks and a typical division figure, the mitotic figure, then forms. The chromatin material from the nucleus forms into definite bodies, the chromosomes, which become arranged at the equator of a spindle. at each of whose poles is an aster; this figure is called the amphiaster. The chromosomes in this egg are small andnumerous: probably there are 38 (diploid number). The chromosomes then divide. half of each chromosome going to each pole; then they reform into new nuclei. The two asters are readily visible in the living egg, and one can watch the indentation of the cytoplasm between the two asters forming the cleavage furrow, which deepens and soon separates the egg into two halves or blastomeres, each with a nucleus formed by the daughter chromosomes.

The first cleavage takes place in this egg in about 50 min. after fertilization at 23° C. In this division, as in all subsequent divisions, the chromatin material, which is a combination of maternal and paternal, is equally distributed to the two daughter cells. By subsequent divisions, 4, 8, 16, etc., cells are formed with clock-like regularity. (See CYTOLOGY; EMBRYOLOGY.)

Number and Size of Eggs.—The simplest form of fertilization takes place in marine animals such as the sea urchin, as described above, mollusks and worms. The eggs and sperm are shed, when ripe. into the sea water. Since the union of egg and sperm is almost entirely by chance, each animal produces millions of eggs and sperm. In the frog, the male clasps the female as the eggs are being laid, and sheds his sperm over them. There are in this case many fewer eggs. In the higher animals, including the mammals, the eggs are fertilized inside the body of the female, on their way down from the ovary to the outside. There are still fewer eggs provided in this case. The eggs of some animals (*e.g.,* birds) are laid soon after fertilization, and since they must develop to a free-living form before hatching, they are supplied with a large amount of nourishment in the form of yolk. In the hen's egg. the young embryo is a small white disc on the surface of the yolk and all the rest of the egg, yolk and white. is nutrient material In most mammals, including man, the young embryo is nourished within the mother by her tissues. so that the egg requires no reserve material and is relatively small and simple.

Fertilization in Man and Other Mammals.—The mature human egg, as well as that of a dog and cow, is approximately 100μ in diameter ($=0.1$ mm. or 1/250 in.), excluding the zona pellucida; it is the largest cell in the body, about the size of a very fine grain of sand, just visible to the naked eye. It is essentially like the sea urchin egg, consisting of a mass of granular cytoplasm with a nucleus which cannot be seen in the living egg, but can be readily seen in stained and sectioned material; in the clearer rabbit egg, the nucleus can be seen in the living cell. There is a clear translucent zone, the zona pellucida, just outside the real cell membrane, about 20μ thick (function unknown. probably protective). It has been estimated that there are about 400.000 eggs, mostly immature: in the two ovaries of a young woman. It is believed by most authorities that all the eggs which will function in life are already present in the new-born girl, though some anatomists think new eggs are formed continuously in the ovary of the adult and that these are the functional ones. Since a woman usually sheds only one egg a month (none during pregnancy) from about 12 to 48 years of age. she needs only about 430 eggs during her lifetime. so that she has, potentially, nearly 1,000 times more than are necessary.

As the egg ripens in the ovary, cells multiply around it to form a follicle. The follicle (about 12 mm. diameter when mature) pushes its way to the surface of the ovary, bursts and releases its contents including the egg; this is ovulation. The egg now leaves the ovary, probably after the first polar body has been formed, and is received by the open end of one of the two oviducts or Fallopian tubes, usually the one on the same side of the body. It passes through the Fallopian tube which is about 11.5 cm. long (= $4\frac{1}{2}$ in.), probably both by means of the current made by the little hairs or cilia lining the tubes and by contraction of the muscle fibres in its walls. The egg takes four days to travel through the Fallopian tube on its way to the uterus.

The mature human spermatozoon is much like that of a rat or a rabbit or even a sea urchin (fig. 1). It has an over-a11 length of about 60μ (= 0.06 mm. or $\frac{1}{400}$ in.). The head. which contains the nucleus. is rounded and asymmetrical. being somewhat flattened; it is about 5μ long, 3μ wide and 1.5μ thick. The tail is about 50μ long and 0.3μ in diameter. It is among ihe smallest cells in the body. The volume of the human sperm is about $\frac{1}{50.000}$ that of the egg. It h a been estimated that all the spermatozoa necessary to produce the next generation in North America could be contained in the space of an ordinary pinhead. The eggs necessary for the next generation could be put in a pint jar. The sperm cells are formed continuously after puberty throughout life. It is estimated that there are 300,000,000 sperm in each ejaculation (4 cc.). and since it takes only one sperm to fertilize an egg, the waste is enormous.

Sperm cells deposited in the vagina by the male make their way in a few hours through the uterus. probably by muscular contraction of the wall. and up into the Fallopian tubes. They swim at the rate of about 2.7 mm. per minute which is near the rate of a good swimmer. length for length. It is in the upper part of the Fallopian tubes that fertilization takes place, that is, if there happens to be a ripe egg present. Fertilization prohahly takes place within a day after ovulation; if not fertilized. the egg clegenerntes after a day. Ovulation usually occurs about 14 days before the onset of the next menstruation. On the third or fourth day after fertilization, probably when in the four or eight cell stage, the developing egg passes into the uterus. It becomes attached to the uterine wall on about the seventh day after fertilization. The empty follicle in the ovary has meanwhile been transformed into the corpus luteum, an organ which produces the important hormone progesterone. (*See* REPRODUCTION; REPRODUCTIVE SYSTEM.)

Sperm can be introduced into the mammalian body artificially, with a pipette, and are functional in fertilizing the eggs. This has been done with horses. dogs and sheep, and was practised by the Arabs in the 14th century. It is now a common practice to trike the sperm from a particularly good bull and send it (with a small amount of glycerine) packed in dry ice to hreeders to fertilize their cows. Some bull sperm has been kept frozen in this manner for four years and has retained its fertilizing capacity. Human sperm, likewise frozen, may be kept in dry ice for three months and still retain its fertilizing power.

Fertilized mammalian eggs (rabbit and monkey) have been recovered from the Fallopian tubes, and motion pictures have been taken of their development for several days after fertilization. Development of the human egg outside the body (in vitro) is much more difficult to obtain, but there is no fundamental reason why this should not be done. The very complicated later development of any mammalian egg, including the human, will be almost impossible to obtain in vitro.

Hybrids. — In most cases the female of one species cannot be fertilized by the male of another. Well-known hybrids. however, do occur, but are usually sterile, *e.g.*, the mule (see HYBRIDISM).

Parthenogenesis. — There are a few animals in which the egg develops naturally without fertilization; such is the case in the plant lice (aphids) and the male bees (drones). There are a number of eggs, notably those of the sea urchin and starfish, which can be made to develop to normal larvae by artificial means instead of by fertilization. Heat. cold, various salts, hypotonic and hypertonic sea water have all been used to cause parthenogenesis in eggs of various animals. In the case of the frog, the eggs can be activated by pricking with a needle. Even mammalian (rabbit) eggs have been reported to develop parthenogenetically, by cooling the unfertilized eggs and then incubating them (G. Pincus and H. Shapiro, 1940). In artificial parthenogenesis, there is, of course, only one set of chromosomes, derived from the mother (see PARTHENOGENESIS).

Merogony.—This is the term applied to the fertilization of a nonnucleate egg or egg fragment. It is possible to shake apart or cut certain marine eggs, so that one part contains the nucleus and the other part has none; eggs can also be broken into two parts by rapid centrifuging. On fertilization, both these fragments, the nonnucleate as well as the nucleate, may develop into larvae. These merogonic eggs have, like the parthenogenetic eggs, only one set of chromosomes, but in this case it is the paternal set.

Parthenogenetic **Merogony.**—A combination of parthenogenesis and merogony can be made by treating nonnucleate fragments with a parthenogenetic agent. These completely nonnucleate egg fragments (of *Arbacia*) have passed through successive cleavages in a fairly normal fashion to the blastula stage (E. B. Harvey. 1956). The very early development of an egg can. therefore, take place without fertilization and without any nucleus.

Fertilization in Plants. — In plants as in animals. a union of male and female cells takes place in fertilization; but only among the lower plants such as the algae, and in the mosses and ferns, is a large cell fertilized by a small free-swimming sperm cell.

In the flowering plants. fertilization takes place in the pistil (often a vase-shaped structure present in the centre of the flower'), within which lies the ovule. and in it the egg cell. The pollen grains are carried by the wind or insects to the pistil; there they elongate into pollen tubes which grow down into the ovule. One of the nuclei of the pollen tube combines with the nucleus of the egg. thus ensuring inheritance from both parents. The fertilization process, as thus simplified: is somewhat complicated by an alternation of generations, a nonsexual generation alternating with the sexual generation. (See **PLANTS** AND **PLANT** SCIENCE; ANGIOSPERMS.)

Investigations After 1950. — Knowledge of the process of fertilization increased considerably after the main facts were established as outlined above. This was largely the result of the development of the electron microscope. Of special interest was the observation of acrosomal filaments of many sperm cells.

In many eggs the cortex, a layer just beneath the surface of the egg. contains special granules which disappear at fertilization and help form the fertilization membrane. In the sea urchin, about 15 to 20 seconds after the attachment of the acrosome filament of the sperm to the egg surface these cortical granules begin to explode in a wave which encompasses the egg surface. The vitelline membrane lifts off the surface because of the colloid osmotic pressure of the substances released by the cortical granules. The remaining material from these granules becomes incorporated into the fertilization membrane when it hardens, and into the hyaline layer which soon appears over the egg surface. There seems to he no doubt that the fertilization membrane is of dual origin, and is a combination of the vitelline membrane and material from the cortical granules.

Studies continued on the method of sperm entry into the egg, the movement of the nuclei within the egg, the fertilization cone and fertilization membrane and polyspermy, and special emphasis was placed upon the chemical changes, probably due to enzymes, that occur during and after fertilization. Since much of this work remains unsettled, definite conclusions cannot be drawn on many of the details of fertilization, especially from the chemical standpoint. See also references under "Fertilization" in the Index volume.

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FERTILIZERS AND MANURES. Fertilizers include both natural and artificial substances that increase the productiveness of plants. In many countries of the world, including the United States and all of Europe, fertilizers stand in the way of widespread starvation. In areas such as China and India where famines have been commonplace, extensive use of fertilizer where needed could significantly reduce the incidence of food shortages. It was estimated that by the second half of the 20th century at least 20% of the food produced in the United States was due directly to commercial fertilizers.

It had become clear that the rapidly growing population of the world must depend increasingly upon commercial fertilizers for its food and fibre.

This article is divided into 14 broad sections dealing with the history and use of fertilizers and manures and providing detailed information about the various kinds of fertilizers. Fertilizer applicators and manure spreaders are described in the article TILLAGE MACHINERY.

In addition to the related articles referred to in the following sections of this article see also AGRICULTURAL EDUCATION AND RESEARCH; PLANTS AND PLANT SCIENCE.

The following are the main divisions of this article:

I. History
II. Essential Elements
III. Determining Fertilizer Needs
IV. Influence of Fertilizers on Livestock and Human Food
V. Analyses, Grades and Ratios
VI. Fertilizer Injury to Crops
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 A. Natural Organics
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IX. Phosphorus-Supplying Fertilizers
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I. HISTORY

When there were large areas of unused frontier land in the world it was often more economical for farmers to move onto new, unfarmed land than to invest additional money in fertilizers for the land they were then farming, a practice continued into the second half of the 20th century in some underdeveloped areas of the world (see TROPICAL AGRICULTURE). However, some use of manure and composts is probably almost as old as agriculture itself and many other materials, such as ground bones, wood ash from burning the felled trees, dried blood, saltpetre, guano and fish were employed long before the chemistry of soils and crops was understood (see AGRICULTURE, PRIMITIVE) The disappearance of the frontiers combined with improvements in the technology of fertilizer manufacture and more effective transportation led to a growing role of fertilizers for producing the needed food and fibre.

The first prerequisite to the use of fertilizers was an understanding of the function of plant nutrients in plant growth. In the light of present knowledge of plant growth, it is difficult to understand some of the concepts that were set forth by the scientists of a few hundred years ago. The milestones in the development of understanding of plant growth and nutrition rank in significance to mankind with the greatest achievements in chemistry, physics. mathematics, astronomy and other disciplines. The Romans, beginning with Cato about 200 B.C. through Columella in the first century A.D., knew enough about soil fertility to recommend crop rotations. liming acid soils, adding manure and growing legumes which fix atmospheric nitrogen. Jan Baptiste van Helmont (1577–1644) conducted a classic experiment with a willow tree as one of the earliest attempts to find the principle underlying plant growth. He planted a 5-lb. tree in 200 lb. of soil. Five years later the tree had grown to 169 lb. but the soil had lost only 2 oz. He concluded that water was the sole nutrient utilized.

A German, J. R. Glauber (1604–68), found large crop responses to saltpetre (potassium nitrate) and believed it to be the principle of life. In 1699, John Woodward grew plants in (a) rain water, (b) water from the Thames river, (c) effluent from the Hyde Park (London) conduit and (d) the effluent plus garden mold. The amount of plant growth increased with greater sediment in the water. He concluded that the soil contained the long-sought principle. About 1750 to 1800, trained chemists began to study plant nutrition. In 1804, Théodore de Saussure introduced quantitative methods and established several important principles. In 1834, Jean Baptiste Boussingault established the first field experiments.

In 1840, Justus von Liebig (*q.v.*) drew wide attention to agricultural fertility investigations with several striking theories contradicting the old notion that plants derive their nourishment from humus. He also proved that strong acid treatment increased the availability to plants of nutrients in bones (see Processing Phosphate Rock, below). In 1886. Hellriegel and Wilfarth determined that certain microorganisms in combination with leguminous plants obtained nitrogen from the air. From the late 1880s research continued at an accelerated rate on the determination of additional essential elements, on the best time, rate and method to apply fertilizers, and on fertilizer formulations.

II. ESSENTIAL ELEMENTS

Of the slightly over go chemical elements that occur naturally in the earth's crust or atmosphere at least 15 are known to be essential for normal plant growth. Another element is added to

TABLE I.—Elements Essential for Normal Plant Growth

Used in large amounts	Symbol	Source	Used in small amounts	Symbol	Source
Carbon. . .	(C)	From air	Boron	(B)	From soil solids
Hydrogen . .	(H)	" "	Copper	(Cu)	" "
Oxygen. . .	(O)	" "	Iron	(Fe)	" " "
Nitrogen . .	(N)	From soil solids	Manganese	(Mn)	" " "
Phosphorus. .	(P)	" " "	Zinc	(Zn)	" " "
Potassium . .	(K)	" " "	Molybde-num	(Mo)	" " "
Calcium . .	(Ca)	" " "			
Magnesium. .	(Mg)	" " "	Chlorine	(Cl)	" " "
Sulfur . . .	(S)	"			

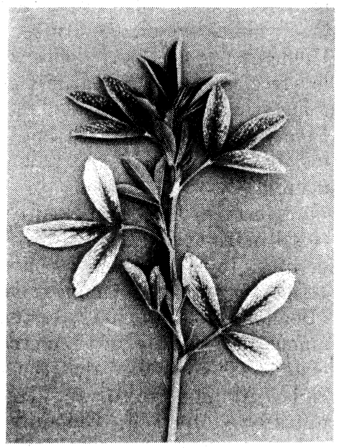
the list on an average of about every 10 or 20 years as new techniques are devised for producing more nearly chemically pure sources of nutrients for plant nutrition studies. The identification of several elements which are needed in almost infinitesimal amounts was long overlooked because the elements were contained as traces of impurities in the chemicals used to supply other nutrients known to be needed. or were dissolved in adequate quantities from the glass containers.

The essential elements and their sources are indicated in Table I. Each element has a specific biological role to play in normal plant growth. Some nutrients become part of the structure of the plant; others are required for normal growth but do not become a structural part of the plant. Several of the minor elements appear to be needed for proper functioning of the enzyme systems which regulate plant growth.

III. DETERMINING FERTILIZER NEEDS

The determination of the fertility needs of economic plants has received more attention from soil and plant scientists than any other aspect of plant growth. Several approaches are used.

Nutrient Deficiency Symptoms. — Many plants exhibit easily recognized symptoms of certain nutrient deficiencies. To the trained person these symptoms are helpful in indicating nutrients to be applied. Relying heavily upon deficiency symptoms has, however, three weaknesses: a profitable response to fertilizer is often possible before the plant shows the symptom; by the time the symptom is recognized it is frequently too late in the growth of the crop to prevent a serious loss of yield; many crops never exhibit identifiable symptoms.



BY COURTESY OF SAMUEL R. ALDRICH

ALFALFA PLANT EXHIBITING CHARACTERISTIC POTASSIUM DEFICIENCY

Soil Tests. — Soil tests carefully made on representative samples and interpreted by a trained soils expert are an important tool in planning a sound soil fertility plan. Soil tests measure the general fertility level and, when made systematically over a period of years, show whether fertility is being maintained, increased or is declining. (See also SOIL TESTING AND ANALYSIS.)

Plant Tissue Tests.—Chemical tests of the tissues of growing plants are sometimes helpful in diagnosing deficiencies, but the interpretation must be made by a trained person because of the complex interplay of soil moisture! temperature and fertility and the effect of one nutrient on another.

Soil Classification. — Soil maps are available for many important soils of the world. The description of the soils frequently gives valuable information on the inherent nutrient status.

Field Experiments and Farm Trials. — In the final analysis actual field experiments are the best guide to fertilizer response. Other techniques are mostly substitutes that are used because they are less costly than widespread field experiments. Many farmers and gardeners can conduct small trials on their own situations.

IV. INFLUENCE OF FERTILIZERS ON LIVESTOCK AND HUMAN FOOD

Fertilizers influence plants that are consumed by livestock and humans in several ways: (1) by increasing the yield and thus the amount of plant available; (2) by making it possible to grow different species of plants on a soil; and (3) by changing the chemical composition of the individual species with respect to minerals, vitamins, proteins or hormones. When a nutrient that is extremely deficient in a soil is added in small amounts the plant usually responds first in increased growth; as the nutrient is added in greater amounts it is likely to accumulate in the plant, frequently in excess of the amount required for optimum growth. Wide variations in inherent soil fertility or fertilizer applications often change yield but do not markedly affect the chemical composition of fruits and seeds although an abundant supply of nitrogen raises the protein content of grains. Data on the effect of fertilizers on vitamins, protein quality and hormones are much less extensive than for mineral composition. Research indicates that climatic factors are more influential than soil factors.

Since grazing livestock obtain all of their food directly from the soil, the nutritional deficiencies related to soil fertility and fertilizers are more common in such livestock. According to Kenneth Beeson: "An abnormally low level of phosphorus in the soil and in forage crops is the most nidespread and economically important factor in nutritional troubles in grazing animals" (American Plant Food Journal, 5:6–11, National Plant Food Institute, Washington. D.C., 1951).

The "styfsiekte disease" common in the Union of South Africa is due to a deficiency of the herbage in phosphorus and calcium. Phosphorus deficient forage has been found in Alabama, Florida, Michigan, Minnesota. Montana, Tennessee. Texas and Wisconsin in the United States. Cobalt deficiencies for livestock are knoun to exist in several areas of the world. The effect of fertilizers and soil fertility on the quality of livestock products is an important consideration because meat, milk and other livestock products contribute a substantial part to human food. Further research is needed but it appears that when enough fertilizers are used to grow desirable species and adequate quantities of plants the nutritive quality of the foods is generally acceptable. Livestock are more directly affected by fertilizer and soil fertility than humans because humans eat mostly the fruits and grains of plants, which are less influenced by soil fertility than the leaves and stems which make up a large part of livestock feed; the diet of humans includes foods brought in from other geographical areas, and many humans eat livestock products which are little affected in quality by changes in the diet of the animal. A notable example of a direct relationship between soil and human health is goitre, caused by a deficiency of iodine. There have also been reported cases of selenium toxicity in some areas of Mexico.

Organic and Inorganic Fertilizers. — Some persons have advanced the claim that chemical fertilizers jeopardize the health of animals and humans. A comprehensive study by the house of representatives of the United States led to the following committee report: "No reliable evidence was presented that the use of chemical fertilizers has had a harmful or detrimental effect on the health of man or animals." Scientific evidence indicates that nutrients actually enter living plants in the same chemical form nhether the nutrients are from organic or inorganic sources. It is possible to add certain harmful elements to the soil and have them absorbed by plants with a subsequent deleterious effect on animals. Selenium, for example, occurs in such abundance in some soils in the great plains region of the United States from Montana to New Mexico that grazing animals develop alkali disease. The effects of using chemical fertilizers should not be confused with the effects of certain chemical insecticides and fungicides which may be retained as residues on harvested crops and eventually be consumed by humans as plant or animal products.

The effect of fertilizers on bacteria, earthworms and other forms of life within the soil is of considerable importance. The consensus of soil scientists is that fertilizers judiciously used are not harmful and in fact may benefit soil life through an increase in the amount of plant residues returned. (See also FEEDS, ANIMAL; NUTRITION.)

Nutrients Removed in Crops. — The number of pounds of some important nutrients that are contained in the above-ground parts of selected crops are shown in Table II.

V. ANALYSES, GRADES AND RATIOS

The standard order to list the nutrients in a mixed fertilizer is nitrogen, phosphorus and potassium. The analysis or grade commonly refers to the percentage composition of the fertilizer in total N (nitrogen). available P_2O_5 (phosphorus anhydride) and water soluble K_2O (potassium oxide); for example, a 12–12–12. In fertilizer terminology P_2O_5 is called phosphoric acid and K_2O is called potash. These terms have been used since the mid-1880s. Some European countries use the elemental system, N, P and K, and it is likely that the rest of the world will adopt this system. Fertilizer recommendations for specific soils and crops are frequently given in terms of the desirable ratio. The ratio of a fertilizer expresses the relationship among the three major nutrients. nitrogen, phosphoric acid and potash, N-P_2O_5-K_2O, and in some cases additional nutrients. A 12–12–12 fertilizer has a 1–1–1 ratio. A mixed fertilizer is one that contains more than one of the three principal nutrients, N, P and K. Fertiliser materials are considered to be the basic materials which may either be applied directly to the soil or be combined with other materials to produce a mixed fertilizer.

Table II.—*Some Plant Nutrients Contained in Crops*

Crop	Nutrients in above-ground parts (in lb.)					
	Nitrogen	Phosphorus anhydride (phosphoric acid)	Potassium oxide (potash)	Calcium oxide	Magnesium oxide	Sulfur
Barley*, roo bu.	120	50	100	26	16	16
Cabbage, 1 ton.	6	2	8	1	1½	1½
Corn*, 100 bu.	160	66	110	42	18	18
Cotton, 1,500 lb. seed, lint; 2,joo lb. stalks, leaves, etc.	81	29	47	51	25	2
Oats*, 100 bu.	88	34	78	26	12	14
Onions, 100 bu. bulbs	15	7	14	2	5	2
Peanuts. 1.000 lb. nuts plus ''inks	73	12	50	30	10	15
Potatoes, 100 bu. tubers	31	9	30	2	4	2
Soybeans*, 100 bu.	350	80	150	15	25	25
Sugar beets, 1 ton beets	5	1½	4	2	1	⅓
Tobacco, 1,000 lb. leaves	74	11	102	89	15	10
Wheat*, roo bu.	152	64	92	28	20	24
Alfalfa hay†, 1 ton	45	11	45	52	12	5
Clover hay†, 1 ton	41	8	33	40	9	5

*Grain crops cannot be rompared on a bushel basis because the weight per bushel varies among crops.
†Composition, especially nitrogen, varies with the maturity of the crop.
Source: Our *Land and Its* **Care,** American Plant Food Council (1955).

Throughout most of the first 100 years of the use of commercial fertilizers. they were manufactured and sold only in the dry solid form. In the mid-1940s anhydrous ammonia gas. NH_3, was first used and in the mid-19 jos liquid mixed fertilizers were introduced. This period was noted for especially rapid changes in fertilizer manufacturing technology and agricultural use.

VI. FERTILIZER INJURY TO CROPS

Persons who are inexperienced in the use of fertilizers frequently observe brown or "burned" spots nhen they fertilize their lawns. and poor stands of vegetables nhen they fertilize their gardens. Fertilizer nutrients are, chemically speaking, supplied as soluble salts. A high concentration of soluble salts in contact with succulent plant tissues. leaves or roots kills the tissue by removing water from it. Injury may be reduced or avoided by applying less fertilizer, by mixing it through the soil surface or applying it in bands not in contact with seeds, by sprinkling a lawn immediately after fertilizing in order to nash the fertilizer off the leaves or by utilizing more costly but safer organic forms of nitrogen.

VII. FOLIAR APPLICATIONS

Plants can absorb nutrients through tiny openings (stomata) in the leaves and in some cases through the stems also. This fact led to speculation that perhaps feeding plants through leaf applications could replace soil applications. Extensive research showed that this was possible but that, with few exceptions, it is economically practical only in the case of minor elements which are required in very small amounts. Often foliar applications of minor elements are more efficient than soil applications because certain soils render the elements unavailable through chemical action.

VIII. NITROGEN FERTILIZERS

A. Natural Organics

The most important natural organic materials used in fertilizers are tankage (meat or garbage waste products), sewage sludge, castor pomace. cottonseed meal, fish scraps and dried animal manures including guano. Prior to 1850, nearly all nitrogen fertilizer came from such organic sources. By the second half of the 20th century natural organics had declined to a minor place in supplying the nitrogen fertilizer of the world. (See also Nitrogen, Fixation of.)

B. Naturally Occurring Chemical Nitrogen Fertilizers

Sodium and Potassium Nitrates.— Sodium nitrate. soda nitre or Chile saltpetre, $NaNO_3$, and potassium nitrate, nitre or saltpetre, KNO_3, were the first sources of chemical nitrogen fertilizer to be developed. They were discovered in 1809 by Thaddeus Haenke between the coastal range and the Andes mountains in Chile. Spaniards began to mine the deposits about 1813. The sodium nitrate layer, known as *caliche*, ranges from a few inches to 14 ft. in thickness. The Guggenheim process used in refining the ore can economically utilize ore as low as 8% in $NaNO_3$ and can extract 75% of the sodium nitrate. Potassium nitrate is produced as well as some iodates, borates, chlorides and sulfates of commercial value.

Coke Oven Ammonia.— Coke is extensively used by the steel industry. Coke is made by heating coal to 1,800° F. in the absence of oxygen. In this process ammonia gas, NH_3, is driven off and reacted with sulfuric acid to produce ammonium sulfate, a dry crystalline fertilizer containing 20.5% nitrogen.

C. Synthetic Nitrogen Fertilizers

Since about 80% of the air is nitrogen, there is a reserve of approximately 2 000,000 tons over each square mile of earth surface. Although this was utilized in a small way through atmospheric fixation by lightning discharges. by symbiotic bacteria mainly associated nith the roots of leguminous plants and by nonsymbiotic bacteria, the vast reserve was essentially denied to man until techniques were developed to fix nitrogen from the air. In the arc process an electric spark is passed through a mixture of nitrogen and oxygen gases to combine the two elements In the cyanamide process the final step involves combining nitrogen with calcium carbide at high temperature to yield calcium cyanamide. $CaCN_2$, containing 22 0% nitrogen. The third and by far the most important method is the Claude-Haber process for producing synthetic ammonia (NH_3).

Developed by Fritz Haber, Walter Nernst and others in Germany folloning the first laboratory production in 1910, and later modified by a Frenchman, Georges Claude, the process is represented by the equation:

$$3H_2 + N_2 \xrightarrow[+\ \text{catalyst}]{400°\text{-}500°\,C.} 2NH_3$$

In 1947 patents were assigned to the Wisconsin Alumni Research foundation for a process involving direct oxidation of nitrogen in gas-fired furnaces.

The most common sources of chemical nitrogen fertilizer are listed in Table III.

Table III.—*Chemical Nitrogen Fertilizers*

Fertilizer	Per cent Nitrogen	Form	Equivalent acidity (A) or basicity (B)*
Ammonium nitrate	33.5	Solid	180 (A)
Ammonium sulfate	20.5	Solid	535 (A)
Anhydrous ammonia	82.0	Gas	180 (A)
Calcium cyanamide	22.0	Solid	285 (B)
Calcium nitrate	15.5	Solid	135 (B)
Potassium nitrate.	13.0	Solid	200 (B)
Sodium nitrate	16.0	Solid	180 (B)
Crea	42.0–46.0	Solid	180 (A)

*Equivalent acidity is the amount of calcium carbonate required to offset the acidity caused by 100 lb. of nitrogen supplied in the fertilizer. Basicity indicates a basic rather than acidic effect.

Ammonium Nitrate.--Ammonium nitrate, NH_4NO_3, with 33.5% nitrogen is produced by reacting ammonia gas with nitric acid. It may be used for direct application or as an ingredient in either liquid or dry mixed fertilizers.

Ammonium Sulfate.— Ammonium sulfate. $(NH_4)_2SO_4$, with 20.5% nitrogen can be produced from by-product ammonia from the coking process or with synthetic ammonia, and reacted with sulfuric acid. In Europe ammonium sulfate is produced by reacting aqueous ammonium carbonate. $(NH_4)_2CO_3$, with gypsum, $CaSO_4$, to yield ammonium sulfate and calcium carbonate ($CaCO_3$). It is used for direct applications, as an ingredient in mixed fertilizers, and in bulk blends which are physically mixed immediately before applying.

Anhydrous Ammonia. — Anhydrous ammonia, NH_3, has 82% nitrogen. The synthetic fixation of ammonia has been previously described. W. B. Andrews initiated research in Mississippi in 1947 which quickly led to widespread use of ammonia in the United States for direct application to the soil. Since anhydrous ammonia is a gas with 211 lb. per square inch pressure at 104° F. and is also highly irritating, it is necessary to use special handling equipment and to insert the gas under several inches of moist soil in order to prevent extensive loss. The principal advantages are that it is the most concentrated source and thus can be transported most cheaply. and it requires no further processing before being applied. It may be metered into irrigation water for rill, that is, surface, but not overhead irrigation.

Anhydrous ammonia is widely used in the manufacture of other nitrogen fertilizers. It is also reacted with phosphoric acid to produce monoammonium phosphate (11% nitrogen and 48% phosphoric acid, or P_2O_5) and diammonium phosphate (21% nitrogen and 54% phosphoric acid).

Calcium Cyanamide. — The production of calcium cyanamide, $CaCN_2$, has been previously described. It is extensively used in Europe. The only producing plant on the North American continent is that of the American Cyanamid company in the province of Ontario. Can., near Niagara falls. When added to the soil, calcium cyanamide undergoes a series of chemical changes not all understood. but finally resulting in urea. A very dry soil or a high pH in the soil is conducive to the formation of a chemically stable, toxic compound, dicyanamide. $(H_2CN_2)_2$. The toxicity of intermediate breakdown compounds is utilized in weed control and in defoliating certain crops prior to harvesting. Because of these toxic compounds cyanamide must be applied to soil a minimum of two to three weeks before a crop is to be planted.

Calcium Nitrate. — Calcium nitrate. $Ca(NO_3)_2$, is produced by neutralizing nitric acid with limestone. It is manufactured mainly in Europe.

Sodium Nitrate. — The mining and processing of naturally occurring sodium nitrate, $NaNO_3$, has been described. Synthetic sodium nitrate production in which sodium carbonate is reacted with nitric acid began in 1929. It is used mainly for direct application as a side dressing or top dressing.

Urea. — Urea. $CO(NH_2)_2$, is prepared by reacting anhydrous ammonia with carbon dioxide gas under high pressure in the presence of a suitable catalyst. Rapidly converted in the soil by the enzyme urease into ammonium carbonate. $(NH_4)_2CO_3$, it is used for direct application and mixed fertilizers including liquids.

Nitrogen Solutions and Aqua Ammonia. — Several combinations of water, ammonia, ammonium nitrate and urea are prepared mainly as nitrogen sources in the preparation of mixed fertilizers, either dry or liquid, but are used to some extent for direct application.

Urea-formaldehyde. — About 1950 research workers in the United States department of agriculture produced urea-formaldehyde combinations in varying ratios of the two ingredients in order to produce a chemical nitrogen fertilizer that would react slowly in the soil and thus be resistant to leaching and available over a longer period of time than earlier sources.

IX. PHOSPHORUS-SUPPLYING FERTILIZERS

A. Reserves and Production

World Reserves. — The estimated world reserves of phosphate rock and apatite are given in Table IV. Additional extensive reserves not yet accurately estimated occur in Chile. China, Ireland, French West Africa, Indonesia, Korea, Nigeria. Rhodesia. Uganda, Union of South Africa and Venezuela. The principal supply of commercially used phosphates is the calcium phosphate mineral apatite (*q.v.*), of which the most common crystalline form is fluorapatite, $Ca_{10}(PO_4)_6F_2$. Iron ore is a minor source of phosphorus-carrying fertilizers, and animal bones supply smaller amounts.

Production and Consumption. — The leading countries in the production of phosphate rock are the United States, Morocco, the U.S.S.R., Tunisia, Nauru Island, Algeria, Egypt, the Christmas Islands, Makatea Island and Japan. The principal consuming areas are the United States, the U.S.S.R., Great Britain, France, Australia, Italy. Germany. Japan, Holland and Canada.

Geological Formations. — Igneous apatite occurs as an intrusive sheet on the Kola peninsula of the U.S.S.R., in eastern Uganda and in eastern Transvaal. The predominant mineral is fluorapatite, which may contain up to 30% phosphoric acid, P_2O_5, equivalent. Marine phosphorites are sometimes deposited on continental shelves when cold water, rising from great depths, warms as it nears the surface and becomes less acid as it loses carbon dioxide, CO_2; phosphates are then precipitated. The large deposits in Montana, Idaho, Utah and Wyoming represent a formation called geosynclinal; the Tennessee blue rock phosphate is a platform deposit. Residual phosphorites arise from the weathering of marine-deposited phosphatic limestones. The phosphoric acid ranges from 15% to 35%. Tennessee brown rock deposits are of this type. River pebble deposits occur on stream bottoms where they accumulate from runoff from weathering phosphatic limestone. These usually are too low in phosphorus to be mined competitively. Phosphatized rock deposits are formed when phosphate that is being leached in acid water comes into contact with limestone or with rocks rich in iron or aluminum and is precipitated as crusts on the surface of joints and cavities. Tennessee white rock and Florida hard rock deposits are of this type and may contain up to 35% phosphoric acid.

Table IV.—*World Reserves of Phosphate Rock and Apatite (4)* (in 000,000 metric tons)

Country	Reserves
French Morocco	21,000
United States	13,526
U.S.S.R.	7,568
Tunisia	2,000
Algeria	1,000
Brazil	572
Islands of Pacific and Indian oceans	182
Egypt	179
23 other countries	670
Total	46,697

Guano is a source of both phosphorus (up to 20% phosphoric acid) and nitrogen (10% to 13%). (See Guano.)

Mining. — Strip mining is practised on most phosphate deposits although there is some shaft mining. Mining started on the North American continent in the provinces of Ontario and Quebec in Canada in 1863. Phosphates had been previously discovered in South Carolina in 1837 but the first mining company in the United States was not formed until 1867. In 1882 phosphate rock was discovered in Florida and from then until World War I the principal market was in Europe, South Africa, Australia and New Zealand. In 1893 and 1896 blue rock and brown rock deposits were found in Tennessee. Smaller deposits occur in Alabama, Arkansas. Kentucky. North Carolina, Pennsylvania! Virginia and other states. Following World War I, production developed in the Pacific and Indian ocean islands and in North Africa.

B. Processing Phosphate Rock

The mineral apatite is relatively unavailable to plants until changed chemically. In fertilizer terminology available phosphoric acid, or P_2O_5 (43.7% phosphorus), is that nhich is water soluble plus that which is soluble in a neutral one normal ammonium citrate solution (citrate soluble). Justus von Liebig demonstrated in 1840 that the availability to plants of the phosphorus in bones was greatly increased by treatment with acid. In 1842 John B. Lawes, co-founder of Rothamsted Experimental station (*q.v.*) near London, patented a process for sulfuric acid treatment of phosphate rock to produce superphosphate, and essentially the same process was still used over 100 years later to produce most of the available P_2O_5 in fertilizers. The findings of Liebig and Lawes marked the beginning of the phosphate fertilizer industry.

There are two general procedures for breaking the apatite structure and making the phosphorus more available: treating the rock uith strong mineral acids and subjecting it to high temperatures.

Acid Processes. — Strong acids break the apatite bond and remove 30% to 40% of the fluorine. Phosphate rock plus sulfuric acid produces ordinary superphosphate with 16% to 20% available phosphoric acid, or P_2O_5. This is the most important supply of phosphorus-carrying fertilizer, used both for direct application and for manufacturing relatively low-analysis mixed fertilizers. Phosphate rock plus orthophosphoric acid, H_3PO_4, produces triple or treble superphosphate with 44% to 48% available P_2O_5, used for direct application and to an increasing extent in high-analysis mixed fertilizers and bulk blends.

Prompted by the shortage of sulfuric acid during World War II, the Tennessee Valley authority developed two processes: Process I uses nitric and phosphoric acid to yield phosphoric acid. monocalcium phosphate. $CaH_4(PO_4)_2$, and calcium nitrate. $Ca(NO_3)_2$. This is ammoniated to convert the highly deliquescent calcium nitrate to dicalcium phosphate, $Ca_2H_2(PO_4)_2$, and ammonium nitrate NH_4NO_3. Process II uses a nitric-sulfuric acid combination and yields phosphoric acid. gypsum and calcium nitrate. As in Process I it is ammoniated and yields similar products plus gypsum.

Heat Processes.—Subjecting phosphate rock to high temperature breaks the apatite bond and drives off nearly all fluorine. Coronet phosphate is named for the company that developed the process. A slurry of ground rock, silica and water is fed into a rotary kiln at 1 500° C. After 20 min the mass is quenched with water jets. The product contains 21% phosphoric acid, P_2O_5, with 18% available. Fused tricalcium phosphate, developed by TVA, contains 22.3% available P_2O_5 but is not used commercially. Phosphate rock-magnesium silicate glass involves heating to fusion temperature phosphate rock with olivine or serpentine. It contains 19% available P_2O_5. Rhenania phosphate, developed in Germany. has been used since 1917. Phosphate rock, soda ash, Na_2CO_3, and silica are calcined at 1,100° C. to 1,200° C. for two hours, quenched nith water before being discharged from the kiln, and ground to 180 mesh. The product carries 27.5% available P_2O_5. Calcium metaphosphate. $Ca(PO_3)_2$, was patented in Germany in 1929. TVA began production in the United States less than ten years later. It is of particular significance because of the extremely high concentration of available P_2O_5 (60% to 65%) which makes it economical to transport long distances. To make it, elemental phosphorus is burned in the presence of finely ground rock. The P_2O_5 produced from the burning phosphorus reacts with the rock. Potassium metaphosphate. KPO_3, was developed and carried to pilot-plant stage by TVA. The fertilizer contains 35% to 38% potash, K_2O, and 55% to 58% P_2O_5. Disposition of the hydrochloric acid used in the process is a problem.

Raw Rock Phosphate.—As previously mentioned, untreated phosphate rock is low in available phosphorus for plants, one-sixth to one-twentieth being citrate soluble. Given adequate time, soil acids accomplish the same purpose as mineral acids, namely to break the apatite bond. The rate of reaction is increased by fine grinding (100 mesh or finer), by moderate soil acidity and by large amounts of decaying plant residues which produce organic acids. Where it is favourably priced, rock phosphate is economically utilized to build the basic soil supply of phosphorus. More readily available sources are used to meet crop needs during the first few years. Long-season forage legumes utilize rock phosphate best. Rock phosphate is not suited to alkaline soils because of inadequate soil acids. The best grades of rock phosphate contain 30% to 36% tofal phosphoric acid. P_2O_5, and 3% to 6% citrate-soluble P_2O_5. The very fine material that settles out in waste ponds is sometimes marketed as colloidal phosphate containing 20% to 24% total P_2O_5.

Other Sources.—Basic slag, a by-product of the steel industry, usually from the Thomas and Gilchrist process. is rich in soluble calcium phosphates and is of commercial importance as a source of phosphorus mainly in Germany. France, Great Britain and other European countries where the slag often carries 17% to 20% phosphoric acid, or P_2O_5. In the United States only the slag from the open-hearth furnaces at Birmingham. Ala., is rich enough in phosphorus (9% to 10% P_2O_5, with 60% to 90% of this being available) to be competitive with other sources. Bone meal was once an important source of phosphorus fertilizer but now is used mainly by the feed industry. Liquid phosphoric acid. wet-process. is produced by treating rock with sulfuric acid. Calcium sulfate results as a precipitate and is separated out, leaving acid with 20% to 54% P_2O_5 depending upon the method used. Thermally produced acid comes from the reduction of phosphate rock in an electric furnace to produce elemental phosphorus which is burned to P_2O_5 and dissolved in water to make orthophosphoric acid, H_3PO_4. Liquid orthophosphoric acid is used on alkaline soils of the western United States mainly in irrigation water.

When orthophosphoric acid is neutralized with ammonia, monoammonium phosphate forms. Fertilizer grades contain 11% nitrogen and 48% P_2O_5. Sometimes this is mixed with ammonium sulfate to produce a nitrogen. phosphoric acid, potash ratio of 16–20–0. When the ammoniation of phosphoric acid is continued and the slurry kept at pH, or acidity, of 5.8 to 6.0, diammonium phosphate is formed. It has 21% nitrogen and 54% P_2O_5.

X. POTASSIUM FERTILIZERS

A. World Reserves

Major Producing Countries.—The potassium reserves of the world are very large but they are not precisely estimated. In the second half of the 20th century estimated world reserves of potash in lake brines and soluble salt deposits in millions of metric tons of K_2O were: Germany, 2,500 to 438,000; the U.S.S.R., 700 to 18.400; Israel, 1,200; the United States, 325; France 300; and Spain, 270. Additional good quality reserves are also found in Japan, Australia, South Africa, India, and in the more recently discovered deposits in Saskatchewan, Can. Vast mineral reserves of lower quality may be utilized when new processes are developed. The ash of giant kelp, a seaweed along the western coast of North America from lower California to Alaska, contains 30% potash or K_2O. The greatest reserve outside the soil itself is sea water, which contains about 2,000,000 tons of potash per cubic mile.

Germany.—The largest known reserves in the world, covering an area of about 24,000 sq.mi., lie in the area from Thuringia to Mecklenburg and westward to Hanover. The potassium-bearing strata are 1,200 to 4.000 ft. below the surface. The deposits are largely carnallite, sylvite, kainite and kieserite, and average 13% potash. K_2O, equivalent.

U.S.S.R.—The second largest reserves mere discovered in Perm on the west side of the Ural mountains. Information on the size of reserves and their commercial development is meagre.

Israel.—The resource is in the high salt concentration of the Dead sea.

United States.—The main potassium supply is in the Carlsbad deposits of the Permian basin area along the Texas-New Mexico border and extending north across Oklahoma and into Colorado and Kansas. The basin was an old inland sea in which potassium salts were concentrated and later buried under sand and shale to a depth of 800 to 1,000 ft. This area supplies 85% or more of the potassium produced in the country. Other reserves include beds in eastern Utah and brine from salt flats at Bonneville, Utah, brine wells at Midland, Mich., and Searles lake brines in California.

France.—The reserves are located in Alsace along the Rhine river about 25 mi. north of the Swiss border. These are among the highest quality ores in the world. The predominant mineral is sylvite. An extensive deposit has been discovered near Dax.

Spain.—Deposits are northwest of Barcelona and about 18 by 75 mi. in area. Strata vary from 8 to 70 ft. in thickness and occur at depths of 70 to 200 ft. below the surface. They are mainly carnallite and sylvite.

Poland.—The deposits are north of the Carpathian range from Kahurz to Stebine. The potassium is in four horizons in beds to 20 ft. thick and consist mainly of kainite, langbeinite, sylvite and carnallite. Rich deposits have been found in the Kujawy district of western Poland.

Canada.—Deposits were discovered in Saskatchewan in 1947. They occur at 4,000 to 12,000 ft. and may cover an area up to 500 sq.mi. when exploration is completed.

Italy.—There are large areas of leucite lava ranging from 7.5% to 10.0% potash equivalent.

Great *Britain.*—Deposits of sylvite and polyhalite in Yorkshire at a depth of 3,600 to 4,800 ft. appear to be a continuation of the salt basin of the German and French beds.

B. History of Potassium Fertilizers

Potassium fertilizer in the form of manure, potassium nitrate and ashes was reported in 300 B.C. The name potash comes from "pot ashes." The settlers in North America found Indians applying wood ashes as fertilizer. The production of potash from wood ashes was common in New Hampshire by 1632 and potash was exported to England for 100 years, reaching a peak in 1825. Potassium salts were discovered in well brine in Germany in 1839 and by 1861 commercial production mas well established. Potassium was found in 1912 in a well drilled for water at Spur. Tex. Exploration for potassium in the United States was greatly stimulated by the loss of the German supply during World War I. The first significant discovery in the great Permian basin deposit was made in an oil-well drilling in 1921 and sylvite was identified in 1925. The first commercial shipment from Carlsbad was in 1931 by the United States Potash company. In 1934 and 1940 two more companies began production and by 1950 the United States had become one of the morld's leading producers.

C. Mining and Processing

The operations at Carlsbad, N.M.. illustrate mining and processing techniques. Langbeinite, a sulfate of potassium and magnesium. $K_2SO_4.2MgSO_4$, is mined at 800 and 850 ft.; sylvinite. a mixture of potassium and sodium chlorides, at 900 ft.; beds are 5 to 12 ft. thick. The ore is drilled, blasted, loaded and hoisted above ground. The principal impurity is sodium chloride from nhich it is separated by selective dissolving nith water. The mass is centrifuged, kiln dried and sold under the trade name Sul-Po-Mag, which contains sulfur. potassium and magnesium. Sylvinite is ground and sized (the coarse fraction being treated on an agglomerating table), deslimed to remove clay, subjected to a flotation process and concentrated on gravity tables. The potassium chloride is removed from the brine by centrifuging, then kiln dried and sold as 50% K_2O granular muriate of potash. The fine fraction is also deslimed. then incorporated with flotation reagents and processed in a series of flotation cells. The concentrate is centrifuged, kiln dried and marketed as 60% muriate of potash.

D. Potassium-Supplying Fertilizers

Potassium content in fertilizers is commonly expressed as water soluble K_2O, or potash (83% potassium), although some European countries express it on an elemental basis.

Muriate of Potash.—The term muriate comes from muriatic acid, the common name for hydrochloric acid of which muriate of potash, KCl, is a salt. Muriate, 50% or 60% potash. K_2O, is used for direct application and to make mixed fertilizers, both liquid and dry. It is readily soluble in water.

Potassium Sulfate.—Composed of K_2SO_4 and containing 48% to 50% potash. or K_2O, equivalent, it is prepared by dissolving langbeinite in water and adding a concentrated muriate of potash (KCl) solution or by treating muriate of potash with sulfuric acid.

Sulfate of Potash-Magnesia.—It is prepared from langbeinite as previously described. The German product differs from the U.S. product in having one molecule of magnesium sulfate, $MgSO_4$, rather than two for each molecule of potassium sulfate, K_2SO_4. It is made by dissolving kieserite in hot water and adding KCl.

Manure Salts.—This is the fertilizer trade name for crude potassium salts that are crushed, screened and bagged with no attempt being made to remove sodium chloride and other salts.

Kainite is a term often applied to low-grade potassium salts ranging from 14% to 20% potash, but technically kainite is a mineral consisting of a hydrated sulfate and chloride of potassium and magnesium. $KCl.MgSO_4.3H_2O$.

Potassium Nitrate, having the formula KNO,, is from the Chilean nitrate deposits described in the section on nitrogen. It is little used as a fertilizer but is of interest agronomically because of the unique balance of nitrogen and potassium (13% nitrogen-~%phosphoric acid-44% potash).

Potassium metaphosphate was previously discussed under phosphorus-supplying fertilizers.

XI. MIXED FERTILIZERS

The term mixed fertilizer indicates more than one of the three major nutrients. nitrogen, phosphorus and potassium. Mixed fertilizers are formulated in hundreds of ways and there is no single typical technique. Of the many chemical reactions that take place, the most significant by iar is the ammoniation of phosphates with anhydrous ammonia or ammoniating solutions. The chemical reactions affect both the availability of certain nutrients and the physical condition of the fertilizer. There is a strong trend toward higher concentrations of nutrients in mixed fertilizers in order to save costs in handling and transporting. Prior to 1950 most mixed fertilizer was pulverized or powdered, but since then an increasing proportion has been made into pellets or granules. which are less dusty and less likely to cake. Home mixing of fertilizers was widely practised until the 1940s but has since rapidly declined. In European countries fertilizers are generally applied as individual materials but in the United States mixed fertilizers are more popular. Bulk blending of fertilizer materials increased in the second half of the 20th century.

XII. SECONDARY ELEMENTS

Calcium, magnesium and sulfur are commonly referred to as secondary nutrient elements but this does not mean they are less essential.

Calcium.—The main importance of calcium (Ca) in humid regions is its role in regulating soil acidity. In subhumid and arid regions with between 15 and 25 in. annual rainfall, calcium accumulates within the soil profile; in humid regions it tends to leach from the surface. Within humid regions there is great variation in the calcium supply of the surface and subsoil depending upon the amount of limestone or other calcium-bearing rock in the soil parent material and the extent of weathering and leaching Deficiencies are corrected by applying liming materials.

Magnesium.—Magnesium (Mg), like calcium, is related to soil pH or acidity. It is a basic part of chlorophyll, which imparts to green plants the ability to utilize sunlight in the photosynthetic process. Deficiencies are most likely to occur on acid soils. It may be supplied in the form of dolomitic limestone or for more immediate effect in the soluble forms such as Sul-Po-Mag and magnesium sulfate (Epsom salts).

Sulfur.—Sulfur (S) is added to the soil in plant residues and manures, in precipitation that carries down sulfur exhausted into the air in smoke from many industries, in commercial fertilizers in ahich sulfuric acid is involved and by soil organisms that utilize sulfur dioxide gas. Sulfur is used to acidify soils for acid-loving plants including rhododendrons and azaleas.

Minor or Trace Elements.—Some elements, though absolutely essential to plant growth, are utilized in minute quantities. Research on deficient areas and plant responses is much less complete than for the major nutrients.

Boron is important for cell division in the actively growing portions of plants. Boron (B) deficiencies cause stunting, discoloration and dying of the growing tips; are most likely to occur on sandy soils; and are aggravated by liming because the solubility of boron compounds decreases with increasing pH. Borax, $Na_2B_4O_7.10H_2O$, with 11% boron, is commonly used to correct deficiencies and is applied in amounts from 25 to about 80 lb. per acre. Water-soluble types are sometimes applied as foliar sprays. Boron is found in Chilean nitrate, in the Searles lake brine in California and in other southwestern states.

Copper, as needed by plants, is deficient in only a few scattered areas of the norld. It is supplied mainly as copper sulfate, $CuSO_4.5H_2O$, and to some extent as cupric oxide, CuO, and in other copper compounds.

Iron is one of the most common elements in the earth's crust and is deficient usually only under alkaline conditions where its solubility is low. It is applied as ferrous sulfate, often in foliar spray. It is especially needed by acid-loving plants.

Manganese is most often deficient on alkaline soils because of low solubility of manganese (Mn) compounds. Foliar sprays are therefore often more effective than soil applications. Manganese sulfate, $MnSO_4$, is the main salt applied.

Molybdenum is one of the most recent elements to be proved essential. Soil molybdenum (Mo) supplies become more available as soil acidity increases. It is nidely used in New Zealand and Australia on legumes. Cauliflower is especially sensitive to deficiency as are the related species, broccoli and brussels sprouts. Sodium molybdate. $NaMoO_4.2H_2O$, and ammonium molybdate are common sources. Deficiencies occur in citrus in Florida.

Zinc is commonly deficient for certain tree fruits in Florida and for corn in a few small areas in the United States. It is usually supplied in fertilizers as the sulfate $ZnSO_4.7H_2O$ and is most effective as a foliar application.

Chelates and Frits.—Minor or trace element deficiencies are frequently caused not by a lack of the element in the soil but rather by a low availability because the nutrient is tied up in insoluble compounds. Minor elements have been formulated as frits (glass) and chelates (organic materials), in which forms they are not subject to soil fixation and are slowly available over a long period.

XIII. MANURES

Farm manure usually consists of animal feces and urine plus bedding materials. Of the nutrients consumed by farm animals about 75% of the nitrogen, 80% of the phosphorus and 90% of the potassium is voided and this constitutes an enormous fertility resource, although in comparison with chemical fertilizers it is low in concentration and subject to large nutrient losses when improperly handled. Approximately half the nitrogen and nearly all of the potassium is leachable if the manure is exposed to rainfall before being applied to the field. Part of the nitrogen in urine readily converts to ammonia and is lost by volatilization. Much of the organic matter may be oxidized and lost when the manure is stacked for several months. Effective techniques for reducing losses include the use of adequate bedding in the stable to absorb the urine; stacking the manure under cover or in pits to prevent leaching; spreading it on fields and incorporating it into the soil as soon as is feasible; and spreading preservative materials in the stable. The most widely used preservative is ordinary superphosphate which contains gypsum, $CaSO_4$, that reacts with ammonium carbonate, $(NH_4)_2CO_3$, to form ammonium sulfate from which the ammonium is not volatilized.

Home gardeners like to use well-rotted manure. It is less odorous, more easily spread and less likely to "burn" plants. The production of rotted manure is wasteful of the organic matter and also results in great losses of soluble nitrogen and potassium unless it takes place under cover. Manure is a highly variable product depending upon kind of livestock as well as handling and storage methods. Widely used figures are 10 lb. of nitrogen, j lb. of phosphoric acid. P_2O_5, and 10 lb. of potash. K_2O, per ton of average stable manure including bedding. Sheep, goat and poultry manures average higher in all nutrients than these figures and these manures are often further concentrated by drying and sometimes by enriching with chemical fertilizers. Animal manures are lowest in phosphorus and this is the first element to consider adding. Typical rates to apply fresh stable manures are 8 to 20 tons per acre. (*See* also GUANO.)

In some of the most densely populated areas of the world. human excrement is an important source of fertilizer nutrients. A typical example is the "night soil" of China which has been used for centuries. Human excrement also makes up part of the sewage of large cities which is sometimes processed and sold as selvage sludge.

XIV. COMPOST

Home owners often have leaves, lawn clippings and garden refuse which may be effectively converted to compost, a product similar to well-rotted animal manure. Compost is made with plant residues, soil, fertilizer and sometimes limestone. The first three materials should be placed in alternate layers of four to six inches of residues, two to four inches of soil and one pound of a complete fertilizer for each eight to ten pounds of plant residues. One-half pound of limestone per pound of fertilizer will maintain a favourable pH for the microorganisms that decay the residues. The compost pile should be straight-sided, located preferably in a damp, shady place and kept moist but not saturated enough to leach soluble nutrients. Several months of summer weather are needed to fully decay the compost heap. The rate of decay may be accelerated by turning and mixing the pile at two-month intervals. Compost of this type is excellent for fertilizing or mulching shrubs and gardens.

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FESCENNINE VERSES (Lat. *Fescennini versus,* also called *carmina Fescennina*), a native Italian form of poetry. At vintage and harvest. according to Vergil and Horace, and probably at other rustic festivals,.according to Tibullus, masked dancers sang jocular dialogues in verse. Festus and Symmachus state that similar songs were in use at weddings. Horace states that they became so abusive that a law was passed to check them; apparently the provision of the Twelve Tables which forbade a *malum carmen* (evil song; *i.e.,* charm intended to hurt) was stretched to include libelous verses. Macrobius refers to *Fescennini* written by Augustus attacking Asinius Pollio. It is also clear from the literary imitations by Catullus (in lxi) and Claudian (xi–xiv) that they were very free, even obscene, in language. Festus says that they averted the evil eye and that therefore some connected the name with *fascinum.* This derivation is supported by G. Michaut in *Histoire de la Comédie romaine: sur les tréteaux latins* and by other scholars, but they suppose *fascinum* to have the sense of "phallus," not "evil eye."

The true derivation may be from Fescennia, an Etruscan city, but it may reasonably be supposed that in their origin they had a magico-religious intent, abuse, buffoonery and obscenity being well-known fertility or luck charms. That they developed into the dramatic satura and thus gave birth to the beginnings of a native drama is implied by Livy but has been seriously doubted in modern times.

See E. Paratore, *Storia del teatro Latino,* pp. 11–14 (1957). (WM. BE.)

FESCH, JOSEPH (1763–1839), cardinal, was born at Ajaccio, Corsica, on Jan. 3, 1763. He was connected with the Bonaparte family by his father's second marriage to the widowed mother of Laetitia Bonaparte. At the outbreak of the French Revolution. he was archdeacon of Ajaccio; he protested against the application to Corsica of the act known as the "civil constitution of the clergy" (July 1790). On the suppression of religious orders and corporations, he had to retire into private life.

He was drawn by the Bonaparte family into espousing the French cause against Paoli and the Anglophiles. and accompanied Laetitia and her son to Toulon, in the early part of the autumn of 1793. His fortunes rose rapidly when Napoleon became First Consul (Nov. 1799). He resumed his clerical vocation, and took an active part in the complex negotiations which led to the signing of the Concordat with the Holy See on July 1j, 1801. He was then made archbishop of Lyons (1802), and cardinal 1803).

In 1804 he succeeded Cacault as French ambassador at Rome. He was assisted by Chbteaubriand. but soon sharply differed with him on many questions. His tact in overcoming the reluctance of the pope to be present at the coronation of Napoleon in Notre Dame. Paris (it was only eight months after the execution of the duc d'Enghien) was rewarded with further honours. Finally. in 1806 Karl von Dalberg, then prince bishop of Regensburg. chose him as coadjutor and designated him as his successor. Before the succession fell vacant, however, Regensburg had been incorporated in Bavaria.

By this time Napoleon mas in sharp collision with the pope on various matters both political and religious. Fesch, who was still ambassador in Rome, went as far as possible in counselling the submission of the spiritual to the civil power. For a time he was not on speaking terms with the pope; but Napoleon was dissatisfied, and recalled him.

Affairs came to a crisis when Napoleon decreed (May 17, 1809) the annexation of the papal states to the French empire. In that year Napoleon conferred on Fesch the archbishopric of Paris, but he refused the honour. In 1811 Fesch presided over a Gallican church council convened by the emperor, but failed to satisfy Napoleon, and was dismissed to his diocese. Next year Napoleon intercepted a letter from Fesch to Pius VII., who was then detained at Fontainebleau, and there was a serious breach. The tension between Fesch and the emperor was less in 1812–13. During the Hundred Days Fesch resumed his archiepiscopal duties at Lyons and became a member of the senate. On the second abdication Fesch retired to Rome. He left many works of art to the city of Lyons. He died at Rome on May 13, 1839.

See Ricard, *Le Cardinal Fesch* (1893); H. Welschinger, *Le Pape et Pempereur* (1905); F. Masson, *Napoléon et sa famille* (4 vols., 1897–1900), this correspondence with Napoleon was edited by Ducasse (1855).

FESCUE, the name given to the numerous and widely distributed perennial grasses of the botanical genus *Festuca,* found chiefly in temperate and cold regions, among which are several pasture and fodder grasses of agricultural importance. The most important of these is the tall or meadow fescue (*F. elatior*) common throughout Europe and in parts of Asia and widely cultivated and naturalized in the United States and Canada. It grows to a height of from two to five feet, and is regarded as one of the most valuable grasses for both fodder and permanent pasture. The red fescue (*F. rubra*), found throughout cool north temperate regions, is sometimes grown in meadows. The sheep's fescue (F. *ovina*), native to the Himalayas and certain mountainous districts of North America and Europe, and widely naturalized in north temperate regions. is sometimes used in dry pastures. A form called the blue fescue (var. *glauca*), with silvery-glaucous leaves, is grown for ornament.

The closely allied genus *Bromus,* which includes the brome grasses, is abundantly represented in north temperate regions, and various species are grown for forage and for ornamental purposes. Among those important agriculturally are the erect brome (B. erectus). useful as a forage grass on dry, chalky soil, and the awnless or Hungarian brome (*B. inermis*), grown for pastures and meadows. See GRASSES.

FESSA (FASA. originally Basa Sir), a town 90 mi. S.E. of Shiraz, on a fertile plain in the province of Fars, Iran. A walled city. it was famous for its large cypress-wood houses, and the manufacturing of rich textiles. For centuries good dates, oranges and nuts have grown there and it also produces other fruits, grain, tobacco and opium. The population (1956) is 11,706 and in the surrounding district of the same name are some 40 villages.

FESSE, one of the ordinaries in heraldry. *See* HERALDRY.

FESSENDEN, WILLIAM PITT (1806–1869), American statesman and financier, was born in Boscawen, N.H., on Oct. 16, 1806. After graduating at Bowdoin college in 1823, he studied law, and in 1827 was admitted to the bar, eventually settling in Portland, Me., where for two years he was associated in practice with his father, Samuel Fessenden (1784–1869), a prominent lawyer and anti-slavery leader. In 1832 and in 1840 Fessenden was a representative in the Maine legislature, and in 1841–43 a Whig member of the national House of Representatives. When his term in this capacity was over, he devoted himself with great success to the law. He became well known, also, as an eloquent advocate of slavery restriction. In 1854 he was chosen by the combined votes of Whigs and' Anti-Slavery Democrats to the United States Senate, where he delivered a speech in opposition to the Kansas-Nebraska bill which made him a force in the congressional anti-slavery contest. He was re-elected to the Senate as a member of the Republican party. As chairman of the Senate committee on finance, his services were second in value only to those of President Lincoln and Secretary Salmon P. Chase in efforts to provide funds for the defence of the Union; in 1864 Fessenden succeeded Chase as secretary of the Treasury. The finances of the country in the early summer of 1864 were in a critical condition; a few days before leaving office Chase had been compelled to withdraw from the market $32,000,000 of 6% bonds. on account of the lack of acceptable bids; gold had reached 285, while the value of the paper dollar had sunk as low as 34 cents. It was Fessenden's policy to avoid a further increase of the circulating medium, and in spite of powerful pressure the paper currency was not increased during his tenure of office. As the sales of bonds and treasury notes were not sufficient for the needs of the Treasury, interest-bearing certificates of indebtedness were issued to cover the deficits. When these began to depreciate Fessenden engaged the services of the Philadelphia banker Jay Cooke (*q.v.*) and secured the consent of Congress to raise the balance of the $400,000,000 loan authorized in 1864 by the sale of the so-called "seven-thirty" Treasury notes (*i.e.,* notes bearing interest at 7·3% payable in currency in three years or convertible at the option of the holder into 6% 5–20 year gold bonds). Through Cooke's activities the sales were enormous; the notes, issued in denominations as low as $50, appealed to the patriotic impulses of the people who could not subscribe for bonds of a higher denomination. In the spring of 1865 Congress authorized an additional loan of $600,000,000 to be raised in the same manner, and for the first time in four years the Treasury was able to meet all its obligations. After thus securing ample funds for the enormous expenditures of the war, Fessenden resigned the Treasury portfolio in March 1865, and again took his seat in the Senate, serving till his death. He was not, however, entirely in accord with the more radical members of his own party, and this difference was exemplified in his opposition to the impeachment of President Johnson and subsequently in his voting for Johnson's acquittal. He died at Portland, Me., on Sept. 6, 1869.

See Francis Fessenden, *Life and Public Services of William Pitt Fessenden* (Boston, 1907).

FESSLER, IGNAZ AURELIUS (1756–1839), Hungarian scholar, was born on May 18, 1756, at Zurány, Hungary. He became a capuchin, and made many enemies by exposing the abuses of the monasteries to the emperor, Joseph II., who ordered a searching examination in consequence. He held a chair at Lemberg university for a short time, but had to leave Hungary after the publication of his tragedy *Sidney* (1788), attacking the English Roman Catholics. He was converted to Lutheranism, and wandered from place to place. In 1796, in Berlin, he was commissioned. with Fichte, to reform the statutes of the free-masons' lodge there. In 1809 Alexander I. offered him a chair at St. Petersburg (now Leningrad), of which he was soon deprived on account of his heterodox opinions. In Nov. 1820 he was appointed consistorial president of the evangelical communities at Saratov, and later became superintendent of the Lutheran communities in St. Petersburg. He died at St. Petersburg Dec. 15, 1839.

Among his numerous works are *Die Geschichten der Ungarn und ihrer Landsassen* (10 vols., Leipzig, 1815–25); *Mathias Corvinus* (2 vols., Breslau, 1793–94); *Die drei grossen Könige der Ungarn aus dem Arpadischen Stamme* (Breslau, 1808); and the autobiographical *Rückblicke auf seine siebzigjährige Pilgerschaft* (Breslau, 1824; 2nd ed, Leipzig, 1851). See J. Koszó, *A. I. Fessler* (1923).

FESTA, CONSTANZO (c. 1495–1545), Italian singer and musical composer, became a member of the Pontifical choir in Rome in 1517, and soon afterwards *maestro* at the Vatican. His motets and madrigals (the first book of which appeared in 1537) excited Dr. Burney's warm praise in his *History of* Music; and among other church music, his *Te* Deum (published in 1596) is still sung at important services in Rome. His madrigal, called in English "Down in a flow'ry vale," is well known.

FESTIVALS, MUSIC. Music festivals, which have had a long continued period of development, generally adopted a basic form—a combination of orchestra and chorus with solo artists, interpreting large and important works.

Successive church services with choral singing and instrumental playing were of the nature of music festivals since the earliest times of Christianity. The oldest church festival in England was the Festival of the Sons of the Clergy, organized in 165j. and held at St. Paul's cathedral in London. The earliest English church festival still preserving its traditions in the second half of the 20th century was founded in 1724 under the name of Three Choirs festival, with concerts presented in Gloucester, Worcester and Hereford in turn, and with choral groups from the three communities taking part.

The once renouned Birmingham festival, founded in 1768, discontinued its activities in 1914. The Norwich festival, inaugurated in 1770, continued irregular meetings, mostly at triennial intervals. The Leeds Musical festival was established in 1858, on the occasion of the opening of the tonn hall by Queen Victoria; it became a triennial event in 1874. The Sheffield festival began in 1896. All suffered interruption during World Wars I and II.

The inception of many provincial festivals in England was motivated by charity. whether for indigent clergy or the poor of the district. But soon purely musical considerations asserted themselves, and many great works of classical music, as well as compositions by English musicians, were heard at these festivals. The movement spread to other cities and towns in Britain (Edinburgh, Liverpool, Cheltenham), culminating in a sumptuous national gathering in London during the Festival of Britain of 1951, when 22 concerts were presented.

One of the features of music festivals in Britain has been a long succession of performances devoted to Handel. The first was held in 1784 as a commemorative function in Westminster abbey. This was a project built on a large scale—525 players and singers—destined to great augmentation in later years. The most important of succeeding festivals were the triennial three-day Handel concerts founded at the Crystal palace, London, in 1857. and presented in gargantuan fashion. By 1923 the orchestra and chorus numbered 4,000. When the Crystal palace was totally destroyed by fire in 1936, the Handel festivals ended, for there was no other building large enough to accommodate so vast a body of performers, or the virtually unlimited public wishing to attend them.

A unique example of such eventful occasions, with, however, more varied programs, was the Musical Festival of the British Empire in 1911, the coronation year of George V. The zoo members of the Sheffield choir, under the direction of Sir Henry Coward, circled the world, giving performances of choral and orchestral works during a period of six months.

In the United States. the oldest music festival was the Peace jubilee. held on Feb 22, 181j, in Boston, Mass., to commemorate the cessation of hostilities between England and the United States. Subsequent peace jubilees took place in Boston in 1869 and 1872; a huge orchestra of 2,000 musicians and a chorus of 20,000 participated at the second of these events.

The triennial festivals of the Handel and Haydn Society of Boston were established in 1868.

A festival concert under the direction of Theodore Thomas, with an orchestra of 150 players, was held at the Centennial exhibition in Philadelphia, Pa., in 1876.

Among other periodic U.S. music festivals the following, with the dates of their formal opening, were of importance: Worcester, Mass.. festival (1858); Oberlin, O., Spring festival (1860); Biennial May festival of Cincinnati, O. (1873); Ann Arbor, Mich., May festival (1893); Bethlehem, Pa., Bach festival (1900); Evanston. Ill., North Shore festival (1908); Westchester County festival, N.Y. (1925); and Aspen, Colo., festival (1949). Elizabeth Sprague Coolidge established an annual Chamber Music festival in Pittsfield, Mass.. in 1918; these festivals were transferred in 1925 to the Library of Congress, Washington, D.C. The prime object of the Coolidge festivals is to promote chamber music by contemporary composers through special commissions of works.

The Eastman School Festival of American Music was started in Rochester, N.Y.. in 1925, by Howard Hanson. The Berkshire festival of the Boston Symphony orchestra was established by Serge Koussevitzky in 1937.

In Europe, the earliest music festival was a series of concerts undertaken in 1673 at Liibeck by Dietrich Buxtehude, under the name "Xbendmusiken." The Tonkiinstler-Societat of Vienna (1772) was active in presenting annual performances of Austrian and German music. The famous Bayreuth festival was inaugurated by Richard Wagner in 1876 to present his music dramas in an appropriate setting. After several years of interruption during World War II, the performances of Wagner's music were resumed in Bayreuth in 1951 under the direction of his grandsons.

Among 20th-century festivals, the most important is that of the International Society for Contemporary Music founded in Salzburg, Aus., in 1922, and held thereafter (except in 1940 and 1943–45) each summer in various European and American cities. Many first performances of modern works were given at these festivals.

In 1933, the annual spring festival, Maggio Musicale, was inaugurated in Florence, It. The Holland Music festival opened an annual series at The Hague in 1948 Music festivals were organized in quick succession in virtually all European centres during the 20th century.

In Germany festivals rapidly developed in the 19th century. Of particular significance were the Lower Rhenish festivals established in 1817 at Elberfeld, but which moved occasionally to Düsseldorf, Aix-la-Chapelle and Cologne. Felix Mendelssohn conducted seven of these festivals and other eminent directors were Anton Rubinstein, Johannes Brahms, Hans Richter, Richard Strauss, etc. The performances lapsed in 191j. Those of the Allgemeiner deutscher Musik-Verein, the concerts of which were known as the *Tonkünstversammlung,* were founded by Karl Franz Brendel, with powerful support from Franz Liszt. The first of these was held at Leipzig in 1859 and others followed, mostly in yearly succession in various German cities. The performances, which lasted several days, featured new works by contemporary composers. They were only interrupted by World War I, but failed to survive World War II.

European festivals became so numerous that, in order to avoid confusion and repetition of programs, a number of the festivals—including those at Berlin. Florence, Venice, It., Bayreuth, Aix-en-Provence, Fr., Vienna, Aus., Munich, Ger., and Ziirich, Switz.,—were amalgamated under the general title. European Association of Music Festivals. A number of cities include opera in their programs, and in some chamber as well as symphonic music is provided.

Competition Festivals.—These festivals date back to ancient times, with prizes awarded for best performances. The Eisteddfod (*q.v.*) in Wales, a national gathering of Welsh bards, held contests as early as the 6th century. Wagner's opera *Tannhauser* depicts the song contest of the German minnesingers of the 13th century.

While competition festivals may be said to have begun with the troubadours. minnesinger, minstrels, etc., in France and Germany in the 13th century, their groath in modem times was particularly marked in Great Britain. This was due in large part to the teaching in the 19th century of amateur sightsinging by the tonic-sol-fa method (movable doe), made popular by John Cunven (1816–1880) and by his son John Spencer Curwen. The latter, who began competitive festivals at London in 1860, offered prizes for the best singing of choral pieces and solos. Eventually the competitions included brass band and other instrumental performances, and spread throughout Britain. To bring order and better methods to the contests. the British Federation of Musical Competition Festivals was founded in 1921. One of its primary functions was the establishment of panels of competent adjudicators whose decisions would satisfy contestants and listeners alike.

In the United States most competition festivals are limited to individual or adjacent states, and in the majority of cases are connected with the music departments of secondary schools, particularly in the matter of bands, orchestras and choruses. In Ireland the principal competition festival is that of Feis Ceoil, founded in 1897, and usually held in Dublin. (N. Sy.; F. Bi.)

Bibliography.—D Stoll, *Music Festivals of Europe* (London, 1938); W. A. Fisher, *Music Festivals in the United States* (Boston, 1934); R. Boughton, *The Death and Resurrection of the Music Festival* (London, 1913); D. Lysons, *History of the Origin and Progress of the Three Choirs of Glozicester, Worcester, and Hereford* (Gloucester, 1812); E Hodges, *An Apology for Church Music and Musical Festivals* (London, 1834); anonymous, *Gwent and Dyfed Royal Eisteddfod and Musical Festival; Historical Account* (Merthyr Tydfil, 1834); F. Spark and J. Bennett, *History of the Leeds Musical Festivals, 1858–1889* (Leeds, 1892); R. Morin. *The Worcester Music Festival; Its Background and History, 1858–1946* (Worcester, Mass, 1946); C. Perkins and others, *History of the Handel and Haydn Society of Boston, Mass., 1815–1933,* 3 vol. (Boston, 1893; Cambridge, 1911, Boston, 1934). (N. Sy.)

FESTOON, an ornament developed from the representation of a garland of leaves, fruit or floaers, cloth or ribbon, supported at two or more points and hanging in curves between. The festoon appears occasionally in late Greek work, particularly as a decoration for Hellenistic altars, but it was the Romans who gave it definite form. Roman festoons are usually made of fruit, grain, leaves and flowers, treated with extreme naturalism, although in wall paintings and stucco decoration simpler and more conventional types are found. The festoon was a favourite motive of the early Italian Renaissance. In Baroque work through Europe many fantastic treatments of the cloth festoon exist.

FESTUS, SEXTUS POMPEIUS (2nd or 3rd century A.D.), Latin grammarian, probably born at Narbo in Gaul, who made an abridgement in 20 books of Marcus Verrius Flaccus' De *verborum significatu.* In this work Festus made a few insertions and comments of his own. The first half of it is lost but a further abridgement of it, made by Paulus Diaconus in the 8th century, survives. Latin words which had long been obsolete he removed with the intention of including them in a separate work (*Priscorum verborum cum exemplis*), but whether this was ever written is doubtful. The remains of Festus' abridgement exist in only one manuscript, the Codex Festi *Farnesianus* at Naples, of which a facsimile was published at Budapest in 1893 by A. Thewrewk de Ponor.

BIBLIOGRAPHY.—The latest editions are those by W. M. Lindsay, in the Teubner series (1913) and in the *Glossaria Latina,* iv (1930). *See* also Pauly-Wissoma, *Real-Encyclopbdie der classischen Altertumswissenschaft,* vol xxi, col. 2316–19 (1952). (*G.* B. A. F)

FET (FOETH), **AFANASI AFANASIEVICH** (1820–1892), who assumed by decree in 1876 the name of Shenshin, Russian poet, was born at Novoselki, Orel, on Dec. 5, 1820, the illegitimate son of a landowner named Shenshin. He was still a student at Moscow university when, in 1842, he published some admirable lyrics in the *Moskvityanin.* In 1850 a volume of his Poems appeared, followed by another in 1856. He then served for several years in the army, retiring with the grade of captain in 1856. In 1860 he settled on an estate at Stepanovka, where he was often visited by Turgenev and Tolstoy. Fet's sincere and passionate lyric poetry strongly influenced later Russian poets, but during his lifetime he was decried because of his reactionary political views and somewhat unattractive personality. He published very little after 1863, but he continued to write nature poetry and love lyrics which were published in a collected edition (4 vol., 1894).

Fet also made some fine translations from Horace, Catullus and Tibullus, of Goethe's Faust and *Hermann und Dorothea.* He died in Moscow on Dec. 3, 1892.

See a paper on Fet in Oliver Elton's *Sheaf of Papers* (1922), which includes some translations.

FETAL DISORDERS, or disorders affecting the unborn human fetus. may be responsible for premature delivery, for the birth of a sick or malformed infant, or may cause death before birth. depending on the severity and variety of the disturbance.

Abortion, Stillbirth, Premature Birth.—The expulsion of a dead fetus in the first half of pregnancy is generally called an abortion; in the latter half of pregnancy it is designated a stillbirth or a late fetal death. The distinction between abortions and stillbirths has never been definitely settled and is based largely on state requirements for reporting, often 20 to 22 weeks. These subjects are discussed in separate articles ABORTION; STILLBIRTH; and PREMATURE BIRTH.

Postmature Birth.—On rare occasions pregnancy may be prolonged sufficiently to damage the child. If pregnancy does not end within three or four weeks of the normal time, the placenta may begin to degenerate and may not be able to supply the fetus with the materials it needs for survival and growth; in such cases death may occur before or during labour. The fetus is ordinarily not unusually large, but its skin may be dry and wrinkled, its fingernails and hair unusually long, and it may seem to be unusually mature. In some instances of prolonged pregnancy, however, the fetus becomes unusually large; this is a hazard to the fetus because delivery is often difficult, and the likelihood of injury is greater than when it is of normal size.

Growth of the fetus to an excessive size (over 4,500 grams or 10 lb.) during the normal length of pregnancy is rare except when the mother suffers from diabetes mellitus or is prediabetic. It has been shown that symptoms of diabetes generally appear within a few months or years following the delivery of an excessively large child, in a woman previously apparently nondiabetic. Any woman giving birth to an unusually large infant should be examined to determine whether or not she may be developing diabetes.

Erythroblastosis **Fetalis.**—Erythroblastosis fetalis is a disorder which has its origin during intra-uterine life as a result of incompatibility of the blood of the mother and the fetus. This is most often on the basis of the Rh factor, although the XB blood group is sometimes responsible.

Fetal blood cells are thought to escape from the placenta into the maternal circulation during any pregnancy. If the blood groups of the mother and the fetus are compatible, no harm results. If the mother is Rh-negative and the fetus is Rh-positive (by inheritance from its father), the mother may be stimulated to produce antibodies against the Rh-positive cells. Since Rh-positive blood cells are not normally present in her body, the response is the same as it mould be to bacteria or any other foreign substance, and antibodies are produced for the specific purpose of destroying Rh-positive cells. These antibodies against Rh-positive cells are so minute that they are able to penetrate the placenta and get into the blood of the fetus. Since their function is to destroy Rh-positive cells, they destroy varying amounts of fetal blood. This may result in anemia. If the fetus is able to produce enough blood cells to compensate for the destruction, anemia will not develop or will be mild. If the fetus cannot produce enough blood to keep pace with the destruction, it will be anemic at birth and will require immediate blood transfusions if it is to survive. Blood destruction continues after birth, producing excessive bilirubin, nhich gives the skin a yellow colour known as jaundice or icterus; parts of the brain may be injured if jaundice is severe and prolonged A form of treatment designated "exchange transfusion," in which the Rh-positive blood of the infant is removed and Rh-negative blood substituted, removes the bilirubin from the circulation and prevents brain damage. Only 5% of Rh-negative women give birth to infants affected by erythroblastosis. A fen fetuses are so severely affected that they die before birth and are stillborn, but the majority are born alive and most of these can be saved by modern treatment; a short time after birth they are entirely normal infants.

Pneumonia.—A fetus may develop pneumonia before birth. Throughout intra-uterine life the fetus normally inspires small amounts of the amniotic fluid by which it is surrounded. This is ordinarily sterile until labour begins or until the sac containing the fluid ruptures. Then bacteria enter, and if labour is very prolonged or if the bag of waters breaks before labour begins, enough bacteria may be inhaled by the fetus to cause pneumonia. Although this may be responsible for death before birth, more often the infant is ill when it is born but does not die for several hours, or may recover.

Malformations.—Malformations may be the cause of late fetal deaths or stillbirths, just as they may be responsible for early fetal deaths or abortions. The agents responsible for malformations in the human infant are almost entirely unknown. although many of the conditions that may be responsible for abortions are thought also to cause malformations

See also ABORTION; MONSTER; STILLBIRTH; PREMATURE BIRTH; PLACENTA AND FETAL MEMBRANES, DISEASES OF.

See Edith L. Potter, *Pathology of the Fetus and the Newborn* (1952); J. Edgar Morison, *Foetal and Neonatal Pathology* (1952). (E. L. Po.)

FETISHISM, a term used in many different senses: (1) the worship of inanimate objects, often regarded as peculiarly African; (2) the worship of inanimate objects conceived as the residence of spirits not inseparably bound up with nor originally connected with such objects; (3) the doctrine of spirits embodied in, or attached to, or conveying influence through certain material objects (Tylor); (4) the use of charms, which are not worshipped but derive their magical power from a god or spirit; (5) the use as charms of objects regarded as magically potent in themselves; (6) loosely, including the worship of inanimate objects, such as the sun. moon and stars, and such phases of primitive philosophy as totemism and animism.

The term may also be understood to mean the worship of or respect for inanimate objects, conceived as inherently magical.

The fetish may be regarded as a mascot or object carried for luck.

In the sense in which Sir Edward Burnett Tylor uses the term, the fetish is (1) a "god house"; or (2) a charm derived from a tutelary deity or spirit, and magically active in virtue of its association with such deity or spirit. In the first of these senses the word is applied to objects ranging from the unworked stone to the pot or the wooden figure, and is thus hardly distinguishable from idolatry. *(a)* The *bohsum* or tutelary deity of a particular section of the community is derived from the local gods through the priests by the performance of a certain series of rites. A *bohsum* may also be procured through a dream, but in this case, too, it is necessary to apply to the priest to decide whether the dream was veridical. *(b)* The *suman* is "an object which is the potential dwelling place of a spirit or spirits of an inferior status, generally belonging to the vegetable kingdom: this object is closely associated with the control of the powers of evil or black magic, for personal ends, but not necessarily to assist the owner to work evil, since it is used as much for defensive as for offensive purposes."

On the Guinea coast the spirit in the object is usually, if not invariably, nonhuman. Farther south on the Congo the fetish is inhabited by human souls also. The priest goes into the forest and cuts an image; when a party enters a wood for this purpose they may not mention the name of any living being unless they wish him to die and his soul to enter the fetish. The right person having been selected, his name is mentioned; and he is believed to die within ten days, his soul passing into the *nkissi*. Nails are driven into these figures in order to procure the vengeance of the indwelling spirit on some enemy. *See* also ANIMAL WORSHIP; ANIMISM; TOTEMISM.

BIBLIOGRAPHY.—See A. B. Ellis, *Tshi-speaking Peoples,* ch. vii, viii, xii; T. Waitz, *Anthropologie der Naturvölker,* ii, 174; R. E. Dennett in *Folklore,* vol. xvi; R. H. Nassau, *Fetichism in West Africa* (1904). Also E. B. Tylor, *Primitive Culture,* ii, 143, and M. H. Kingsley, *West African Studies,* 2nd ed. (1901), where the term is used in a more extended sense; Maurice Delafosse, *Les Civilisations Négro-Africaines* (1925); R. S. Rattray, *Ashanti* (1923) and *Religion and Art in Ashanti* (1927); P. Amaury Talbot, *The Peoples of Southern Nigeria,* vol, ii (1926).

FETTERS AND HANDCUFFS: *see* HANDCUFFS AND FETTERS

FETTI (FETI), **DOMENICO** (1588/89–1624), Italian painter of the Baroque period, was born in Rome and died in Venice, apparently as the result of dissipation. In Rome he was a pupil of Lodovico Cigoli but was principally influenced by the followers of Michelangelo Merisi da Caravaggio and also by Adam Elsheimer. Through Cigoli he attracted the attention of Cardinal Ferdinando Gonzaga: when the cardinal went to Mantua to become Duke Ferdinando II, Fetti became his court painter at about the end of 1613. At Mantua he saw the works of Rubens as well as those of Giulio Romano, and his style was considerably modified. Later, the influence of Venetian art was even more marked although he probably first visited the city about 1621 to buy works of art for his patron. At the end of Aug. 1622 Fetti left Mantua, apparently very hurriedly, and went to Venice, refusing to return in spite of the duke's efforts.

Fetti's best-known works are small, with small-scale figures, and painted in bright, rich colours, many of the most popular being representations of the biblical parables as scenes from everyday life. There are examples in Hampton court, Dresden, Mantua, Venice and Vienna of these and of other works.

See Baglione, *Vite de' Pittori . . .* (1642); M. Endres-Soltmann, D. F. (1914); R. Oldenbourg, D. F., mainly pictures (1921). (P. J. MY.)

FETUS, the unborn young of any vertebrate animal, particularly of a mammal. Biologists arbitrarily speak of the earliest stages of development of the fertilized egg (ovum) as the embryonic period. This period ends when the external form of the embryo begins to resemble clearly the newborn of the group to which it belongs. The next period, culminating in birth, is spoken of as the fetal period. Likewise a distinction is made between the embryo and the fetus. In human development this transition occurs at approximately the end of the ninth week after fertilization. At this time the embryonic clefts (harelip) of the face disappear, the paddlelike embryonic limb buds develop free fingers and toes and so take on the form of the human limbs, and the relatively long embryonic tail has nearly disappeared. After these changes and until birth the distinctly human-appearing embryo is technically a fetus.

See EMBRYOLOGY; EMBRYOLOGY, HUMAN; FETAL DISORDERS; etc. (H. W. MN.)

FEU, in Scotland, the common mode of land tenure. The word is the Scots variant of "fee" (*q.v.*). The feudal system still dominates Scots conveyancing, but its forms are now extensively modified by the Titles to Land (Consolidation) (Scotland) Act 1868, the Conveyancing (Scotland) Act 1874, the Conveyancing (Scotland) Act 1924, and some other statutes. It now contains three variants of holding.

Burgage holding is the system by which land in royal burghs is held, Blench holding is by a nominal payment, as of a penny Scots to be rendered upon demand only. In feu holding proper there is a substantial annual payment in money in return for the enjoyment of the land. The crown is the first overlord or superior, and land is held of it by crown vassals, but they in their turn may "feu" their land, as it is called, to others who become *their* vassals, while they themselves become mediate overlords or superiors. This process of subinfeudation may be repeated to an indefinite extent, except in cases where subinfeudation has been conventionally prohibited prior to the year 1874. If the vassal does not pay the annual feu duty for two years, the superior, among other remedies, may obtain by legal process a decree of irritancy, whereupon *tinsel* or forfeiture of the feu follows. Casualties, which are a feature of land held in feu, are additional payments to the superior, contingent on the happening of certain events.

By the Feudal Casualties (Scotland) Act 1914 all such casualties as may not have been redeemed or commuted by Jan. 1, 1930, shall be extinguished and discharged.

See Erskine's *Principles;* Bell's *Principles;* Rankine, *Law of Land-ownership in Scotland.*

FEUCHERES, SOPHIE, BARONNE DE (1795–1840), Anglo-French adventuress, was born at St. Helens, Isle of Wight, in 1795, the daughter of a drunken fisherman named Dawes. She grew up in the workhouse. went up to London as a servant, and became the mistress of the duc de Bourbon, afterward prince de Condé, who gave her a good education in modern and ancient languages. He arranged her marriage to Adrien Victor de Feuchères, and the baroness, pretty and clever, became a person of consequence at the court of Louis XVIII. De Feuchères discovered the relations between his wife and Condé, whom he had been assured was her father, obtained a legal separation in 1827, and the king forbade her appearance at court. Thanks to her influence, however, Condé was induced in 1829 to sign a will bequeathing more than 66,000,000 fr. to the duc d'Aumale, fourth son of Louis Philippe.

Again the baroness was in high favour. Charles X received her at court, Talleyrand visited her, her niece married a marquis and her nephew was made a baron. Condé, wearied by his mistress's importunities, and but half pleased by the advances made him by the government of July, had made up his mind to leave France secretly. However, he was found hanging dead from his window (Aug. 27, 1830). The baroness returned to London, where she died in Dec. 1840.

FEUCHTERSLEBEN, ERNST, FREIHERR VON (1806–1849), Austrian physician, poet and philosopher, was born in Vienna on April 29. 1806, of an old Saxon noble family. He was educated at the University of Vienna, and in 1844 was appointed dean of the faculty of medicine. In 1848, while refusing the presidency of the ministry of education, he accepted the appointment of undersecretary of state in that department. He died in Vienna on Sept. 3, 1849. He was not only a clever physician, but a poet of fine aesthetical taste and a philosopher. Among his medical works may be mentioned: *Über das Hippokratische erste Buch von der Diat* (Vienna, 1835), *Ärzte und Publicum* (Vienna, 1848) and *Lehrbuch der ärztlichen Seelenkunde* (1845). His poetical works include *Gedichte* (Stutt, 1836), among which is the well-known beautiful hymn, which Felix Mendelssohn set to music, "Es ist bestimmt in Gottes Rat." As a philosopher he is best known by his *zur Diätetik der Seele* [Dietetics of the Soul] (Vienna, 1838).

See M. Necker, "Ernst von Feuchtersleben, der Freund Grillparzers," in the *Jahrbuch der Grillparzer Gesellschaft,* vol. iii (1893).

FEUCHTWANGER, LION (1884–1958), German writer, best known for his historical novels, was born in Munich on July 7, 1884, of a Jewish family, his father being a manufacturer. He studied philosophy in Berlin and Munich and early devoted himself to literature. His first works were dramatic pieces, original or translations: *Die Perser* (Aeschylus) (1915); *Vasantasena* (1915); *Friede* (Aristophanes) (1916); *Kriegsgefangenen* (1916); *Thomas Wendt* (dramatic novel, 1919); *Der hollandische Kaufmann* (1921). He broke new ground in 1923 with a noteworthy historical novel of Margarete Maultasch, duchess of Tirol *(Die hässliche Herzogin;* English trans., *The Ugly Duchess,* 1927), in which the life of 14th-century Tirol was reproduced with great dramatic force. *Jud Suss* (1925, English trans., *Jew Suss,* 1927), a novel of 18th-century Germany, was even more notable. Feuchtwanger's later works included *Angelsächsische Trilogie* (1927); a translation of Christopher Marlowe's *Edward 11* (1925); *Power* (1926); *Success* (1930); the historical trilogy of *Josephus* (1932), *The Jew of Rome* (1935) and *Josephus and the Emperor* (1942); *The Pretender* (1937); and *Proud Destiny* (1947). In 1933 Feuchtwanger was expelled from Germany and later settled in the U.S., where he died in Los Angeles on Dec. 21, 1958.

FEUD, animosity, hatred, especially a permanent condition of hostilities between persons, and hence applied to a state of private warfare between tribes, clans or families, a "vendetta," (*q.v.*).

FEUDALISM (from Late Lat. *feodum* or *feudum,* a fee or fief; *see* FEE). In every case of institutional growth in history two things are to be distinguished from the beginning for an understanding of the process and its results. One of these is the change of conditions in the political or social environment which made growth necessary. The other is the already existing institutions which began to be transformed to meet the new needs. In studying the origin and growth of political feudalism, the distinction is easy to make.

The prevailing need of the later Roman and early mediaeval society was protection — protection against the sudden attacks of invaders or revolted peasants, against the unwarranted demands of government officers, or even against the legai but too heavy exactions of the government. The protection which the government normally furnished, the weak freeman and the small landowner could no longer obtain. He must seek protection wherever he could get it, and pay the price demanded for it.

These are the great social facts — the failure of government to perform one of its most primary duties, the necessity of finding some substitute in private life — extending through the whole formative period of feudalism.

Roman Origins. — The institutions which the need of protection seized upon had both long existed in the private, not public, relations of the Romans. One of them related to the person, the other related to land. There are thus distinguished at the beginning those two great sides of feudalism which remained to the end more or less distinct.

The personal institution needs little description. It was the Roman patron and client relationship which had remained in the days of the empire, in later times less important perhaps legally than socially. This institution. the *patrocinium,* was firmly enough entrenched to survive the German conquest, and to be continued by the conquerors. In its new use, alike in the later Roman and the early German state, the landless freeman who could not support himself offered his services, those proper to a freeman, to some powerful man in return for shelter and support.

This transaction, called commendation, gave rise in the German state to a written contract which related the facts and provided a penalty for its violation. It created a relationship of protection and support on one side, and of free service on the other.

The other institution, relating to land, was that known to the Roman law as the *precarium,* because of the prayer of the suppliant by which the relationship was begun. The *precarium* was a form of renting land not intended primarily for income, but for use when the lease was made from friendship, for example, or as a reward, or to secure a debt. Legally its characteristic feature was that the lessee had no right of any kind against the grantor. The owner could terminate the relation at any time, for any reason, or for none at all, and the heirs of neither party were bound by it.[1] The legal character of this transaction is summed up in a well-known passage in the *Digest* (xliii. 26. 12) which may be paraphrased as follows: — The *precarium* tenant may employ the interdict against a third party, because he cannot use the ordinary civil action, his holding being not a matter of business but rather of favour and kindness.

As used for protection in later Roman days the *precarium* gave rise to what was called the commendation of lands, *patrocinium fundorum.* The poor landowner surrendered to his powerful neighbour the ownership of his lands, which he then received back as a *precarium* — gaining protection during his lifetime at the cost of his children, who were left without legal claim and compelled to make the best terms they could.[2] Applied to this use the *precarium* found extensive employment in the last age of the empire. The government looked on the practice with disfavour, because it transferred large areas from the easy access of the state to an ownership beyond its reach. The laws repeatedly forbade it under increasing penalties, but it could not be stopped.

Frankish Development. — These practices the Frankish conquerors of Gaul found in full possession of society, and they seem to have made them their own without material change. The *patrocinium* they could understand by the existence of a somewhat similar institution among themselves, the *comitatus,* described by Tacitus. The *comitatus* made contributions of its own to future feudalism, to some extent to its institutional side, largely to the ideas and spirit which ruled in it. Probably the ceremony which grew into feudal homage, and the oath of fealty, certainly the honourable position of the vassal and his pride in the relationship, the strong tie which bound lord and man, and the idea that faith and service were due on both sides in equal measure, may be traced to German sources. But we must not forget that the origin of the vassal relationship, as an institution, is to be found on Roman soil.

To the *precarium* German institutions offered no close parallel. The advantages which it afforded were obvious, and this side of feudalism developed as rapidly after the conquest as the personal. The new German noble was as eager to extend his lands and to increase the numbers of his dependants as the Romans had been. The new German government furnished no better protection from local violence, nor was it able any more effectively to check the practices which were creating feudalism. *Precarium* and *patrocinium* easily passed from the Roman empire to the Frankish kingdom, and became firmly rooted in the new society. Up to this point we have seen only the small landowner and the landless man entering into these relations. Feudalism could not be established, however, until the great of the land had begun to enter the clientage of others and to hold lands by the *precarium* tenure. The first step was quickly taken. The same class continued to furnish the king's men, and to form his household and body-guard whether the relation was that of the *patrocinium* or the *comitatus,* and to be made noble by entering into it. It was later that they became clients of one another, and in part at least as a result of their adoption of the *precarium* tenure. In this latter step the influence of the Church rather than of the king seems to have been effective. The large estates which pious intentions had bestowed on the Church it was not allowed to alienate. It could most easily make them useful by employing the *precarium* tenure. On the other side, the great men were ready without persuasion to annex portions of these estates for their own on the easy terms of this tenure, not always indeed observed by the holder, or able to be enforced by the Church. The employment of the

[1] *Digest,* xliii. 26. 14, and *cf.* 17.
[2] Salvian, *De* gub. *Dei,* v. 8, ed. Halm, p. 62.

precarium by the Church seems to have been one of the surest means by which this form of landholding was carried over from the Romans to the Frankish period and developed into new forms. It came to be made by degrees the subject of written contract, by which the rights of the holder were more definitely defined and protected than had been the case in Roman law. The length of time for which the holding should last came to be specified, at first for a term of years and then for life, and some payment to the grantor was provided for, not pretending to represent the economic value of the land, but only to serve as a mark of his continued ownership.

The Carolingian Age.—These changes characterize the Merovingian age, which had practically ended, however, before these two institutions showed any tendency to join. Nor had the king up to that time exerted any apparent influence on the processes that were going forward. It was the advent of the Carolingian princes that carried these institutions a stage further forward. Making their way up from a position among the nobility to be the rulers of the land, and finally to supplant the kings, the Carolingians had especial need of resources from which to purchase and reward faithful support. The fundamental principle of the Frankish military system, that the man served at his own expense, was still unchanged. It had indeed begun to break down under the strain of frequent and distant campaigns; but it was long before it was changed as the recognized rule of mediaeval service. If now, in addition to his own expenses, the soldier must provide a horse and its keeping, the system was likely to break down. To solve this problem the early Carolingian princes, especially Charles Martel, grasped at the land of the Church. The means devised to permit its use were found in the *precarium* tenure. Keeping alive, as it did, the fact of the grantor's ownership, it did not in form deprive the Church of the land. Recognizing that ownership by a small payment not corresponding to the value of the land, it left the larger part of the income to meet the need which had arisen. At the same time undoubtedly the new holder of the land, if not already the vassal of the prince, was obliged to assume an obligation of service with a mounted force when called upon. This expedient gave rise to the numerous *precariae verbo regis,* of the Church records, and to the condemnation of Charles Martel in the visions of the clergy to worse difficulties in the future life than he had overcome in this. The most important consequences of the expedient, however, was the bringing together of the two sides of feudalism, vassalage and benefice, as they were now commonly called. It emphasized military service as an essential obligation of the vassal; and it spread the vassal relation between individual proprietors and the sovereign.

During the reign of Charlemagne and the later Carolingian age continued necessities, military and civil, forced the kings to recognize these new institutions more fully, even when standing between the government and the subject, intercepting the public duties of the latter. The incipient feudal baron had not been slow to take advantage of the break-down of the old German military system. The poor Frank could escape the ruinous demands of military service only by submitting himself and his lands to the count, who did not hesitate on his side to force such submission. Charlemagne legislated against this tendency, trying to make it easier for the poor freeman to fulfil his military duties directly to the state, and to forbid the misuse of power by the rich. Finally the king was compelled to recognize existing facts, to lay upon the lord the duty of producing his men in the field and to allow him to appear as their commander. This completed the transformation of the army into a vassal army: it completed the recognition of feudalism by the state, as a legitimate relation between different ranks of the people; and it recognized the transformation in a great number of cases of a public duty into a private obligation.

In the meantime another institution had grown up in this Franco-Roman society, which probably began and certainly assisted in another transformation of the same kind. This is the immunity. Suggested probably by Roman practices, it received a great extension in the Merovingian period, at first and especially in the interest of the Church, but soon of lay land-holders By the grant of an immunity to a proprietor the royal officers, the count and his representatives, were forbidden to enter his lands to exercise any public function there The duties which the count should perform passed to the proprietor, who now represented the government for all his tenants free and unfree. Apparently no modification of the royal rights was intended by this arrangement, but the beginning of a great change had really been made. The king might still receive the same revenues and the same services from the district held by the lord as formerly, but for their payment a private person in his capacity as overlord was now responsible In the course of a long period characterized by a weak central government, it was not difficult to enlarge the rights which the lord thus obtained, to exclude even the king's personal authority from the immunity, and to translate the duties and payments which the tenant had once owed to the state into obligations which he owed to his lord. even finally into incidents of his tenure. The most important public function whose transformation into a private possession was assisted by the growth of the immunity was the judicial. The lord's court gradually took the place of the public court in civil, and even by degrees in criminal cases. The plaintiff, even if he were under another lord, was obliged to sue in the court of the defendant's lord, and the portion of the fine for a breach of the peace which should have gone to the state went in the end to the lord

The transfer of the judicial process, and of the financial and administrative sides of the government as well. into private possession, was not, however, accomplished entirely by the road of the immunity. As government weakened after the strong days of Charlemagne, and disorder, invasion, and the difficulty of intercommunication tended to throw the locality more and more upon its own resources, the officer who had once been the means of centralization. the count, was able to exercise the powers which had been committed to him as an agent of the king, as if they were his own private possession Nor was the king's aid lacking to this method of dividing up the royal authority, any more than to the immunity, for it became a frequent practice to make the administrative office into a fief. and to grant it to be held in that form of property by the count In this way the feudal county. or duchy, formed itself, corresponding in most cases only roughly to the old administrative divisions of the state.

DIFFERENT STAGES OF GROWTH

In its earliest stage of growth the feudal system was that of the private possession only. For protection the great landowner forced his smaller neighbours to become his dependants in return under a great variety of forms, but especially developing thereby the *precarium* land tenure and the *patrocinium* personal service, and organizing a private jurisdiction over his tenants. and a private army for defence. Finally he secured from the king an immunity which excluded the royal officers from his lands and made him a quasi-representative of the state In the meantime his neighbour the count had been following a similar process. His right to exact military, financial and judicial duties for the state he had used to force men to become his dependants, and then he had stood between them and the state, freeing them from burdens which he threw with increased weight upon those who still stood outside his personal protection. The kings first adopted for themselves some of the forms and practices which had thus grown up, and by degrees recognized them as legally proper for all classes. It proved to be easier to hold the lord responsible for the public duties of all his dependants because he was the king's vassal and by attaching them as conditions to the benefices which he held, than to enforce them directly upon every subject When this stage was reached the formative ape of feudalism may be considered at an end When the government of the state had entered into feudalism, and the king was as much lord as king; when the vassal relationship was recognized as a proper and legal foundation of public duties; when the two separate sides of early feudalism were united as the almost universal rule, so that a man received a fief because he owed a vassal's duties, or looked at in the other and finally prevailing way, that he owed a vassal's duties because he had received a fief; and finally, when the old idea of the temporary character of the *precarium* tenure was lost sight of, and the right of the vassal's heir to receive his father's holding was recognized as the general rule—then the feudal system may be called full grown. We shall not be far wrong if we place the end of its formative age near the beginning of the 10th century.

Results in England.— The growth which we have traced took place within the Frankish Empire. In Anglo-Saxon England *precarium* and *patrocinium* were lacking. Certain forms of personal commendation did develop, certain forms of dependent land tenure came into use, but these were not characteristic of the actual line of feudal descent. Scholars are not yet agreed as to what would have been their result if their natural development had not been cut off by the violent introduction of Frankish feudalism with the Norman conquest, whether the historical feudal system, or a feudal system in the general sense. To the writer it seems clear that the latter is the most that can be asserted. They were forms which may rightly be called feudal, but only in the wider meaning in which we speak of the feudalism of Japan, or of Central Africa, not in the sense of 12th-century European feudalism; Saxon commendation may rightly be called vassalage, but only as looking back to the early Frankish use of the term for many varying forms of practice, not as looking forward to the later and more definite usage of completed feudalism; and such use of the terms feudal and vassalage is sure to be misleading. There is no trace of the distinctive marks of Frankish feudalism in Saxon England, not where military service may be thought to rest upon the land, nor even in the rare cases where the tenant seems to some to be made responsible for it, for between these cases as they are described in the original accounts, legally interpreted, and the feudal conception of the vassal's military service, there is a great gulf.

The Completed System.—The temptation to use the larger part of any space allotted to the history of feudalism for a discussion of origins does not arise alone from greater interest in that phase of the subject. It is almost impossible even with the most discriminating care to give a brief account of completed feudalism and convey no wrong impression. We use the term "feudal system" for convenience sake, but with a degree of impropriety if it conveys the meaning "systematic." Feudalism in its most flourishing age was anything but systematic. Great diversity prevailed everywhere, and different facts or customs are found in every lordship But underlying all the apparent confusion of fact and practice were certain fundamental principles and relationships, which were alike everywhere. The chief of these are: the relation of vassal and lord; the principle that every holder of land is a tenant and not an owner, until the highest rank is reached, sometimes even the conception rules in that rank; that the tenure by which a thing of value is held is one of honourable service, not intended to be economic, but moral and political in character; the principle of mutual obligations of loyalty, protection and service binding together all the ranks of this society from the highest to the lowest; and the principle of contract between lord and tenant, as determining all rights, controlling their modification, and forming the foundation of all law.

The foundation of the feudal relationship proper was the fief, which was usually land, but might be any desirable thing, as an office, a revenue in money or kind. the right to collect a toll, or operate a mill. In return for the fief, the man became the vassal of his lord; he knelt before him, and, with his hands between his lord's hands, promised him fealty and service; he rose to his feet and took the oath of fealty which bound him to the obligations he had assumed in homage; he received from his lord ceremonial investiture with the fief. The faithful performance of all the duties he had assumed in homage constituted the vassal's right and title to his fief. So long as they were fulfilled, he, and his heir after him, held the fief as his property, practically and in relation to all under tenants as if he were the owner. In the ceremony of homage and investiture, which is the creative contract of feudalism, the obligations assumed by the two parties were determined, as a rule, by local custom. In detail the vassal's services differed widely, but they fall into two classes, general and specific. The general included all that might come under the idea of loyalty, seeking the lord's interests, keeping his secrets, betraying the plans of his enemies, protecting his family, etc. The specific services covered military service, which included appearance in the field on summons with a certain force, often armed in a specified way, and remaining a specified time. It often covered also the duty of guarding the lord's castle. and of holding one's own castle subject to the plans of the lord for the defence of his fief. Hardly less characteristic was court service, which included the duty of helping to form the court on summons, of taking one's own cases to that court instead of to some other, and of submitting to its judgments. The duty of giving the lord advice was often fulfilled in sessions of the court, and in these feudal courts the obligations of lord and vassal were enforced, with an ultimate appeal to war. Under this head may be enumerated the financial duties of the vassal, which were either intended to mark the vassal's tenant relation, like the relief, or to be a part of his service, like the aid, that is, he was held to come to the aid of his lord in a case of financial as of military necessity. The relief was a sum paid by the heir for the lord's recognition of his succession. The aids were paid on a few occasions, determined by custom, where the lord was put to unusual expense, as for his ransom when captured by the enemy, or for the knighting of his eldest son. The most lucrative of the lord's rights were wardship and marriage.

Ideally regarded, feudalism covered Europe with a network of these fiefs, rising gradually from the smallest, the knight's fee, at the bottom, to the king at the'top, who was the supreme landowner, or who held the kingdom from God. Actually not even in the most regular of feudal countries, like England or Germany, was there any fixed gradation. A knight might hold directly of the king, a count of a viscount, a bishop of an abbot, or the king himself of one of his own vassals, or even of a vassal's vassal, and in return his vassal's vassal might hold another fief directly of him.

The Government of Feudal Countries.—It is now possible perhaps to get some idea of the way in which the government of a feudal country was operated. The early German governments whose chief functions, military, judicial. financial. legislative, were carried on by the freemen of the nation, and were performed as duties owed to the community for its defence and sustenance, had given way to new forms of organization in which these conceptions had not entirely disappeared but in which the vast majority of cases a wholly different idea of the ground of service and obligation prevailed The members of the feudal court met, not to fulfil a duty owed to the community, but a private obligation which they had assumed in return for the fiefs. The feudal state was one in which, as it has been said, private law had usurped the place of public law. Public duty had become private obligation. To understand the feudal state it is essential to realize that all sorts of services, which men ordinarily owe to the public or to one another, were translated into a form of rent paid for the use of land. and defined and enforced by a private contract. In every feudal country, however, something of the earlier conception survived A general military levy was occasionally made. Something like taxation occasionally occurred, though the government was usually sustained by the scanty feudal payments, by the proceeds of justice and by the income of domain manors. About the office of king more of this earlier conception gathered than elsewhere in the state. and gradually grew, aided not merely by traditional ideas, but by the active influence of the Bible, and soon of the Roman law. The kingship formed the nucleus of new governments as the feudal system passed away.

Actual government in the feudal age was primitive and undifferentiated. Its chief and almost only organ, for kingdom and barony alike, was the curia—a court formed of the vassals This acted at once and without any consciousness of difference of function, as judiciary, as legislature, and as council, and it exercised final supervision and control over revenue and administration. Almost all the institutions of modern states go back to the *curia regis,* branching off from it as the growing complexity of business forced differentiation of function and personnel. In action it was an assembly court, deciding all questions by discussion and the weight of opinion, though its decisions obtained their legal validity by the formal pronunciation of the presiding member, *i.e.,* of the lord whose court it was. In a government of this kind the essential operative element was the baron. So long as the government remained dependent on the baron, it remained feudal in its character. Feudalism disappeared as the organization of society. when a professional class arose to form the judiciary, nhen the increased circulation of money made regular taxation possible and enabled the government to buy military and other services, and when better means of intercommunication and the growth of common ideas made a wide centralization possible and likely to be permanent. In nearly all the states of Europe the end of the feudal age was reached about the close of the 13th century.

Decline and Survivals.— As feudalism passed into decline, its customs tended to crystallize into fixed forms. At the same time a class of men arose interested in these forms for their own sake. professional lawyers or judges. who wrote down for their onn and others' use the feudal usages with which they were familiar. The great age of these codes was especially the second half of the 13th century. The codes in their turn tended still further to harden these usages into fixed forms, and we may date from the end of the 13th century an age of feudal law regulating especially the holding and transfer of land, and much more uniform in character than the law of the feudal age proper. This was particularly the case in parts of France and Germany where feudalism continued to regulate the property relations of lords and vassals longer than elsewhere. and where the underlying economic feudalism remained in large part unchanged.

Feudalism formed the starting-point also of the later social nobilities of Europe. They drew from it their titles and ranks and many of their regulative ideas. though these were formed into more definite and regular systems than ever existed in feudalism proper. It was often the policy of kings to increase the social privileges and legal exemptions of the nobility while taking anay all political poner, so that it is necessary in the history of institutions to distinguish sharply between these nobilities and the feudal baronage proper. It is only in certain backward parts of Europe that the terms feudal and baronage in any technical sense can be used of the nobility of the 15th century.

See also English Law; French Law and Institutions; Hide; Knight Service; Manor; Scutage; Villeinage.

(G. B. A.; X.)

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For Germany *see* G. Waitz, *Deutsche Verfassungsgeschichte* (1844 foll.), H. Brunner, *Grundzüge der deutschen Rechtsgeschichte* (1901); V. Menzel, *Die Entstehung des Lehenswesens* (1890); and G. L. von Maurer's works on the early institutions of the Germans.

FEUERBACH, ANSELM (1829–1880), German painter, who was, apart from Arnold Böcklin, the most important representative of late classicism in Germany. Nephew of the philosopher, L. Feuerbach, he was born at Speyer. Bavaria. on Sept. 12, 1829. He began to study art in 1845 at the Diisseldorf academy under F. W. Schadow (*q.v.*). From 1848 to 1850 he worked under Karl Rahl in Munich and during 1851–54 twice stayed for some time in Paris. There Thomas Couture exerted a great influence on him, one which was to be decisive in his subsequent development. Two early works painted in Paris show his dependence on Couture: "Hafiz at the Well" (1852) and the "Death of Aretino" (1854). Idealistic, philosophical figure compositions, the intrinsic values of which were lyrical and elegiac, later became his main interest. During a stay of many years in Italy (1855–73), first in Venice, then in Florence and Rome, Feuerbach came under the influence of the Renaissance painters, chief among them Titian—whose "Assumption" he copied in Venice—and Paolo Veronese.

The principal aorks of the Italian years of his maturity are "Dante Walking nith the Noble Ladies of Ravenna" (1858), the two pictures representing "Iphigeneia" (1862, 1871), "Paolo and Francesca" (1864), "Plato's Symposium" (1869. second composition 1873), the "Judgment of Paris" (1870) the "Battle of the Amazons" (1869–73), and various compositions on the "Medea" theme (1866–70). A uniform dark tone with little contrast in colour matches the lyrical, secretly tragic basis of these works. Feuerbach's gifts were not suited to dramatic action and consequently the "Fall of the Titans," the ceiling piece in the hall of the Vienna Academy of Fine Arts (where he became a professor in 1873), is one of his weaker and more derivative compositions. The work was strongly criticized by contemporary critics. This failure in addition to illness caused Feuerbach finally to leave Vienna and return to Italy in 1876. He died in Vienna on Jan. 4, 1880. His greatest and most original accomplishments are his formal, statuesque portraits, including the various ones of his model, Nanna Risi and his stepmother, Henriette Feuerbach, a few individual "heroic" landscapes and numerous drawings. With his painting may be considered his literary work: *Vermächtnis,* published in 1882. which told the story of his struggles, and his letters to his stepmother, which appeared in 1911.

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(F. Ny.)

FEUERBACH, LUDWIG ANDREAS (1804–1872), German philosopher, fourth son of the eminent jurist *(see* Feuerbach, Paul Johann Anselm), was born at Landshut, Bavaria, on July 28, 1804. His influence was greatest upon the anti-Christian theologians such as D. F. Strauss, author of *Das Leben Jesu,* and Bruno Bauer, who like Feuerbach had passed from Hegelianism to a form of naturalism. After two years in Berlin, under Hegel, Feuerbach studied natural science at Erlangen in 1828. His first book, published anonymously, *Gedanken über Tod und Unsterblichkeit* (1830), attacks personal immortality and advocates the Spinozistic immortality of reabsorption in nature. He then published *Darstellung der Geschichte der neuern Philosophie* (2 vol., 1833–37), *Abalard und Heloise* (1834), *Pierre Bayle* (1838) and *Uber Philosophie und Christentum* (1839), in which he claimed "that Christianity has in fact long vanished not only from the reason but from the life of mankind, that it is nothing more than a fixed idea." This attack is followed up in his most important work, *Das Wesen des Christentums* (1841; Eng. trans. by George Eliot, 1853), which aims to humanize theology. He lays it down that man is to himself his own object of thought. Religion is consciousness of the infinite. Religion therefore is "nothing else than the consciousness of the infinity of the consciousness; or, in the consciousness of the infinite, the conscious subject has for his object the infinity of his own nature." Thus God is, so to speak, the outward projection of man's inward nature. In the first part of the book Feuerbach develops the "true or anthropological essence of religion." Treating of God in his various aspects "as a being of the understanding." "as a moral being or law." "as love" and so on, he shows that these aspects correspond to some need of human nature. In the second part he discusses the "false or theological essence of religion," contending that the view which regards God as having a separate existence leads to a belief in revelation and in sacraments, which are pieces of religious materialism. Feuerbach denied that he was rightly called an atheist. but the denial is merely verbal. During the troubles of 1848–49 Feuerbach's attack upon orthodoxy made him something of a hero with the revolutionary party. His *Theogonie* (1857) was followed by

Gottheit, Freiheit und Unsterblichkeit (1866). He died on Sept. 13, 1872.

Some of Feuerbach's ideas were taken up by those engaged in the struggle between church and state in Germany and by those who, like F. Engels and Karl Marx, were leaders in the revolt of labour against capital.

Feuerbach's *Werke* were published in 10 vol. (1846–66; 1903–11); and the correspondence, ed. by K. Griin, in 2 vol. (1874).

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FEUERBACH, PAUL JOHANN ANSELM, RITTER VON (1775–1833), the German jurist, chiefly remembered for his work in the field of criminal law reform, was born at Hainichen, near Jena, on Nov. 14, 1775, and brought up at Frankfurt am Main. At 16, he ran away from home to study at Jena where, despite ill-health and poverty, he took his doctorate in philosophy in 1795. With the birth of a son in 1796, he was forced to turn from philosophy and history to law, which offered better prospects. In 1796 he published *Kritik des natürlichen Rechts* . . . ("Critique of Natural Rights") followed by *Anti-Hobbes*, . . . (1798), a dissertation on the limits of the civil power. Feuerbach, as the founder of a new theory of penal law, the so-called "psychological-coercive or intimidation theory," gave to the rigorous Kantian doctrine that punishment ought only to be given for its own sake, a secular purpose, namely to enforce the threat of the law which deters the would-be law breaker. In this he was a fierce adversary of the idea of individual prevention put forward by Karl Grolmann, who was his life-long friend.

Feuerbach's famous *Lehrbuch des gemeinen in Deutschland geltenden peinlichen Rechts* ("Textbook of Common Law generally applied in Germany"; 1801) remained the leading textbook in Germany for half a century. This, and his earlier works, were a powerful protest against vindictive punishment and furthered the reform of the' German criminal law. The administration of justice was, before Feuerbach's time, distinguished by two characteristics: the superiority of the judge to all law, and the blending of the judicial and executive offices. Feuerbach, using as his chief weapon the *Revision der Grundbegriffe* ("Revision of the basic assumption"; 1799) achieved the recognition of the formula, *nullum crimen, nulla poena sine lege* ("no crime and no punishment unless provided by statutory law").

In 1805 he was given a post in the ministry of justice and commanded to draft a penal code for Bavaria (*Strafgesetzbuch für das Konigreich Bayern*). Practical reform was begun in Bavaria under his influence with the abolition of torture in 1806. In 1808 appeared the first volume of his *Merkwiirdige Criminalfalle* ("Remarkable Criminal Cases"), completed in 1811. In his *Betrachtungen über das Geschworenengericht* ("Remarks on the Jury Principle"; 1812) Feuerbach criticized, from a legal point of view, the defects of the jury, at that time recommended in accordance with the French code, but he was prepared to accept the jury as a political safeguard of civil rights, provided that it fitted into a wider framework of constitutional guarantees and the rule of law. The Bavarian criminal code was promulgated in 1813; distinguished by the clarity of its definitions and its careful classifications, it remained, together with the French *code pénal,* a model for European states until the Prussian criminal code of 1861.

During the war of liberation (1813–14) Feuerbach published several political brochures which, owing to the writer's position, had almost the weight of state manifestoes. In 1814 he was appointed second president of the court of appeal at Bamberg, and three years later he became first president of the court of appeal at Anspach. In the two treatises which he subsequently published in 1821 and 182j, he strongly urged publicity in all legal proceedings and showed himself a forerunner of modern efforts in the field of comparative law.

As one of his last activities he championed the cause of the mysterious foundling Kaspar Hauser. He died suddenly at Frankfurt on May 29, 1833.

See *Leben und Wirkens Ans. von Feuerbachs,* 2 vol. (1853) with its occasional notes by his fourth son Ludwig, a distinguished philosopher. *See* also M. Gruenhut, *A. von F. und das Problem der strafrechtlichen* (1922); G. Radbruch, *P. J. A. Feuerbach* (1934, 2nd ed. 1957); E. Wolf, *Grosse Rechtsdenker der deutschen Geistesgeschichte,* 3rd ed., pp. 536–583 (1951). (J. F. LR.)

FEUILLANTS, CLUB OF THE, a political association which played a prominent part during the French Revolution. It was founded on July 16, 1791, by several members of the Jacobin club who refused to sign a petition presented by this body, demanding the deposition of Louis XVI. Among them were B. Barère and E. J. Sieyès, who were later joined by other politicians, Dupont de Nemours being among them. The name of Feuillants was popularly given to this group because they met in the house in the rue Saint-Honor6 which had been occupied by the religious order bearing this name. The official name of the club was *Société des amis de la Constitution,* the title being a sufficient indication of the line they intended to pursue. This consisted of opposing everything not contained in the constitution of 1791; in their opinion, the latter was in no need of modification, and they hated all those who were opposed to it, whether *émigrés* or Jacobins. They affected to avoid all political discussion, and called themselves merely a "conservative assembly." This attitude they maintained after the constituent assembly had been succeeded by the legislative, but not many of the new deputies became members of the club.

With the rapid growth of extreme democratic ideas the Feuillants soon began to be looked upon as reactionaries, and to be classed with aristocrats. They did, indeed, represent the aristocracy of wealth, for they had to pay for attendance a subscription which was at that time a large sum. Moreover, the luxury with which they had surrounded themselves, and the restaurant which they had annexed to their club, seemed to mock the misery of the half-starved proletariat and added to the suspicion with which they were viewed, especially after the popular triumphs of June 20 and Aug. 10, 1792. A few days after the insurrection of Aug. 10 their papers were seized, and 841 members were proclaimed as suspects. This was the deathblow of the club. It had made an attempt, though a weak one, to oppose the forward march of the revolution, but, unlike the Jacobins, had never sent out branches into the provinces. The name of Feuillants, as a party designation, survived. It was applied to those who advocated a policy of cowardly moderation, and *feuillantisme* was associated with *aristocratie* in the mouths of the sans-culottes.

FEUILLETON, originally a kind of supplement attached to the political portion of French newspapers. Its inventor was Bertin the elder, editor of the *Débats.* It was usually separated from the political part of the newspaper by a line, and printed in smaller type. In French newspapers it consists chiefly of nonpolitical news and gossip, literature and art criticism, a chronicle of fashions, epigrams, charades, etc. The term came into English use to indicate the installment of a serial story printed in one part of a newspaper.

FEUQUIERES, ISAAC MANASSÈS DE PAS, MARQUIS DE (1590–1640), French soldier and diplomatist, born at Saumur on June 1, 1590, came of a distinguished family of which many members held high command in the civil wars of the 16th century. He entered the royal army at the age of 30, and soon achieved distinction.

In 1626 Feuquières served in the Valtelline, and in 1628–29 at the siege of La Rochelle, where he was taken prisoner. He was made *maréchal de camp* in 1629, serving in the fighting on the southern frontiers of France and occupying various military positions in Lorraine. Richelieu repeatedly employed him on diplomatic missions. He was sent as an ambassador into Germany where he rendered important services in negotiations with Wallenstein; he renewed at Heilbronn (April 19, 1633), the treaty of alliance with Sweden; and he was also employed in the tortuous negotiations at Frankfurt in 1634. In 1636 he commanded the French corps operating with the duke of Weimar's forces. With these troops he served in the campaigns of 1637 (in which he became lieutenant general), 1638 and 1639, At the siege of Thionville (Diedenhofen) he was mortally wounded

His *Lettres inédites* appeared (ed. by Gallois) in Paris in 1845.

His grandson ANTOINE MANASSÈS DE PAS, MARQUIS DE FEUQUIÈRES (1648–1711), who entered the army at the age of 18, won a promotion to the rank of captain for his conduct at the siege of Lille in 1667. In the campaigns of 1672 and 1673 he served on the staff of Luxemburg, and at the siege of Oudenarde in the following year the king gave him command of the royal marine regiment, which he held until he obtained his own regiment in 1676. Promoted to *maréchal de camp,* he served under Catinat against the Waldenses, and in the course of the war won the nickname of the "Wizard."

In 1692 he made a brilliant defense of Speierbach against greatly superior forces. and was rewarded with the rank of lieutenant general. Marshal Villeroi impressed him less favourably than his old commander Luxemburg, and the resumption of the war in 1701 found him in disfavour in consequence. The rest of his life. embittered by the refusal of the marshal's baton he spent in compiling his celebrated memoirs. which, coloured as they were by the personal animosities of the writer, mere yet considered by Frederick the Great and the soldiers of the 18th century as the standard work on the art of nar as a whole.

The *Mémoires de la guerre* (1701, 1711, 1725, 1735, etc., London 1736, Amsterdam subsequently) mere translated into English (1737) and German (1732). They deal in detail with every branch of the art of nar and of military service.

FÉVAL, PAUL HENRI CORENTIN (1817–1887), French author of sensational novels and dramatist, was born at Rennes on Sept 27. 1817. His *Mystères de Londres* (1844) was published under the pseudonym "Sir Francis Trolopp." Other novels include *Le Fils du diable* (1846); *Les Compagnons du silence* (1857); *Le Bossu* (1858); *Le Poisson d'or* (1863); *Les Habits noirs* (1863): *Jean le diable* (1868), and *Les Compagnons du trésor* (1872). Féval later considered his chronicles of crime an evil influence, and he revised his earlier works and wrote religious pamphlets. He died in Paris on March 8, 1887. His *Oeuvres* (38 vol) appeared in 1895.

FEVER is a manifestation of disease, characterized by elevation of the body temperature. Although most often associated with infection, it is also observed in other pathologic states, such as cancer, coronary artery occlusion and disorders of the blood.

Under normal conditions the temperature of deeper portions of the head and trunk does not vary by more than 1°–2° F. in a day, and does not exceed 99° in the mouth or 99.6" in the rectum. There is a small rhythmic diurnal variation, highest in the late afternoon, lowest in the early hours of the morning. In persons with fever the temperature may rise to 106°, and daily fluctuations of 5°–9° may occur. with peak levels tending to occur in the late afternoon. Transient elevations to 112°–113° have been recorded, but are very rare

During fever the blood and urine volumes become reduced as a result of loss of water through increased vaporization. Body protein is rapidly broken down, leading to increased excretion of nitrogenous products in the urine.

At a time when the body temperature is rising rapidly the affected person may feel chilly, or even have a shaking chill; conversely, when the temperature is declining rapidly he may feel warm and have a flushed moist skin. Drugs such as aspirin, nhich reduce fever, seem to exert their effect on the temperature-regulating areas of the brain; they do not influence body temperature in health.

The mechanism of fever appears to involve a disturbance in the brain's control of various processes affecting heat production and heat loss; *i.e.,* muscle tone, flushing. sweating, etc. The generally accepted hypothesis is that in febrile diseases certain products of tissue injury are carried by the blood to the brain, where they disturb the function of the heat-control centres. A material capable of such an effect has been demonstrated in white blood cells. The liberation of products of this type from injured cells may be the cause of fever in disease. *See* also ANIMAL HEAT.

See George W. Pickering, "Regulation of Body Temperature in Health and Disease," Lancet, vol. i, pp. 1–9 and 59–64 (Jan. 1958). (P. B. B.)

FEYDEAU, ERNEST-AIME (1821–1873), French author, mas born in Paris. He gained a great success with his novel *Fanny* (1858), followed in rapid succession by a series of similar stories. Besides his novels Feydeau wrote several plays. He died in Paris on Oct. 27, 1873.

FEZ (*Fās*), city in northern Morocco. Its historical importance, the wealth of its population, its many craftsmen and its famous university entitle Fez to be called the real centre—religious, political and economic—of the Shereefian empire. It lies in 34° 6' 3″ N., 4° 38' 15″ W., about 230 mi. N.E. of Marrakesh, 100 mi. E. from the Atlantic and 85 mi. S. of the Mediterranean on the main line of communication between the Atlantic coast and Algiers. It is in a deep valley on the Wad Fas, an affluent of the Wad Sebu, which divides the town into two parts—the ancient tonn, Fas el Bali, on the right bank, and the new, Fas el Jadid, on the left. Pop. (1952) 179,372.

Fez stretches out between low hills, crowned by the ruins of ancient fortresses. The city is surrounded except on the south by hills, interspersed with groves of orange, pomegranate and other fruit trees. and large olive gardens.

From its peculiar situation Fez has a drainage superior to that of most Moorish towns. When the town becomes dirty, water is allowed to run down the streets by opening lids for the purpose in the conduits and closing the ordinary exits, so that it overflows and cleanses the pavements.

Streets and Trade.—Most of the streets are exceedingly narrow, and as the houses are high, and built in many cases over the thoroughiares, these are often very dark and gloomy; but since wooden beams, rough stones and mortar are used in building, there is less of that ruined, half-decayed appearance so common in other Moorish towns where mud concrete is used.

Fez is the principal native industrial and commercial centre of Morocco. It lies at the crossing of the east-west route, from Algeria and the Atlantic cities of Morocco. and the north-south caravan route between Tangier and the Sahara. Manufactures include yellow slippers of the famous Morocco leather, fine white woolen and silk haiks, silk embroidery, woolen cloths and blankets. cotton and silk handkerchiefs, silk cords and braids, leather bookbinding, swords and guns, saddlery, brass trays, Moorish musical instruments, rude painted pottery and coloured tiles.

Schools and Mosques.—In the early days of Moslem rule in Morocco. Fez was the seat of learning and the pride of Islam. Its schools of religion, philosophy and astronomy enjoyed a great reputation in Africa and also in southern Europe, and were even attended by Christians. On the expulsion of the Moors from Spain, refugees of all kinds flocked to Fez, and brought with them some knowledge of arts. sciences and manufactures, and thither flocked students to make use of its extensive libraries. But its glories were brief, and though still the university town of Morocco, it retains but a shadow of its greatness. A number of students read at the Karueein. They pay no rent, but buy room keys from the last occupants, selling them again on leaving.

The Karueein (Karuwiyin) is celebrated as the largest mosque in Africa. On account of the vast area covered, the roof, supported by 366 pillars of stone, appears very low. The side chapel for services for the dead contains 24 pillars. All of these columns support horseshoe arches, on which the roof is built, long vistas of arches being seen from each of the 18 doors of the mosque. The number of lights in the mosque is given as 1,700. The mosque of Mulai Idris, built by the founder of Fez about A.D. 810, is considered so sacred that the streets which approach its entrance are forbidden to Jews, Christians or four-footed beasts.

A new city, begun in 1916. grew up three miles to the west of the old town, leaving the picturesque charm of the latter unspoilt. This new town. with modern buildings and tree-lined streets, lies between the old city and the station of the railway which connects Fez with Rabat. Casablanca and Tangier and continues as far as Taza. Oujda and Algiers.

According to Moslem historians Fez was founded in 807 by Idris II, although a settlement is now known to have existed in

801. The original town was in two sections, that of the people of Quairan and that of 8,000 Berber families expelled from Spain.

In the 13th century Fez. Jadid and many other beautiful colleges were built to house the foreign students; some are still standing, and are the purest examples of Spanish-Moorish art in Morocco.

On May 21, 1911, the French entered Fez at the request of the sultan, Mulai Hafid, who sought their aid in quelling a local rebellion. It was at Fez that M. Regnault signed the treaty of March 30, 1912, establishing the French protectorate over Morocco. A riot broke out, and Fez was besieged by the Berbers, but order was restored by General Lyautey. (P. W. I.)

FEZZAN, the ancient Phazania, or country of the Garamantes, became one of the three provinces of the United Kingdom of Libya in 1951. It is a region covering about 220,000 sq.mi. of desert south of Tripolitania. Four-fifths of its population of 54,438 (1954) live in scattered oases and the rest are nomadic. The Fezzan's international boundaries with Algeria and French West Africa follow those established by the former Italian colonial government of Tripolitania in the Franco-Italian convention of Sept. 1919. Its boundary in the east with Cyrenaica follows roughly the 19th meridian east and in the north with Tripolitania a line in the region of the 29th parallel.

Physical Geography. — The political area of the Fezzan has no clear relationship to natural boundaries. But among the physical features of the area are Jebel el-Soda (the Black mountain) in the north and the Tummo mountains in the extreme south. Between them are areas of sand dunes, stony desert, hilly outcrops of rock and two main depressions in which subterranean water permits settled habitation.

These depressions run in a northeasterly direction from the Ahaggar mountains of southern Algeria and support the principal oases of the province, Murzuk, Sebha and Brak. Hon and Waddan are to the north of Jebel el-Soda and in the southern part of the region are small settlements based on isolated water holes. Only in the north is there sufficient rainfall to provide sparse grazing. Elsewhere rain seldom falls except in the form of isolated storms which may occur only once in several years. The climate is Saharan, marked by low humidity, a wide range of daily temperature, extreme summer heat and temperatures sometimes falling below freezing point in the winter.

Flora and Fauna. — The date palm flourishes in the oases, where cereals and fruit can also be successfully cultivated on irrigated land. Outside the oases such vegetation as may be found is characteristic of the Sahara but most of the region is naked desert.

In the uninhabited oases, gazelle and desert antelopes are found in small and decreasing numbers. Camels and goats can find sufficient grazing for their meagre needs in the north together with jackals and hyenas. Among birds are ostriches, falcons, vultures, swallows and ravens; in summer wild duck are numerous but in winter they seek a warmer climate. There are no remarkable insects or snakes. A species of Artemia or brine shrimp, about a quarter of an inch in length, of a colour resembling goldfish, is caught with cotton nets in the saline Bahr el-Dud in the Wadi el-Gharbi. These are mixed with dates into a paste having the taste and smell of salt herring which is considered a delicacy by the people of the Fezzan.

History. — The country formed part of the territory of the Garamantes, described by Herodotus as a very powerful people. Attempts have been made to identify the Garamantes with the Berauna of the Arabs of the 7th century, and to the period of the Garamantes, H. Duveyrier, a French archaeologist who travelled in Fezzan during 1859–61, assigns the remains of remarkable hydraulic works and certain tombs and rock sculptures — indications, it is held, of a Negro civilization of ancient date which existed in the northern Sahara. The Garamantes, whether of Libyan or Negro origin, certainly had a considerable degree of civilization when in the year 19 B.C. they were conquered by the proconsul L. Cornelius Balbus Minor and their country added to the Roman empire. By the Romans it was called Phazania, whence the name Fezzan. After the Vandal invasion Phazania appears to have regained independence and to have been ruled by a Berauna dynasty. At this time the people were Christians, but in 666 the Arabs conquered the country and all traces of Christianity seem speedily to have disappeared. At first the area was subject to the caliphs, but early in the 10th century an independent Arab dynasty was established, with its capital at Zaila.

In 1174 Fezzan was conquered by an expedition sent by Saladin (*q.v.*), but it seems to have reasserted itself. In the 13th century the country became part of the Born empire (see BORNU), but it is probable that it was governed by a native tribe of hereditary rulers, who were dethroned in the 14th century by the Khorman, an Arab tribe which reduced Fezzan to slavery. It was rescued in about the middle of the 16th century by a sherif of Morocco, Montasir-b.-Mohammed, who founded the dynasty of Beni Mohammed. This dynasty, which came into frequent conflict with the Turks in Tripoli, gradually extended its borders as far as Sokna in the north. It was the Beni Mohammed who chose Murzuk as their capital. They became intermittently tributary to the pasha of Tripoli, but within Fezzan the power of the sultans was absolute. The last of the Beni Mohammed sultans was killed in 1811 by El-Mukkeni, one of the lieutenants of Yusef Pasha, the last sovereign but one of the independent Karamanli dynasty of Tripoli. El-Mukkeni then made himself sultan of Fezzan. and became notorious by his slaving expeditions into the central Sudan, in which he advanced as far as Bagirmi. In 1831, Xbd-el-Jelil, a chief of the Aulad-Sliman Arabs, usurped the sovereign authority. After a troublous reign of ten years he was slain in battle by a Turkish force under Bakir Bey, and Fezzan was added to the Turkish empire in 1842.

After the founding of the White monastery at Beida, Cyrenaica, by the Senussi (*q.v.*) order (tariqa) in 1843, emissaries following the Saharan caravan routes founded lodges (*zawaya*) in the Fezzan. The Senussi order became the dominant influence under the Abid branch of the Senussi family. But the expansion of French rule from equatorial Africa began to weaken Senussi authority at the beginning of the century and the Italian invasion of Tripolitania and Cyrenaica in 1911 led to its eclipse. The treaty of Ouchy in 1912 which ended the Italo-Turkish War (*q.v.*) was quickly followed by the occupation of the Fezzan although it was abandoned again after the reverses suffered by the Italians in 1915 at the hands of the Senussi-inspired tribes. The subsequent defeat of the Senussi army by British forces in the western desert of Egypt led to anarchy in the Fezzan when Sayyid Mohammed Abid was obliged to withdraw to Kufra. Gen. Rodolfo Graziani reoccupied the whole area in 1930 and the Fezzan became part of the Italian military territory of Southern Tripolitania.

During World War II the Fezzan was occupied by French forces under Gen. J. Leclerc in the winter of 1942–43 and was administered as an occupied enemy territory until the formation of the United Kingdom of Libya in Dec. 1951. (See also LIBYA.)

Population. — The total population in 1954 was 54.438. The inhabitants are mixed people who have settled in oases along desert routes between the Mediterranean and equatorial Africa. They include Arabs and Berbers from the north, Tuareg from the west, Teda and Bornu from the south. The principal languages are Arabic, Kanuri and Hausa.

The capital of the Fezzan is at Hon, 280 mi. S.W. of Tripoli and nearly 500 mi. from the southern extremity of the province.

Constitution. — The status of the Fezzan as a province in the United Kingdom of Libya stems from a resolution of the general assembly of the United Nations on Nov. 21, 1949. The French military occupation administration, the successors of the Italian colonial regime, transferred its powers to a Libyan governor (*wali*) on Dec. 24, 1951.

The governor is appointed by the king of Libya whom he represents with full royal powers and prerogatives. Provincial executive authority is exercised by an executive council under a president appointed by the king in consultation with the governor, and each member (nazir) is responsible for an administrative department. There is also a provincial legislative council to which three-quarters of the members are elected. The Fezzan sends eight members to the senate of the kingdom of Libya, half nominated by the king and half elected by the legislative council, and five elected members to the house of representatives. The first elections were held on Feb. 19, 1952.

Resources. — Apart from the dates exported to Tripoli, the Fezzan is singularly lacking in economic resources. In 1956 concessions to prospect for oil were given to British, French and United States companies and the discovery in 1955 of oil resources in unconfirmed quantities close to the Algerian frontier of the Fezzan raised hopes that they might meet with success. (D. C. CG.)

FFESTINIOG, an urban district of Merionethshire, Wales, 19 mi. N. of Dolgelley by road. Pop. (1951) 6,920. Area 25.5 sq.mi. It includes the town of Blaenau Ffestiniog and the village of Ffestiniog. The urban district, beautifully situated at the head of the vale of Ffestiniog in the Snowdonia National park, is 600 ft. above sea level.

The slate mines of Blaenau Ffestiniog are famous. Roman remains have been found in the vicinity. Nearby are the Beddau Gwyr Ardudwy (the graves of the men of Ardudwy), half-legendary memorials of early warfare, and Hafod Ysbyty farm, an old stone-staired monastic hospital or sanatorium. A large pumped storage hydroelectric scheme, the first of its kind in Great Britain, was being developed in the mid-1950s.

FIACRE (FIACHRACH), **SAINT** (d. *c.* 670), Irish anchorite of noble descent. His *Acta,* which have little historical value, relate that he went to France and with the permission of St. Faro, the bishop of Meaux, built a monastery at Prodilus, the modern Breuil, in the province of Brie. There he received St. Chillen (? Kilian), who was returning from a pilgrimage to Rome, and there he remained until his death. In 1568, at the time of the religious troubles, his remains were transferred to a shrine in the cathedral of Meaux. St. Fiacre is the patron of Brie, and gardeners invoke him as their protector; his feast is kept on Aug. 30.

See O'Hanlon, *Lives of the Irish Saints,* vol. viii, pp. 421–447 (1875–1904).

FIARS PRICES, in the law of Scotland, the average prices of each of the different sorts of grain grown in each county, as fixed annually by the sheriff, usually after the verdict of a jury. They serve as a rule for ascertaining the value of the grain due to feudal superiors, to the clergy, or to lay proprietors of teinds, to landlords as a part or the whole of their rents, and in all cases where the price of grain has not been fixed by the parties. It is not known when or how the practice of striking the fiars, as it is called, originated. It probably was first used to determine the value of the grain rents and duties payable to the crown.

FIAT MONEY, irredeemable money issued and made legal by government order (fiat) but not secured by a gold or silver or other adequate reserve. It is usually paper but may also consist of coins of baser metals whose metallic content is worth far less than their face value.

The issue of fiat money tends to cause the withdrawal from circulation of sound money and a great inflation of prices in terms of the unsecured currency. Fiat money was issued freely in the United States during the Revolutionary War and the Civil War periods.

FIBIGER, JOHANNES ANDREAS GRIB (1867–1928), Danish pathologist and professor at the University of Copenhagen, whose experiments on the production of gastric tumours in rats led to the first experimental production of cancer, and who was awarded the Nobel prize for medicine and physiology for 1926, was born at Silkeborg, Den.. on April 23, 1867, and died at Copenhagen on Jan. 30. 1928. While examining tuberculous rats, Fibiger found three with cancer of the stomach. The tumours contained a parasite (afterward named *Gongylonema neoplasticum)* which he was able to trace to a tropical type of cockroach that had come in sugar from the West Indies. When the cockroaches were eaten by rats infesting the particular sugar refinery, the larvae coiled up in their muscles developed into the adult nematodes in the stomachs of the rats. By feeding rats and mice similarly Fibiger was able to produce stomach tumours of which one in a mouse proved transplantable.

Fibiger's experiments — rightly considered a pattern of methodical research — encouraged K. Yamagiwa to begin tar-painting of animals to produce cancer, a method at once adopted by Fibiger as superior to his own, and leading into modern chemical cancer research.

It was later shown that Fibiger's animals must have been lacking in the then unknown vitamin A, which deficiency is now known to produce lung lesions corresponding to those interpreted by Fibiger and contemporaries as cancer metastases. Also gastric proliferations similar to those interpreted in Fibiger's time as fully developed cancer will occur under vitamin A deficiency in the presence of the *Gongylonema,* although they will be reduced in degree in the absence of either of those two factors. Thus, most of Fibiger's tumours would not fulfill modern criteria for fully developed cancer. It is true that his thesis of a carcinogenic effect of some parasites has been supported in other ways. However, no detailed analysis nor any final proof of its validity has yet been produced.

See K. Secher, *Johannes Fibiger* (1947); C. R. Hitchcock and E. T. Bell, "Studies on the Nematode Parasite, *Gongylonema neoplasticum* . . . ," *J. Nat. Cancer Inst.,* 12:1345–87 (June 1952). (Js. C.)

FIBONACCI, LEONARDO: *see* LEONARDO OF PISA.

FIBRE PLANTS. Plants that have long slender threadlike thick-walled cells or groups of cells growing through the leaves, stems or fruits are fibre-yielding plants. More than 2,000 species of such plants have been catalogued in various parts of the world. Of this number, less than fifty are of commercial importance. For a selected list of widely used commercial vegetable fibres *see* table in the article FIBRES.

Abaci (manila or manila hemp), sisal (sisal hemp) and similar plants yielding leaf fibres are native to the tropics, while flax, cotton, hemp and other fibre-yielding plants grow better in the temperate zone. Although the United States uses large quantities of vegetable fibres, with the exception of cotton and some palm fibres, none are grown in commercial quantities within its borders. India and Pakistan supply jute and like fibres from which hessians (coarse textiles) and twine are made. Mexico, Cuba and Africa produce henequen and sisal used in the manufacture of rope and twine. Abacá, from which the better grades of cordage are made, comes mostly from the Philippines. Flax and hemp are produced in Russia and other European countries.

Most plant fibres are readily grouped according to their structure, to their origin in the plant, or according to their use. A simple classification that includes all vegetable fibres follows: (1) seed and fruit hair fibres, sometimes called surface fibres; (2) structural or leaf fibres frequently referred to as hard fibres; (3) bast or soft fibres, often referred to as stem fibres; (4) miscellaneous fibres, including root and stem fibres; and (5) pulp fibres from tree trunks, bamboo and similar sources used in the manufacture of paper.

Uses. — The principal uses made of vegetable fibres in industry may be grouped under seven major headings which can in turn be subdivided to include all products made of fibres. The major uses are: (1) textiles; (2) cordage; (3) brush; (4) filling and padding; (5) paper; (6) plaited and felted fibres; and (7) raw materials for the chemical industry, particularly cellulose.

Many fibre-yielding plants produce other products that may be of equal or greater value than the fibre. Cottonseed yielding linters (fibres and fuzz not removed in ginning and used for batting, etc.), oil and meal; flaxseed yielding linseed oil and meal; the coconut yielding oil; and the yuccas (of the lily family) and lechuguilla (of the same family as the century plants, agave [*q.v.*]) yielding saponin *(see* SAPONINS AND SAPOGENINS), from which drugs and other products are made, are examples of the importance of by-products in the fibre industry.

Seed and Fruit Hair Fibres. — Seed and fruit hair fibres grow as short single-celled seed hairs in cotton, as pod fibres in kapok and as husk or hull fibres in the coconut. Cotton is by far the most important vegetable fibre grown, as to quantity and uses made of the fibre. The improvement in quality and yield of fibre resulting from breeding and selection, the progress in completely mechanizing production and the improvement in spinning and weaving and the manufacturing of cotton-made products, all contribute to its universal use.

Kapok, pachote, samohu and several similar fibres grow in seed pods on trees. The properties of these fibres make them useful as filler, as insulation and in life preservers and cushions on boats.

Coir. the fibre from the coconut, is used in door mats, coarse twine, rope and brushes.

Leaf Fibres. — Structural or leaf fibres are hard and stiff in texture and extend lengthwise through the pulpy tissue of long leaves or leaf stems of monocotyledonous or endogenous plants. They impart rigidity and stability to the plant and help protect it from injury by wind and weather Most of these plants are native to the western hemisphere. With the exception of phormium (New Zealand flax, or flax lily), native to New Zealand, and the istles (various agaves) native to northern Mexico, the leaf fibres are all grown in tropical or subtropical climates. Plants like henequen and lechuguilla thrive in the arid climate and rocky soils of Yucatan and northern Mexico, while abaci grows best in a fertile, well-drained soil having an ample supply of moisture.

Sisal is native to Yucatan but grows better in Africa and other areas where more fertile soils and more moisture are available. Leaf fibres come from perennial plants that produce fibre over a period of 5 to 20 years or more, depending on soil, climate and harvesting procedures. The leaves of the agaves, including the genus and *Furcraea,* are harvested for fibre as they mature. When mature, the entire abaci stalk is harvested.

Most of the leaf fibres are extracted by mechanical methods involving macerating and scraping. Machines ranging from a crude dull knife and a block of wood with which 10 to 15 lb. of fibre can be scraped daily, to the large powerful raspador type decorticators, which are capable of producing up to 3.000 lb. of dry fibre per hour, are in use.

Many leaf fibres, as the istles in Mexico and caroa in Brazil, are harvested from the wild state and are processed by hand scraping. Others, as sisal and henequen (see SISAL FIBRE), and abaci are grown under cultivation on large plantations where decorticating. which is the process of extracting the fibre from the leaves. is highly mechanized. All other operations use large amounts of hand labor. The raspador type decorticator as used on most plantations consists of two large rotating drums equipped with dull knives operating against curved surfaces and disposed adjacent to offset gripping devices which carry the plant material through the machine.

Cantala, sisal, pita floja (a wild pineapple) and others are occasionally retted, or soaked, for local use, but the fibre is inferior in strength and colour.

Bast or Stem Fibres. — Bast fibres are secured from dicotyledonous or exogenous plants groan mostly as annuals planted from seed each year. In order to produce long slender stalks free from leaves and branches, the plants must be grown in a dense stand. The fibres are soft and flexible in character and extend through the inner bark of the stalk or stem of the plant. The stalks average one-half inch in diameter and are from 5 to 15 ft. tall. The best quality of the bast fibre is produced by water retting or by chemically treating the fibre. The retting process for jute and similar fibres is accomplished by submerging bundles of stalks in the back waters of rivers or in ponds or artificial pools where bacteria consume the nonfibrous material. leaving a slimy substance that is readily washed from the remaining fibre ribbon or strand. The time of retting varies from 5 to 20 days or more, depending on the age of the stalk and the temperature and kind of water.

Retting is usually considered complete when the bark and fibre slip easily from the woody part of the stalk. The fibre is cleaned and washed by workers who wade waist deep into the water. Drying is done in the open air.

Flax fibre contains more cellulose and is finer and stronger than jute. It brings a higher price on the market. More care is used in the handling and in the retting procedure. Under-retted fibre does not clean well and if over-retted it loses strength and luster thus lowering its value. In the United States and Canada and in some European countries the retting is done in large tanks under controlled conditions. The washing is done by draining off the retting media and flushing several times with fresh water. The retted stalks are spread out on the grass or are stood up in shocks and completely dried before breaking, scutching, or separating, and hackling, or combing. The flax industry has been mechanized to a large degree but many operations are still done by hand in European countries.

The name hemp has been applied to many fibres that are in no way related to true hemp (*Cannabis sativa*). True hemp is one of the strongest vegetable fibres. comparing well with flax, ramie and others. Before the advent of abaci it was used for most of the marine rope and for other high-grade cordage. The better grades of fibre are produced by water retting. A large part of the crop is cut and spread on the stubble nhere it remains until retting is completed by dews, rains and snows.

Hemp production has been mechanized in the United States; but much hand labour and many of the old hand-operated brakes and scutchers are still in use in the countries where most of the fibre is grown.

Ramie (Rheas China Grass) is one of the few bast fibre plants grown as a perennial. It is of the Urticaceae or nettle family, but is free of stinging hairs typical of most nettles. Plantings are established from root pieces planted in rows. The young plants soon spread out over the entire area and grow in a crowded condition much like other bast fibres. Once established, a plantation should produce fibre for ten years or more before replanting is necessary. Ramie is native to China but grows well in many other countries where soil and climate are favourable. The better grades of ramie fibre are produced by decorticating or ribboning the stalk and treating the resulting crude product chemically to purify the fibre. When degummed, ramie filasse (fibre prepared for manufacture) is white in colour with a soft luster that is much like silk in appearance. It contains a high percentage of cellulose which accounts for many of its unique properties.

Miscellaneous Fibres. — Miscellaneous fibres include the stiff roots of some grasses and stem fibres as Spanish moss. The principal root fibre is known as zacaton in Mexico where most of it is produced. It is also known as broomroot, rice root, etc. The root fibres are coarse, crinkled and stiff when properly treated. They are used mostly in brushes. Cheaper palm fibres are replacing this fibre and its demand is decreasing. Spanish moss is an air plant of the pineapple family. It has been produced in Louisiana, Mississippi, Florida and other states along the Atlantic seaboard. At one time it ranked next to horsehair as an upholstery material, and for mattress and cushion filler. Foam rubber and other rubberized products have largely replaced it.

For additional information the reader is referred to the articles on specific plants, as ABACÁ FIBRE; COIR; HEMP; etc. For uses see BRUSH; CELLULOSE; PAPER: *Manufacture;* ROPE AND ROPEMAKING; TEXTILES; etc. For production see articles on countries and states.

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FIBRES, the general term for certain structural components of animal and vegetable tissue utilized in manufactures, and in respect of such uses, divided for the sake of classification into textile, paper-making, brush and miscellaneous fibres.

Textile Fibres. — Textile fibres are mostly products of the organic world, elaborated in their elongated form to subserve protective functions in animal life (as wool and epidermal hairs, etc.) or as structural components of vegetable tissues (flax, hemp and wood cells). It may be noted that the inorganic world provides an exception to this general statement in the fibrous mineral asbestos (*q.v.*), which is spun or twisted into coarse textiles. Other silicates are also transformed by artificial processes into fibrous forms, such as "glass," which is fused and drawn or spun to a continuous fibre, and various "slags" which, in the fused state, are transformed into "slag wool." Lastly, we note that a number of metals are drawn down to the finest dimensions, in continuous lengths, and these are woven into cloth or gauze, such metallic cloths finding valuable applications in the arts. Certain metals in the form of fine wire are woven into textile fabrics used as dress materials. Such exceptional applications are of insignificant importance, and will not be further considered in this article.

The common characteristics of the various forms of matter comprised in the widely diversified groups of textile fibres are those of the colloids. Colloidal matter is intrinsically devoid of structure, and in the mass may be regarded as homogeneous; whereas crystalline matter in its proximate forms assumes definite and specific shapes which express a complex oi internal stresses. The properties of matter which condition its adaptation to structural functions, first as a constituent of a living individual, and afterwards as a textile fibre, are homogeneous continuity of substance, with a high degree of interior cohesion, and associated with an irreducible minimum of elasticity or extensibility. The colloids show an infinite diversity of variations in these essential properties: certain of them, and notably cellulose (*q.v.*), maintain these characteristics throughout a cycle of transformations such as permit of their being brought into a soluble plastic form, in which condition they may be drawn into filaments in continuous length. The artificial silks or lustra-celluloses or rayons are produced in this way, and have already taken an established position as staple textiles. For a more detailed account of these products see CELLULOSE and SYNTHETIC FIBRES.

The animal fibres are composed of nitrogenous colloids of which the typical representatives are the albumens. fibrines and gelatines. They are of highly complex constitution and their characteristics have only been generally investigated. The vegetable fibre substances are celluloses and derivatives of celluloses, also typically colloidal bodies. The broad distinction between the two groups is chiefly evident in their relationship to alkalis. The former group are attacked, resolved and finally dissolved, under conditions of action by no means severe. The celluloses, on the other hand, and therefore the vegetable fibres, are extraordinarily resistant to the action of alkalis.

The animal fibres are relatively few in number but of great industrial importance. They occur as detached units and are of varying dimensions; sheep's wool having lengths up to 36in., the fleeces being shorn for textile uses at lengths of 2 to 16in.; horse hair is used in lengths of 4 to 24in., whereas the silks may be considered as being produced in continuous length, "reeled silks" having lengths measured in hundreds of yards, but "spun silks" are composed of silk fibres purposely broken up into short lengths.

The vegetable fibres are extremely numerous and of very diversified characteristics. They are individualized units only in the case of seed hairs, of which cotton is by far the most important; with this exception they are elaborated as more or less complex aggregates. The bast tissues of dicotyledonous annuals furnish such staple materials as flax, hemp, rhea or ramie and jute. The bast occurs in a peripheral zone, external to the wood and beneath the cortex, and is mechanically separated from the stem, usually after steeping, followed by drying.

The commercial forms of these fibres are elongated filaments composed of the elementary bast cells (ultimate fibres) aggregated into bundles. The number of these bundles, of any part of the filament may vary from 3 to 20. In the processes of refinement preparatory to the spinning (hackling, scutching) and in the spinning process itself, the fibre-bundles are more or less subdivided, and the divisibility of the bundles is an element in the textile value of the raw material. But the value of the material is rather determined by the length of the ultimate fibres (for, although not the spinning unit, the tensile strength of the yarn is ultimately limited by the cohesion of these fibres), qualified by the important factor of uniformity.

Thus, the ultimate fibre of flax has a length of 25 to 35mm.; jute, on the other hand, 2 to 3mm.; and this disparity is an essential condition of the difference of values of these fibres. Rhea or ramie, to cite another typical instance, has an ultimate fibre of extraordinary length, but' of equally conspicuous variability, viz., from 50 to 200mm. The variability is a serious impediment in the preparation of the material for spinning and this defect, together with low drawing or spinning quality, limits the applications of this fibre to the lower counts or grades of yarn.

The monocotyledons yield still more complex fibre aggregates, which are the fibro-vascular bundles of leaves and stems. These complex structures as a class do not yield to the mechanical treatment by which the bast fibres are subdivided, nor is there any true spinning quality such as is conditioned by bringing the ultimate fibres into play under the drawing process, which immediately precedes the twisting into yarn. Such materials are therefore only used for the coarsest textiles, such as string or rope. An exception to be noted in passing is to be found in the pineapple (*Ananas comosus*) the fibres of which are worked into yarns and cloth of the finest quality. The more important fibres of this class are manila, sisal, phormium. A heterogeneous mass of still more complex fibre aggregates; in many cases the entire stem (cereal straws, esparto), in addition to being used in plaited form, *e.g.,* in hats, chairs, mats: constitute the staple raw material for paper manufacturers., requiring a severe chemical treatment for the separation of the ultimate fibres.

In this class we must include the woods which furnish wood pulps of various classes and grades. Chemical processes of two types (a) acid and (*b*) alkaline, are also employed in resolving the wood, and the resolution not only effects a complete isolation of the wood cells, but, by attacking the hydrolpsable constituents of the wood substance (lignocellulose), the cells are obtained in the form of cellulose. These cellulose pulps are known in commerce as "sulphite pulps" and "soda pulps" respectively. In addition to these raw materials or "half stuffs" the paper-maker employs the rejecta of the vegetable and textile industries, scutching, spinning and cloth wastes of all kinds. which are treated by chemical (boiling) and mechanical means (beating) to separate the ultimate fibres and reduce them to the suitable dimensions (0·5–2·0mm.). These paper-making fibres have also to be reckoned with as textile raw materials! in view of a new and growing industry in "pulp yarns" (*Papierstoffgarn*), a coarse textile obtained by treating paper as delivered in narrow strips from the paper machine; the strips are reeled. dried to retain 30–40% moisture, and in this condition subjected to the twisting operation. which confers the cylindrical form and adds considerably to the strength of the fibrous strip. The following are the essential characteristics of the economicallv important fibres.

Animal Fibres.—A. Silk. (*a*) The true silks are produced by the *Bombyx mori,* the worm feeding on the leaves of the mulberry. The fibre is extruded as a viscous liquid from the glands of the worm, and solidifies to a cylindrical thread. The cohesion of these threads in pairs gives to raw silk the form of a dual cylinder. If they are used for textile purposes the thread is reeled from the cocoon, and several units. five and upwards. are brought together and suitably twisted. (b) The "Wild" silks are produced by a large variety of insects, of which the most important are the various species of Antherea. which yield the Tussore silks. These silks differ in form and composition from the true silks. While they consist of a "dual" thread. each unit of these is complex, being made up of a number of fibrillae. This unit thread is quadrangular in section, and of larger diameter than the true silk, the mean breadth being 0·052mm., as compared with 0·018, the mean diameter of the true silks. The variations in structure as well as in dimensions are, however, very considerable.

B. Epidermal hairs. Of these (a) wool. the epidermal protective covering of sheep, is the most important. The varying species of the animal produce wools of characteristic qualities, varying considerably in fineness, in length of staple, in composition and in spinning quality. Hence the classing of the fleeces or raw wool followed by the elaborate processes of selection, *i.e.,* "sorting" and preparation, which precede the actual spinning or twisting of the yarn. These consist in entirely freeing the fibres and sorting them mechanically (combing, etc.), thereafter forming them into continuous lengths of parallelized units. This is followed by the spinning process which consists in a simultaneous drawing and twisting, and a continuous production of the yarn with the structural characteristics of *worsted* yarns. The shorter staple—from 5 to 25% of average fleeces—is prepared by the "carding" process for the spinning operation, in which drawing and twisting are simultaneous, the length spun being then wound up, and the process being consequently intermittent. This section of the industry is known as "woollen spinning" in contrast to the former or "worsted spinning." (b) An important group of raw material closely allied to the wools are the epidermal hairs of the Angora goat (mohair), the llama, alpaca. Owing to their form and the nature of the substance of which they are composed, they possess more lustre than the wools. They present structural differences from sheep wools which influence the processes by which they are prepared or spun, and the character of the yarns; but the differences are only of subordinate moment. (c) Various animal hairs, such as those of the cow, camel and rabbit, are also employed; the latter is largely worked into the class of fabrics known as felts. In these the hairs are compacted together by taking advantage of the peculiarity of structure which causes the imbrications of the surface. (d) Horse hair is employed in its natural form as an individual filament or monofil.

Vegetable Fibres.—The subjoined scheme of classification sets out the morphological structural characteristics of the vegetable fibres:—

Produced from	
Dicotyledons.	*Monocotyledons.*
A. Seed hairs.	D. Fibro-vascular bundles.
B. Bast fibres.	E. Entire leaves and stems.
C. Bast aggregates.	

In the list of the more important fibrous raw materials subjoined, the capital letter immediately following the name refers the individual to its position in this classification. In reference to the important question of chemical composition and the actual nature of the fibre substance, it may be premised that the vegetable fibres are composed of cellulose, an important representative of the group of carbohydrates, of which the cotton fibre substance is the chemical prototype, mixed and combined with various derivatives belonging to the subgroups. (a) Carbohydrates. (b) Unsaturated compounds of benzenoid and furfuroid constitutions. (c) "Fat and wax" derivatives, *i.e.*, groups belonging to the fatty series, and of higher molecular dimensions—of such compound celluloses the following are the prototypes:—

(*a*) Cellulose combined and mixed with "pectic" bodies (*i.e.*, pecto-celluloses), flax, rhea.

(*b*) Cellulose combined with unsaturated groups or ligno-celluloses, jute and the woods.

(*c*) Cellulose combined and mixed with higher fatty acids, alcohols, ethers, cuto-celluloses, protective epidermal covering of leaves.

The letters a, b, *c* in the table below and following the capitals, which have reference to the structural basis of classification, indicate the main characteristics of the fibre substances. (See also CELLULOSE.)

Miscellaneous Fibres.—Various species of the family Palmaceae yield fibrous products of value, of which mention must be

	Botanical identity. Genus and order.	Country of origin.	Dimensions of ultimate.	Textile uses.
Cotton, A.*a* .	Gossypium hfalvaceae	Subtropical and tropical countries	12–40mm. 0·019–0·025. Av. 28mm.	Universal. Also as a raw material in chemical industries, notably explosives, celluloid.
Flax, B.a . .	Linum Linaceae	Temperate countries, chiefly European	6–60mm. 0·011–0·025. Av. 28mm.	General. Special effects in lustre damasks. In India and America plants grown for seed (linseed).
Hemp, B.a . .	Cannabis Cannabineae	Temperate countries, chiefly Europe	5–55mm. 0·016–0·050. Av. 22mm. Av. 0·022	Coarser textiles, sail-cloth, rope and twine.
Ramie, B.a . .	Boehmeria Urticaceae	Warm temperate, China	60–200mm. 0·03–0·08. Av. 120mm. Av. 0·050	Clothing in China: "grass cloth:" gas mantels.
Jute, B.b . .	Corchorus Tiliaceae	Tropical countries, chiefly India	1·5–5mm. 0·020–0·025. Av. 2·5mm. Av. 0·022	Coarse textiles, chiefly "Hessians" and sacking. "Line" spun yarns used in cretonne and furniture textiles.
Sunn-hemp, B.b .	Crotalaria Leguminosae	India	4·0–12·0. 0·025–0·050. Av. 7.5. Av. 0·022	Twine and rope. Coarse textiles.
Ambari, B.b . .	Hibiscus	Persia, Russia, India	2–6mm. 0·014–0·033. Av. 4mm. Av. 0·021	Coarse textiles. H. *Elams* has been extensively used in making mats.
Sida, B.b . .	Sida Malvaceae	Tropical and subtropical	1·5–4mm. 0·013–0·02. Av. 2mm. Av. 0·015	Coarse textiles. Appears capable of substituting jute.
Chingma, B.b	Abutilon Malvaceae	China Manchuria Japan		Coarse fabrics, twines.
Lime or Linden, C.b . . .	Tilia Tiliaceae	European countries, chiefly Russia	1·5mm. 0·014–0·020. Av. 2mm. Av. 0·016	Matting and binder twine.
Mulberry, C	Broussonetia Moraceae	Far East	5–31mm. 0·02–0·04. Av. 15mm. Av. 0·03	Paper and paper cloths.
Manila, D	Musa Musaceae	Tropical countries, chiefly Philippine Islands	3–12mm. 0·016–0·032. Av. 6mm. Av. 0·024	Twine and ropes. Produces papers of special quality.
Sisal, D .	Agave Amaryllideae	Tropical countries	1·5–4mm. 0·020–0·032. Av. 2·5. Av. 0·024	Twine and ropes.
Yucca . . .	Yucca Liliaceae	do.	0·5–6mm. 0·01–0·02.	do.
Bow-string hemp.	Sansevieria Liliaceae	East Indies, Ceylon, East Africa	1·5–6mm. 0·015–0·026. Av. 3mm. Av. 0·020	do.
Phormium, D .	Phormium tenax Liliaceae	New Zealand	5·0–1 jmm. 0·010–0·020. Av. 9mm. Av. 0·016	Twine and ropes. Distinguished by high yield of fibre from green leaf.
Pineapple, D .	Ananas Bromeliaceae	Tropical East and West Indies	3·0–9·0mm. 0·004–0·008. Av. 5. Av. 0·006	Textiles of remarkable fineness. Exceptional fineness of ultimate fibre.
Henequén, D .	Agave Amaryllidaceae	Yucatan, Cuba	1·5–4 mm. 0·02–0·03	Binder twine, rope.
Cantala, D . .	Agave Amaryllidaceae	Java, Philippines		Twines and ropes.
Tula ixtle, D .	Agave Amaryllidaceae	Mexico		Twines, "Tampico," brushes.
Jaumave ixtle, D.	Agave Amaryllidaceae	Mexico		Twines, "Tampico," brushes.
Palma, D. . .	Samuela Yucceae	Mexico		Twines.
Piteira, D. .	Furcraea Amaryllidaceae	Brazil, Mauritius	1·3–3·7 mm. 0·015–0·24	Ropes, sacks.

made of the following. *Raffia,* epidermal strips of the leaves of *Raphia ruffia* (Madagascar), R. taedigera (Japan), largely employed as binder twine in horticulture, replacing the "bast" (linden) formerly employed. Coir, the fibrous envelope of the fruit of the *Cocos* nucifera, extensively used for matting and other coarse textiles. Carludovica *palmata* (Central America) yields the raw material for Panama hats, the *Corypha australis* (Australia) yields a similar product. The leaves of the date palm, Phoenix dactylifera, are employed in making baskets and mats, and the fibro-vascular bundles are isolated for working up into coarse twine and rope; similarly, the leaves of the Elaeis *guineensis,* the fruit of which yields the "palm oil" of commerce, yield a fibre which finds employment locally for special purposes. *Chamaerops humilis,* the dwarf palm, yields the well-known "Crin d'Afrique." Locally (Algiers) it is twisted into ropes, but its more general use, in Europe, is in upholstery as a stuffing material. The cereal straws are used in the form of plait in the making of hats and mats. Esparto grass is also used in the making of coarse mats.

The processes by which the fibres are transformed into textile fabrics are in the main determined by their structural features. The following are the distinctive types of treatment:

A. The fibre is in virtually continuous lengths. The textile yarn is produced by assembling together the unit threads, which are wound together and suitably twisted (silk; artificial silk).

B. The fibres in the form of units of variable short dimensions are treated by more or less elaborate processes of scutching, hackling, combing, with the aim of producing a mass of free parallelized units of uniform dimensions; these are then laid together and drawn into continuous bands of sliver and roving, which are finally drawn and twisted into yarns. In this group are comprised the larger number of textile products, such as cotton, wool, flax and jute, and it also includes at the other extreme the production of coarse textiles, such as twine and rope.

C. The fibres of still shorter dimensions are treated in various ways for the production of a fabric in continuous length.

The distinction of type of manufacturing processes in which the relatively short fibres are utilized, either as disintegrated units or comminuted long fibres, follows the lines of division into long and short fibres; the long fibres are worked into yarns by various processes, whereas the shorter fibres are agglomerated by both dry and wet processes to felted tissues or felts. It is obvious, however, that these distinctions do not constitute rigid dividing lines. Thus the principles involved in felting are also applied in the manipulation of long fibre fabrics. For instance, woollen goods are closed or shrunk by milling, the web being subjected to a beating or hammering treatment in an apparatus known as "the stocks," or is continuously run through squeezing rollers, in weak alkaline liquids. Flax goods are "closed" by the process of beetling, a long-continued process of hammering, under which the ultimate fibres are more or less subdivided, and at the same time welded or incorporated together. As already indicated, paper, which is a web composed of units of short dimensions produced by deposition from suspension in water and agglomerated by the interlacing of the component fibres in all planes within the mass, is a species of textile. Further, whereas the silks are mostly worked up in the extreme lengths of the cocoon, there are various systems of spinning silk wastes of variable short lengths, which are similar to those required for spinning the fibres which occur naturally in the shorter lengths.

The fibres thus enumerated as commercially and industrially important have established themselves as the result of a struggle for survival, and each embodies typical features of utility. There are innumerable vegetable fibres, many of which are utilized in the locality or region of their production, but are not available for the highly specialized applications of modern competitive industry to qualify for which a very complex range of requirements has to be met. These include primarily the factors of production and transport summed up in cost of production, together with the question of regularity of supply; structural characteristics, form and dimensions, including uniformity of ultimate unit and adaptability to standard methods of preparing and spinning, together with tenacity and elasticity, lustre. Lastly, composition, which determines the degree of resistance to chemical disintegrating influences as well as subsidiary questions of colour and relationship to colouring matters. The quest for new fibres, as well as modified methods of production of those already known, require critical investigation from the point of view of established practice. The present perspective outline of the group will be found to contain the elements of a grammar of the subject. But those who wish to pursue the matter will require to amplify this outlined picture by a study of the special treatises which deal with general principles, as well as the separate articles on the various fibres.

Analysis and Identification.—For the analysis of textile fabrics and the identification of component fibre, a special treatise must be consulted. The following general facts are to be noted as of importance.

All animal fibres are effectively dissolved by 10% solution of caustic potash or soda. The fabric or material is boiled in this solution for ten minutes and exhaustively washed. Any residue will be vegetable or cellulose fibre. It must not be forgotten that the chemical properties of the fibre substances are modified more or less by association in combination with colouring matters and mordants. These may, in many cases, be removed by treatments which do not seriously modify the fibre substances.

Wool is distinguished from silk by its relative resistance to the action of sulphuric acid. The cold concentrated acid rapidly dissolves silk as well as the vegetable fibres. The attack on wool is slow, and the epidermal scales of wool make their appearance. The true silks are distinguished from the wild silks by the action of concentrated hydrochloric acid in the cold, which reagent dissolves the former, but has only a slight effect on Tussore silk. After preliminary resolution by these group reagents, the fabric is subjected to microscopical analysis for the final identification of its component fibres (see H. Schlichter, Journal *Soc.* Chem. Ind., 1890, p. 241).

A scheme for the commercial analysis or assay of vegetable fibres, originally proposed by the author (Col. Ind. Exhibition, 1886, Miscellaneous Reports) and now generally adopted, includes the following operations:—

1. Determination of moisture.
2. Determination of ash left after complete ignition.
3. Hydrolysis:
   (a) loss of weight after boiling the raw fibre with a 1% caustic soda solution for five minutes;
   (b) loss after boiling for one hour.
4. Determination of cellulose: the white residue after
   (a) boiling for five minutes with 1% caustic soda,
   (b) exposure to chlorine gas for one hour,
   (c) boiling with basic sodium sulphite solution.
5. Mercerizing: the loss of weight after digestion with a 20% solution of sodium hydrate for one hour in the cold.
6. Nitration: the weight of the product obtained after digestion with a mixture of equal volumes of sulphuric and nitric acids for one hour in the cold.
7. Acid purification: treatment of the raw fibre with 20% acetic acid for one minute, the product being washed with water and alcohol, and then dried.
8. Determination of the total carbon by combustion.

Paper-making.—The paper-making industry (see PAPER MANUFACTURE; PAPER MATERIALS) employs as raw materials a large proportion of the vegetable fibre products already enumerated, and, for the reasons incidentally mentioned, they may be, and are, employed in a large variety of forms; in fact any fibrous material containing over 30% "cellulose" and yielding ultimate fibres of a length exceqding 1 mm. can be used in this industry. Most important staples are cotton and flax; these are known to the paper-maker as "rag" fibres, rags, *i.e.,* cuttings of textile fabrics, new and old, being their main source of supply. These are used for writing and drawing papers. In the class of "printings" two of the most important staples are wood pulp, prepared by chemical treatment from both pine and foliage woods, and in England esparto cellulose, the cellulose obtained from esparto grass by alkali treatment; the cereal straws are also used and are resolved into cellulose by alkaline boiling followed by bleaching. In the class of "wrappings" and miscellaneous papers a large number of other materials find use, such as various residues of manufacturing and preparing processes, scutching nastes, ends of rovings and yarns. flax, hemp and manila rope waste, adansonia bast and jute wastes, raw (cuttings) and manufactured (bagging).

Brush Fibres, **Etc.**—The fibres in brushes are mainly drawn from the badger, hog, bear, sable. squirrel and horse. Brushes required for cleansing purposes are composed of fibres of a more or less hard and resilient character, such as horse hairs, and other tail hairs and bristles. For painting work brushes of soft quality are employed, graduating for fine work into the extreme softness of the "camel hair" pencil. Of vegetable fibres the following are used in this industry. The *Caryota urens* furnishes the Kittul fibre, obtained from the base of the leaf stalks. Piassava is obtained from the *Attalea funifera*, also from the *Leopoldina piassaba* (Brazil). Palmyra fibre is obtained from the *Borassus flabellifer*. These are all members of the natural order of the Palmaceae. Mexican fibre. or Istle, is obtained from the agave. The fibre known as Whisk, largely used for dusting brushes, is obtained from various species of the Gramineae; the "Mexican Whisk" from *Epicampes macroura;* and "Italian Whisk" from *Andropogon*. The *coir* fibre mentioned above in connection with coarse textiles is also extensively used in brush-making. Aloe and agave fibres in their softer forms are also used for plasterers' brushes. Many of the whitewashes and cleansing solutions used in house decoration are alkaline in character, and for such uses advantage is taken of the specially resistant character of the cellulose group of materials.

Stuffing **and** Upholstery. — Another important use for fibrous materials is for filling or stuffing seats and cushions in upholstery. One of the most important is the floss or seed-hair of the *Ceiba pentandra,* known as Kapok. The fibre is soft, silky and resilient, and maintains its resiliency in use. Horse hair is extensively used in this industry, as are also wool flocks and other short animal hairs and uastes.

For hat and matting manufactures a large range of the fibrous products above described are employed, chiefly in their natural or ram state.

See also ALPACA; COTTON AND THE COTTON INDUSTRY; FELT; FLAX; HEMP; JUTE; MOHAIR; WOOL; CELLULOSE; SYNTHETIC FIBRES; SHODDY; SILK AND SCRICULTURE; RAMIE; KAPOK; FUR; etc. (C. F. C.)

FIBRIN is the essential part of the blood clot, a substance that connects the edges of a wound and prevents passage of the blood corpuscles. It results from a chemical process in the plasma that causes dissolved fibrinogen to separate out. *See* BLOOD.

FICHTE, IMMANUEL HERMANN (originally HARTMANN) **VON** (1796–1879), German philosopher: son of Johann Gottlieb Fichte (*q.v.*) was born at Jena on July 18, 1796. Having held educational posts at Saarbrucken and Dusseldorf, he became professor of philosophy at Bonn in 1836 and at Tübingen in 1842. He died at Stuttgart on hug. 8, 1879.

Fichte's most important writings are: *System der Ethik* (1850–53), *Anthropologie* (1856), *Psychologie* (1864–73), *Die theistische Weltansicht und ihre Berechtigung* (1873). His general views on philosophy are marked by an eclecticism, a predominantly historical treatment of problems and a conciliatory tone. He edited the works and correspondence of his father.

See R. Mehlich, *I. H. Fichtes Seelenlehre und ihre Beziehung zur Gegenwart* (1935); J. Ebert, *Sein und Sollen bei Immanuel Hermann Fichte* (1938).

FICHTE, JOHANN GBTTLIEB (1762–1814), German philosopher and patriot, who was recognized, together with Friedrich Schelling and Hegel, as one of the three immediate claimants to the Kantian succession, was born at Rammenau in Upper Lusatia on May 19, 1762, the son of a ribbon weaver. Educated at the Pforta school (1774–80) and at the universities of Jena (1780) and of Leipzig (1781–84), he started work as a tutor. In this capacity he went to Zurich in 1788 and to Warsaw in 1791, but left after two weeks' probation. Meanwhile, at Leipzig in 1790, he had composed his "Aphorismen iiber Religion und Deismus" (1st ed. in the *Sämmtliche Werke,* i; see *Bibliography* below), reminiscent of Spinoza's determinism. The major influence on his thought at this time, however, was that of Kant, whose doctrine of the inherent moral worth of man harmonized with his character; and he resolved to devote himself to perfecting a true philosophy, the principles of which should be practical maxims. Having already begun an abridgment (never completed) of the *Critique of Judgment,* he went from Warsaw to see Kant himself at Königsberg. The first interview was disappointing, but when Fichte submitted his *Versuch einer Kritik aller Offenbarung* ("Essay Toward a Critique of all Revelation") to Kant, the latter was favourably impressed by it and helped to find a publisher (1792). Fichte's name and preface were accidentally omitted from the first edition and the work was ascribed by its earliest readers to Kant himself; when Kant corrected the mistake while commending the essay, Fichte's reputation was made.

From the *Critique of Pure Reason* it was clear that for Kant speculative theology must be purely negative, while the *Critique of Practical Reason* as clearly indicated the view that the moral law is the absolute content or substance of any religion. A critical investigation of the conditions under which religious belief was possible was still wanting; and this it was that Fichte sought to supply in the *Versuch.* His exposition of the conditions under which revealed religion is possible turns upon the absolute requirements of the moral law. Religion itself is the belief in this moral law as divine, and such belief is a practical postulate, necessary in order to add force to the law. The revelation of this divine character of morality is possible only to a being in whom the lower impulses have been, or are, successful in overcoming reverence for the law. In such a case it is conceivable that a revelation might be given in order to add strength to the moral law. Religion ultimately then rests upon the practical reason and satisfies the needs of man, insofar as he stands under the moral law. In this conclusion we see the prominence assigned by Fichte to the practical element and the tendency to make the moral requirements of the ego the ground for all judgment on reality. Having reached this point he had to press forward and leave the Kantian position.

In 1793 Fichte married Johanna Maria Rahn, whom he had met during his stay in Zurich. In the same year he published anonymously two remarkable political works, *Zurückforderung der Denkfreiheit von den Fürsten Europens* and *Beitrag zur Berichtigung der Urteile des Publikums iiber die franzosische Revolution.* Of these the latter, which is much the more important, was intended to explain the true nature of the French Revolution, to demonstrate how inextricably the right of liberty is interwoven with the very existence of man as an intelligent agent and to point out the inherent progressiveness of state arrangements and the consequent necessity of reform or amendment.

As in the *Versuch,* the rational nature of man and the conditions necessary for its realization are made the standard for political philosophy.

When K. L. Reinhold vacated the chair of philosophy at Jena (1793), Fichte was called to succeed him. To the ensuing period belongs his most important philosophical work *(see* below). In this period he published *Einige Vorlesungen iiber die Bestimmung des Gelehrten* (1794; Eng. trans., *The Vocation of the Scholar,* 1847), being lectures on the importance of the highest intellectual culture and on the duties that it imposed, delivered not merely to his own pupils but to all students of the university; the introductory *Über den Begriff der Wissenschaftslehre* and the theoretical *Grundlage der gesamten Wissenschaftslehre* (both also 1794), supplemented by *Grundriss des Eigentümlichen der Wissenschaftslehre* (179j); the practical *Grundlage des Naturrechts* (1796; Eng. trans., *The Science of Rights,* 1869 and 1889); *Erste Einleitung . . . , Zweite Einleitung in die Wissenschaftslehre* and *Versuch einer neuen Darstellung der Wissenschaftslehre* (all three 1797); and *System der Sittenlehre nach den Principien der Wissenschaftslehre* (1798; Eng. trans., *The Science of Ethics as Based on the Science of Knowledge,* 1897). To the theme of his *Wissen-*

schaftslehre ("doctrine of knowledge" or "science") he was to recur continually throughout his life.

In 1795, however, Fichte had become one of the editors of the *Philosophisches Journal;* and in 1798 his friend F. K. Forberg sent him an essay on the development of the idea of religion. Before printing this, Fichte, to prevent misunderstanding, composed a short preface, "On the Grounds of Our Belief in a Divine Government of the Universe," in which God is defined as the moral order of the universe, the eternal law of right which is the foundation of all our being. The cry of atheism was raised, and the electoral government of Saxony, followed by all the German states except Prussia, suppressed the *Journal* and demanded Fichte's expulsion from Jena. After publishing two defenses *(Appellation an das Publikum uber die . . . ihm beigemessenen atheistischen Äusserungen* and *Der Herausgeber des philosophischen Journals gerichtliche Verantwortung gegen die Anklage des Atheismus,* both 1799), Fichte threatened to resign in case of reprimand. Much to his discomfort, his threat was taken as an offer to resign and was duly accepted.

Except for the summer of 1805 (which he spent at Erlangen, delivering the lectures published in 1806 as *Uber das Wesen des Gelehrten,* a longer version of his Jena lectures of 1794), Fichte resided in Berlin from 1799 to 1806. Among his friends were the leaders of German romanticism, A. W. and F. Schlegel and F. Schleiermacher. His works of this period include *Die Bestimmung des Menschen* (1800; Eng. trans., *The Vocation of Man,* 1848); *Der geschlossene Haudelsstaat* (also 1800), an intensely socialistic treatise m favour of tariff protection; *Sonnenklarer Bericht an das grössere Publikum uber die neueste Philosophie* (1801; Fr. trans., *L'Essence de la théorie de la science,* 1916) ; two new versions of the *Wissenschaftslehre* (composed in 1801 and in 1804; published posthumously), marking a great change in the character of the doctrine; *Grundzüge des gegenwartigen Zeitalters* (1806; lectures delivered 1804–05; Eng. trans., *Characteristics of the Present Age,* 1849), analyzing "the Enlightenment" and defining its place in the historical evolution of the general human consciousness, but also indicating its defects and looking forward to belief in the divine order of the universe as the highest aspect of the life of reason; and *Die Anweisung zum seligen Leben, oder Religionslehre* (1806; Eng. trans., *The Way Towards the Blessed Life,* 1849). In this last-named work the union between the finite self-consciousness and the infinite ego or God is handled in a deeply religious fashion reminiscent of the Gospel of St. John. The knowledge and love of God is declared to be the end of life. God is the All; the world of independent objects is the result of reflection or self-consciousness, by which the infinite unity is broken up. God is thus over and above the distinction of subject and object; our knowledge is but a reflex or picture of the infinite essence.

The French victories over the Prussians in 1806 drove Fichte from Berlin to Konigsberg (where he lectured for a time), then to Copenhagen, whence he returned to Berlin in Aug. 1807. From this time his published writings are practical in character; not till after the appearance of the *Nachgelassene* and of the *Sämmtliche Werke* was the shape of his final speculations known. We may here note the order of these posthumously published writings as important for tracing the development of Fichte's thought. From 1806 we have the remarkable *Bericht uber die Wissenschaftslehre* (*Sämmtl. Werke,* viii), with its sharp critique of Schelling, and from 1810 the *Thatsachen des Bewusstseyns* (published 1817), of which another treatment is given in lectures of 1813 (*Nach. Werke,* i). Of the *Wissenschaftslehre* we have, in 1812–13, four separate treatments contained in the *Nachgelassene Werke.* Perhaps the most interesting are the lectures of 1812 on transcendental logic *(Nach. Werke,* i). From 1812 we have notes of two courses on practical philosophy, *Rechtslehre* (*Nach. Werke,* ii) and *Sittenlehre (ibid.,* iii). A finished work in the same department is the *Staatslehre* (published 1820), which gives the Fichtean utopia organized on principles of pure reason; in many cases what it proposes amounts to despotism.

From 1807, however, Fichte was mainly occupied with public affairs. In 1807 he drew up a plan for the proposed new university of Berlin. In 1807–08 he delivered at Berlin his noble addresses to the German nation *(Reden an die deutsche Nation),* full of practical views on the only true foundation for national recovery and glory. From 1810 to 1812 he was rector of the new Berlin university. During the great effort of Germany for national independence in 1813. he lectured on the idea of a true war (*Über den Begriff eines wahrhaften Kriegs,* forming part of the *Staatslehre)*.

At the beginning of 1814, Fichte caught a virulent hospital fever from his nife, who had volunteered for work as a hospital nurse. He died on Jan. 27, 1814.

Philosophy. — The philosophy of Fichte falls chronologically into the periods of Jena and of Berlin, which are also different in their fundamental philosophic conceptions. The former period is marked by its ethical emphasis, the latter by the emergence of a mystical and theological metaph'ysic of being. Fichte was prompted to change his original position because he came to appreciate that religious faith surpasses moral reason. He was also influenced by the general trend which the development of thought took. It cannot be denied that his own turn coincided with, and resembled, the direction in which romanticism and the speculation of Schleiermacher, Schelling and Hegel moved.

But the system of 1794 was the historically most original and also the most characteristic work that Fichte produced. It was incited by Kant's critical philosophy and especially by the *Critique of Practical Reason.* From the outset it was less critical, precisely because it was more systematical, aiming at a self-sufficient, well-rounded doctrine in which epistemology and ethics were intimately united. Fichte's ambition was to demonstrate that practical (moral) reason is really (as Kant had only intimated) the root of reason in its entirety, the absolute ground of all knowledge as well as of humanity altogether. To prove this, he started from a supreme principle which was supposed to be independent and sovereign so that all other knowledge was deduced from it. Fichte did not assert that this supreme principle was self-evident, but rather that it had to be postulated by pure thought. He followed thereby Kant's doctrine that pure practical reason postulates the existence of God, but he tried to transform Kant's rational faith into a speculative knowledge, on which he based both his theory of science and his ethics.

The supreme principle is therefore at the same time a theoretical thesis and a practical act, and it is the practical act that prevails and dominates the meaning of the whole system. The supreme act concerns the origin of the ego itself. Insofar as the ego is the ego of a moral agent it does not originate from any source outside itself, since in that case it would not be responsible for its actions. It can be responsible only if its actions are rooted in the supreme act by which it "posits" itself. Fichte used this new term in order to indicate that the supreme act unites thinking and doing in originating both the highest speculative thesis and the highest ethical reality.

In one of the introductions to his *Wissenschaftslehre* we find an illuminating sentence: "What a philosophy a man embraces depends upon the kind of man he is." This does not mean that philosophy is an outcome of a man's individual nature or that he may choose his philosophy according to his temper or mood, as the existentialists of the 20th century would allow. On the contrary, it means that there is only one true philosophy, namely that which is in agreement with moral reason. A man by choosing his philosophy makes his character manifest. If he is what he ought to be, he has no choice but to obey the moral law. This is the same in thinking as in doing. The moral law governs the will as well as the thinking mind and therefore dictates the true philosophy. It is not merely a matter of science, but it is also and even primarily a matter of conscience when a man decides about the supreme principle of his philosophy. Only by obeying the moral law and the dictate of moral reason can he reach the truth in speculation and become truly free.

Whereas in all other things reality and thought are separable, a man as a moral being can be real only if he brings forth himself; he is not an ego if he does not act as such; and he cannot act as an ego if he is not aware of such action. Ego and self-consciousness are bound together, and only by virtue of this intrinsic bond is he a self. The philosopher has to be moral reason incarnate. Consequently he has to make the absolute ego the Archimedean point from which his system departs and on which it relies. The term "absolute ego" is however not free from a certain ambiguity.

Historians differ in their interpretations of this term. The absolute ego, Fichte says, posits itself. What is this absolute ego? Is it that of an empirical and finite man, inasmuch as he is a moral agent and only thereby an ego? Or is it absolute because it is no longer finite but infinite and therefore the ego not of man but of God? It is difficult to give a precise answer. But the supreme principle certainly points to an ideal ego; *i.e.,* to an ego which is in no way determined by any finite conditions but which determines itself and only thereby posits itself as a self. Yet this ideal self is not merely an ideal or an idea in the mind of finite man. On the contrary, it is even more truly real than any merely finite self; it is more truly a self, precisely because it is not finite and not restricted in its freedom. One might say that Fichte's "absolute ego" resembles the idea of God in Archbishop Anselm's ontological proof; if it were merely an idea, it would not be as absolute as it is supposed to be.

The absolute ego is absolute, Fichte says, in form as well as in content. It is absolute in positing itself by itself and it is absolute in positing itself as an ego. There is no higher reason that could be adduced to prove that it posits itself as an ego; if such a reason could be given, the absolute ego would no longer be absolute and an ego. Out of the same unconditional sovereignty the absolute ego posits over against itself its own opposite. This second act is absolute only as to its form (negation), but not with respect to its content, since there is no content that could be negated except the absolute ego itself. Since the act of self-negating is as independent as the act of self-positing, we cannot ask why the absolute ego brings forth its own opposite and thereby somehow restricts itself and even contradicts itself. Only later when the system unfolds do we learn why a supreme antithesis had to be put as a second supreme principle. The reason is again purely moral; the absolute ego restricts itself in order to originate that sphere in which morality can work; for morality cannot work and the will cannot operate without a certain resistance. Although morality depends upon the absolute freedom of the will, still this freedom itself has a moral significance and dignity only if it overcomes temptation and remains victorious in its struggle with desire and impulse.

Here again Fichte is the disciple of Kant transforming his teacher's doctrine in the direction of ethical speculation. "The world is nothing but the material of our duties"; these words illuminate Fichte's deepest intentions and reveal the very soul of his system. The absolute ego creates its own counterpart to make possible the finite moral person and the finite moral life of man. It is the religious mystery of creation that Fichte in his bold antithesis tries to expound philosophically. The moral will of the human being is both absolute and conditioned, infinite and finite and only thereby the will of an ever-striving, ever-fighting, ever-longing human person. Fichte sought the ultimate foundation of this contradiction inherent in our own existence and in the world in which we have to live and to act. And from this supreme antithesis Fichte develops in the course of his system the peculiarity of world and self in an utterly abstract dialectical procedure.

The dynamic of the system is set in motion by the contradiction of the two highest principles. They have to be reconciled to each other. The solution of this task is directed by the superiority of the thesis in which the absolute ego posits itself. Even the act of self-negation is still an act of the absolute ego and, as such, within the domain of its creative activity, which is indestructible and in the end victorious. How can the absolute ego defeat its opponent? The answer is given by means of the first synthesis in the system, which combines both thesis and antithesis on the ground of the thesis. The absolute ego posits itself according to this synthesis as both determined by its negative counterpart (called the nonego) and determining it; in the first case the world of sense perception and ultimately of scientific knowledge arises; in the second case the practical world of persons and of their purposes emerges. In each case new contradictions obstruct a final solution and new solutions have to be sought.

In the process of this dialectical deduction Fichte demonstrates that the world of sense is necessarily a world in space and time, ordered by causality and subject to general laws; and that the practical world is necessarily built on impulse and desire, inclination and longing, yet ultimately under the legislation of pure practical reason. Man can overcome the obstacles of his nature only by approximating to the goal of a community regulated by the moral conscience of its members. This goal, however, is infinitely remote. The finite ego can never restore within itself the original absolute ego. In this respect no final solution of the supreme contradiction can be attained.

A grandiose ethical intuition underlies the *Wissenschaftslehre* of the Jena period. But it is also evident that the system suffers from an incurable ill; though it claims to be perfect and self-sufficient, it never arrives at its own end. The beginning could be justified only if the end were attainable, but the tension between the contrasting poles of the infinite and the finite ego, between the ideal and the real self, is never completely solved. Ethical speculation defeats itself. The ambiguity of the absolute ego proves fatal to the system. Fichte himself was aware of this defect. This was the reason why he changed again and again the foundations of his *Wissenschaftslehre* and, especially, why he transformed it into a religious metaphysic in which the ethical speculation was not completely given up but was subordinated to a philosophic theology. These later drafts, however, he did not publish, probably because he felt that his day in the development of German idealism had passed.

The popular writings which Fichte did publish disclose in what direction his mind moved. Already in the *Bestimmung des Menschen* he had defined the absolute ego as the infinite moral will of the universe, God, in whom are all the individual egos, from whom they have sprung. More precise utterances are given in the *Thatsachen des Bewusstseyns* and in the later lectures. In them God is the absolute Life, the absolute One, who becomes conscious of himself by self-division and translation into the individual egos. The individual ego is only possible as opposed to a nonego, to a world of the senses; thus God, the infinite will, manifests himself in the individual and the individual has over against him the nonego or thing. "The individuals do not make part of the being of the one life, but are a pure form of its absolute freedom." "The individual is not conscious of himself, but the Life is conscious of itself in individual form and as an individual." In order that the Life may act, though it is not necessary that it *should act,* individualization is necessary. "Knowledge is not mere knowledge of itself, but of being, and of the one being that truly is, namely God. . . . This one possible object of knowledge is never known in its purity, but ever broken into the various forms of knowledge which are and can be shown to be necessary. The demonstration of the necessity of these forms is philosophy or *Wissenschaftslehre" (Thatsachen des Bewusstseyns).* The idea and the method of the *Wissenschaftslehre* prepare the way for Hegelian dialectic; while Schopenhauer's philosophy is very largely contained in the later writings of Fichte. *(See* also HEGEL, GEORG WILHELM FRIEDRICH, and SCHOPENHAUER, ARTHUR.)

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FICHTELGEBIRGE, a mountain group of Bavaria, forming the centre from which various mountain ranges radiate—the Elstergebirge, linking it to the Erzgebirge, in a northeast, the Frankenwald in a northwest and the Böhmer Wald in a southeast direction. The streams which rise there are the Eger and the Saale, both flowing into the Elbe; the Weisser Main into the Rhine and the Naab into the Danube. The chief peaks of the group are the Schneeberg (3,448 ft.) and the Ochsenkopf (3,360 ft.). The district is thickly wooded and is rich in mineral wealth, producing iron, vitriol, sulfur, copper, lead and many kinds of marble. A large population is supported by the iron mines, forges and blast furnaces: and by charcoal burning. Although surrounded b~ railways and crossed b~ the several lines, the Fichtelgebirge, because of its raw climate and bleakness, is not much visited. Of interest are Alexandersbad and Luisenburg.

FICINO, MARSILIO (1433–1499), Italian philosopher and scholar, one of the leaders of Renaissance Platonism, was born on Oct. 19, 1433, at Figline near Florence. His father, a physician, was acquainted with Cosimo de' Medici and with St. Antoninus (archbishop of Florence from 1446 to 1459). After the customary training in Latin language and literature, Ficino studied Aristotelian philosophy and medicine, probably at Florence, but his early interests included also the thought of Epicurus, of Plato and the Neoplatonists, of Augustine and of Thomas Aquinas. After having studied the sources available in Latin, he acquired a thorough knowledge of Greek and devoted the greater part of his life to the translation and interpretation of Plato and of his ancient followers. as well as to the formulation and diffusion of his own Christianized and modernized version of Platonic philosophy. Encouraged and supported by Cosimo de' Medici and his successors. Ficino began his formal activity as a translator and teacher and as the head of the so-called Platonic Academy of Florence in 1462. His numerous translations from Greek into Latin include, besides some Neoplatonic and early Christian writings, the so-called Hermetic corpus (1463; printed in 1471) and, above all, the complete works of Plato and of Plotinus. Whereas several Platonic writings had been translated before, this was the first complete translation of Plato into any western language (begun in 1463, completed *c.* 1470, printed in 1484) and hence a major event in the intellectual history of Europe. In the case of Plotinus, it was the first translation of significance (1484–86; printed 1492). Both versions are excellent and were in general use until the 18th century.

Among Ficino's commentaries, those on Plato's *Symposium* (1469; printed 1484, translated into Italian by Ficino) and on Plotinus (printed 1492) were especially important and influential. Ficino's original works include the *Theologia Platonica* (1482), his chief philosophical work; *Epistolae* (1495), his collected letters, among which many of his shorter philosophical treatises are inserted; and works on medicine and astrology (*De vita libri tres,* 1489) and on theology (*Liber de Christiana religione,* 1474). Ficino's letters and prefaces show that he was engaged in more or less informal teaching, holding courses, orations and discussions, and that his personal and scholarly connections gradually extended from Florence to the rest of Italy and of Europe. Ficino was ordained as a priest in 1473, received several ecclesiastic benefices and became a canon of Florence cathedral. Having been closely identified with the Medici and particularly with Lorenzo, who was his pupil, Ficino retired after the expulsion of the Medici in 1494 and died on Oct. 1, 1499.

Whereas Ficino's role as a scholar, that is, as a translator and commentator of ancient Platonism, has always been recognized, his place as a philosopher in his own right is more difficult to assess. In an age which took pride in a revival of everything ancient, Ficino assumed the task of reviving ancient Platonism. In doing so, he felt free to add medieval and modern ideas to the authentic heritage. Citing the testimony of St. Augustine, he believed that there was a basic agreement between Christian religion and Platonic philosophy and that each of them had its own venerable tradition which remained fundamentally stable in spite of surface variations. In conceiving the universe as a hierarchy of substances that descends from God to matter, he was strongly influenced by Neoplatonic and medieval views. Yet in assigning to the human soul a privileged, central place in this hierarchy and in stressing that the soul through its universal, infinite aspirations and thoughts links the highest with the lowest beings and acts as a bond and knot of the universe, Ficino reveals his originality and his affinity with the thought of Renaissance humanism which had given special emphasis to man and his dignity. His notion of the world as an animated being held together by a dynamic unity was to dominate much speculation on nature during the 16th century and afterward. In accordance with the Neoplatonists and with the medieval mystics, he conceives the task of human existence as an inner ascent of the soul through higher and higher degrees of knowledge and of love, a process which culminates in the immediate contemplation and enjoyment of God. Since this ultimate end cannot be attained during our present life, Ficino postulates the immortality of the soul and assigns to the proofs for this immortality a prominent place in the *Theologia Platonica.* Elaborating on classical and Christian notions, he explains the human relations of love and of friendship in their highest form through a common share in God and in the contemplative life; and in his commentary on Plato's *Symposium* he laid the ground for the theory of spiritual or "Platonic" love that was to become dominant in the poetry and literature of the 16th century. His notion that religion is natural to all men and that every form of religion has a measure of truth whereas Christianity is the most perfect of all seems to have inspired Lord Herbert of Cherbury and later deists. In many other ways, the direct and explicit influence of Ficino's ideas can be traced through the 16th century, whereas his anonymous influence, disguised under the name of Plato or Plotinus, persisted to the end of the 18th.

The *Marsilii Ficini opera* were published (2 vol. 1576), and a *Supplementum Ficinianum,* ed. by P. O. Kristeller, (2 vol. 1937).

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FICK, AUGUST (1833–1916), German philologist, a pioneer in Indo-European etymological research, was born on May 5, 1833, at Petershagen, Westphalia, and was educated at the university of Gottingen, where he became a professor in 1876. His second professorship, at the university of Breslau (1888–91), was relinquished for ill-health, but his research continued. His most enduring contributions fall under two headings. (1) He was the first to undertake a comprehensive study of the common vocabulary of the Indo-European languages. The first edition, *Wörterbuch der indogermanischen Grundsprache in ihrem Bestande vor der Völkertrennung* (1868) reconstructed a "parent" language of remote prehistoric times. In subsequent editions the title was more reserved! *Vergleichendes Wörterbuch der indogermanischen Sprachen;* while giving more emphasis to comparison of the recorded ancient languages, Fick did not discard reconstruction of the prehistoric source. (2) In *Die griechischen Personennamen nach ihrer Bildung erklärt* (1874; 2d. ed. with F. Bechtel, 1894), Fick showed how the formation of many proper names in Greek corresponded exactly to the manner of forming names in most other Indo-European languages (except Latin). This demonstration favoured the conception of the original Indo-European community as a stable aristocracy whose descendants became rulers of the Greek. Hindu, Iranian, Celtic, Germanic and other great nations of antiquity. Fick's method contained some features which were already outdated in his lifetime. Yet his lucid presentation and his orderly grasp of an immense repertory of facts made his writings useful for more than a generation. and much of his research has been incorporated rather than superseded by recent scholars. He died on March 24, 1916, at Hildesheim, Germany. (S. Ln.)

FICTION: *see* Novel; Romance; *see* also separate articles on various national literatures.

FICTIONS, or legal fictions, in law, the term used for false averments, the truth of which is not pennitted to be called in question. English law as well as Roman law abounds in fictions. Sometimes they are merely the condensed expression of a rule of law; *e.g.,* the fiction of English law that husband and wife were one person, and the fiction of Roman law that the wife was the daughter of the husband. Sometimes they must be regarded as reasons invented in order to justify a rule of law according to an implied ethical standard. Of this sort seems to be the fiction or presumption that everyone knows the law, which reconciles the rule that ignorance is no excuse for crime with the moral commonplace that it is unfair to punish a man for violating a law of whose existence he was unaware. Again, some fictions are deliberate falsehoods, adopted as true for the purpose of establishing a remedy not otherwise attainable. Of this sort are the numerous fictions of English law by which the different courts obtained jurisdiction in private business, removed inconvenient restrictions in the law relating to land, etc.

What to the scientific jurist is a stumbling block is to the older writers on English law a beautiful device for reconciling the strict letter of the law with common sense and justice. Blackstone, in noticing the well-known fiction by which the court of king's bench established its jurisdiction in common pleas (viz., that the defendant was in custody of the marshal of the court), says, "These fictions of law, though at first they may startle the student, he will find upon further consideration to be highly beneficial and useful; especially as this maxim is ever invariably observed, that no fiction shall extend to work an injury; its proper operation being to prevent a mischief or remedy an inconvenience that might result from the general rule of law. So true it is that in *fictione* juris semper *subsistit aequitas"* ("in a fiction of law equity must always exist").

Fictions form one of the agencies by which, in progressive societies, positive law is brought into harmony with public opinion. The others are equity and statutes. Fictions in this sense include. not merely the obvious falsities of the English and Roman systems, but any assumption which conceals a change of law by retaining the old formula after the change has been made. It thus includes both the case law of the English and the Responsa Prudentum of the Romans. "At a particular stage of social progress they are invaluable expedients for overcoming the rigidity of law; and, indeed, without one of them, the fiction of adoption, which permits the family tie to be artificially created, it is difficult to understand how society would ever have escaped from its swaddling clothes, and taken its first steps towards civilization." (Sir H. Maine, Ancient Law.)

The bolder remedial fictions of English law have been to a large extent removed by legislation. Thus in ejectment cases the mysterious sham litigants have disappeared. The bond of entail can be broken without having recourse to the collusive proceedings of fine and recovery. Many fictions must have begun their career as metaphors concealing principles. The conception that a man-of-war is a floating island, or that an ambassador's house is beyond the territorial limits of the country in which he resides, was originally a figure of speech designed to set a rule of law in a striking light. It is then gravely accepted as true in fact, and other rules of law are deduced from it. On the other hand, obsolete principles may be classed as fictions when they are quoted as having a present existence. Thus the legal attributes of the king, and even of the house of lords, are fictions. Again, many would hold that the assertion that any elective government really represents the people is hardly more than a fiction.

Bentham notices the comparative rarity of fictions in Scots law. As to fiction in particular, compared with the work done by it in English law, the use made of it by the Scottish lawyers is next to nothing. No need have they had of any such clumsy instrument. They have two others "of their own making, by which things of the same sort have been done with much less trouble. *Nobile officium* gives them the creative power of legislation; this and the word desuetude together the annihilative." And he notices aptly enough that, while the English lawyers declared that James II had abdicated the throne (which everybody knew to be false), the Scottish lawyers boldly said he had forfeited it. (Historical Preface to the second edition of the Fragment on Government.)

FICUS, a very large genus of the Moraceae (*q.v.*) family, comprising trees, shrubs and woody root-climbing vines, with milky sap, minute flowers and seeds inside an ovoid, a globose or pyriform receptacle (or fig) that has a small opening at the apex. Well-known examples are the cultivated figs (*q.v.*), the banyan (*q.v.*), the bo tree and the rubber plant (*F. elastica*). (J. M. BL.)

FIDEICOMMISSION, the name given in Roman law to a provision made by a testator directing his heir or legatee to enter on the inheritance and subsequently denude wholly or partially in favour of a third party. It was introduced formally in the time of Augustus, previously having had no legal force. As cases arose of a legatee failing to comply with this request a court was instituted, the praetor *commissarius*, with special powers of adjudication. *See* SETTLEMENT.

FIDELITY AND SURETY BONDS. A fidelity bond usually provides protection against loss from dishonest acts of persons covered by the bond. It may also protect against losses discovered while the bond is in effect even though they were sustained earlier. A surety bond usually provides that the party furnishing the surety will make good any default by the person covered by the bond (the obligor or principal) in performance of an obligation.

Suretyship is a relationship whereby one party, the surety, promises to reimburse the obligee of a principal for default in the performance of the principal's duty. According to the narrow view, the prevailing view in U.S. jurisdictions, the surety is allied with the principal and has a primary obligation to pay the principal's debt. This is distinguished from guaranty, whereby the guarantor's obligation is conditioned upon nonpayment by the principal, and hence is a secondary obligation. Unless the duty is primary, under the narrow view, the relationship is one of guaranty. According to the broad or British view, followed in a minority of U.S. courts, guaranty is included within the suretyship meaning. In such case, the surety's obligation may be either primary or secondary. The surety upon making payment, usually has a right to be reimbursed.

The principal types of fidelity bonds are individual, schedule, position and blanket bonds. An individual bond protects against loss up to a stated amount resulting from dishonest or fraudulent acts of the named individual employee. There are two types of schedule bonds: a name schedule bond covers the employees named in the bond, each for a specified amount; a position schedule bond is similar but specifies the amount of coverage for each position rather than for each person, and an employee is covered so long as he occupies the position stated. A blanket fidelity bond covers all employees, and names, schedules or positions are not specified. Rates for fidelity bonds depend partly upon the classification of the insured, such as importer, exporter, manufacturer, distributor, wholesaler or retailer. Public officials and employees are under fidelity protection through bonds written especially for such purpose in meeting statutory requirements. Their dishonest acts are covered and guarantees of faithful performance of duties are given.

The principal types of surety bonds are contract bonds, judicial proceedings court bonds, fiduciary court bonds and miscellaneous bonds.

A contract bond guarantees the surety will make good the obligation of principal or obligor should he default on the contract in relation, for example, to construction, maintenance or repairs of a building. The principal or obligor may default in performance, may be unable to meet time limitations for completion of a project, or may default in payment of labour or material costs. Special types of contract bonds include bid or proposal bonds, performance bonds, payment of labour and materials bonds, and maintenance bonds. A bid or proposal bond guarantees the bidder will enter into the contract and provide a performance bond, should his bid be accepted within a specified time period. Labour and materials bonds guarantee payment for labour and materials used in completion of the project. Maintenance bonds guarantee against defective workmanship and materials.

A court bond guarantees the preservation of the opposing litigant's rights and assures the solvency of the principal and his willingness to fulfill his obligations to such party. These bonds, which include appeal and attachment bonds, cover many forms of actions in civil, criminal and admiralty proceedings. The filing of court bonds and their coverage are governed by statute.

A court fiduciary bond, usually required by law, guarantees a court fiduciary will faithfully perform his duties as guardian, receiver, trustee, administrator or executor of property.

Miscellaneous bonds may be required by governmental bodies, individuals, corporations or other legal entities. They include auctioneers' bonds, convict lease bonds for the lease and hiring of state convicts, and depository and indemnity bonds.

Various other types of bonds are written by surety companies. Forgery bonds indemnify the insured against loss for having paid money, given. value, extended credit or delivered property upon the faith of instruments or documents on which the signature has been forged, the amount raised or other alterations made. Checks, drafts, promissory notes or trade acceptances and securities may be covered. See also GUARANTEE. (V. G.)

FIDES, a Roman goddess, deified "good faith." Her cult was traditionally founded by Numa. She was closely connected with Jupiter, and her temple at Rome, dating from 254 B.C., was located on the Capitol near his. Sacrifices were made to her with covered hands symbolic of secret inviolable trust. On coins her symbol is often a pair of clasped hands. (R. B. LD.)

FIDUCIARY, a term derived from Roman law and used in those foreign codes which have been chiefly influenced thereby. The idea, but hardly the law, corresponds with the English trustee. (See TRUST AND TRUSTEES.) Many relations give rise to fiduciary obligations, and are even treated as occasioning trust obligations; *e.g.,* parent and child, guardian and ward, principal and agent, etc. (See CHILDREN: LAWS CONCERNING; INFANT; AGENCY.) Such obligations exist, however, independently of the true notion of trusteeship and are to be found where this notion is but rudimentary. They may rather be said, being in relation to property, to arise from auasi-contract. where not statutory.

FIDUCIARY ACCOUNTING is the branch of accounting pertaining to the records and reports rendered by a fiduciary—one who is in a position of unusual trust and confidence. Because of the requirement for good faith, fiduciary accounting is largely prescribed by courts and emphasizes that the fundamental equation for double entry is assets (properties) equal responsibilities. Whether acting under court jurisdiction or private trust instruments. the fiduciary will charge himself with asset values assumed and with increases in asset values; he will credit himself for decreases in value, values turned over to beneficiaries and for approved expenses. Fiduciary accounting includes accounting for decedents' estates, for trust arrangements and for firms in financial difficulty. With the separation of corporate ownership and control there is some inclination to treat managers as fiduciaries and general corporate accounting as fiduciary accounting. Both are governed by the objectives of general accounting. (C. T. D.)

FIDUCIARY ISSUE, that portion of a note issue. whether that of a government or of a bank, which is not protected by a specific backing of metal or coin or assets capable of being converted into coin or bullion on demand. Thus, where no metallic reserve or other assets capable of automatic conversion into metal is kept, the whole issue is of a fiduciary character. The term does not imply that there are no assets of any kind maintained against the note, but only that such assets as are kept are of a nonmetallic character—commercial bills of exchange, government securities or floating debt due by government. In the modern world where many central banks keep part of their "metallic reserves" not in their own vaults but in the shape of deposits with other central banks or in the shape of short-dated bills payable in other gold-using countries, it is no longer possible to draw a sharp line of distinction between the fiduciary and the nonfiduciary portion of the total circulation, and what is regarded as "gold cover" has in such cases to be defined carefully by the legislation governing the issue. Strictly, the fiduciary circulation consists of all that part of the total issue which is not directly covered by gold coin or bullion in vault or such metal "earmarked" (*i.e.,* held specifically segregated) on account of the issue in some other institution.

It does not follow that the mere maintenance of a cash reserve adds to the safety of a note issue. To do so the whole of the note issue must be convertible; *i.e.,* the reserve against the notes must be used in case holders desire them to be redeemed. Unless the note is effectively convertible, an increase in the total note issue accompanied by an increase in the total reserve will not necessarily prevent "over issue," *i.e.,* a total of notes so large that its value falls in terms of the standard of value.

The fiduciary amount may be fixed absolutely in amount: *i.e.,* the issuer may be prohibited from issuing more than a certain volume of uncovered notes. Or the note issue may be based upon the principle of a fixed absolute amount, the proportion of covered to uncovered notes being left to the discretion of the issuing authority. Or the note issue may be based upon the idea of a proportionate reserve without any absolute limit to the total, a minimum proportion of cash indirectly fixing the amount bf the fiduciary issue. The system of proportional reserves and of a fixed fiduciary amount may be partly combined by providing that if the total issue exceeds the sum of the fully covered notes and the fixed fiduciary amount (the so-called tax-free contingent) the excess shall be taxable. The reserve proportion is allowed to vary (thus varying the fiduciary portion), subject to provisions by which the tendency to over-issue is checked by a scale of taxation rising as the reserve proportion falls. (See GOLD RESERVES.) (T. E. G.; X.)

FIEF, a feudal estate in land, land held from a superior (see FEUDALISM). The word is the French form, which is represented in medieval Latin as jeudum or *feodum,* and in English as "fee" or "feu" (see FEE). The A.Fr. *feoffer,* to invest with a fief or fee has given the English law terms "feoffee" and "feoffment."

FIELD, CYRUS WEST (1819–1892), U.S. capitalist and promoter of the first trans-Atlantic telegraphic cable, was born in Stockbridge, Mass.. Nov. 30, 1819. At the age of 15 he went to New York city and worked as an errand boy in a dry goods store. He was employed briefly as an assistant by his brother Matthew, a paper manufacturer. In 1841 he organized the firm of Cyrus W. Field and Co. of New York city, wholesale paper dealers. He was one of the founders (1854) of the New York, Newfoundland and London Telegraph Co., formed to lay a trans-Atlantic cable, and helped to organize a similar company, the Atlantic Telegraph Co., in Great Britain (1856). Unsuccessful attempts to lay a cable mere made in Aug. 1857 and in June 1858. A complete cable was laid between July 7 and Aug. 5, 1858, and operated successfully for three weeks, but the insulation failed. In July 1866, a successful cable was finally laid. For this achievement Field received many honours at home and abroad.

In 1877 he bought a controlling interest in the New York Elevated Railroad company. of which he served as president (1877–80). He developed the Wabash railroad with Jay Gould. and later owned the *Mail* and Express. He suffered heavy financial losses in later years. Field died July 12, 1892, in New York city. He was buried at Stockbridge, Mass.

See Isabella Field Judson, Cyrus W. *Field, His Life and Work* (1896); Charles Bright, *The Story of the Atlantic Cable* (1903). (J. R. LT.)

FIELD, DAVID DUDLEY (1805–1894), father of U.S. legal reform, was born in Haddam, Conn., on Feb. 13, 1805. He studied at Williams college, but did not graduate. Thereafter he studied law in Albany and New York city, being admitted to the bar in 1828. He entered vigorously upon the practice of law, and became an acknowledged expert in both common law and equity pleading. Subsequently he began a campaign to bring about a codification of common law procedure in New York, which campaign was ultimately to spread over the United States and abroad. The movement began in 1837 with a letter to Gulian G. Verplanck, a member of the New York state legislature, in which Field urged the reform of the judicial system. When a constitutional convention was called, to meet in 1846, Field, a master of propaganda, reorganized the arguments of 1837 which now appeared in a series of articles in the *New* York Evening Post, being later reprinted in pamphlet form as *The Reorganization of the Judiciary;* it was instrumental in persuading the convention to report in favour of a codification of the law. The legislature in 1847 appointed a commission on pleading and practice for both procedural and substantive law of which Field became a member. After several preliminary reports to the legislature, a code of civil procedure was reported and enacted in 1848. A code of criminal procedure was completed. but not adopted until later. Within a quarter of a century after 1848, the New York code of procedure. in some form, was adopted in 24 states, two territories, the district court, and in the federal courts. The Civil Code of Procedure was adopted in England and Ireland in 1873, and later by several British overseas possessions. including India. Xlthough Field became chairman of a state commission for the reduction of the whole body of state law into a systematic code, the resulting codification was only partially adopted in New York; these codes were more extensively adopted in such other states, as California, where Field's brother, Stephen (*q.v.*) was a distinguished judge. He died in New York city on April 13, 1894. (A. RY.)

FIELD, EUGENE (1850–1895), U.S. poet and journalist, known as the "poet of childhood," mas born in St. Louis, Mo., Sept. 2, 1850 (or Sept. 3; Field himself confused the date). After his mother died when he was six, Field was sent to relatives in Amherst. Mass. He entered Williams college, soon transferring to Knox college and then to the University of Missouri. but took no degree. At the university he was less a student than a prankster, a role he was to play all his life. For the local newspaper he wrote humorous verse which marked the beginning of his career in journalism.

After his marriage in 1873 Field did editorial work on the *St. Louis Journal,* the *St. Joseph Gazette,* the *Kansas City Times* and the *Denver Tribune.* From his *Tribune* column, "Odds and Ends," he gathered comic paragraphs to make his first small volume, *The Tribune Primer* (1882), journalistic joking in the tradition of Artemus Ward, Bill Nye and Josh Billings. These squibs served as apprentice work for his major literary achievement, his "Sharps and Flats" column in the *Chicago Morning News* (renamed the *Record* in 1890). This column (1883–95) did much to establish the daily personal column as a newspaper feature. In it Field satirized the cultural pretensions of the newly rich Chicago meat barons. Some of these paragraphs were later collected and entitled *Culture's Garland* (1887). In the column also appeared some delicate stories and verses. The best of his verse was collected in *A Little Book of Western Verse* (1889), drawn in part from his column—poems in Pike county dialect. after the manner of Bret Harte and John Hay, verses for children in an affected Old English dialect, translations of Horace and the much-loved "Little Boy Blue" and the "Dutch Lullaby" ("Wynken, Blynken, and Nod"). His last work included *Echoes From the Sabine Farm* (1892), rhymed translations of Horace by Field and his brother Roswell (18j1–1919), and *The Love Affairs of a Bibliomaniac* (1896), an amusing discussion of book collecting. His collected works in ten volumes were published the year after his death, and two more volumes were added in 1901.

Eugene Field was a gay, high-spirited person, whose ebullience and wit, often taking the form of elaborate practical joking, charmed his friends. Xlthough some felt that indulging his fondness for the whimsical and eccentric led him to squander his very real literary talent, all were attracted by his rare and lovable nature, which his friends Slason Thompson and Charles Dennis sought to perpetuate in their volumes of personal reminiscence. A later age, however, has had to judge the man by his writing alone. Together with the characters in his fanciful lullabies, Field is memorialized in a bronze monument in Lincoln park, Chicago.

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FIELD, JOHN (1782–1837), Irish composer and pianist, was born at Dublin on July 26, 1782. He came of a musical family, his father being a violinist and his grandfather the organist in one of the Dublin churches. From the latter the boy received his first musical education. He appeared at the Rotunda in Dublin at the age of ten. In 1794, when the family had settled in London. he made his debut there. He became the favourite pupil of Muzio Clementi, whom he accompanied to Paris to show off the Clementi pianos. and later, in 1802, on his great concert tour through France, Germany and Russia. Field appeared in most of the European capitals, and remained in St. Petersburg as a music teacher when Clementi returned to England. Field made frequent concert tours in Russia and in 1822 settled in Moscow. In 1831 he visited England for a short time. and for the next four years led a wandering life in France: Germany and Italy. He died in Moscow on Jan. 23, 1837. His nocturnes for the pianoforte still live because of their continuous flow of beautiful melody, They were Chopin's models,

FIELD, MARSHALL (1835–1906), U.S. merchant, was born at Conway, Mass., on Aug. 19, 183j. At the age of 17 he became a clerk in a dry goods store at Pittsfield, Mass. In 1856 he moved to Chicago, where he became a clerk in the large mercantile establishment of Cooley, Wadsworth and company. In 1860 he was admitted to a junior partnership. In 1865, with Potter Palmer (1826–1902) and Levi Z. Leiter (1834–1904), he organized the firm of Field, Palmer and Leiter, which subsequently became Marshall Field and company. Under Field's management the annual business of the firm increased to more than $40,000,000 in 1895. He died in New York city on Jan. 16, 1906. Field's public benefactions were numerous: notable among them being his gifts to The University of Chicago and to the Field Columbian Museum of Natural History.

FIELD, NATHAN (1587–1619?), English actor and playwright, son of John Field, Puritan divine, was baptized at St. Giles, Cripplegate, Oct. 17, 1587. He attended St. Paul's school. In 1600 he a-as impressed for the Children of the Queen's Chapel. His biography is largely the story of his connection with this and other dramatic companies; various Queen's Revels troupes, 1604–13; the Lady Elizabeth's Men, 1614–16; and the King's Men, 1616 (161)-I. He had probably died by Aug. 1619, when his successor at King's was named in an actor list; his administratrix was commissioned on Aug. 2, 1620.

Field was famed for such adult male roles as Bussy in *Bussy D'Ambois* and Littlewit in *Bartholomeu Fair.* He wrote two comedies, *A Woman Is a Weathercock* (acted 1609, printed 1612) and *Amends for Ladies* (acted by 1611, printed 1618), and collaborated with Philip Massinger in *The Fatal Dowry* (printed 1632) and with others in some of the Beaumont-Fletcher plays. In 1928 R. Florence Brinkley showed that the bachelor Nathan was distinct from his married stationer brother Nathaniel (1 581–1633), with whom he had often been confused since 1679.

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FIELD, STEPHEN JOHNSON (1816–1899), U.S. jurist and supreme court justice from 1863 to 1897, was born at Haddam, Conn., on Nov. 4, 1816. the son of a Congregational minister. Like his brother, David Dudley Field (*q.v.*) he attended Williams college. nhere he graduated as valedictorian in 1837. He was admitted to the bar in 1841, and practised with his brother in New York until 1848. In 1849 he went to California and settled in Marysville. His eventful career is recounted in his *Personal Reminzscences of Early Days ın Calzfornia,* privately printed in 1878. As a legislator, he carried to enactment the civil and criminal practice acts of 1851. The former provided "the most liberal exemptions from forced sale of the personal property of the debtor," and gave effect in law to the customs and regulations established by miners. Field sat on the California supreme court from 1857 until his appointment, on March 10. 1863, to a newly created tenth seat on the U.S. supreme court. There he served—perhaps too long—until Dec. 1897, surpassing even Chief Justice John Marshall's record.

A war Democrat, Field tended to read small the powers resulting from rebellion. He spoke for the court in holding invalid state and congressional test oaths; he struggled, unsuccessfully in the end, to invalidate the legal tender act. In the slaughterhouse cases, in 1873, he wrote a memorable dissent arguing that economic *laissez faire* was a part of the "privileges and immunities" secured by the 14th amendment. Dissenting in *Munn* v. *Illinois* and companion cases! in 1877, he contended that the regulation of rates of railroads and grain elevators was beyond the powers of government. The spirit of these dissents came to prevail in the early decades of the 20th century. In 1895 he entered whole-heartedly into overturning the income tax law, warning against "a war of the poor against the rich." Field had a syllogistic mind, and went ever-confidently wherever first principles seemed to lead.

In 1880 and 1884 Field aspired to the Democratic nomination for the presidency. and in the latter year concluded, "had I received the cordial support, instead of opposition of (California) my candidacy. according to the judgment of my friends, would have stood great chances of success." He died in Washington. D.C. on April 9, 1899.

See Carl B. Swisher, Stephen J. Field (1930). (C. Fn.)

FIELD ARTILLERY: see ARTILLERY.

FIELD EMISSION is a physical effect consisting of the emission of electrically charged particles from a conductor under the action of a strong electric field. Particularly field emission of electrons from cold metals into a vacuum is an elementary effect comparable with thermionic, photoelectric or secondary emission. The effect is also called field electron emission, cold emission or autoelectronic emission.

The field emitter is the most effective of all cathodes for releasing electrons from the structure of a metal. Investigations conducted with it have made significant contributions to basic science, and provided early evidence in support of the wave mechanical theory. Technical application of field cathodes is still very difficult.

Field emission of either electrons or positive ions is applied in the field emission microscope. It was this most powerful of microscopes. in which helium ions from a cold emitter point produce an image, that made the atoms of a metal surface visible for the first time (E. W. Müller, 1956).

Historical Development. — Field electron emission from cold metals requires a field strength of order of magnitude 30,000,000 v. per centimetre. Because electrical breakdown in gases occurs at much lower field, the effect can be observed only in highly evacuated tubes. To produce such a high field with a reasonably low voltage, usually in the kilovolt range, the emitting electrode must have a small radius of curvature. as provided by a fine wire, a sharp edge or a needle point. It was in tubes containing such electrodes that field emission was first observed by R. W. Wood (1897) In the early 1920s J. E. Lilienfeld attempted to use field emission cathodes in high-voltage rectifiers and X-ray tubes. but high-vacuum techniques as well as theoretical understanding were not yet sufficiently advanced. Application of the then new quantum mechanics to the electron theory of metals in the late 1920s brought forward the theory of R. H. Fowler and L. Sordheim, describing field emission as "tunneling" of electrons through the metal's surface potential barrier. Experimental advances were made possible with the introduction of the field emission microscope and a cathode point polished to atomic smoothness by E. W. Müller in 1937. Subsequently, the field emission microscope was widely used for the investigation of field emission itself and for the study of adsorption phenomena and other problems of surface chemistry. A modified version led to the discovery of field ion emission. When the field emission microscope was operated with helium ions and the emitter cooled to the temperature of liquid hydrogen, the resolution of the best electron microscopes was surpassed by far and it became possible to see the atoms constituting a metal surface. The adaptation of radar microsecond pulse techniques to field emission studies by W. P. Dyke and co-workers (1953) had great technical significance. Very high-current densities became accessible, and the emitter could also be operated at elevated temperatures (T-F emission) to secure better stability and lifetime for technical applications.

Theory of Field Emission. — Classical electron theory failed to explain the experimental facts of field emission. In their quantum mechanical theory Fowler and Nordheim use the following assumptions: The conduction electrons in a metal form a gas of free particles obeying Fermi-Dirac statistics. The metal surface is assumed to be an ideal plane. causing a classical image force acting on an electron outside the metal. The basic concept of wave mechanics is that conduction electrons arriving at the inside of the metal surface are not totally reflected but can rather penetrate or tunnel through the potential barrier, which is sufficiently thinned by the applied field (fig. 1). The number of electrons

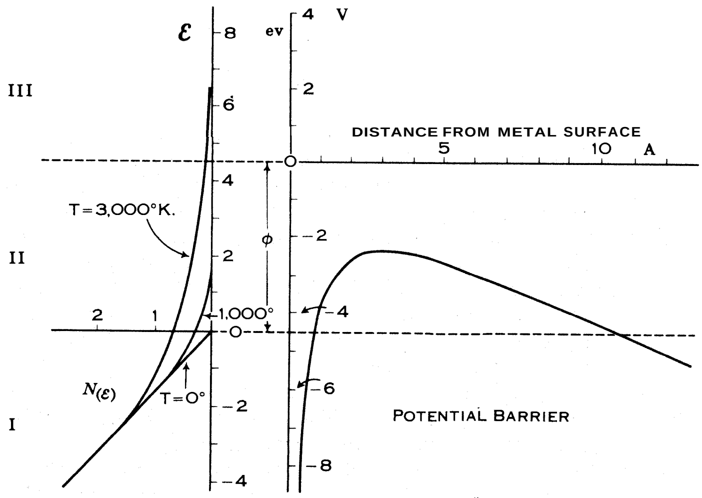

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FIG. 1. — FIELD ELECTRON EMISSION OCCURS BY PENETRATION OF ELECTRONS NEAR FERMI LEVELTHROUGH POTENTIAL BARRIER AT METAL SURFACE. EXAMPLE SHOWN IS FOR A FIELD OF 40,000,000 VOLTS PER CENTIMETRE, AND A WORK FUNCTION OF $\phi = 4.5$ EV

emitted per unit area from each energy level ε (measured here from the Fermi level) is then the product of the number of incident electrons, called the supply function, N (E), and the transmission coefficient, D (ε), at this level. The total current density is the integral of this product taken over all energies ε and multiplied by the electron charge. Using Fermi-Dirac statistics one obtains for the supply function

$$N(\epsilon) = \frac{4\pi mkT}{h^3} \log \left(1 + e^{-\frac{\epsilon}{kT}}\right)$$

where m = mass of electron, k = Boltzmann constant, T = absolute temperature. and h = Planck's constant. The transmission coefficient is found from a solution of the Schrodinger equation written for the assumed potential, which gives in the WKB approximation

$$D(\epsilon) = e^{-\frac{8\pi\sqrt{2m(\phi-\epsilon)^3}}{3heF}v(y)} \qquad (2)$$

where ϕ = thermionic work function, F = field strength, and $v(y)$ is an elliptic function of the variable

$$y = \frac{\sqrt{e^3F}}{\phi - \epsilon}$$

which describes the image force effect and for which some data are given in Table I.

TABLE I

y	v(y)
0	1.000
0.2	0.937
0.4	0.789
0.6	0.577
0.8	0.312
1	0.000

The total current density as obtained by an approximated integration for the case of negligible temperature is then

$$i = \frac{e^3F^2}{8\pi h\phi} e^{-\frac{8\pi\sqrt{2m}\phi^{3/2}}{3heF} v\left(\frac{\sqrt{e^3F}}{\phi}\right)} \qquad (3)$$

and with ϕ measured in e-volts (electron volts) and F in volts/cm., one obtains

$$i = \frac{1.54\times10^{-6}F^2}{\phi} e^{-\frac{6.83\times10^7\phi^{3/2}}{F} v\left(\frac{3.79\times10^{-4}F^{1/2}}{\phi}\right)} \text{ amp./cm.}^2 \qquad (4)$$

(A more detailed discussion of the possibilities of integrating the product of eq. (1) and (2) for finite temperatures is given in the *Bibliography:* Good and Müller.) Computed current densities for a typical tungsten emitter ($\phi = 4.5$ ev) are shown in fig. 2. Emitter temperature is not of great influence below 1,000° K. Here, the majority of the electrons comes from the conduction band below the Fermi level, shown as region I in fig. 1. At higher temperatures and at high fields most of the emitted electrons are thermally excited and tunnel through the barrier in region II. This kind of emission has been called temperature-and-field emission or T-F emission. At high temperatures and also at low fields barrier penetration is negligible compared to the number of electrons spilling over the hump in region III, which is thermionic emission.

Field emission of positive ions can be understood as the evaporation of ions over the potential barrier. The height of this barrier is the binding energy of the ion (without field) reduced through the image force by the Schottky effect. The emitted positive ions come either from an adsorption layer or from the atoms of the emitter itself, so that the supply is rather limited. A continuous-field ion emission can be obtained however, by supplying atoms or molecules from gas surrounding the emitter. At a field of more than 250,000,000 v. per centimetre in the case of hydrogen, and more than 400,000,000 v. per centimetre for helium, all incident gas molecules are ionized very close to the tip when one electron tunnels out of each molecule and enters the metal surface. while the ions are ejected by the field. This complex mechanism can be treated quantitatively (see *Bibliography:* Good and Muller).

Experimental Work in Field Emission. — Together with radioactive alpha-decay. field emission provides the experimentally most easily accessible example of the quantum mechanical tunnel effect. A number of experiments have therefore been carried out to prove the validity of the Fowler-Nordheim theory and its consequences. Difficulties arise from the fact that only the applied voltage and the resulting current can be measured directly, while the theory provides the dependence of the current density upon field strength and work function. For a given atomically clean metal tip as a cathode, neither the field nor the work function is homogeneous over the entire emitting surface. Laborious experimental techniques have been applied to determine the exact shape of the emitter needle point by electron microscopy, to ensure cleanliness of the surface by ultra high-vacuum techniques and to find the work function of the various crystal planes of the tip metal. The dependence upon electrical field of eq. (4) has been confirmed within the possible errors of 5% up to current densities of 6 × 10^6 amp/cm.^{2} At higher fields slight deviations in the direction of smaller currents have been observed which may be due to space charge, the effect of atomic surface structure upon the image force or details of the electron band structure of the metal. Tungsten tips have been operated with microsecond pulses up to field strengths of 70 × 10^6 v./cm., where at current densities of about 10^8 amp./cm.^{2} a destructive vacuum arc is initiated by heat development in the tip (see *Bibliography:* Dyke and Dolan).

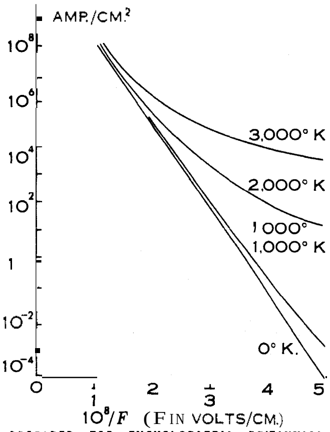

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FIG 2 —COMPUTED CURRENT DENSITY OF FIELD EMISSION FROM TUNGSTEN ($\phi = 4.5$ EV) AT VARIOUS TEMPERATURES, PLOTTED AS A FUNCTION OF RECIPROCAL FIELD

Field Emission Microscopy. — The specimen is a needle-shaped field emitter, with an approximately hemispherical tip of radius 10^{-5} to 10^{-4} cm., arranged in a vacuum tube opposite to a fluorescent screen at anode potential (fig. 3). The emitted electrons move to the screen along nearly radial trajectories, there producing an enlarged pattern of the emission details of the tip surface The magnification equals approximately the ratio of tip-screen distance to tip radius and can easily be 1,000,000 diameters. The resolution is limited by the inherent tangential velocity component of the field electrons, amounting to a few tenths of an electron volt, and by diffraction caused by the wave nature of the electrons, or, equivalent to it, the Heisenberg uncertainty principle. Under the usual condition the resolution is 20–30 Å.

The image depicts the distribution of current density which is determined by the local field strength due to tip geometry and local arrangement of surface atoms, and by the work function. The latter may again depend upon the atomic structure of the involved crystal planes, various kinds of disorder in the atomic arrangement, and the presence of adsorbed matter. The proper interpretation of the pattern in view of these features is the objective of field emission microscopy. Clean or presumably clean surfaces have been studied with a number of metals such as tungsten, tantalum. molybdenum. iridium. platinum, titanium, nickel, iron, silicon and copper, and some alloys such as stainless steel. Surface migration. details of crystal groath, phase transformation and motion of grain boundaries have been investigated.

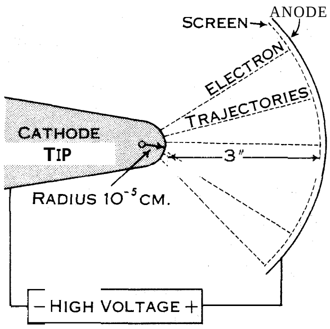

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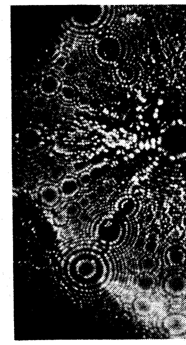
FIG. 3.—SCHEMATIC DIAGRAM OF FIELD EMISSION MICROSCOPE

The potential barrier at a metal surface may be considerably influenced by adsorption. The presence of a small fraction of a monomolecular layer or even of some individual molecules can be detected in the field emission microscope, making it a versatile tool for research in surface chemistry and catalysis The behaviour of oxygen. hydrogen and other gases on the surface of various metals has been studied in a range from liquid helium temperatures (by immersing the entire microscope in liquid helium) to 2,000° K. Skillful interpretation of the patterns allows conclusions to be made about the electron exchange betueen adsorbate and substrate and the resulting binding forces. (For detailed results of the investigations of adsorption by field emission microscopy it is necessary to refer to the works listed in the *Bibliography.)*

If the tip of a field emission microscope is operated at sufficiently high positive voltages, surface atoms of an adsorption layer or from the tip metal itself are emitted as positive ions. The ion current, however. is usually too small to produce a visible pattern on the screen. Therefore the tip must be made negative again in order to inspect the changes in the electron emission pattern. Field desorption can be observed continuously when the microscope is operated with alternating current of adjustable half waves, the positive half causing field desorption and the negative one electron emission for viewing the surface. Quantitative study of field desorption provides a new way of investigating binding energies in surface chemistry. Field desorption is also a means of perfectly cleaning and smoothening the surface of the specimen in the microscope without the application of heat. For instance, at room temperature tungsten evaporates at a rate of one monolayer per second under the influence of an electrical field of 500,000,000 v. per centimetre.

Field Ion Microscope. — This modification of the field emission microscope was introduced by E W. Muller (1951) in order to improve the resolving power. Compared mith electron emission, in the case of field ion emission the tangential velocity components of the image forming particles can be greatly reduced by lowering the tip temperature, and diffraction effects are negligible because of the much shorter de Broglie wave length of the ions. By cooling the tip mith liquid hydrogen to 21° K., filling the microscope with helium at about 1 micron pressure and operating the positive tip at a field strength of 400,000,000 v. per centimetre, a resolution of 2.7 Å, has been obtained (fig. 4, Muller. 1956). The field ion microscope is the first microscopic device to depict the individual atoms that constitute a surface. Although the extremely high field limits its application to the refractory metals, and some other metals with high melting points, it is a most promising tool for some problems of metallurgy, such as the study of dislocations of fatigue under cycling stress or radiation damage.

Technical Applications.— From the report above it appears that field emission is mainly a subject of and a tool for basic research. The unique properties of field electron emission, such as instantaneous emission from a cold cathode, the extremely high-current density of up to 10^8 amp. per square centimetre, and the minute size of the point emitter have for a long time encouraged physicists and electrical engineers to design devices for practical use. As a result of all the experience of many researchers and particularly the successful work of Dyke and collaborators, technical application can be expected. A direct-current bias method has been found for stabilizing the electrical performance of the microsecond-pulsed T-F emission cathode during long periods of operation at useful power levels. Needle cathodes have been operated in parallel to yield a peak power of 3 megawatts. for instance, as a cathode in an X-ray flash tube. The minute dimensions of the electron source suggest further application in cathode ray tubes, X-ray microscopes and traveling-nave amplifiers.



BY COURTESY OF E. W MULLER

FIG. 4.—PHOTOGRAPH OF ATOMS FORMING THE CRYSTAL LATTICE ON A METAL SURFACE FIELD ION MICROSCOPE PICTURE SHOWS CENTRAL PART OF TUNGSTEN TIP OF RADIUS 1,000 A.

BIBLIOGRAPHY.—R. H. Good and E. W. Müller, "Field Emission," *Encyclopaedia of Physics* (Handbuch der Physik, 2nd ed.) vol. xxi, pp. 176–231, in English (1956) ; W. P. Dyke and W. W. Dolan, "Field Emission," *Advances in Electronics and Electron Physics,* vol. viii, pp. 90–182 (1956) ; J. A. Becker, "Adsorption on Metal Surfaces and Its Bearing on Catalysis," *Advances in Catalysis,* vol. vii, pp. 135–211 (1955) ; R. Gomer, "Field Emission Microscopy and Some Applications to Catalysis and Chemisorption," *Advances in Catalysis,* vol. vii, pp. 93–134 (1955). (E. W. MR.)

FIELDFARE, *Turdus pilaris,* one of the thrushes and a common winter visitor to the British Isles. In spring it nests in north European and Siberian birch forests, migrating to southern Europe, India and northern Africa in winter. It is gregarious in habit and somewhat resembles the mistle thrush (*T. viscivorus)* in appearance. The nest, placed high in a tree, is similar to that of the blackbird *(T. merula)*, as are the eggs. The song is low and poor, the call note harsh and loud. It feeds upon worms, slugs and insect larvae, adding, in hard weather, hips, haws and other berries. It is accidental in Greenland and at Foxe basin, arctic America. Structurally very like the fieldfare, but differing in appearance and habits is the North American *Turdus migratorius,* called the robin (*q.v.*), because of its ruddy breast and familiar habits. It is essentially a migrant, ranging from Greenland to Guatemala and almost everywhere an abundant species. It has a pleasant song and is of great service as a destroyer of insects.

FIELD GLASSES: *see* BINOCULAR INSTRUMENT.

FIELDING, HENRY (1707–1754), English novelist and playwright. was born at Sharpham Park, near Glastonbury, Somerset, on April 22, 1707. The family moved later to East Stour. Dorset. His father, Lieut. Edmund Fielding, was a grandson of the earl of Desmond, who belonged to the younger branch of the Denbigh family. Sarah Fielding was Henry's sister. Up to the time of his mother's death Fielding was educated by a clergyman named Oliver, and then went to Eton, probably as an oppidan. If we may believe his first biographer, Arthur Murphy, he left Eton "uncommonly versed in the Greek authors. and an early master of the Latin classics"––a statement which should perhaps be qualified by Fielding's own uords to Sir Robert Walpole in 1730:

Tuscan and French are in my head ;
Latin I write, and Greek—I read

Thomas Winnington and Sir Charles Hanbury Williams were among his friends at Eton. The chief, however, was George, later Baron. Lyttelton, of Frankley.

When Fielding left Eton is unknown. But in Nov. 172j he was staying at Lyme and apparently bent on carrying off, if necessary by force, a local heiress, Miss Sarah Andrew, whose fluttered guardians promptly hurried her away, and married her to someone else *(Athenaeum,* June 2, 1883). He consoled himself by translating part of Juvenal's sixth satire into verse as "All the Revenge taken by an injured Lover.'! After this he must have lived the usual life of a young man about town, and probably at this date improved the acquaintance of his second cousin. Lady Mary Wortley Montagu, to whom he inscribed his first comedy, *Love in Several Masques* (Drury lane, Feb. 1728). Almost immediately afterward (March 16), Fielding entered himself as "Stud. Lit." at Leyden university. He had apparently left before the annual registration of Feb. 1730; and in Jan. 1730 he brought out a second comedy at the newly opened theatre in Goodman's Fields. Like its predecessor, the *Temple Beau* was an essay in the vein of William Congreve and William Wycherley. His chief dramatic successes. from a critical point of view, the *Author's Farce* (1730) and *Tom Thumb* (1730, 1731), were burlesques; and he was also fortunate in two translations from Molière, the *Mock Doctor* (1732) and the *Miser* (1733). Other plays which might be recorded were *The Coffee-House Politician,* a comedy (1730); *The Letter Writers,* a farce (1731); *The Grztb-Street Opera,* a burlesque (1731); *The Lottery,* a farce (1732); *The Modern Husband,* a comedy (1732); *The Covent Garden Tragedy,* a burlesque (1732); *The Old Debauchees,* a comedy (1732); *Deborah; or, a Wife for you all,* an afterpiece (1733); *The Intriguing Chambermaid* (from Jean François Regnard). a two-act comedy (1734); and *Don Quixote in England,* a comedy (1734), which had been partly sketched at Leyden.

On Nov. 28, 1734, he married Charlotte Cradock of Salisbury, at St. Mary Charlcombe, near Bath (see *Macmillan's Magazine,* April 1907), and early in 1735, he seems for a time to have retired with his bride to his old home at East Stour.

Early in March. 1736. he was back again managing the Haymarket theatre with a so-called "*Great Mogul's* Company of *English* Comedians." This new enterprise opened well. The first piece (produced on March j) was *Pasquin, a Dramatick Satire on the Times.* Its success was unmistakable; and its author followed it up by the *Historical Register for the Year 1736,* of which the effrontery was even more daring. But the Licensing act of 1737, which restricted the number of theatres, rendered the lord chamberlain's licence an indispensable preliminary to stage representation, and—in a word—effectually put an end to Fielding's career as a dramatist. *Tumble-Down Dick; or, Phaeton in the Suds, Eurydice* and *Eurydice Hissed* are the names of three occasional pieces which belong to the last months of Fielding's career as a Haymarket manager.

As a means of support he reverted to the profession of the law and. in Kov. 1737, he entered the Middle Temple. He also did a good deal of literary work, the best known of which is contained in the *Champion,* a news journal of the *Spectator* type, undertaken with James Ralph, whose poem of "Night" is made notorious in the *Dunciad.* On June 20, 1740, Fielding was called to the bar, and occupied chambers in Pump Court. He travelled the western circuit, and attended the Wiltshire sessions. Although, with the *Champion,* he professed, for the time, to have relinquished periodical literature, he still wrote at intervals, but whether he actually wrote the famous *Apology for the Life of Mrs. Shamela Andrews* (1741), a parody of *Pamela,* as Samuel Richardson certainly thought, is quite uncertain.

In any case it is certain that the reading of *Pamela* was the point of departure of Fielding's first novel. *Joseph Andrews,* which made its appearance in Feb. 1742. Professing, on his title page, to imitate Cervantes. Fielding set out to cover *Pamela* with Homeric ridicule by transferring the heroine's embarrassments to a hero. supposed to be her brother. Fielding saw in Pamela's virtue a certain interested quality, and he set out to parody her in the person of Joseph. But the element of parody fell speedily into the background as its author warmed to his theme. His secondary speedily became his primary characters, and Lady Booby and Joseph Andrews do not interest us now as much as Mrs. Slipslop and Parson Adams—the latter a personage who ranks in literature with Laurence Sterne's "Uncle Toby" and Oliver Goldsmith's "Vicar." By the time he had reached his second volume, he had convinced himself that he had inaugurated a new fashion of fiction; and in a remarkable preface he announced his discovery. Postulating that the epic might be "comic" or "tragic" prose or verse, he claimed to have achieved what he termed the "Comic Epos in Prose." of nhich the action was "ludicrous" rather than "sublime," and the personages selected from society at large, rather than the restricted ranks of conventional high life. His plan was happily adapted to his gifts of humour, satire and, above all. irony. That it was matured when it began may perhaps be doubted, but it was certainly matured when it ended. Indeed, except for the plot. which, in his picaresque first idea. had not preceded the conception, *Joseph Andrews* has all the characteristics of *Tom Jones.*

A minor work was a *Vindication of the Dowager Duchess of Marlborough* (1742), then much before the public by reason of the *Account of her Life* which she had recently put forth. Later in the same year, David Garrick applied to Fielding for a play; and an early effort, *The Wedding Day,* was hastily patched together and produced at Drury Lane in Feb. 1743 with no great success. It was, however, included in Fielding's next important publication, the three volumes of *Miscellanies* issued by subscription in April 1743. These comprised some early poems, some essays, a Lucianic fragment entitled a *Journey from this World to the Next,* and last but not least, occupying the entire final volume, the *History of the Life of the late Mr. Jonathan Wild tlze Great.* It is probable that *Jonathan Wild* was actually written before *Joseph Andrews.* Taking for his ostensible hero a well-known thieftaker, who had been hanged in 1725, Fielding proceeds to illustrate, by a mock-heroic account of his progress to Tyburn, the general proposition that greatness without goodness is no better than badness. He will not go so far as to say that all "Human Nature is Newgate with the Mask on"; but he evidently regards the description as fairly applicable to a good many so-called great people. Irony (and especially irony neat) is not a popular form of literary art; and the remorseless pertinacity with which Fielding pursues his demonstration is to many readers discomforting and even distasteful. Yet—in spite of *Scott*— *Jonathan Wild* has its softer pages; and as a purely intellectual conception it is not surpassed by any of the author's works. It will always remain a masterpiece of that irony which is based on understatement.

The events of Fielding's life, both before and after the publication of *Jonathan Wild,* are obscure. He had become early a martyr to gout, and his wife died of fever in his arms, leaving him for the time so stunned and bewildered by grief that his friends feared for his reason. For some years his published productions were unimportant. He wrote prefaces to the *David Simple* of his sister Sarah in 1744 and 1747; and, in 1745–46 and 1747–48, produced two newspapers in the ministerial interest, the *True Patriot* and the *Jacobite's Journal,* both of which were connected with, or derived from, the rebellion of 1745. In Nov. 1747 he married his wife's maid, Mary Daniel, at St. Benet's, Paul's Wharf; and in Dec. 1748 he was made a principal justice of peace for Middlesex and Westminster, an office which put him in possession of a house in Bow street, and £300 per annum "of the dirtiest money upon earth."

Meanwhile he had intermittently occupied himself in composing his second great novel, *Tom Jones; or, the History of a Foundling,* published in Feb. 1749, with a dedication to Lyttelton. In *Tom Jones* Fielding systematically developed the "new Province of Writing," in which he had made a beginning in *Joseph Andrews.* He paid closer attention to the construction and evolution of the plot; he elaborated the initial essays to each book. which provide part of its unending interest, and he compressed into his work the flower and fruit of his forty years' experience of life. He has, indeed, no character quite up to the level of Parson Adams, but his Westerns and Partridges, his Allworthys and Blifils, his parson Thwackum and his philosopher Square have the inestimable gift of life. He drew pictures of ordinary humanity with absolute truthfulness neither extenuating nor disguising defects and shortcomings The bill of fare he provided for his readers he himself describes in the introduction of Book I as "human nature" pure and simple. As for his purpose and method he says in the Dedication: "I have employed all the wit and humour of which I am master. in the folloning history; wherein I have endeavoured to laugh mankind out of their favourite follies and vices." Incidentally he produced a "document" of unrivalled excellence on the social life of the England of his time. *Tom Jones* follows the picaresque method of *Joseph Andrews,* but its plot, in spite of great diversity of its characters, the amazing variety of its incidents and its vast canvas, has a unity and coherence which is new.

Much of *Tom Jones* has become classic. Take the dispute betueen Thwackum and Square on the definition of honour. "Honour." says Thwackum, "is not therefore manifold, because there are many absurd opinions about it; nor is religion manifold, because there are various sects and heresies in the world. When I mention religion, I mean the Christian religion; and not only the Christian religion, but the Protestant religion; and not only the Protestant religion, but the Church of England. And when I mention honour, I mean that mode of Divine grace nhich is not only consistent with, but dependent upon, this religion; and is consistent with and dependent upon no other. . . ." Square in his reply says: "I have asserted that true honour and true virtue are almost synonymous terms, and they are both founded on the unalterable rule of right, and the eternal fitness of things; to which an untruth being absolutely repugnant and contrary, it is certain that true honour cannot support an untruth."

Meanwhile Fielding was taking his duties as a magistrate seriously. His novels provide abundant evidence of his view of the unsatisfactory state of penal law and administration. In May 1749 he became chairman of quarter sessions at Westminster, and in 1751 he wrote an *Enquiry into the Causes of the Late Increase of Robbers, etc.* These preoccupations left their mark on his next novel, *Amelia* (1752), which is more concerned with social problems and popular grievances than its forerunners. Amelia herself, in whom, as in the Sophia Western of *Tom Jones,* he reproduced the traits of his first wife, is certainly, as Johnson admitted, "the most pleasing heroine of all the romances," and the drawing of Dr. Harrison and Col. Bath is admirable. But in 1749 he had been dangerously ill, and his health was visibly breaking. The £1,000 which Millar is said to have given for *Amelia* must have been painfully earned. Pamphlets and an unsuccessful newspaper adventure, the *Covent Garden Journal* (1752) followed. He resigned his post as magistrate and tried various specifics to restore his health. Finally he tried change to a warmer climate. On June 26, 1754, he accordingly left for Lisbon, in the "Queen of Portugal." The protracted discomforts of the sick man and his family on this voyage are narrated at length in the posthumous tract entitled *Journal of a Voyage to Lisbon,* which, with a fragment of a comment on Bolingbroke's then recently-issued essays, was published in Feb. 1755 "for the Benefit of his (Fielding's) Wife and Children" Reaching Lisbon at last in Aug. 1754, he died there two months later (Oct. 8) and was buried in the English cemetery, where a monument was erected to him in 1830. *Luget Britannia gremio non dari fovere natum* is inscribed upon it.

There is but one absolutely authentic portrait of Fielding, a familiar outline by Hogarth, executed from memory for Andrew Millar's edition of his works in 1762. It is the likeness of a man broken by ill-health and affords but faint indication of the handsome Harry Fielding. who in his salad days "warmed both hands before the fire of life."

Fielding has a great place in the history of the English novel. If the *Spectator* is to be credited with foreshadowing the characters of the novel, Defoe with its earliest form, and Richardson with its experiments in sentimental analysis, it is to Henry Fielding that we owe its first accurate delineation of contemporary manners. He owed much to *Don Quixote,* something to the best of the French picaresque novels. but his own creation was different from that of any of his predecessors Fielding drew a large and varied picture of life, of people neither good nor bad, but human, with a tolerance and a humour and penetrating insight which are rare enough. Fielding is the master from whom Dickens and Thackeray and the great school of the English Victorian novelists descend.

Among the many editions of Fielding's works may be mentioned those edited by A. Murphy (1762), G. Saintsbury (1893), E. Gosse (1899); the Harvard University edition (1903), etc. For Fielding's lifework *see* A. Dobson, *Fielding* (1907); G. M. Godden, *Henry Fielding* (1910); W. L. Cross, *The History of Henry Fielding* (Yale, 1918); F. T. Blanchard, *The Novels of Fielding* (Yale, 1926).

FIELDING, SIR JOHN (1722–1780), English police magistrate (justice of the peace) in London, younger stepbrother of Henry Fielding, and his worthy successor in the arduous task of suppressing professional crime and of establishing reformed methods in London's administration of criminal justice. He was appointed a justice of the peace, at first as his brother's assistant, about 1750; and though already blinded (probably by an accident, at the age of 19) he became locally famous as "the Blind Beak," and was reputed to be able to recognize by their voices some 3,000 thieves. He was a pioneer in the treatment of juvenile offenders and in numerous details of police administration. He was knighted in 1761 for his services, and his name stands in the honour roll in the history of the modern police system. His only authentic published writings are *A Plan for Preventing Robberies within 20 Miles of London* (1775), *An Account of the Origin and Effects of a Police*, etc. (1758) and *Extracts from Such of the Penal Laws as Relate to the Peace and Good Order of the Metropolis* (1768).

There is an impressive portrait of Fielding in judicial robes by N. Hone, showing the massive head, lion locks and close-lidded eye sockets.

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(J. H. Wi.)

FIELDING, WILLIAM STEVENS (1848–1929), Canadian journalist and statesman, was born in Halifax, Nova Scotia, on Nov. 24. 1848. From 1364 to 1884 he was on the staff of the *Morning Chronicle*, the chief Liberal paper of the province, and worked at all departments of newspaper life. In 1882 he entered the local legislature as Liberal member for Halifax; and from 1884 to 1896 was premier and provincial secretary of the province, but in the latter year became finance minister in the dominion administration of Sir Wilfrid Laurier and was elected to the house of commons for Shelburne and Queen's county. He opposed confederation in 1864–67, and as late as 1866 won a provincial election on the promise to advocate the repeal of the British North America act. His .administration as finance minister of Canada was important, since in 1897 he introduced a new tariff, granting to the manufactures of Great Britain a preference, subsequently increased; and later he imposed a special surtax on German imports owing to unfriendly tariff legislation by that country. In 1902 he represented Canada at the colonial conference in London. He was a plenipotentiary for the negotiations of the Franco-Canada commercial treaties in Paris (1907, 1909 and 1922); served on several royal commissions; and negotiated various other commercial agreements. He was one of the Canadian delegates to the assembly of the League of Nations in 1922. From 1917–25 he was M.P. for Shelburne and Queen's county, and from 1921–2j held office as minister of finance. In 1923 he was made privy councilor.

He died at Ottawa on June 23, 1929.

FIELD IONIZATION: *see* FIELD EMISSION.

FIELD MOUSE, the designation of such mouselike rodents as are not house mice, more strictly, *Apodemus*, the long-tailed field mouse of Europe and Asia. *See* MOUSE.

FIELD OF CLOTH OF GOLD, often erroneously called Field of the Cloth of Gold, is the name given to the place between Guines and Ardres where Henry VIII of England met Francis I of France in June 1520. Before the castle of Guînes a temporary palace, covering an area of nearly 12,000 sq.yd., had been erected for Henry. It was decorated sumptuously and furnished with a profusion of golden ornaments. For less distinguished visitors 2,800 tents were erected. The size of Henry's following may be gathered from the fact that in one month 2,200 sheep were consumed. The two monarchs met at the Val Doré, a spot midway between the two camps. on June 7. The subsequent tournaments, banquets and entertainments lasted until the 24th. The meeting made a great impression on contemporaries, but its political results were very small. Henry shortly after enjoyed an equally friendly meeting with Francis' rival, the emperor Charles V.

The *Ordonnance* for the Field is printed by J. S. Brewer in the *Calendar of State Papers, Henry VIII*, vol. iii (1867). *See* also J. S. Brewer, *Reign of Henry VIII* (1884); A. F. Pollard, *Henry VIII*, new ed. (1905).

FIELDS, JAMES THOMAS (1817–1881), U.S. publisher and author, was born in Portsmouth, N.H., Dec. 31, 1817, the son of a shipmaster who died when Fields was a child. At the age of 14 he went to Boston as clerk in a bookseller's shop. While working there he began to write for the local newspapers. In 1829 he became junior partner in the bookselling firm of Ticknor, Reed and Fields. which became Ticknor and Fields in 1854 and Fields, Osgood and Co. in 1868. He was the publisher of the foremost contemporary U.S. writers, with most of whom he was on terms of close personal friendship; Whittier, for instance, depicted him in *The Tent on the Beach*. He was also the U.S. publisher of some of the best-known British writers of his time.

In 1862–70, as the successor of James Russell Lowell, he edited the *Atlantic Monthly*. His writings include: *Poems* (1849); *Yesterdays With Authors* (1872) and *Hawthorne* (1876). He died in Boston on April 24, 1881. His second wife, Annie Xdams Fields, whom he married in 1854, was the author, among other works, of *Under the Olive* (1880), a book of verses.

FIELDS, number systems whose elements behave like the numbers of elementary algebra. The usual textbook for college algebra contains a list of what are called the properties of real numbers. These are really the postulates defining a *general field*. Thus a field F is any set consisting of at least two elements a, b, . . . such that the sum $a+b$ and product ab of any two elements of F is in F and the following seven laws hold:

I. Commutative law for addition. If a and b are in F then $a+b=b+a$; that is, a sum is independent of the order of its summands.

II. Associative law for addition. If a, b and c are in F then $a+(b+c)=(a+b)+c$; that is, a sum is independent of the grouping of its summands.

III. Subtraction law. If a and b are in F there are elements x and y in F such that $a+x=b$, $y+a=b$.

IV. Distributive law. If a, b, c are in F then $a(b+c)=ab+ac$ and $(b+c)a=ba+ca$.

V. Commutative law for multiplication. If a and b are in F then $ab=ba$; that is, a product is independent of the order of its factors.

VI. Associative law for multiplication. If a, b and c are in F then $a(bc)=(ab)c$; that is, a product is independent of the grouping of its factors.

VII. Division law. If a and b are in F and a is not zero there are elements x and y in F such that $ax=b$ and $ya=b$.

The set of postulates as we have given them are formulated so as to be *independent*. They can then be used in other topics. (*See* ALGEBRAS (LINEAR].) If I and II hold, the numbers x and y of III are equal and unique and we write $x=b-a$ and call x the *difference* of b and a. The number $0=a-a$ is the unique *zero* element of F and the concept occurs in VII.

If V and VI hold, the numbers x and y of VII are unique and we write $x=ba^{-1}$ (read b, a inversej and call x the quotient of b by a. In particular $1=aa^{-1}$ is the unique *unity element* of a field.

The most elementary types of fields are fields whose elements are ordinary complex numbers. Indeed, a set F of complex numbers is a field if the sum, product, difference and quotient with nonzero denominator of any two members of F is in F.

A subset H of a field F is called a subfield of F providing H is a field relative to the addition and multiplication operations of F. Thus we have defined subfields of the field of all complex numbers above. Every field of complex numbers contains the field of all rational numbers as a subfield.

Fields which contain a subfield mathematically equivalent to the field of all rational numbers are called nonmodular fields. In the contrary case the field is called modular and there exists an integer p which is always a prime number such that the sum $1+1+ \ldots +1$ with p terms is equal to zero. where 1 is the unity element defined above. The unity element 1 then generates a field of p elements 0, 1, 2, . . ., $p-1$ which can be thought of as a field of remainder classes of all integers on division by p. If $p=2$, the classes are the class of all odd integers and the class of all even integers. The integer p is called the characteristic of the modular field.

Extensions of Fields.—A field K is called an extension of a field F if F is a subfield of K. If x is in K the set of all rational functions of x with coefficients in F forms a subfield of K usually designated by $F(x)$ (read F of x). This field is called a simple transcendental or a simple algebraic extension of F according as x is not or is a root of an equation. $f(x)=x^n+c_1 x^{n-1}+ \ldots +c_n=0$, with coefficients $c_1, \ldots, c_n$ in F. In the latter case we can always select a polynomial $f(x)$ of least possible degree; this polynomial will always have the property that it is not the product of two factors with coefficients in F; every element of $F(x)$ will be a polynomial $a_0+a_1x+ \ldots +a_{n-1}x^{n-1}$ with coefficients $a_0, \ldots, a_{n-1}$ in F.

We may also consider fields $Y=F(y_1, \ldots, y_t)$ consisting of all rational functions with coefficients in F of t quantities $y_1, \ldots, y_t$ in an extension field K of F. Then if all of the simple extensions $F(y_1)$, $F(y_2)$, . . ., $F(y_t)$ are algebraic, every element y in Y will generate a simple algebraic extension of F. There will then be an integer n and n quantities $u_1, \ldots, u_n$ in Y such that every quantity of x is uniquely expressible in the form $a_1u_1+ \ldots +a_nu_n$ for $a_1, \ldots, a_n$ in F. We call such a field Y an algebraic extension of degree n over F.

Ii every element y of an algebraic extension Y of finite degree n over F is a root of some corresponding equation which has coefficients in F and no multiple roots, the field Y is said to be separable. Then it can be shown that there exists a quantity x in Y such that Y is the simple algebraic extension $F(x)$. Every algebraic extension of finite degree n over a nonmodular field F is separable.

A separable field Y over F is said to be normal if every element of Y is the root of an equation with its coefficients in F and its roots in Y. Then $Y=F(x)$ where $x=P_1(x)$ is a root of $f(x)=0$ whose other roots are polynomials $P_2(x)$, $P_3(x)$, . . ., $P_n(x)$. It can be shown that $P_i[P_j(x)]=P_k(x)$ for some integer k. Every separable field is contained in a normal field. The theory of normal fields is usually called the Galois Theory.

It may happen that the roots of $f(x)=0$ are the iteratives $P(x)$, $P^2(x)=P[P(x)]$, . . ., $P^n(x)=P[P^{n-1}(x)]=P^0(x)=x$ of a single polynomial $P(x)$. Then $F(x)$ is called a cyclic field over F. Cyclic and normal fields are of great importance in linear algebras and other branches of algebra.

An algebraic number field is an algebraic extension of finite degree over the field of all rational numbers. A Galois or finite field is a field consisting of a finite number of elements. It is a modular field of characteristic p and can be shown to be a normal field over its subfield of p elements.

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FIENNES, NATHANIEL (c. 1608–1669), English politician, second son of William, first Viscount Saye and Sele, was educated at Winchester and at New College, Oxford, where as founder's kin he was admitted a perpetual fellow in 1624. After some time spent on the continent, where he came into touch with Calvinist leaders he returned to Scotland in 1639, and established communications with the Ccvenanters and the Opposition in England, and as member for Banbury in both the Short and Long Parliaments he took a leading part in the attacks upon the Church of England. He was one of the commissioners appointed to attend the king to Scotland in Aug. 1641; and was nominated one of the committee of safety in July 1642. In the Civil War he commanded a troop of horses in Essex's army, was present at the relief of Coventry in August, at Worcester and at Edgehill. In Feb. 1643 Fiennes was sent down to Bristol, arrested Colonel Essex the governor, executed the two leaders of a plot to deliver up the city, and received a commission himself as governor on May 1, 1643. On the arrival of Prince Rupert (July 22) Fiennes capitulated. He was tried at St. Albans by the council of war in December, was pronounced guilty of having surrendered the place improperly. and sentenced to death. He was, however, pardoned, and subsequently exonerated. He held various appointments under the Commonwealth. He took no part in the Restoration, and died at Newton Tony in Wiltshire on Dec. 16, 1669. Fiennes married (1), Elizabeth, daughter of Sir John Eliot, by whom he had one son, afterward 3rd Viscount Saye and Sele; and (2), Frances, daughter of Richard Whitehead of Tuderley, Hants, by whom he had three daughters. Fiennes was the author of a large number of pamphlets. some of which have been reprinted in the series of Thomason and Somers tracts.

FIERI FACIAS: see PRACTICE AND PROCEDURE.

FLESCHI, GIUSEPPE MARCO (1790–1836), Corsican adventurer. was born at Murato, Corsica on Dec. 13, 1790. He served under Murat, then returned to Corsica, where he was condemned to ten years' imprisonment and perpetual surveillance by the police for theft and forgery. He eluded the police, obtained a small post in Paris, and took lodgings on the boulevard du Temple. There, with two members of the Société des Droits de l'Homme, Morey and Pépin by name, contrived an "infernal machine." On July 28, 1835, as Louis Philippe was passing along the boulevard to the Bastille, accompanied by his three sons and a numerous staff, the machine exploded. Marshal Mortier was killed, with 17 other persons, and many were wounded; but the king and the princes escaped. Fieschi himself was severely wounded. He was condemned to death, and was guillotined on Feb. 19, 1836. Morey and Pépin were also executed, another accomplice was sentenced to 20 years' imprisonment and one was acquitted.

See *Procès* de Fieschi (2 vols., 1836); also P. Thureau-Dangin, *Hist.* de la monarchie de *Juillet* (vol. iv, ch. xii, 1884).

FIESCO (DE' FIESCHI), **GIOVANNI LUIGI** (*c.* 1523–1547), count of Lavagna was descended from one of the greatest families of Liguria, first mentioned in the 10th century. He married Eleonora Cibb, marchioness of Massa, in 1540, a woman of great beauty and family influence. The Fiesco belonged to the French or popular party, while the Doria were aristocrats and Imperialists. When Fiesco determined to conspire against Doria he found friends in many quarters. Pope Paul III was the first to encourage him, while both Pierluigi Farnese, duke of Parma, and Francis I of France encouraged him. Among his associates in Genoa were his brothers Girolamo and Ottobuono, Verrina and R. Sacco. A number of armed men from the Fiesco fiefs were secretly brought to Genoa, and it was agreed that on Jan. 2, 1547, during the interregnum before the election of the new doge, the galleys in the port should be seized and the city gates held. The first part of the program was easily carried out, and Giannettino Doria, aroused by the tumult, rushed down to the port and was killed, but Andrea escaped from the city in time. Giovanni Luigi, while crossing a plank from the quay to one of the galleys, fell into the water and was drowned. The news spread consternation among the Fiesco faction, and Girolamo Fiesco found few adherents. They came to terms with the senate and were granted a general amnesty. Doria returned to Genoa on the 4th thirsting for revenge, and in spite of the amnesty he confiscated the Fiesco estates. Girolamo Fiesco and Verrina were captured, tried, tortured and executed. Ottobuono Fiesco, who had escaped, was captured eight years afterward and put to death by Doria's orders.

There are many accounts of the conspiracy, of which perhaps the best is in E. Petit's *André Doria*, ch. xi and xii (1887). *See* also E. Callegari, *La Congiura del Fiesco* (1892) and A. Gavazzo, *Nuovi documenti sulla congiura del conte Fiesco* (1886); E. Rernabb-Brea, in his *Sulla congiura di Giovanni Luigi Fieschi* (1865) publishes many important documents, while L. Capelloni's *Congiura del Fiesco*, edited by A. Olivieri (1858) and A. Mascardi's *Congiura del conte Giovanni Luigi de' Fieschi* (1629) may be commended among the earlier works. The Fiesco conspiracy has been the subject of many poems and dramas, of which the most famous is *Fiesco* by Johann Schiller. *See* also under DORIA, ANDREA; FARNESE.

FIESOLE, GIOVANNI DA: *see* ANGELICO, FRA.

FIESOLE, MINO DA (1430–1484), Italian sculptor, was born at Poppi in the Casentino. Trained in Florence, supposedly in the studio of Desiderio da Settignano, he worked in this town and in Rome, where he was active in 1454, 1463 and from about 1473 to 1480. He died in Florence in 1484. In Florence Mino executed the monuments of Giovanni Salutati, bishop of Fiesole (d. 1466), in Fiesole cathedral, and of Bernardo Giugni (d. 1466) and Count Hugo of Andersburg in the Badia. The latter was begun in 1471 and completed after Mino's return from Rome in 1482. In 1473 he carved two reliefs for the pulpit by Antonio Rossellino in Prato cathedral, and in 1481 a tabernacle for S. Ambrogio, Florence. Mino's work in Rome has been confused with that of the sculptor Mino del Reame. In Rome he worked in association with Giovanni Dalmata on the tomb of Pope Paul II for St. Peter's (Grotte Vaticane), and executed, among many other works, the monuments of Niccolo Forteguerri (Sta. Cecilia in Trastevere), Pietro Riario (SS. Apostoli), Cristoforo della Rovere (Sta. Maria del Popolo) and Francesco Tornabuoni (Sta. Maria sopra Minerva). Much of Mino's work in Rome was undertaken in conjunction with Andrea Bregno and others.

Mino enjoyed popularity as a portrait sculptor. His earliest portrait bust, that of Niccolo Strozzi (Kaiser Friedrich museum, Berlin), was carved in Rome in 1454. Other notable portrait busts by Mino are those of Astorgio Manfredi (National Gallery of Art, Washington), R. della Luna (Museo Nazionale, Florence) and D. Neroni (1464; Louvre, Paris). These well-characterized busts are among the earliest Renaissance portrait sculptures.

Though much admired in the 19th century, Mino's sculptures came to occupy a place below those of Desiderio da Settignano and Antonio Rossellino. In his larger works the treatment of form is frigid and mannered, and he appears, perhaps as a result of long absence from Florence, to have lacked the ready invention and technical proficiency of his great contemporaries.

See W. R. Valentiner, "Mino da Fiesole," in *Studies of Italian Renaissance Sculpture* (1950). (J. W. P.-H.)

FIESOLE (anc. *Faesulae*), a town and Episcopal see of Toscana, Italy, province of Firenze; it is 3 mi. N.E. of the city of Florence by electric tramway. Pop. (1951) 4,194. It is on a hill with two summits 970 ft. above sea level. and commands a fine view. The cathedral of S. Romolo is an early and simple Tuscan Romanesque basilica, begun 1028 and restored 1256. The picturesque battlemented campanile belongs to 1213. The 13th-century Palazzo Pretorio contains a small museum of antiquities. The inhabitants of Fiesole are largely engaged in straw-plaiting.

Below Fiesole, between it and Florence, lies San Domenico di Fiesole (485 ft.). In the Dominican monastery the painter, Fra Giovanni Angelico da Fiesole (1387–1455), lived until he went to S. Marco at Florence. Here, too, is the Badia di Fiesole, re-erected about 1456–1466 by a follower of Brunelleschi. It is an irregular pile of buildings, in fine and simple early Renaissance style; a small part of the original façade of 1028 in black and white marble is preserved. The slopes of Fiesole are covered with beautiful villas, the Villa Medici and the Villa Palmieri are among the finest. To the southeast lies Monte Ceceri (1,358 ft.), with quarries of gray *pietra serena*, largely used in Florence for building. To the east of this lies the 14th-century castle of Vincigliata restored and fitted up in the mediaeval style.

FIFE, an eastern county of Scotland, bounded north by the Firth of Tay, east by the North sea, south by the Firth of Forth and west by the shires of Perth, Kinross and Clackmannan. The Isles of May, Inchkeith, Inchcolm, and the islet of Oxcar belong to the shire. The land area is 504.5 sq.mi.; its population was 306,778 in 1951. Its coast line measures 108 mi.

The Lomond hills to the south and southwest of Falkland reach a height of 1,712 ft.; their summits show intrusive sheets of dolerite and basalt penetrating the Lower Carboniferous rocks, as does that of Benarty, on the confines of Kinross. Volcanic structures of various ages occur widely; in the north they are of Old Red Sandstone age and form the higher ground bordering the Firth of Tay, the Howe (or Hollow) of Fife; south of this tract, and watered in part by the river Eden, is a lowland underlain by soft Upper Old Red Sandstones; the quarries in these rocks in Dura Den are famous for their fossil fishes. The Carboniferous formations occupy the rest of the county southward. Many necks of volcanoes of the Permian period are traced in east Fife, as at Largo Law, and in the example of columnar basalt at Kincraig point on the coast. Of the rivers the Eden is the longest; formed on the borders of Kinross-shire by the confluence of Beatie burn and Carmore bum, it pursues a wandering course for 30 mi. northeastward, partly through the Howe of Fife, to the North sea. There is good trout fishing in its upper waters, but weirs prevent salmon from ascending it. The Leven and its tributary the Ore, and the Motray water, are the other streams. The only large valley is the fertile Stratheden.

The term Fife was once applied to the peninsula lying between the estuaries of the Tay and Forth and separated from the rest of the mainland by the Ochil hills. Its inhabitants were Picts of the northern branch, and their country was long known as Pictavia. Doubtless it was because of the long continuance of an independent king that Fife itself came to be called distinctively the Kingdom. The Romans, probably only temporarily, occupied a few points, and left no impression on the civilization of the natives. Christian missionaries—especially St. Serf, St. Kenneth, St. Rule, St. Adrian, St. Monan and St. Fillan—have left memorials in the numerous coastal caves between Dysart and St. Andrews, and in crosses and sculptured stones, some doubtless of pre-Christian origin, at various places. The word Fife, according to W. F. Skene, seems to be identical with the Jutland *Fibh* (pronounced Fife) meaning "forest" and was probably first used by the Frisians to describe the country behind the coasts of the Forth and Tay, where Frisian tribes are supposed to have settled at the close of the 4th century. The next immigration was Danish, which left lasting traces in many place names (such as the frequent use of *law* for hill). In 1426 the first shire of Kinross was formed, consisting of Kinross and Orwell, and was enlarged to its present dimensions by the transference from Fife of the parishes of Portmoak, Cleish and Tulliebole. Although the county has lain outside the main stream of Scottish history, Dunfermline, Falkland and St. Andrews were often the scene of pageantry and romantic episodes during the reigns of the earlier Stuarts. Of the 66 royal burghs in Scotland 14 are in the shire. Notwithstanding the marked preference of the Stuarts, the Kingdom played the leading part in the dramas of the Reformation and the Covenant, and by the 18th century the people had ceased to regard the old royal line with any but sentimental interest, and the Jacobite risings of 1715 and 1745 evoked only lukewarm support.

Many notable buildings are to be found in St. Andrews (*q.v.*); these include the cathedral, St. Rule's tower and church, the castle and the United college, principal centre of university life. Dunfermline abbey is distinguished as being the burial place of seven kings of Scotland, the last being Robert the Bruce. Culross contains many fine examples of Scottish domestic architecture dating from the town's prosperity during the 17th and 18th centuries, and Falkland palace, dating from the early 16th century, was one of the favourite retreats of the royal family of Scotland.

About 10% of the total area of 249,738 ac. devoted to farming is rough grazing, including hill pastures. Farming gave employment to 4,895 workers in 1951. The principal crops grown, in order of importance judged by acreage figures, are oats, hay, potatoes, barley, turnips, wheat and sugar beets. Cattle numbers are fairly divided between cattle kept for beef production and cattle kept for milk production. Sheep breeding and feeding are important branches of farming. East Fife, which is favoured by its soil and a low rainfall (about 30 in.), is mostly devoted to arable farming with cattleand sheep feeding. West Fife, less favoured by climate and soil but having a large industrial population, is mostly concerned with milk production. The whole of the coastal belt from Kincardine on Forth to Newburgh on Tay and in the valleys formed by the rivers Motray, Eden, Leven and Ore is very fertile and produces early crops. Elsewhere the soil is naturally poor but has been much improved by liming and other treatment. The poorest soils are mostly under afforestation.

Fife possesses large reserves of coal and is an area of expanding production. The coal fields comprise roughly three areas: the western field of Saline, Oakley, Blairhall and Valleyfield; the central basin, centred on Cowdenbeath, stretching from Dunfermline on the west to Cardenden and Kinglassie on the east; and the eastern field of Dysart-Markinch-Leven with known extensions under the Firth of Forth. From these reserves are produced first-class house coals and a wide range of industrial fuels for general purposes. Beds of limestone and sandstone lying near to coal seams are quarried, as also are exposures of basaltic whinstone of unusual hardness and durability.

The manufacture of linen ranks with agriculture as the county's oldest industry and continues to flourish in Dunfermline and Kirkcaldy as well as at Falkland, Cupar, Leven and Strathmiglo. The weaving of pure silk and artificial fibres has also been introduced. Kirkcaldy. Newburgh and Falkland are famous for the manufacture of linoleum, and paper is made at Guardbridge, Inverkeithing, Markinch and Leslie. There are engineering works and iron foundries at Kirkcaldy, Dunfermline and Leven; shipbuilding is carried on at Burntisland, boatbuilding at Anstruther and St. Monance, and shipbreaking at Inverkeithing. The distillery at Cameron Bridge produces whisky which is blended at Markinch. The white fishing industry is centred on Pittenweem and salmon fishing occurs in the river Tay. Other industries include furniture and carpetmaking, and the manufacture of bobbins, plastics, scales, oilskins, blankets and golf clubs.

From the Forth bridge the main railway line follows the coast as far as Dysart and then turns northward to Ladybank, where it diverges to the northeast for Cupar and the Tay bridge. From Thornton junction a branch runs to Dunfermline and there begins also the coast line for Leven, Crail and St. Andrews which touches the main line again at Leuchars junction.

The population at the 1951 census was 306,778, and both Gaelic and English were spoken by 623 persons. The chief towns are the large burghs of Kirkcaldy (pop., 1951, 49,050) and Dunfermline (44,719); and of the 23 small burghs the largest are Buckhaven and Methil (20,152), Burntisland (5,668), Cowdenbeath (13,151), Cupar (5,530), Leven (8,868), Lochgelly (9,103) and St. Andrews (9,457). The county council meets in Cupar and there are seven county districts. For parliamentary purposes Fife is divided into the county constituencies of East Fife and West Fife, and the burgh constituencies of Dunfermline Burghs (Dunfermline, Cowdenbeath, Inverkeithing and Lochgelly) and Kirkcaldy Burghs (Kirkcaldy, Buckhaven and Methil, Burntisland and Kinghorn).

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FIFE, originally the small primitive cylindrical transverse flute, now the small B♭ military flute, usually conoidal in bore, used in a drum and fife band. The pitch of the fife lies between that of the concert flute and piccolo. The words *fife* and the Fr. *fifre* were undoubtedly derived from the Ger. *Pfeiff*. The O.E. spelling was *phife*, *phiphe* or *ffyffe*. The fife was in use in England in the middle of the 16th century. At the battle of St. Quentin (1557) the list of the English army employed states that one trumpet was allowed to each cavalry troop of 100 men, and a drum and fife to each 100 of foot. *A drumme* and *phife* were also employed at one shilling per diem for the "Trayne of Artillery." This was the nucleus of the modem military band.

FIFTH COLUMN, a term of modern origin denoting the existence within a potential or actual enemy state of a group of hidden and unsuspected activists who promote the cause of the enemy and undermine national solidarity by whatever means at their disposal. It is the near-synonymous equivalent of disloyalty, subversion and treason. The term generally is credited to Gen. Queipo de Llano, a participant in the Spanish Civil War (1936–39) on the rebel side. When four rebel army columns were moving on Madrid, the general referred to his militant supporters within the capital as his "fifth column," intent on undermining the resistance of the Loyalist government from within. The term thus connotes a modern parallel to the ruse of the Trojan horse.

Next to espionage and sabotage, the main technique of the fifth column is infiltration of sympathizers into the entire fabric of the nation under attack, and particularly into positions of policy decision and national defense. Fifth-column activities find a conspicuous field of operation in psychological and actual warfare between the rival ideological camps of totalitarianism and democratic constitutionalism. The techniques of infiltration and subversion, in preparation for subsequent military attack, were utilized with striking success by Adolf Hitler against neighbouring democratic nations, partly in literal imitation of the Trojan horse (hiding troops in the holds of vessels peacefully anchoring in the harbours of the land to be victimized), partly by availing himself of the support of local sympathizers, for whom Vidkun Quisling (*q.v.*), minister of defense of Nor–ray, has provided a generic name.

The technique of the fifth column in all its disguises is also assumed to be standard practice of international communism. In most cases, however, Communist practice differed from that of the Nazis, an openly operating Communist party taking the place of the clandestine fifth column. Occupancy by Communists of the ministries of the interior and of defense, in control of the police and the armed forces, respectively, together with the establishment of communist militia or action squads; proved the most effective methods of the fifth column, as illustrated by the fall of Czechoslovakia in 1948.

The defense of democratic states against totalitarian infiltration was handicapped by observance of the principle of freedom of political expression accorded to all; further, such states were accustomed to repress only overt criminal acts. However, realizing their danger, many European democracies passed legislation before World War II for the defense of the constitutional state, aiming primarily at preventing subversion from within and disloyalty of public officials and armed forces. The ideological "cold war" after the war resulted in the adoption of similar measures by most western states against Communist infiltration. In particular, in the United States a vast body of legislation was enacted, and supplementary activity undertaken, including the loyalty review of the entire public service of the federal government and the states. In this context the term fifth column as such found access to a legal document, the Internal Security (McCarran) act of 1950 (64 Stat. 987), section 2. Whether the danger of fifth-column penetration was such as to warrant the infringement of traditional civil liberties that resulted from the precautionary policy was a matter of dispute. *See also* ESPIONAGE; SABOTAGE.

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flict: Communist Techniques of World Revolution (1953). (K. L.)

FIFTH MONARCHY MEN were an extreme Puritan sect which came into prominence in England during the Commonwealth and Protectorate. They were so called from their belief that the time of the fifth monarchy uas at hand, that is. of the monarchy which should succeed the Assyrian, Persian, Greek and Roman and during which Christ should reign on earth with His saints for 1,000 years. After the fall of the Commonwealth they at first supported Oliver Cromwell; and the Nominated or Barebone's Parliament of 1653, chosen from nominees of the Independent Churches, raised their hopes of bringing in speedily the rule of the saints. The establishment of the Protectorate, however, dashed these hopes and turned the sect against Cromwell. The violence of their agitation led to the arrest of their leaders—Maj. Gen. Thomas Harrison, Maj. Gen. Robert Overton, Christopher Feake. John Rogers and others—and an attempt at an armed rising, led by Thomas Venner in April 1657, was easily suppressed. Venner attempted another. and equally abortive, rising in Jan. **1661.** He and a number of others were executed and the special doctrines of the sect died out.

See S. R. Gardiner. *History of the Commonwealth and Protectorate, 1649–1656* (London, 1903); Sir C. Firth, *The Last Years of the Protectorate* (London, 1909). (R. B. WM.)

FIG, the popular name given to various plants of the genus *Ficus,* of the mulberry family (Moraceae), comprising more than 1,800 species, the flowers being borne on the inner surface of a hollow receptacle or syconium which matures into a spherical or pear-shaped multiple fruit. The species vary greatly in habit—some being low trailing shrubs. others gigantic trees. among the most striking forms of the tropical forests to which they are chiefly indigenous. They have alternate or sometimes opposite leaves and abound in a milky, usually acrid. juice. This juice contains caoutchouc in considerable quantity.

Ficus carica, which yields the well-known figs of commerce, is a bush or small tree—from a few feet to 30 or **40** ft. high—with broad, rough, deciduous leaves. deeply lobed or sometimes nearly entire. The fig is indigenous to an area extending from Asiatic Turkey to north India, but natural seedlings grow in most Mediterranean countries. It was undoubtedly one of the earliest fruit trees cultivated by primitive man, and spread in remote ages over all the districts around the Aegean and Levant. The Greeks are said to have received it from Caria (hence the specific name); Attic figs became celebrated throughout the east, and special laws mere made to regulate their exportation. The fig was one of the principal articles of sustenance among the Greeks; the Spartans especially used it at their public tables. Pliny enumerates many varieties, and alludes to those from Ebusus (the modern Iviza) as most esteemed by Roman epicures; he describes those of home growth as furnishing a large portion of the food of the slaves, particularly those employed in agriculture, by whom great quantities were eaten in the fresh state at the periods of fig harvest. In Latin myths the plant plays an important part. Held sacred to Bacchus. it was employed in religious ceremonies; and the fig tree that overshadowed the twin founders of Rome in the wolf's cave, as an emblem of the future prosperity of the race, testified to the high value set upon the fruit by the nations of antiquity.

In the old world, figs are grown commercially in the following countries in order of usual importance: Italy, Turkey. Algeria, Greece, Portugal and Spain. In Spain the most important fig provinces are Málaga, nhere figs are grown in regular orchards as well as mixed plantings with other fruit trees; Huelva, the centre of the industry being at Lepe, where a fig variety of the same name is grown; Murcia, reported to have the largest number of trees and the greatest production of any of the provinces; Huesca, where the Fraga fig grown near Lérida has a good market reputation; and Majorca. the largest of the Balearic Islands. Spanish figs are mostly of the common type, although the Turon fig grown in southern Granada is a variety of the Smyrna type. In Algeria figs are gronn commercially in the mountainous coastal districts, principally in the vicinity of Tizi Ouzou and Bougie. The unirrigated orchards are on rolling hills or steep mountain sides and consist mostly of Smyrna-type varieties with Kabylian names.

The commercial production of figs in Italy is mostly south of Naples, the principal producing centres being Lecce in the south, Cosenza in the interior and Agropoli on the coast. Dottato is the principal commercial variety, but numerous other figs are widely planted for the production of fresh and dried fruit. The famous Smyrna figs of Turkey are produced mainly in the Meander valley, but the dried product is largely packed and marketed in Izmir. Sari Lop is the variety gromn for drying while Bardajic is consumed in the fresh state. Both are of the Smyrna type. The commercial production of figs in Portugal is mostly confined to the province of Algarve, and Faro is the principal centre of growing and packing. In Greece figs of the Smyrna type comprise the bulk of the dried figs entering into commerce. Messenia is the variety most widely gromn in the province of the same name, and

A. BRANCH OF COMMON FIG TREE (FICUS CARICA) BEARING RIPE AND IMMATURE FRUITS. B. LONGITUDINAL SECTION THROUGH FIG SHOWING CARPELLATE FLOWERS. C. ONE CARPELLATE FLOWER. ENLARGED. D. LONGITUDINAL SECTION THROUGH THE CAPRI FIG, SHOWING BOTH STAMINATE AND CARPELLATE FLOWERS. E. ONE STAMINATE FLOWER. ENLARGED

Kalamata is the city where the fig-packing industry is centralized. Greek string figs are so called from the fact that the figs are flattened out, then strung on reeds about **1.5** lb. to each string before shipment to market.

Commercial fig culture in the United States is largely confined to California and Texas, although fig trees are very common in yards throughout the south and with winter protection thrive as far north as New Tork city. The varieties grown in California in order of importance are Calimyrna. Adriatic, Mission, Kadota and Brown Turkey. California fig orchards are practically all grown under irrigation.

The Texas fig industry is centered in the vicinity of Houston and is devoted mainly to the production of fresh figs for canning and preserving, mostly in glass containers. Because of summer rains and high humidity, figs are not dried commercially. Almost all the commercial plantings are of the Brunswick fig known in Texas as the Magnolia. The smaller Celeste is grown a few trees in a place from Texas to Florida and is used in Louisiana for preserving on a small commercial scale.

The varieties of figs grown in various parts of the world run into the hundreds. Their nomenclature is very much confused, since the same fig is often grown in neighbouring provinces under entirely different names. When introduced into other countries a new name is commonly coined. Thus Lob Injir of Smyrna became Calimyrna in California, and Dottato of Italy became Kadota. The Italian San Piero is known in England as Negro Largo, in France as Aubique Noire and in California as San Pedro Black, Brown Turkey or Black Spanish. There are four general horticultural types of the fig. The most primitive is the caprifig, commonly regarded as the wild type from which edible figs have evolved. Trees of the caprifig characteristically produce three series of fruit buds each growing season; the first gives rise to the profichi or spring crop, the second to the mammoni or summer crop and the third to the mamme or winter crop. Most caprifigs are inedible, but all three crops harbour the larvae; pupae or temporarily the adults of the fig wasp.

The other three types of fig are Smyrna, White San Pedro and Common. Smyrna-type figs develop only when fertile seeds are present, and these seeds account for the generally excellent quality and nutty flavour of the fruit. Figs of the White San Pedro type combine the characteristics of both the Smyrna and the Common type on one tree. First-crop figs develop without flower pollination while second-crop figs in axils of leaves require it. Common figs such as the Dottato. Fraga and Brown Turkey do not require pollination of flowers of either crop, the seeds in the mature fruit usually being hollow. The flowers of such figs were once regarded as incapable of fecundation and were therefore designated as mule flowers; but this is incorrect; it has been proved that all common figs can produce fertile seeds if the flowers are pollinated.

Fig fruits are borne singly or in pairs above the scars of fallen leaves or in axils of leaves of the present season. The flowers are of two kinds, female and male. Long-styled female flowers are characteristic of the fruits produced on most garden and orchard fig trees. Short-styled female flowers are found only in fruits of the caprifig tree and are adapted to the egg-laying habits of the fig insect or *Blastophaga.* Male flowers, which produce pollen, are found in caprifigs, usually near the apex. Young receptacles of Smyrna-type figs drop from the tree owing to lack of fecundation. which circumstance has led from ancient times to the practice of caprification or the placing of caprifigs containing mature *Blastophagas* in the cultivated trees. The insects as they issue from the caprifigs become dusted with pollen; they enter the Smyrna-type figs and crawl over the long-styled flowers in a vain attempt to find a suitable place to deposit their eggs. The flowers thus become pollinated and the resulting fecundation causes the fruit to set and eventually to mature. Hormone sprays will induce Smyrna-type figs to set and mature into seedless or even "seeded" edible fruit.

In most districts figs partially dry on the tree and drop naturally to the ground from which they are picked up and placed on trays in the sun. Turning and manipulating during the drying process improves the texture and quality of the product. The packing of dried figs in boxes, mats, baskets, cartons, bricks, etc., gives employment to thousands of men, women and children during the fall and winter seasons.

In Mediterranean countries, the fig is so widely used both fresh and dried that it is called "the poor man's food." Figs are known to possess in an unusual degree two important food qualities, a definite laxative effect and a high excess alkalinity of ash. The laxative effect is probably due to the bulk of seeds and fibre combined with some specific solvent present in the juice. The chief nutritive element in dried figs is sugar, the content of reducing sugar running as high as 64%. The vitamin content of figs depends somewhat upon the variety. For example: in California, fresh Mission figs contain about twice as much vitamin A precursor as Kadotas and considerably more than Calimyrnas. Vitamin B appears to be unfavourably affected by sulfuring preceding sun drying. In the fig districts of the old world both fresh and dried figs are commonly used for stock feed. Even the leaves are harvested when they are mature and stored or sold for fodder.

Fig trees are so readily propagated from woody cuttings that no other method of propagation is considered in a commercial way. Cuttings of dormant wood taken in February and planted in nursery rows should grow in one season to a height of 4 ft. and be ready to transplant at the end of the growing season. The trees thrive in a wide range of soil types and in most Mediterranean countries receive water only from the natural rainfall. Some varieties produce one crop only in summer or fall. Some bear two crops, the first maturing in June or July on wood of the previous season's growth. the second ripening in summer and fall in the axils of leaves of the same season. In cool climates such as England and central France most varieties mature only the first crop. Pot culture of figs in greenhouses has long been practised in England and some other countries.

Species of the genus *Ficus* are classified by botanists into groups depending upon the kind and distribution of flowers which on the inside of the receptacle are either male, pseudohermaphrodite. or female with long- or short-styled pistils. Classification may also be made on the fruiting habit or method of producing receptacles. Some fig trees produce fruit singly or doubly in the axils of leaves. Some bear single fruits,on the large branches or on the trunk; some bear clusters of fruit on woody knobs or leafless twigs while others have strings of figs on drooping branches. In a few species the figs are borne below ground on leafless runners, such figs being designated as geocarpic or earth figs. How these figs are pollinated underground or whether they are uprooted by animals is not apparent.

Some fig trees, for example: *Ficus religiosa* and *F. benghalensis,* commonly start life from seeds deposited by birds. squirrels, monkeys, or fruit-eating bats. high up on a palm or other native tree. The roots grow downward, attached to the trunk of the supporting plant, but are not parasitic. Such figs are known as epiphytes or more accurately as hemi-epiphytes, as they pass their early life on the trunks of trees but subsequently become connected with the ground by their own root system. The name "strangler" has become attached to fig trees which grow in this way, since their descending and encircling roots become at length largely or entirely confluent! forming a pseudo trunk hollow at the centre through which the dead or dying host plant passes. These fig trunks are roots and not stems, a fact which should be taken into account in studying their anatomy. Roots of fig trees often enter cracks and crevices, thus causing serious injury to buildings and walls on which they are growing. In a vivid description of an old ruin in Ceylon one writer states that a fig tree forms one of the most remarkable objects of the place, its roots streaming downward over the walls as if their wood had once been fluid, following every sinuosity of the building and terraces till they reach the earth.

The Sycomore fig, *F. sycomorus,* is a tree of large size, with heart-shaped leaves. The deep shade cast by its spreading branches makes it a favourite tree in Egypt and Syria, where it is often planted along roads and near houses. The fruit is borne in clusters on specialized leafless shoots attached to the older branches. Sycomore figs become edible only if the apex is cut open to prevent the development of the insect which normally inhabits the fruit. The prophet Amos was thus a "fig dresser."

The Sacred fig: peepul or bo *(F. religiosa),* a large tree with heart-shaped, long-pointed leaves on slender stalks, is much grown in southern Asia. The leaves, bark and fruit are used in native medicine, and a gum resembling caoutchouc is obtained from the juice; but in India it is chiefly planted with a religious object, being regarded as sacred by both Brahmans and Buddhists. A gigantic bo, growing near Anarajapoora, in Ceylon. is said to have been a branch of the tree under which Gautama Buddha became endued with his divine powers, and has always been held in the greatest veneration. Planted in 288 B.C., it (or suckers from it) is probably the oldest historical tree in the world.

Ficus elastica, the India rubber tree, the large, oblong-shaped glossy leaves and pink buds of which are familiar in U.S. greenhouses, furnished most of the caoutchouc obtained from the East Indies, previous to the cultivation of Brazilian rubber trees in the orient. It grows to a large size, and is remarkable for the snakelike roots that extend in contorted masses around the base of the trunk. The small fruit is unfit for food.

Ficus benghalensis, the banyan, of India, has heart-shaped leaves commonly used as elephant fodder. The branches send out numerous aerial roots that grow down to the soil and form props or additional trunks eventually developing the broadest crown of any plant. Some have as many as 300 trunks and a circumference of 2,000 ft. The fruits, fresh or dried, are eaten in various parts of India especially in times of food scarcity.

In southern Florida, two native species occur, the Golden fig *(F. aurea)* and the Short-leaved fig *(F. brevifolia)*, both stranglers.

Many species are native to Mexico and Central America. The Common fig (*F. carica)* is sparingly naturalized in old fields and along roadsides from Virginia to Florida and Texas. Numerous species are grown as greenhouse ornamentals and as standard trees out of doors in Florida and California. No species of *Ficus* is native to the Hawaiian Islands, but several have been introduced and widely distributed for reforestation purposes. F. *macrophylla,* the Moreton Bay fig of Australia, is well suited to this project. Previous to 1921 fertile seeds of this fig had to be imported from its native home. During that year, however, the wasp. essential to pollination of Moreton Bay figs,, was introduced into Hawaii and ripe figs containing fertile seeds secured. This was the second case on record where the wasp of a wild fig tree had been established outside its natural habitat, the first being the colonization of the *Blastophaga* on caprifigs in California A single tree of *F. macrophylla* in Honolulu produced in 1922 fruits from which 224 lb of dry seeds were secured. These seeds, if properly sown, might have yielded 6,558,720 seedlings which, advantageously placed, would reforest all the watersheds on the islands of this group.

See also FRUIT.

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FIGEAC, a town of southwestern France, capital of an *arrondissement* in the *département* of Lot, 47 mi. E.N.E. of Cahors on the Orléans railway. Pop. (1954) 5,636 It stands on the right bank of the Célé, here crossed by an old bridge. Figeac grew up round an abbey founded by Pippin the Short in the 8th century, and throughout the middle ages it belonged to the monks. At the end of the 16th century the lordship was acquired by the duke of Sully, who sold it to Louis XIII in 1622.

The town is very rich in medieval houses, notably the Hôtel de Balène, of the 14th century. Another house. dating from the 15th century, was the birthplace of the Egyptologist J. F Champollion. The church of St. Sauveur, once belonging to the abbey of Figeac, is 12th century restored. Notre-Dame du Puy belongs to the 12th and 13th centuries. The altar-screen is a fine example of carved woodwork of the end of the 17th century. Of the four obelisks which used to mark the limits of the authority of the abbots of Figeac. two to the south and the west of the town remain.

Figeac is the seat of a subprefect and has a communal college. Trade is in cattle, leather, wool. plums. chestnuts, walnuts and grain, and there are zinc mines in the neighbourhood.

FIGG, JAMES (*c.* 1695–1734), generally acknowledged the first champion of England at fighting with bare fists. was born at Thame, Oxfordshire. about 1695. For years he was the leading pugilist and master of the "noble art" of self-defense. He was also famous for his swordsmanship, and for cudgeling and wrestling. He was only beaten once. and then he is said to have been ill.

Figg opened a boxing academy, called Figg's amphitheatre, and, a magnificent and resolute figure, he was ready at all times to accept a challenge to fight. Figg died on Dec. 7, 1734. *See* also BOXING.

FIGNER, VERA NIKOLAEVNA (1852–1942), Russian revolutionist and martyr, was born on June 24, 1852, in the province of Kazan, the eldest of six children in an aristocratic family. Her father, Kikolai Figner, was a government forester; her mother, Ekaterina Kupriyanov, was a daughter of the district judge in Tetyushy. From 1863 to 1869 Vera Figner attended a finishing school for the daughters of Russian nobility in the city of Kazan. During the year following her graduation, her uncle Kupriyanov, a "liberal democrat," awakened in her a wish to find some useful activity. In the summer of 1870 she decided, as did many Russian women of her class and generation, to study medicine and become a doctor among the peasants. Her parents opposed the plan and with the hope of discouraging her design introduced her to a season of polite-society in the capital of the province. There she met Alexei Filipov, a magistrate, who shared her views; they were married on Oct. 18, 1870. In the spring of 1872 Vera Filipov, her husband, who resigned his post in order to accompany her, and younger sister Lydia, went abroad and matriculated at the University of Zurich. Through her contact with Russian men and women student refugees then in Switzerland, she became familiar with the literature of socialism, and within the year joined with her sister a secret society called the "Frichi" club. By 1873 she was conversant with a new revolutionary doctrine which later received the name of "Populism," favouring Mikhail Bakunin's active optimism that aimed at inducing revolt against the ruling power. That summer the students were ordered to return to Russia by a government decree; the Zurich group disbanded, some obeying the summons. others staying in Europe. Vera Filipov continued abroad, determined to complete her studies, for she believed that once she was licensed to practise medicine among the people, she would also be in a position to impart the new doctrine which she had accepted. By Dec. 1875, however, many of those who had gone back to Russia had been arrested or exiled for their political activities. At the urgent request of former members of the secret circle who remained free, and six months before the end of her medical course, Vera Filipov went back to Moscow to assist in carrying on the program they had begun. In 1876 she obtained a divorce from her husband, who did not sympathize with her political interests, and resumed her maiden name. From that time on, her life was linked with the destinies of the Russian revolutionary movement.

In the autumn of 1876 she joined with Mark Nathanson and others in founding the secret society "Land and Liberty" which hoped to provoke a mass uprising among the people. Between 1877 and 1879 she established herself as an able surgeon, and combined the practice of medicine with that of revolutionary propagandist in the provinces of Samara and Saratov. With the assistance of a younger sister, Evgenia, also a doctor, she conducted a free school for peasant children. But the warfare waged against them by the police and village officials, who were suspicious of their purpose, brought Vera Figner to the conviction that the only course by which the existing order would be changed was the course of violence. Her certainty was strengthened by a discussion with Alexander Solovyev, who visited her prior to his unsuccessful attempt to kill the tsar in April 1879, in which he argued convincingly for the course he was to pursue.

In 1879 "Land and Liberty" split up over the question of the place of political terror in its program, and Vera Figner became a member of the executive committee of the more radical division called "the People's Will." Plans were put in motion for a series of terrorist acts, including the assassination of the tsar. In September Vera Figner was sent to Odessa with dynamite for the bombing of the railroad over which he was expected to pass when returning from the Crimea. This venture failed, and she resumed her underground work in St. Petersburg (Leningrad). In 1881 she assisted Sophie Perovskaya and others in organizing the conspiracy, and took part in making the bombs that brought about the death of Alexander II on March 1 (13). Immediately afterward she was sent to Odessa to manage the local affairs of the party. By June of 1882 the executive committee had been annihilated, due to the successful manoeuvres of the police in ferreting out the leaders, and Vera Figner was its only representative still free in Russia. In Kharkov she strived to create a centre which should compensate in some degree for its absence, and managed to form a military group; but within a few weeks Vera Figner, the army men and those who still were left in the ranks of the party, were betrayed to the police by Sergy Dagayev, a former trusted member of the organization. Arrested on Feb. 10, 1883, she was imprisoned in the Peter Paul fortress in St. Petersburg. Following her trial 20 months later, Sept. 22, 1884, she was condemned to death but the sentence was commuted to penal servitude for life. On Oct. 12, 1884 she was removed to Schlusselburg fortress where she was kept in solitary confinement for the greater part of the next 20 years. On Sept. 20, 1904 she was exiled to Archangel, then to Kazan province, and later to Nijni-Novgorod. In 1906 she was permitted to go abroad and while living in Switzerland, France and England, she engaged in winning support for Russian prison reform. At the outbreak of World War I she returned to Russia but was arrested at the frontier and detained in Nijni-Novgorod until the end of 1916 when she was allowed to go to St. Petersburg. After the February revolution, which she witnessed, she was made chairman of an amnesty committee that helped the political prisoners freed from tsarist prisons.

For some years after the Russian Revolution she was occupied in writing and publishing her memoirs (7 vol.), which afford a major clue to the terrorist methods employed by the Russian military police at the time, and magazine articles which describe the revolutionists and movements with which she had been associated. Between 1928 and 1929 a collection of her works, including some of her poems, was issued. Many of the productions that came from the pen of Vera Figner, which aside from their historical content contain artistic literary value, were translated into foreign languages.. In later years she lived in Moscow where she died June 16, 1942, at the age of 90. An old revolutionist, E. Yaroslavsky, writing her obituary in the Russian newspaper *Pravda,* June 1942, declared that "the name of Yera Figner will live in the history of Russia as one of the first women to declare war on tsarism."

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FIGUEIRA DA FOZ, a seaport of central Portugal. in the district of Coimbra. Pop. (1950) 10,486. Figueira da Foz is an important fishing-station. and one of the headquarters of the coasting trade in grain. fruit, wine. olive oil, cork and coal. Glass is manufactured. and the city attracts many visitors by its excellent climate and sea-bathing. A residential suburb, the Bairro Novo, exists chiefly for their accommodation, to the northwest of the old town. Figueira da Foz received the title and privileges of a city in 1882.

FIGUEROA, FRANCISCO DE (1536–1617?), Spanish poet, of whose life little is known, was born at Alcalá. Although Figueroa ordered that his poems should be burnt at his death, the order does not seem to have been carried out for Luis Tribaldos de Toledo in 1625 edited over 60 of Figueroa's poems which exhibit his mastery over blank verse and his inclination to the pastoral tradition. A facsimile of this edition was published by A. M. Huntingdon (1903).

See his *Poesias,* edit. A. de Cortes in "Bib. de Autores Esp." vol. xlii. (1857); *Poésies inidites de Figueroa,* edit. R. Foulché-Delbosc in *Revue Hispanique,* vol. xxv. (1911); *Varias composiciones inéditas,* edit. A. Lacalle Fernandez in *Rivista crítica hispano-americana* (1919). *See* also J. Fitzmaurice-Kelly, *A New Hist. of Span. Literature* (1926).

FIGULUS, PUBLIUS NIGIDIUS (not later than 98–45 B.C.), Roman savant and writer, next to Yarro the most learned Roman of the age. He was a friend of Cicero, to whom he gave his support at the time of the Catilinarian conspiracy (*see* CATILISE). He was praetor in j8, sided with Pompey in the Civil War, was afterward banished and died in exile. He sought to revive Pythagorean doctrines and combine them with Etruscan and oriental beliefs, notably a belief in astrology, and apparently gathered some adherents. Suetonius and Apuleius tell of Figulus' supernatural powers. Jerome calls him *Pythagoricus et magus.* The indifference of the Romans to such abstruse and mystical subjects caused his works to be soon forgotten. They included *De* dis ("Concerning the gods"), in at least 19 books, the earliest comprehensive work on Roman religion, but soon superseded by Varro's *Res divinae; Commentarii grammatici,* in at least 29 books. a loose collection of notes concerned among other matters with synonyms, inflexion, orthography, word formation, syntax and etymology; *De extis* ("Concerning sacrificial meats"); *Augurium privatum; De ventis* ("Concerning winds"), in at least four books; De *animalibus,* in at least four books, used by the elder Pliny; De *hominum natura,* in at least four books; *Sphaera graecanica et sphaera barbarica;* and a rhetorical treatise *De gestu* ("Concerning gesture").

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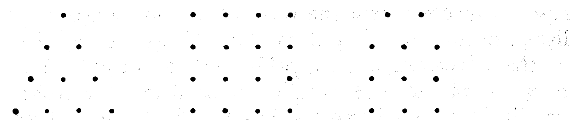
FIGURATE NUMBERS. The early Greek mathematicians found that if groups of dots were used to represent numbers, they could be arranged so as to form geometric figures, examples of which are as follows:



Of these, the first represents a triangular number; since there are 10 dots, 10 is a triangular number. It is also seen from the upper portions of the configuration that 3 and 6 are triangular numbers. The second figure is a square, and from it one sees that 4, 9 and 16 are square numbers. From the third it is seen that 12 is a pentagonal number; for if the perimeter is traced a five-sided figure results. The triangular numbers may be represented by $\frac{1}{2}n\ (n+1)$, where n is any positive integer. The square numbers are represented algebraically by n^2, and the pentagonal numbers by $n^2+\frac{1}{2}n\ (n-1)$. The Greeks also considered oblong (heteromecic) numbers, the sides (or factors) of which differ by unity. Thus. 3×4. $4\times$ j. . . . are oblong numbers. There were also prolate (promecic) numbers. the factors differing by two or more, as in the case of 2×5; but these were often included under oblong numbers. Besides various other types of plane numbers there are solid numbers. For example, 8 is a cubic number, and j is a pyramidal one. Numbers which are related to geometric figures in such ways are called figurate numbers or figured numbers. Plane figurate numbers are also called polygonal numbers, the solid figurate numbers being designated as polyhedral. The theory probably goes back to Pythagoras (*c.* 530 B.C.). Such numbers were studied and described by Nicomachus (c. A.D. 100), Theon of Smyrna (*c.* 125). Boëthius (*c.* 480–524) and many later writers.

See NUMBERS, THEORY OF.

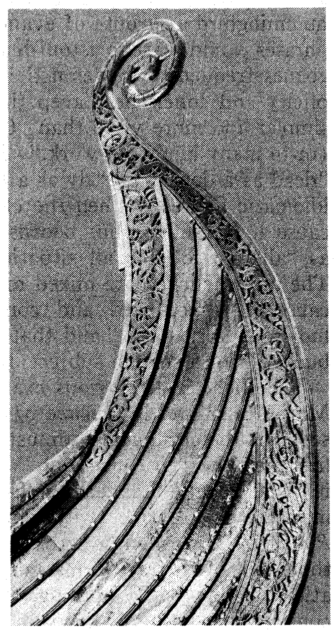
See Sir Thos. L. Heath, *History of Greek Mathematics,* vol. i, p. 76 (1921); D. E. Smith. *History of Mathematics,* vol. ii, p. 24 (1923–25).

FIGURED BASS (also known as THOROUGH-BASS. GENERAL BASS and BASSO CONTINUO) is a kind of musical shorthand, whereby the harmonies of a composition are indicated by means of figures above or belon the bass part, instead of in the ordinary notation. It came into existence early in the 17th century in Italy, being introduced in the first place for the use of the organist or cembalist accompanying a choral composition, and thereafter was very aidely and generally employed for a long period, but nowadays it is retained in use only in harmony textbooks and similar technical norks. The principle of the system is quite simple, the figures indicating the interval of the note to be played. reckoning from the bass upward. Thus a 3 represents a third, a 5 a fifth, a 6 a sixth, and so on. *e.g.,* $\begin{smallmatrix} & 6 & \\ 5, & 6, & 5 \\ 3 & 4 & 3 \end{smallmatrix}$ and the like. chromatic signs being added when necessary to indicate the inflection of a given interval, *e.g.,* $\begin{smallmatrix} \sharp 6, & \flat 9, & \natural 4 \\ 5 & 4 & 3 \end{smallmatrix}$. Much skill and taste were none the less required for the proper interpretation of a figured bass. more especially as in course of time the signs used were still further abbreviated and simplified. leaving more and more to the knowledge and understanding of the performer, who was required further, not merely to provide the bare harmonies indicated but to place and connect them in accordance nith the laws of correct part-writing, to embellish them with runs. ornaments and so on. and generally to provide. on the strength of the mere indication of the essential harmonies, a complete and satisfying accompaniment.

FIGUREHEADS, SHIPS', ornamental symbols or figures formerly placed on some prominent part of a ship, usually at the bow. A figurehead could be a religious symbol, an emblem indicating nationality, or a figure to symbolize the ship's name. Figureheads have been discontinued on most ships since World War I.

The custom of decorating a vessel apparently began in ancient Egypt or India, nhere an eye was painted on either side of the prow. The Chinese followed this custom nith their river junks. The ancients are supposed to have believed that the eyes or *oculi* could help a vessel find its way safely over the water. The first prominent navigators and traders of the western world, the Phoenicians. probably spread this custom throughout the Mediterranean and handed it down to the Greeks and Romans.

As early as 1000 B C. the stem and sternpost were carved and painted to distinguish one ship from another, and at least one class of vessel used an identifying symbol: a falcon or a falcon's eye generally appeared on the bows of funeral barges of the Nile. Although the *oculi* were the most popular symbols used by early sailors. some figureheads were fashioned for the purpose of terrorizing less civilized tribes. The Egyptians probably originated the practice of using religious symbols; other Mediterranean peoples extended this practice by using carvings and paintings of their principal deity to identify the vessel with its city-state. The Carthaginians, for example, often used a carving of Xmmon while the Athenians used a statue of Xthena.



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THE COILED-SNAKE FIGUREHEAD FROM THE OSEBERG SHIP, *c.* 800 A.D.

The ships of the ancient Egyptians. Phoenicians. Greeks and early Romans were constructed with heavy vertical timbers at the bow and stern to which the side planking was attached. These stem and sternposts protruded well above the hull and their prominent and semierect position and form created a focal point of interest and a shape obviously suited for decoration. When the ram type of prow was developed as a weapon of warfare, the stem lost its prominence and the ram was decorated instead. One Athenian vessel of about 500 B.C. had the entire ram carved in the shape of a boar's head. After the ram type of prow lowered the prominent bow features of the ship, greater emphasis was placed on decorating the stern. This trend was carried to an extreme by the Romans at the height of their naval power when their ships were distinguished by a very high sternpost carved to sweep up and around in graceful curves which terminated in the gilded head of a swan or other figures. Even in the Roman merchantman of about 200 A.D., when the bowsprit first was used. the chief emphasis in decorating the vessel continued to be at the stern; but the trend was changing. for some paintings reappeared on the bow.

Along the more blustery northwest coast of Europe, good seamen such as the Vikings. Danes and Normans continued to build their ships with high bows and a projecting stem. The figurehead of the Oseburg ship of about 800 A.D. was a coiled snake with head upreared. In 1004 A.D. a Danish ship bore a dragon's head at the bow. and obtained the effect of a huge sea serpent by having the graceful sweep of the bulwarks terminate aft in a high-coiled tail. The ships of William the Conqueror are represented in the Bayeux tapestry as similar to those of his Korse ancestors, but the decorative symbols (except for the lion's head on the stern) reflect the spread of the Christian church.

In the 13th and 14th centuries a boarding platform was attached forward and projected out over the stem. With this type of construction the figurehead practically disappeared. Gradually the boarding platform was moved back until it formed the forecastle and the beakhead of the 16th century was added to become the natural place for a figurehead. Gradually the beakhead was reduced in size and moved back under the bowsprit until just the figurehead remained. During this period the fashions in figureheads varied from the popular carvings of the saints, to national emblems such as the lion and the unicorn, then to the simple scroll and the billethead, and finally to the carving representing the person for nhom the vessel mas named.

It is interesting to note that figureheads were carved from oak or elm in England, while pine was used almost exclusively in America. The cost of a figurehead in the United States about 1816 ranged from $700 for a 74-gun vessel, $600 for a 44-gun craft, $200 for a sloop, to $46 for the "head" on the revenue cutter "Eagle."

The "Sovereign of the Seas," a galleon built in 1637, was the most highly decorated vessel in the history of shipbuilding. Her carving and gilding cost about £7,000, while the comparative total cost of the ship was £41,000. Figureheads varied in size from 18 in. for small heads and busts to 8 or g ft. for full-length figures.

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(M. H. I.)

FIGURES OF SPEECH is a broad term for a large variety of uses of words, phrases, clauses and sentences to achieve desired effects in meaning, sound and style. Traditionally it is defined as deviation in the use of words from the literal sense or from simple and common practice, and includes figures of rhetoric, syntax, etymology and orthography.

METAPHOR, SIMILE AND KINDRED FIGURES

Figures of Resemblance. — The most basic of all figures is the metaphor (Gr. *metaphora,* from *meta*, "over," and *pherein,* "to carry"), which states an analogy, similarity or relation betneen tno things. The difference between metaphor and synonym is that the metaphor does not mean that the two things are the same, only that they are similar in their relations to something else. For example. calling the first observed robin the "herald of spring" means that the robin is to the beginning of spring weather as the herald (announcer) is to his prince. A like set of relations is conveyed by the metaphorical use of the verb in "the ship plows the sea." Thus in a metaphor one thing is said to be another only as a fiction or useful analogy. A literal description is not figurative, *i.e.*, symbolical. "Blue" or "green" ocean is literal, but "sky-blue ocean," which compares the colour of the ocean to the colour of the sky, is metaphorical.

As Aristotle pointed out in his *Rhetoric,* the difference between a simile and a metaphor is slight, the simile being only a metaphor nith an explanation: "Thus when Homer says of Achilles that 'he rushed on, a very lion,' it is a metaphor. for here. as valour is an attribute to both. he transfers to Achilles the metaphorical appellation of 'a lion'" In general, the metaphor is more compact, forceful and suggestive. The simile requires a phrase beginning with "like." "as." "as if," etc., which makes it not only more prolix than a metaphor but also labels the thought as make-believe. Severtheless. the simile can be effective in prose or poetry. The extended comparison is often called the "epic simile" from Homer's frequent use of it in his poems, as in the *Iliad,* Book VIII, 5jj–j60 (reprinted from *The Iliad of Homer,* translated by Richmond Lattimore by permission of The University of Chicago Press. Copyright 1951 by The University of Chicago).

As when in the sky the stars about the moon's shining
are seen in all their glory, when the air has fallen to stillness,
and all the high places of the hills are clear, and the shoulders out-jutting,
and the deep ravines, as endless bright air spills from the heavens
and all the stars are seen, to make glad the heart of the shepherd.
such in their numbers blazed the watchfires the Trojans were burning
between the waters of Xanthos and the ships, before Ilion.

Here the comparison, beginning with literal description, conveys spaciousness, multiplicity and implies cosmic significance. The "epic simile," in fact, often takes on the exaggeration of hyperbole to magnify the miraculous strength and courage of mythical heroes. The pseudo-epic James Macpherson's *Ossian* is full of examples: "As autumn's dark storms pour from the echoing hills. so towards each other approached the heroes. As two dark streams from high rocks meet and mix. and roar on the plain: loud, rough, and dark in battle meet Lochlin and Innisfail."

Figures of Relationship. — The synecdoche (Gr. *synekdochē,* from *synekdechestkai,* "to receive jointly") is a variety of metaphor whereby a part stands for the whole, such as a "sail" for a ship, or ten "head" of cattle for that number of animals. or "motor" for automobile. The part must be characteristic, important and conspicuous. A ship is not referred to as a "rudder," or an automobile as a "taillight."

Closely akin to synecdoche is the metaphor called metonymy (Gr. *metōnymia,* from *meta,* "change," and *onoma* or *onyma,* "name"), by which a name closely associated with an object is used instead of the usual name of the object, as "crown" or "scepter" for king; "White House" for president (or presidential staff) of the United States, sometimes even personified. "The White House announces . . ." Other variations of metonymy are cause for effect, or vice versa, such as "gray hair" for old age, or "shade" for trees, the latter very common in 18th-century "poetic diction," which overused both synecdoche and metonymy. The Anglo-Saxon kenning also used a part for the whole; in *Beowulf* the ocean is called "swan's-bath," "whale-road," etc.

A kindred metaphor is the antonomasia (L. *anti,* "instead of," and *onoma,* "name"), in which the surname of an individual becomes a generic term for persons of similar activity, condition or characteristic; or for a noun associated with the proper name. For the latter, note "Venus" for love, "Bacchus" for wine, "Mars" for war. etc. Recent history has contributed "quisling" for traitor, "McCarthy" and "McCarthyism" for demagogue and demagoguery. If the use of a name becomes so widespread that its origin is commonly forgotten, it is then a part of the language and is not usually regarded as a figure of speech. Examples are "macadam," small broken stones for paving a road, a process developed by John L. McAdam, and "mackintosh," a waterproof coat invented by Charles Macintosh.

Play Upon Words. — Etymology is one source for the pun (It. *puntiglio,* "fine point" or "verbal quibble"), a humorous play upon two or more meanings for one sound (homophone or homonym). Thoreau, no less than Shakespeare, was a master of such quibbles Three roads leading to a village, he said, make it "trivial." In Shakespeare's time "raskall" was a lean deer out of hunting season; when applied to a person, therefore, the word nas an abusive metaphor (called by the Greeks *catachresis),* but only the abusive connotation remains in "rascal" today. What is most often called a pun, however. is actually paronomasia (Gr. *para,* "beside." and *ononza,* "name"), a play on similar but not identical sounds. O. W. Holmes illustrates it in pretending to condemn the pun in *Autocrat of the Breakfast Table:* "Homocide and verbicide — that is, violent treatment of a word with fatal results to its legitimate meaning, which is its life — are alike forbidden. Manslaughter, which is the meaning of the one, is the same as man's laughter, which is the end of the other." Prosonomasia involves a nickname created by a play on the sound of the person's name. An opponent of Erasmus called him "Errans Mus" (wandering mouse). Hostility breeds such coinages as "Dr. Fraud" for Dr. Sigmund Freud, founder of psychoanalysis.

Enlarged Metaphors. — When the pun is used seriously, it may become a symbol, as when Thoreau finds "concord" (harmony, peace) in the discordant cries of the mild goose and the onl. A symbol begins in a metaphor but acquires additional and more pervasive meaning each time it is used. If the meaning accumulates through a whole literary composition, the symbols merge into allegory. Myth is also an extension of metaphor, dramatizing syinbolical fictions on the origin and purpose of man and nature.

The parable is allegory on a limited scale, being a story nith both a literal and a figurative meaning, such as Christ's parable of the mustard seed; as is the fable, which instructs by making animals act like men. From proverbs such as "wise as serpents" or "harmless as the dove" are derived symbols of wisdom, peace, etc. The legend makes a symbol of heroic action, and uses the lives of great men as paradigms (L. *paradigma,* "example").

The Decay of Metaphor and the Cliché. — As noted above the common noun "mackintosh" illustrates one process of language formation in the decay of metaphor, and the cliché illustrates another. The former has ceased to be a figure of speech; the latter is still figurative, but lacks the impact of newly coined or unfamiliar metaphors. When Emily Dickinson described the flight of a hummingbird as

> A route of evanescence
> With a revolving wheel . . .

she created metaphor, fresh, accurate and thrilling in sense-appeal. But if many people began referring to the flight of a hummingbird as "route of evanescence" or "revolving wheel" the phrases would cease to astonish and become clichés. Though pedagogues frequently condemn the use of clichés, their brevity, simplicity and conciseness keep them alive. "Jack-of-all-trades" is simpler and more vivid than "One who can turn his hand to any (or to many kinds of) work." Phrases such as "eat like a horse," "dead as a doornail," "sly as a fox" — implied also in "foxy" — are idiomatic figures. When the cliché is objectionable it is not because it is familiar but because it is used inappropriately. such as "allergic to" for all situations of dislike or incompatibility. The mixed cliché, like mixed metaphors of all kinds, is inept because it is confused and contradictory, often unintentionally ludicrous, *e.g.,* "The hand that rocked the cradle has kicked the bucket," for a solemn subject, the death of a mother.

The cliché is an obvious example of a basic linguistic process. Max Müller said in *Science of Language* that "under the microscope of the etymologist almost every word discloses traces of its first metaphorical conception." Emerson expressed the same idea in "The Poet": "Language is fossil poetry." Owen Barfield summarizes this doctrine (with which he does not entirely agree) in *Poetic Diction* when he writes: "every modern language, with its thousands of abstract terms and its nuances of meaning and associations, is *apparently* nothing, from beginning to end, but an unconscionable tissue of dead, or petrified, metaphors." (London, Faber & Faber Ltd., 1952). These decayed and petrified metaphors are the fossils of mythology ("jovial" from Jove) ; folklore ("lunatic," moon-struck, *i.e.,* made insane by exposure to moonlight) ; social custom ("jubilee," from Hebrew *jobil,* "ram's horn," used as a trumpet to announce a celebration) ; and every field (another metaphor) of human activity. Taboos and the desire to avoid unpleasant subjects also give rise to euphemisms, like "go west" for dying. *i.e.,* follow the setting sun:

FIGURES FOR EMPHASIS

Figures of Degree of Emphasis. — One of the most vigorous of all figures for emphasis is hyperbole, mentioned above under metaphor, which magnifies things beyond their natural bounds or attributes miraculous powers and qualities to persons. Emily Dickinson. to convince her lover of the steadfastness of her devotion, asks rhetorically and answers hyperbolically:

> Alter? When the hills do.
> Falter? When the sun
> Question if his glory
> Be the perfect one.

Humour. — American especially — often employs hyperbole. Mark Twain: "Noise proves nothing. Often a hen who has merely laid an egg cackles as if she [had] laid an asteroid."

Emphasis can be secured by the reverse of hyperbole: by litotes (Gr. *litotes* from *litos,* "plain, simple"), or understatement. Litotes asserts by the use of a negative: "He is not an ordinary man." meaning he is really a remarkable man. The understatement emphasizes by diminishing. Usually to be fully appreciated it must be taken in context. When Henry James has one of his characters say. "This is my little point," he means that he thinks his point is very important indeed.

The psychological origin of understatement may be either false modesty or a deeper sense of irony. Irony (Gr. *eirōneia,* from *eirōn,* "dissembler in speech") is one of the most emphatic of all figures and the most subtle and insinuating. It states the opposite of the intended or true meaning in such a way that the truth is underscored. In dramatic irony the speaker is unaware of the true import of his words, as when silly Dogberry in *Much Ado* says as a joke, "Write me down an ass!" But serious irony can be profoundly pathetic or even tragic. as when Oedipus sets out to find the guilty person and ends by bringing himself to justice, arising from a sense of human frailty (especially prominent in Greek tragedy), or in protest against overwhelming odds, stupidity, arrogance, etc. Mark Antony in his oration at Caesar's funeral casts doubt on Brutus's motives by repeating "But Brutus is an honourable man." To his pretended consolers Job replies, "No doubt ye are the people, and wisdom shall die with you." Irony resembles, and often makes use of, paradox, antithesis, understatement, anticlimax.

Other Rhetorical Figures. — Of other figures that promote or express emphasis, one of the most obvious is the exclamation, expressing sudden or strong feeling. The exclamation may be a single word ("oh!", "alas!"), a phrase ("For shame!"—which is also a figure of syntax, ellipsis; *see* below), a sentence or whole passage: "What a piece of work is a man! how noble in reason! how infinite in faculties! . . ."

Another common figure is the interrogation or rhetorical question, *i.e.,* a question asked only for effect, the answer being obvious. The Greek Sophists were fond of this figure, and it has always been a favourite with orators, lawyers and special pleaders. The apostrophe is also much used by orators, though found often, too, in older poetry. especially heroic. Here the speaker interrupts his discourse to address directly the thing or subject discussed—if a thing, this likewise involves personification, as when Milton begins *Lycidas* by begging the indulgence of literary fame ("laurel") and invoking the symbol of elegy ("myrtle"):

> Yet once more, O ye laurel, and once more,
> Ye myrtles brown, with ivy never sere, . . .

Figures of Syntax. — Although most figures of speech are some variety or combination of metaphor, the term figure of speech is also applied to variations from normal usage in syntax. word-form, and spelling. Of these the most important are figures of syntax, which include omissions, repetitions and unnecessary addition of words. Ellipsis is the omission of words, phrases or clauses, as in the command, "Go home!" (subject understood but not expressed). Ellipsis is used for pithiness and economy. In asyndeton connectives are omitted for the same reasons: Julius Caesar's "I came, I saw, I conquered." The opposite is polysyndeton, in which connectives are repeated, like the famous "and's" of the Bible. The usual effect is, again, to increase emphasis: "Day after day the wind blew, and the snow melted, and the ground appeared, and thawed, and clucked like a hen . . ." (Sylvia Townsend Warner, *Summer Will Show,* New York, Viking Press, Inc., 1936, p. 25). These repetitions likewise affect the rhythm of the sentence or passage, as do anaphora, repetition of the beginning word or phrase; and anadiplosis, repetition of the last word or phrase.

Faulty or needless repetition is called pleonasm, tautology or redundancy. Primitive folk ballads sometimes employ ungrammatical repetition for metrical purposes: "Mary, she said," for "Mary said." Wasteful use of words is called circumlocution, verbosity, prolixity, and is an error of syntax and style rather than true figures of speech.

OTHER FIGURES

Etymological Figures. — Etymological figures include aphaeresis, omission or elision of a syllable ("'neath" for "beneath"; "'twas" for "it was"); syncope, elision of middle letter ("ne'er" for "never"); apocope, dropping or elision of a final letter or sound ("mo'" for "more"; "mos'" for "most"); prothesis, prefixing of a syllable — sometimes reverting to a more archaic form of the word — for emphasis or rhythm ("arunning" for "running"; "beloved" for "loved"); paragoge, adding a syllable at the end of a word ("deary" for "dear"; illiterate "drunken" for "drunk"); diaeresis, the separation of a diphthong into two vowels — or resisting elision of two vowels —, indicated by two dots over the second vowel (coöperate, Thaïs); synaeresis, the opposite of diaeresis (Harvard students call their "Coop. Store" the "Coop." rhyming with "dupe"); tmesis, inserting a word between compounds ("which thing soever" for "whichsoever thing").

Orthographic Figures. — Figures of orthography include mimesis, which is deliberate misspelling for comic effect or mimicry of dialect, as when Josh Billings claimed that "Hamericans speak Hinglish"; metathesis, displacing of a letter or syllable ("Fastolph" for "Falstaff"); and archaism, the resurrection of a word or expression no longer in common usage ("fain" for "glad"; "forsooth" for "in truth"). But none of these are especially important in modern literature. In fact, the linguistic study of figures of speech has been largely superseded by psychological and esthetic analysis of imagery, which includes any use of words for sense-appeal.

LITERARY STUDY OF FIGURES OF SPEECH

The Literature of Figures of Speech. — The Greeks and Romans of classical antiquity and both medieval and Renaissance scholars of Europe elaborately classified, defined and rationalized the use of figures of speech. Such a list is found in Quintillan's *Institutio Oratoria* in the 1st century A.D. In the 16th century George Puttenham translated the classical names into English. Aristotle's observations in his *Rhetoric* (4th century B.C.) on the use of metaphors are still sound. To adorn, he says, borrow metaphors from things superior; to disparage, from things inferior. "It is proper to derive metaphors . . . from objects which are closely related to the thing itself but which are not immediately obvious." Metaphors should suggest things beautiful in sound, in association, or have a strong sense-appeal. Note the epithet (another classical figure much used by Homer) in "rosy-fingered dawn." Observe the difference in literal "purple," "red" or even figurative "purple-fingered" or "red-fingered."

The unintentional degrading of a subject by using metaphors of low or repulsive associations has been definitively treated by Alexander Pope in "The Art of Sinking in Poetry." This can be illustrated by a passage in Shakespeare's *Henry V* when the King boasts (IV, iii):

> And those that leave their valiant bones in France,
> Dying like men, though buried in your dunghills,
> They shall be fam'd; for there the sun shall greet them,
> And draw their honours reeking up to heaven,
> Leaving their earthly parts to choke your clime,
> The smell whereof shall breed a plague in France.

Hugh Blair, an 18th-century Scottish rhetorician, calls this "a gross transgression. . . having mentioned a dunghill, [Shakespeare] presently raises a metaphor from the steam of it; and on a subject, too, that naturally led to much nobler ideas."

The Function of Figures of Speech. — Figures of speech have often been regarded as mere decoration, or even as deceptive or insincere. Because in classical Greece they were cultivated and taught by the Sophists, Plato distrusted the trickery of professional rhetoricians, though he himself was a master of figurative language; and Aristotle, as has been seen, rationalized the use of metaphor. If intelligently employed, all the figures of speech promote clarity and vigour of thought and expression. Far from being useless decoration, figures may be an essential part of the thought — or *the* thought, as when Isaiah says "All flesh is grass." In the case of onomatopoeia, the word imitates the sound made by the subject, and all good figures are a kind of intellectual onomatopoeia. *See* also ALLITERATION; ONOMATOPOEIA.

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FIJI, a British colony consisting of an archipelago in the Pacific ocean. betaeen 15° and 22° S. and on or about the meridian of 180°. There are more than 300 islands, varying greatly in size, with a total area of 7.055 sq.mi. Suva, the capital, is situated in the southeast of Viti Levu (4,114 sq.mi.), the principal island of the group. Suva has a population (1956) of 37,371 (metro.). The island is mountainous in the interior, and the Rewa river is navigable by small craft for 70 mi. Vanua Levu (2,393 sq mi.) is the second island in size and lies 40 mi. N.E. of Viti Levu. Other islands of some importance are Taveuni (168 sqmi.), which has highly developed plantations; Kandavu (158 sq mi.). the first landfall for ships and planes approaching Suva from the south; Ovalau, rich in historical associations centred round Levuka, the early capital of the colony; and Makongai, known for its leprosy hospital, which serves a large area of the South Pacific. The dependency of Rotuma (18 sq.mi.) lies about 400 mi. to the north.

Physical Features. — The larger islands are of volcanic origin and are mountainous, with peaks of over 3.000 ft., the highest being Mt. Victoria (4,341 ft.) on Viti Levu. The surface of these islands is rugged and the vegetation is tropical in its luxuriance. The smaller islands are of the low coral reef type, and the larger islands are surrounded by coral reefs. The southern islands contain dense forests on the windward side, with many valuable woods, while the leeuard slopes are open grassland. The flora resembles that of New Guinea (*q.v.*).

The climate. for the tropics, is temperate, the temperature seldom falling below 60° F. or rising above 90°. The prevailing minds are the trades, but in this area they are easterly rather than southeasterly. At Suva, which has the climatic conditions of the windward coasts. the annual rainfall is 120.8 in., distributed throughout the year, whereas on the leeward coasts annual averages range from 70 to 90 in., but most of this rain falls during the four months of the hot season, from December to March, when there are northerly monsoonal winds. Tropical cyclones are of occasional occurrence, some part of the colony being affected by one almost every year.

History — The Dutch navigator Abel Tasman sighted a few islands in the northeastern part of the archipelago in 1643; Capt. James Cook visited the isolated southern island of Vatoa in 1774, and Capt. James Wilson of the missionary ship "Duff" discovered islands in northern Lau in 1797. Capt. William Bligh of H.M.S. "Bounty" recorded most of the islands when, after the mutiny, he went through the group in the track of the trade wind. J. S. C. Dumont d'Urville in the "Astrolabe" carried out a more accurate survey in 1827, but it was a U.S. exploring expedition that made the first thorough survey in 1840.

The trade in sandalwood attracted United States ships and East Indiarnen at the beginning of the 19th century, and for nearly 30 years the only Europeans known to the Fijians mere beachcombers and the crens of visiting ships. Firearms salvaged from wrecks were used in native wars and were largely the monopoly of the chiefs of the small island of Mbau, who. using muskets against clubs and spears, raised themselves to a dominant position. Traders and missionaries came to settle, the first missionaries (Wesleyans) arriving from Tonga in 1835; but the native wars continued and reached a climax in the 1850s when Thakombau, the most powerful chief, was driven back on Mbau. He renounced his ancient gods and became the champion of the missionaries. The issue then became a struggle between the old ways and the new. It was decided when the king of Tonga with 2,000 warriors came to the help of Thakombau and was completely successful. Thakombau then became paramount chief of western Fiji. In 1857 a British consul was appointed at Levuka. Shortly afterward the Americans demanded of Thakombau the payment of indemnities fixed three years previously for outrages suffered by United States citizens. The chief sought relief by offering to cede his territories to Great Britain. offering 200,000 ac. of land on condition that the United States claims were paid. The offer was turned down and the British consul was recalled. Finally, however, after the near ruin of the islands by a government of settlers who had set themselves up to administer under Thakombau, a deed ceding Fiji unconditionally was drawn up and completed on Oct. 10, 1874, and Fiji was proclaimed a possession and dependency of the British crown.

The outbreak of war in the Pacific in Dec. 1941 gave the Fiji archipelago an unexpected military significance. It became an important supply station on the route from the American west coast and Honolulu to Australia and New Zealand, and extensive installations mere constructed rapidly to facilitate air and naval warfare. It served as an advanced training area for the and New Zealand expeditionary force, and later it was a forward base for the United States military, air and naval forces.

Population. — The population in 1946 was 259.638; at the census of 1956 it was 345,737. comprising 148,134 Fijians, 169,403 Indians, 6,402 Europeans, 4,155 Chinese. 7.810 part-Europeans and 9,833 other Pacific races. At the time of the cession of Fiji in 1874 the population, composed almost entirely of Fijians, numbered about 200,000. Epidemics reduced the numbers, and the population reached its lowest point. 83,000, in 1919.

The development of the colony demanded more labour than could be found locally, and in 1879 the immigration of indentured labourers from India was started. By 1911 there were 43,000 Indians, in 1936 there were 85,000, and by 1956 the number was 169,403. This immigration was stopped in 1919. The hard-working Indians have gradually improved their economic status; from poorly paid indentured labourers they have mostly evolved into the position of leaseholders. Besides sugar cane, the Indians also cultivate rice, cotton and corn. (W. H. Is.)

The Fijian People. — The Fijians are of mixed ,Melanesian and Polynesian stock, Polynesian influence being most noticeable in the eastern islands where contact with Tongans and to a less extent with Samoans is evident in a lighter skin colour, straight rather than frizzy hair, and the more prominent position taken by the womenfolk in many customs. The social structure of the Fijians has predominantly Polynesian characteristics except in western Viti Levu. nhere the institution under which a chief holds office hereditarily subject to acceptability of his leadership by the people is not found. The physical features of the highlanders of Viti Levu are similar to those of other Melanesians, and they maintain that they are the autochthonous people of Fiji, in contrast with the large majority of Fijians, who trace their origin to an arrival by sea from the west. The dialects spoken by the Fijians belong to the Malayo-Polynesian group of languages, but the dialect of Mbau is understood, spoken and written throughout the archipelago.

Most Fijians live a communal life in villages on land they themselves own. With the gradual spread of industrial activities, however, the tendency has become marked for many Fijians to take up work in one of the several centres of population, where their traditional way of life is appreciably affected. Their houses in the villages are built with a timber framework and thatched walls and roof, but an increasing use is made of corrugated iron for roofs even in the remotest villages. The work of housebuilding is undertaken by the members of the social unit to which the householder belongs. The family house is usually about 2j or 30 ft. long by 18 or 2j ft. wide and is divided by screens of reeds or plaited bamboo or bark cloth into living and sleeping quarters. Kitchens are built separately near by. Many Fijians, however, have built themselves houses of timber and corrugated iron on a European plan. Fijians no longer build the tall, steep-roofed houses nor the huge double-hulled sailing canoes for which they are justly known as master craftsmen, but in some areas they continue to practise other crafts with consummate skill. Pottery is made without the use of a wheel; large cooking vessels, bowls and water containers are expertly made from clay and sand with wooden patting tools. Bark cloth is made from beaten-out lengths of the bast of a mulberry tree which are joined to make large sheets and then covered with intricate patterns in reddish brown and black. Mats are plaited from the leaves of a screw pine cultivated for the purpose and are used mostly for floor coverings or as bedding. All these three crafts are practised by women, and the products of their work are sold or bartered as well as being used for domestic purposes by the people themselves. Many of these products are decorated with stylized designs, the detail of which depends on the nature of the material used.

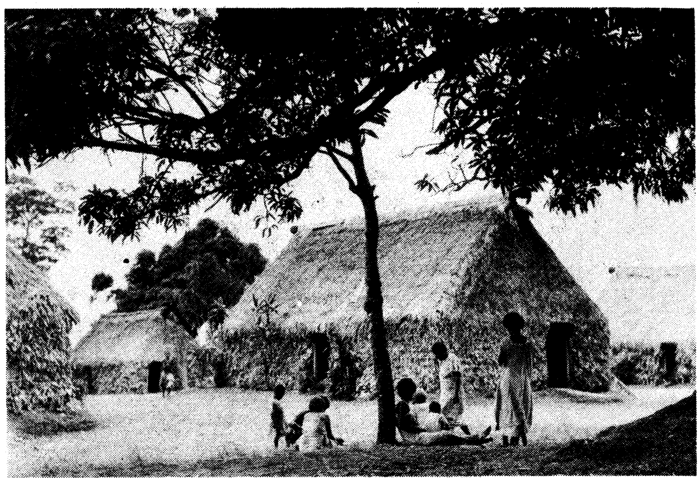
Elaborate ceremonial dress and personal decoration were worn on the numerous occasions when ritual was practised. Men wore a fringed kilt and arm and leg bands of coloured leaves, their faces were blacked and their hair was dusted with powdered yellow turmeric; women wore white or decorated bark cloth; and both sexes oiled their skins with scented coconut oil. A modified version of this customary dress is still worn on special occasions.

Some of the old customs were cruel, yet they were practised as an integral part of the Fijian way of living. They were gradually dropped during the second half of the 19th century under the influence of Christian missionaries; the leading Fijian chiefs agreed to abandon the worship of the spirits of their ancestors, usually performed through the medium of a priest who affected to determine the fate of such activities as warfare or fishing expeditions.

Certain ceremonies embodying a modicum of ritual little changed since pre-cession days are still carried out in all parts of Fiji. One which all Fijians regard as of much importance is the formal presentation of a tambua; that is, a sperm whale's tooth to the ends of which a plaited coconut fibre cord is attached for convenience in handling. This is offered as a token of good will on the occurrence of births, marriages and deaths, or on other special occasions, as, for example, council meetings. In each instance the party making the presentation accompanies it with a request, perhaps for nothing more than a reciprocal expression of good will or perhaps for something more tangible, such as permission to plant on a piece of communal land or help in time of trouble. The recipient is expected to carry out the request if he accepts the whale's tooth; if he cannot do so, he should not accept it. A kava plant is sometimes offered as a mark of good will on a less formal occasion instead of a whale's tooth, but as a preliminary to a council meeting both whale's tooth and kava plant are presented, and then follows the preparation of the kava drink, the first cup being offered with ritual to the senior chief present. Kava is a species of pepper plant, and the drink consists of a solution of the pounded root in cold water, strained of all bits of fibre; it is drunk as soon as it has been made. It is not alcoholic but it has a slight diuretic effect when large quantities are consumed. When prepared for ceremonial purposes kava used to be drunk in small quantities but in a strong solution;. the latent narcotic properties found in the root of this plant may then have caused slight temporary'muscular weakness, but it does not appear to have affected the mental powers.

ROB WRIGHT FROM BLACK STAR

OUTRIGGER SAILING CANOE IN SUVA HARBOUR. FIJI



PHILIP GENDREAU

TYPICAL THATCHED-ROOF HOUSES OF FIJI

Meetings that are of sufficient importance for these ceremonies to be performed are usually attended by large numbers of persons, who reciprocate the hospitality of the hosts by gifts of food, mats or bark cloth as well as by vigorous communal gesture-dances in which the precision of movement in unison is assisted by an orchestra using wooden gongs or bamboo stamping tubes.

An important aspect of the social organization of the Fijians is the inseparable connection between the social unit to which a person belongs and the land that all the members of the unit, chiefs and people alike, own in common. This common o nership by related groups of peoples of their family lands and of their customary fishing rights over the shore reefs is the basis of Fijian economic activities today, just as the principles of Fijian social organization have been successfully used, with modifications, as the foundation for the present system of native administration.

(G. K. R.)

Religion. — Out of a total population of 345.737. the 1956 census recorded 138,147, mostly Fijians. as Methodists and 137.206, all Indians, as Hindus. The total number of Christians nas 178,161 Roman Catholics numbering 27,542 and Anglicans 5,130. Indian Moslems numbered 25,394.

Education. — —In 1957 there were 508 primary schools with an enrolment of 65,645. There nere 32 secondary and postprimary schools with 3.480 and five postsecondary institutions with 216 The enrolment of girls is not far short of that of boys except in the case of Indians. where the difference is greater. Apart from government and a number of mission schools. village school committees, Indian organizations and two commercial concerns also maintain schools. In general the government trains and supplies moat teachers and administers the educational system. Voluntary bodies provide buildings for nongovernment schools and 25*s*. a year for each pupil. There are three technical centres and there is also at Suva a central medical school with 200 students training as assistant medical oractitioners. A number of students are maintained in higher educational institutions in New Zealand. Evening classes for adults in a number of professional and technical subjects are well developed at Suva. The literacy rate for Fijians is 87.62% and of Indians 35.62%.

Welfare. — Medical services are for the most part provided by the government. In 1956 there nere 2.160 beds and 23,120 hospital admissions. Outpatients numbered 347,039. Health is generally good. Tuberculosis is the most serious disease. Malaria does not occur. A government housing scheme for workers in Suva is in operation.

There is no provision for unemployment relief or social insurance or pensions. but indoor and outdoor relief is provided for the infirm, aged and destitute.

Administration. — Government is provided for under letters patent, 1937, and royal instructions. These provide for an executive council presided over by the governor and consisting of 3 ex

ROB WRIGHT FROM BLACK STAR

FIJIAN BOY DEMONSTRATING AN ANCIENT WAR DANCE

officio members and 6 nominated, and a legislative council with 16 official and 1j unofficial members, of whom 5 are European. 5 Indian and 5 Fijian. Roth the European and Indian representation is made up of three elected and two nominated members. There is also a Fijian administration which constitutes a local government system with jurisdiction over all Fijians in the colony. In order to protect them from exploitation Fijians are not permitted to alienate their land.

Production. — The economy of Fiji is primarily dependent on agriculture. The total area of land under cultivation is estimated at 350,000 ac. The principal export crops are sugar cane, coconuts and bananas, nith pineapples and miscellaneous fruits and vegetables as minor export crops. The colony produces most of its requirements of staple foods: rice, dalo (taro), yams, tapioca, pulses, fruits and vegetables.

Apart from gold mining, which is an important industry at Vatukoula near the north coast of Viti Levu, industrial production is limited to the processing of sugar cane, the dehydration of coconut meat in the preparation of copra, and the production of coconut oil, coconut meal and margarine.

Communications. — There are 798 mi. of all-weather surface roads and about 400 mi. of narron-gauge light railway operated by the Colonial Sugar Refining company. There are an airport and a flying boat base and four airstrips on the main islands. The main ports of call are Suva and Lautoka but shipping calls also at Levuka, Savusavu and Rotuma. *See* also PACIFIC ISLANDS.

Export Figures for the Principal Fijian Products, 1946–51

Year	Sugar		Coconut products		Gold	
	Tons	Value	Tons	Value	Fine ounces	Value
1947 .	111,573	£2,840,307	36,542	£1,430,685	94,353	£ 905,775
1948 .	135,314	£4,265,406	34,796	£1,807,485	93,059	£ 893,439
1949 .	124,915	£3,205,524	29,156	£1,713,880	104,036	£1,125,156
1950 .	115,724	£3,705,712	25,250	£1,552,720	103,394	£1,424,335
1951 .	85,223	£2,625,273	31,113	£2,033,152	—	—

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FIKRET, TEVFIK (1867–191j), Turkish poet, who. continuing the work of Xbdiilhak Hâmid (*q.v.*), succeeded in freeing Turkish poetry from the rules of Persian literary composition and established the forms and themes of western poetry. Born in Istanbul of a central Anatolian family, the son of a government official, he was educated at the Galatasaray *lycée* where he later .became principal. Tradition bound in his early years. he soon came under the influence of French literature and in 1896 became the editor of the avant-garde periodical *Servetifünum* that gave its name to the literary school of the 1890s. Early sentimental poems about the humble and poor and simple descriptive pieces gave place to a series of powerful poems included in the *Rübabi Shikeste* and the *Haluk' un Defteri* in which the poet gave expression to his hatred of tyranny and fanaticism, his love of liberty and his faith in mankind's advancement. (F. I.)

FILAMENT is the cathode in one of the common types of vacuum tube for radio receiving sets. The filament may be the source of the electron (*q.v.*) emission which constitutes the current flowing through the vacuous space. (*See* CATHODE RAYS; ELECTRON TUBE; THERMIONICS.)

FILANGIERI, CARLO (1784–1867), PRINCE OF SATRIANO, Neapolitan soldier and statesman, was the son of Gaetano Filangieri (*q.v.*). At the age of 15 he decided on a military career and, having obtained an introduction to Napoleon Bonaparte, then first consul. was admitted to the military academy at Paris. He received a commission in an infantry regiment in 1803 and took part in the campaign of 1805 under Louis Nicolas Davout, first in the Low Countries and later at Ulm, Mariazell and Austerlitz, where he fought with distinction. He returned to Naples as captain on Masséna's staff to fight the Bourbons and the Austrians in 1806 and subsequently went to Spain, where he followed Joseph Bonaparte in his retreat from Madrid. In consequence of a fatal duel in 1810, he was sent back to Naples; there he served under Joachim Rlurat with the rank of general and fought against the Anglo-Sicilian forces in Calabria and at Messina. On the fall of Napoleon he took part in Murat's campaign against Austria and was severely wounded at the battle of the Panaro (1815). On the restoration of the Bourbon king, Ferdinand IV (I). Filangieri retained his rank and command, but found the army utterly disorganized and impregnated n·ith Carbonarism. In the disturbances of 1820 he adhered to the Constitutionalist party and fought under Gen. Guglielmo Pepe (*q.v.*) against the Austrians. On the re-establishment of the autocracy he was dismissed from the service and retired to Calabria. where in 1819 he had inherited the princely title and estates of Satriano.

In 1831 he was recalled by Ferdinand II and entrusted with various military reforms. On the outbreak of the troubles of 1848 Filangieri advised the king to grant the constitution. n·hich he did in Feh. 1848, but when the Sicilians formally seceded from the Neapolitan kingdom Filangieri was given the command of an armed force with which to reduce the island to obedience. In September he began the bombardment of Messina, which he captured (Sept. ?) after very severe fighting. He then advanced southward, besiege? and took Catania, where his troops committed many atrocities, and by May 1849 he had conquered the whole of Sicily, though not without much bloodshed. He remained in Sicily as governor until 18jj, when he retired into private life, since the hostility of Giovanni Cassisi. the minister for Sicily, prevented his carrying out the reforms that he desired. On the death of Ferdinand II (May 22, 1859) the new king, Francis II, appointed Filangieri premier and minister of war. He promoted good relations with France, then fighting with Piedmont against the Austrians in Lombardy, and strongly urged on the king the necessity of an alliance with Piedmont and a constitution as the only means whereby the dynasty might be saved. These proposals being rejected, Filangieri resigned his office. In June 1860 Francis at last promised a constitution, but it was too late, for Giuseppe Garibaldi was in Sicily and Naples was seething with rebellion. On the advice of Liborio Romano, the new prefect of police, Filangieri was ordered to leave Naples. He went to Marseilles with his nife and subsequently to Florence, where at the instance of Gen. A. F. La Marmora he undertook to write an account of the Italian army. Although he adhered to the new government he refused to accept any dignity at its hands. and died at his villa of San Giorgio a Cremano. near Naples. on Nov. 2, 1867. *See* also NAPLES, KINGDOM OF.

His biography was written by his daughter, Teresa Filangieri Fieschi Ravaschieri, *Il Generale Carlo Filangieri* (1902), an interesting although somewhat too laudatory volume based on the general's own unpublished memoirs. *See* also P. Cala Ulloa, *Di Carlo Filangievi nella storia de' nostri tempi* (1871) ; V. Finocchiaro, *La Rivoluzione siciliana del 1848–49,* with bibliography (1906).

FILANGIERI, GAETANO (1752–1788), Italian lawyer, author of an influential work on legislation in which he advocated economic, legal and religious reforms, was born at Naples on Aug. 18. 1752. His father planned a military career for him. but he soon abandoned it for the study of law. At the bar his knowledge and eloquence early secured his success, while his defense of a royal decree reforming abuses in the administration of justice gained him the favour of the king, Charles, afterward Charles III of Spain, and led to several honourable appointments at court. The first two books of his great work, *La Scienza della legislazione,* appeared in 1780. The first book contained an exposition of the rules on which legislation in general ought to proceed, while the second was devoted to economic questions. These two books showed him to be an ardent reformer and vehement in denouncing the abuses of his time. He insisted on unlimited free trade and the abolition of the medieval institutions which impeded production and national well being. Their success was great and immediate not only in Italy but throughout Europe at large. In 1783 he married, resigned his appointments at court and, retiring to Cava. devoted himself steadily to the completion of his work. In the same year appeared the third book, devoted entirely to the principles of criminal jurisprudence. The suggestion which he made in it as to the need for reform in the Roman Catholic Church brought upon him the censure of the ecclesiastical authorities. and it was condemned by the Congregation of the Index in 1784 In 178j he published three additional volumes, making the fourth book of the projected work and dealing with education and morals. In 1787 he mas appointed a member of the supreme treasury council by Ferdinand IV, but his health, impaired by close study and overwork in his new office. compelled his withdrawal to the country at Vico Equense. He died on July 21, 1788, having just completed the first part of the fifth book of his *Scienza.* He left an outline of the remainder of the work, which was to have been completed in six books.

The best edition of the *Scienza* is that by Villari, 3 vol. (1864–76) ; the book was translated into most of the European languages, Eng. trans. by R. Clayton, *The Science of Legislation* (1806).

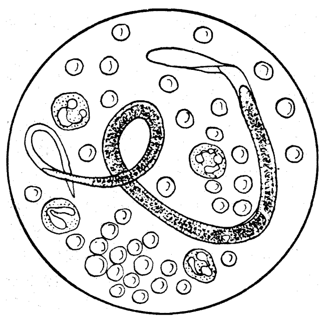
FILARETE (ANTONIO DI PIETRO AVERLINO or AVERULINO) (*c.* 1400–1469), Italian sculptor and architect, who from 1433 until 1445 was employed in Rome on the bronze door of St. Peter's, is thought to have been born in Florence and trained under Ghiberti. In 1448 he fled from Rome back to Florence, entering in 1451 the service of Francesco Sforza, duke of Milan. In Milan he was active principally as an architect, and designed the Ospedale Maggiore (1457–65), the first Renaissance building in Lombardy. Between 1460 and 1464 Filarete wrote his *Trattato d'architettura.* Inspired by Leone Battista Alberti's *De re aedificatoria,* this describes a model city called Sforzinda, and was dedicated to Piero de' Medici, for whom Filarete made a bronze reduction of the equestrian statue of Marcus Aurelius, now in the Albertinum, Dresden (1465). According to Giorgio Vasari, he returned in 1465 to Rome, where he died.

The two wings of the famous door at St. Peter's are divided into unequal rectangular areas, with figures of God the Father and the Virgin Mary, St. Peter and St. Paul, and representations of the martyrdoms of these saints. Between them are historical scenes, and in the foliated borders are figures from classical mythology. By comparison with the bronze doors of Lorenzo Ghiberti and Donatello in Florence, Filarete's door is ill-planned and crudely executed, and its importance derives from its hieratic classicizing style. The first Renaissance monument of a specifically Roman type, it influenced the work of Isaia da Pisa and later Roman sculptors. (J. W. P.-H.)

FILARIASIS. This group of infections is caused by slender, threadlike roundworms called filariae (*see* NEMATODA). Filariae are parasitic in blood, tissues and body cavities of a great variety of animals, including man.

The principal human filariae are *Wuchereria bancrofti, W. malayi, Onchocerca volvulus* and *Loa loa.* The resulting infections are Bancroftian filariasis, Malayan filariasis, onchocerciasis and loaiasis, respectively. Filarial worms of lesser medical importance include *Acanthocheilonema perstans,* A. *streptocerca* and *Mansonella ozzardi.*

Many characteristics are shared by the four principal human filariae. Adult female worms living in body tissues give birth to large numbers of microscopic, motile embryos called microfilariae, which appear either constantly or periodically in blood or lymph vessels of the skin of an infected person. Unless ingested by suitable insect hosts (mosquitoes for *W. bancrofti* and *W. malayi,* black flies for *O. volvulus* and deer flies for *L. loa),* microfilariae cannot develop further and are destroyed by the human body. However, once in their particular insect host, microfilariae migrate quickly from the digestive tract to selected tissues, where, after about two weeks, they complete a series of growth stages. Then, as infective larvae, they move to the mouth parts of the insect to await transfer to a new human host. As the insect takes another blood meal, the larval worms escape onto or into the person's skin and penetrate to subcutaneous tissues or lymph vessels. Little is known of the development of larvae in man, except that the worms mature in about a year.



BY COURTESY OF DR. E. C. FAUST

SHEATHED EMBRYO (MICROFILARIA) OF WUCHERERIA BANCROFTI, THE CAUSATIVE ORGANISM OF BANCROFT'S FILARIASIS. AS SEEN IN THE BLOOD OF A PATIENT AT MIDNIGHT. ORIGINAL X 300

Bancroftian Filariasis.—Adult *W. bancrofti* live in lymphatic vessels and lymphoid tissues, especially in the pelvic region. Microfilariae usually show nocturnal periodicity, swarming into cutaneous blood vessels at night and migrating to internal organs, especially the lungs, during the day. In inhabitants of certain South Pacific islands, however, microfilariae are present continuously in peripheral blood. Some authorities regard this nonperiodic form as a separate species, *W. pacifica.*

Bancroftian' filariasis is widely but unevenly distributed in the tropics. It occurs along the coasts and watercourses of tropical Africa and of Asia from Arabia to China, along the northeastern coasts of Australia and South America, and on many tropical islands in the Pacific and Indian oceans and the Caribbean sea.

The principal mosquito vectors are *Culex fatigans,* C. *pipiens* and *Aedes polynesiensis.* Several species of *Anoplzeles* are of local importance.

Many infected persons have no symptoms of disease. When symptoms do occur, they may appear as early as $3\frac{1}{2}$ months after infection. Lymphangitis (inflammation of lymph vessels) and lymphadenitis (swelling of lymph nodes) near the worms are early symptoms. Acute attacks last a week or less, then subside, only to recur at irregular intervals of time. Between attacks the affected lymphatics remain swollen but not painful. These reactions probably result from sensitization of tissues to filariae. Severity of symptoms is intensified by secondary bacterial infections.

After repeated attacks, chronic disease causes blockage of lymph channels. The arms. legs. scrotum or breast may become permanently swollen (elephantiasis). Deeper lymphatic channels of the body may rupture into the bladder, body cavity or tunica vaginalis.

Effects of medicinal treatment on filariasis are not consistent. Diethylcarbamazine, arsenicals and antimonial compounds are valuable in eliminating microfilariae and perhaps adult worms, but their effectiveness against filarial disease is unproved. Surgical treatment offers relief from chronic forms of the disease (elephantiasis. etc.). but these conditions tend to relapse.

Prevention of Bancroftian filariasis consists of antimosquito measures, protection from mosquito bite and use of antifilarial drugs (especially diethylcarbamazine) to reduce microfilarial infections in the human population.

Malayan **Filariasis.**—Infections with *W. malayi* generally resemble those with *W. bancrofti.* However, both adult worms and microfilariae of the two species can be differentiated. Other distinctive characteristics of *W. malayi* are its distribution and its mosquito vectors. *W. malayi* is found in river valleys of southeastern Asia from India to southern Korea and on adjacent islands. Several species of *Mansonia* mosquitoes are the principal vectors. Control of Malayan filariasis was complicated by discovery of microfilariae that appear to be *Ti'. malayi* in Malayan monkeys.

Onchocerciasis.—Adult *O. vulvulus* are found either free or in tumours in subcutaneous tissues. Related species of *Onchocerca* occur in other animals. Onchocerciasis is prevalent in equatorial Africa and in coffee-growing areas of Mexico, Guatemala and Venezuela. Several species of black flies transmit *O. volvulus (see* BLACK *FLY).*

Early in the infection, adult filariae wander freely in subcutaneous tissues, but eventually they are trapped by growth of fibrous tumours around them. Microfilariae are found in nodules and the skin. Few appear in peripheral blood. In Africa, nodules are most abundant on the trunk, thighs and arms. but in Central America they occur most commonly on the head and shoulders. The nodules vary in size and firmness and may provoke intense itching but are otherwise painless. Wandering microfilariae may enter the eyes through small lymphatic vessels, become trapped and eventually cause blindness. Impaired vision is found in 30% of infected persons in Guatemala and up to 85% in Belgian Congo.

Surgical removal of tumours is recommended, since this eliminates the source of microfilariae. Suramin sodium and diethylcarbamazine rapidly destroy microfilariae but also may precipitate severe allergic reactions. Application of DDT as an emulsion to rivers in Africa effectively controlled black fly populations. In Guatemala. however, these flies breed in tiny mountain streams that are difficult to locate and control. *See* also BLINDNESS

Loaiasis.—Adult *Lou loa* lives freely in subcutaneous tissues. Microfilariae. usually with diurnal periodicity, are found in peripheral blood. Loaiasis is found in equatorial rain forests of Africa, and several species of *Chrysops* (deer flies) act as vectors. *Loa* produces a chronic disease characterized by itching, irritation and fugitive snellings. The latter, known as Calabar swellings, are temporary inflammatory reactions appearing suddenly and disappearing in about three days. They probably result from sensitivity to the parasite or its products. In their wanderings adult worms may pass through the anterior chamber of the eye, hence the name "eye worm." They do not materially affect vision.

Diethylcarbamazine destroys microfilariae and, in recently acquired infections, adult worms as well. Long-established infections are more resistant to chemotherapy. Adult worms can be removed surgically when they move close to the surface of the skin.

Prevention of loaiasis includes use of antifilarial drugs to reduce human sources of infection and vector control measures. In some areas, control is seriously complicated by loaiasis in monkeys. *See* also PARASITIC DISEASES.

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FILBERT, the name applied to plants and nuts of the genus *Corylus (see* HAZEL). This genus includes at least 11 known species of deciduous, catkin-bearing plants which together nearly encircle the land portion of the globe in the north temperate zone. The filberts C. *americana* and the beaked filbert, C. *cornuta,* attain heights of 10 to 15 ft.; the California filbert: C. *californica,* sometimes grows to 30 ft. The other species are the Chinese filbert, *C. chinensis;* the European filbert. C. *avellana;* the giant filbert. *C. maxima;* the Himalaya filbert, C. *ferox;* the Japanese filbert, *C. sieboldiana;* the Siberian filbert. C, *heterophylla;* the Tibetan filbert. *C. tibetica;* and the Turkish filbert. C. *colurna.* Hybrids between several of the species have occurred naturally or under cultivation. The American and beaked filberts have been used as pistillate parents in crossing with choice varieties of the European filbert to breed hardy varieties for use in the northern states and British Columbia. Breeding filberts by making backcrosses on the chance-hybrid Rush variety was begun in 1919 by J. F. Jones of Lancaster, Pa. Later breeding by J. U. Gellatly, Westbank, B. C., utilized the beaked filbert from the Peace river valley. The U.S. department of agriculture and the New York Experiment

J. HORACE MCFARLAND CO

AMERICAN FILBERT (CORYLUS AMERICANA)

station introduced some hybrid varieties after 1950.

The European and giant filberts, together with some of their natural hybrids, furnish the commercial varieties under cultivation in Europe, Turkey and the United States. The plants range from shrubs to trees 25 ft. in height. In various parts of Asia, varietal selections for local use have been made from the Himalaya and Siberian species. The Chinese and Turkish filberts are free growing species, the former reaching heights of 120 ft. and the latter of 60 ft. or more. As known in western Europe and the United States, the nuts of both are rather small, thick-shelled and of mild flavour. Nevertheless, both are important food producers in their respective habitats. Ornamental shrubby filberts include the Japanese with its red catkin flowers, the Winkler American variety with its red fall colour and the well-known purple foliaged variety of giant filbert. One variety has contorted limbs.

Culturally, the European filbert requires a cool to cold, but not rigorous climate, a definite period of winter chilling, a deep, medium rich soil. freedom from dense shade, an abundance of one-year wood for fruiting and pollen from other varieties. Wherever it grows, it is likely to be vulnerable to winter injury; the staminate flowers may be killed for part or all of their length. or the branches may be frozen back. Flower injury, which is more common in most varieties, may occur during midwinter or while the pollen is being shed. It is most frequent when the flowers are open, when daily minimum temperatures suddenly drop from above freezing to several degrees below and when there are strong accompanying winds. Actually the damage is more largely due to desiccation by wind than to low temperatures, and it may be prevented to a great extent by windbreaks.

Filbert roots penetrate deeply into the soil; where hardpans are less than ten ft. below the surface, the trees do not perform well after the first few years. All species tolerate considerable shade, but when this becomes too great, fruiting falls off sharply. By English systems of pruning, the trees are appreciably dwarfed as they are hard-pruned in late winter after the pollinating period is over and again in summer by merely nipping off certain new shoots. In Oregon and Washington valleys pruning is mostly limited to opening up the branches to permit the sun to reach all of the fruiting spurs, and to controlling the suckers which, with most varieties, tend to spring up thickly about the base of the tree. Also in the Lnited States, all new plantings include trees of pollinizer varieties at regular intervals throughout the orchard. The usual ratio of pollinizers to the principal varieties is 1 to j or 8.

In England and the U.S. many varieties are grown. In England. Kentish Cob, the favourite, bears a large. attractive appearing nut u-hich is oblong, wide and thick, and of excellent eating quality. Of the United States varieties, the first and a second in popularity are Barcelona and Du Chilly. The former bears a nut of irregularly rounded form, but of large size. The tree is a stronger grower and a more fruitful bearer than Du Chilly, though the nut is not its equal in fine flavour. Du Chilly resembles Kentish Cob so closely as to seem to be identical with it. Royal is a giant fruited variety of Oregon origin. Germany has produced hardy varieties. Turkey, Italy and Spain were leading producers in the second half of the 20th century. The U.S. was a relatively small producer, mostly in Oregon and Washington. (J. C. McD.)

FILCHNER, WILHELM (1877–1957), German scientist and explorer who led the German antarctic expedition of 1911–12, was born at Munich on Sept. 13. 1877, and was educated at the Prussian militafy academy. A journey across the Pamirs in 1900 aroused his scientific curiosity and was followed by an expedition to Tibet in 1903–05. In 1911–12 he took a German expedition to Antarctica in the "Deutschland," having previously visited Spitsbergen (1910) to test equipment. In Antarctica Filchner discovered the southwestern continuation of Coats land and made observations of ice drift in the Weddell sea. War frustrated plans for a second expedition. In 1926–28 he led a further expedition to Tibet carrying out cartographic surveys and magnetic observations. In 1939–40 he made a magnetic survey of Nepal. The period of World War II he spent in India. He died in Zurich on May 7. 19j7.

His published accounts of his travels include *Ein Ritt über den Pamir* (1903); *Das Ratsel des Matschu* (1907); *Zum sechsten Erdteil* (1922); Om *mani padme hum* (1929); *Bismillah* (1938); *Ein Forscherleben* (1950). (H. G. KG.)

FILE-FISH or **TRIGGER-FISH,** the name given to fishes of the genus *Balistes* of the family Balistidae and sub-order Balistiformes, inhabiting all tropical and subtropica! seas. The body is compressed and not covered with ordinary scales, but with small juxtaposed scutes. The first of the three dorsal spines is very strong, roughened in front like a file and hollowed out behind to receive the second much smaller spine, which, besides, has a projection in front, at its base, fitting into a notch of the first. Thus these two spines can only be raised or depressed simultaneously, in such a manner that the first cannot be forced down unless the second, which has been compared to a trigger, has been previously depressed. Both jaws are armed with eight strong incisor-like and sometimes pointed teeth, by which these fishes are enabled to break off pieces of madrepores and other corals on which they feed, and to chisel a hole into the hard shells of Mollusca in order to extract the soft parts. In this way they do much injury to pearl-fisheries. The related file-fish (*Monacanthus*) has only one dorsal spine and a velvety skin. Some 30 different species are sometimes referred to as *Balistes*. About coral reefs of the Indian and Pacific oceans there are brightly coloured, boldly patterned trigger-fishes (*Balistapus rectangulus* and *B. aculeatus)* with the Hawaiian name "humuhumu-nukunuku-apua'a," which are reputed to be poisonous to eat.

FILELFO, FRANCESCO (1398–1481), Italian humanist whose life and works illustrate the power acquired by men of letters in 1 jth-century Italy. He was born at Tolentino, July 25, 1398 In 1421 he went to Constantinople, returning to Italy in 1427, and from then until his death (July 31, 1481, at Florence) he moved from one city to another as a teacher of classical languages and literature. Exceptionally productive was the period spent in the service of the dukes of Milan, from about 1440 until 1471. His literary output, in Latin. Greek and Italian, was, like his culture, unusually extensive. including epic and lyric poetry, erudite classical works and treatises on philosophy. His most interesting achievement was his large collection of letters, an invaluable source of information on the period.

Filelfo's work is relatively unimportant as a contribution to philology or the history of poetry, but his life and writings together are of significance in the social history of his time since they show the influence letters had acquired. His services were eagerly sought by nearly all the Italian princes, who offered him the money and power for which he was ambitious in return for the subjection of his personality and principles.

In Filelfo is epitomized the division of literature as a profession from moral considerations and personal feelings which was to constitute one of the main features of Italian history until the Risorgimento.

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FILIBUSTER, a name originally given to the buccaneers (*q.v.*). The term is probably derived from the Dutch *vry buiter,* "freebooter"; it was revived in the L.S. to designate those adventurers who, after the termination of the war between Mexico and the United States, organized expeditions within the United States to take part in West Indian and Central American revolutions. The modern use of the word in this sense denotes one who engages in private warfare against any state.

With the passage of time, the term has taken on another meaning applicable to legislative bodies and especially to the United States senate. It refers to the practice of using delaying tactics or engaging in prolonged discussion for the purpose of preventing a vote. It is consequently a device whereby a determined minority by delay and interminable debate seeks to prevent the majority from expressing its will in legislation. The intent is to wear out the majority so that from fatigue or under the pressure of other business, it will give up and either lay aside the pending measure or alter it significantly to induce the minority to lay aside the filibuster. It is thus a stratagem to make the minority — rather than the majority—will prevail.

In the C.S. house of representatives a minor form of filibustering is sometimes carried through by frequent quorum calls. But the power of the rules committee to prescribe limits on debate normally assures the house of the ability to come to a vote. It is in the U.S. senate that the practice of filibustering has found its fullest development. Its effectiveness is greater near the end of a session when pressure to adjourn is great, the time is short and there tends to be a mass of other legislation to pass upon.

In most deliberative bodies attempts at filibustering can be prevented by the parliamentary action of moving the previous question. This motion, like those to adjourn and to lay on the table. is not debatable. If this motion carries. then the vote on the pending business must immediately take place. The United States senate had such a previous question rule from 1789 and 1806, and it mas widely used in the British parliament in the 17th and 18th centuries. From 1789 to 1828 the presiding officer of the senate also had, in practice, the unappealable power to stop superfluous motions and tedious speeches, and evidence seems to indicate that this power was used by vice-presidents John Adams. Thomas Jefferson and Aaron Burr.

In 1825 John Randolph of Virginia was elected to the senate and proceeded to make irrelevant and tedious speeches which Vice-Pres. John C. Calhoun refused to rule out of order. In 1828, apparently in order to check such devices, the senate not only specifically provided that the presiding officer had such powers, but also made his rulings appealable to the senate itself. Apparently the purpose was to strengthen rather than weaken senate discipline by adding the weight of the majority to questions of order. A rule of relevancy was also available to limit debate.

But in 1872, Vice-Pres. Schuyler Colfax ruled that "under the practice of the Senate the presiding officer could not restrain a Senator in remarks which the Senator considers pertinent to the pending issue." With this ruling, the heyday of the filibusters arrived.

During the so-called Progressive era, from 1907 to 1917, the filibuster was used a number of times on ideological grounds, notably by Sen. Robert M. La Follette, Sr. and others against the Aldrich-Vreeland Banking bill of 1908, the Canadian Reciprocity bill of 1911, the Ship Purchase bill of 191j and finally Pres. Woodrow Wilson's Armed Merchant Ship bill of March 1917.

Rule 22.—This last filibuster by the so-called "willful 11" during the closing days of the 64th congress, as relations with Germany reached a crisis, led to the adoption of cloture provisions in the opening days of the 6jth congress. Under pressure from Sen. Thomas J. Walsh of Montana. rule xxii was amended so that a petition of 16 senators to close debate on "any pending measure" should, after two days' delay. be brought before the senate for a vote and could be passed by the affirmative votes of two-thirds of those present and voting. If this motion carried, then each senator was entitled to speak for not more than one hour on all motions, and dilatory motions or amendments were to be ruled out of order.

In the entire history of this version of rule xxii (1917–49), the closing of debate was successfully invoked on the treaty of Versailles in 1919, the World court in 1926 and on two other occasions. Though frequently tried, it was never affirmatively voted for the so-called civil rights bill of the 1930s and 1940s; *e.g.*, federal bills against lynching and use of the poll tax as a prerequisite to voting and bills for fair employment practices.

In 1949, a determined effort was made to modify rule xxii so that cloture would not be so difficult. But the move backfired when a coalition of the conservative, southern uing of the Democratic party and the middle western and western wing of the Republican party under the guise of broadening the rule to cover "motions or other matters" as well as "measures," made it more, rather than less, difficult to limit debate. This was done by requiring for passage of a cloture motion an affirmative vote of two-thirds of the members "duly chosen and sworn." A second change, although little noticed at the time, was even more important. namely. that there could be no limitation of debate on a motion to bring up a change in the rules. This new rule xxii, added to the historic underrepresentation of the populous states in the senate. was designed to give the senators of a small fraction of the people—from just 17 states—an unchangeable veto power over legislation.

Rules for the Senate.—A group of senators, however, believed that there was a crack in the filibuster defenses and that under the express constitutional provision that "each House may determine the Rules of its Proceedings" (art. i, sec. 5), it was possible for the senate. like the house, to change its rules at the beginning of a new congress without being inhibited by rule xxii itself. The opponents of this theory argued that the senate, as a "continuing body," carried over its rules from congress to congress and was, therefore, bound by rule xxii from the very beginning of a new congress.

A motion was therefore made by the proponents of a change at the beginning of the 83rd congress on Jan. 3, 1953 to proceed to the consideration of rules for the senate. After a brief debate, the Republican leader, Sen. Robert A. Taft, moved to table this motion, and this was done by a vote of 70 to 21. In Jan. 1957, this effort was renewed and again tabled. But this time there were 38 votes (and 3 others absent) against tabling the motion. During the discussion an opinion generally favourable to the motion was handed down by Vice-Pres. Richard M. Nixon.

Immediately following this vote! two main resolutions were presented for changing rule xxii. The majority and minority leaders. senators Lyndon Johnson and William Knowland, sponsored one which merely called for the re-establishment of the 1917 rule calling for cloture by a two-thirds vote of those present and voting, but also provided that senate rules should continue from one congress to the next and could only be changed in accordance with their own terms.

Sen. Paul H. Douglas of Illinois with 13 other senators presented an alternative resolution providing that after two days' notice on motion of 16 senators debate could be limited by two-thirds of those "present and voting," and after 15 days by an affirmative vote of a majority of those "duly chosen and sworn." The sponsors of this resolution pointed out that they wanted to provide for full and free debate, but that after a due period of discussion a majority was entitled to obtain a vote.

These resolutions were referred to the rules committee which. after full hearings by a subcommittee, in 1958 reported out the Douglas resolution by a majority vote. It was not called up for action by the senate leadership, and the proponents of a change in rule xxii announced that the battle to restrict filibustering would be a continuing one until successful.

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FILICAIA, VINCENZO DA (1642–1707), Italian poet once highly esteemed for a wealth of sonorous verse on political and religious themes, was born at Florence, Dec. 30, 1642. He was educated by the Jesuits and studied law at Pisa university. He then returned to Florence where he devoted himself to literary studies. He secured the patronage of Christina of Sweden, entered the Arcadia (see ITALIAN LITERATURE), and was later appointed governor of Volterra (1696) and Pisa (1700) by Cdsimo III, grand duke of Tuscany. Filicaia won fame with six spirited *canzoni* (1684) on the relief of Vienna from the Turkish siege by John Sobieski and the Poles. His sonnets lamenting the fate of Italy (*e.g.*, "Dovè, Italia, il tuo braccio?") were also admired until well into the 19th century; and for Lord Macaulay he was a major poet. Yet to modern taste—except for a few religious lyrics. such as the lines "Alla beata Vergine"—Filicaia's verses seem bombastic and pretentious. He died at Florence, Sept. 24. 1707. His Poesie Toscane was published in 1707 and Poesie e lettere in 1864.

(D. M. WE.)

FILIGREE, jewel work of a delicate kind made with twisted threads usually of gold and silver. Though filigree has become a special branch of jewel work it was originally part of the ordinary work of the jeweler. A. Castellani states, in his *Memoir on the Jewellery of the Ancients* (1861), that the jewelry of the Etruscans and Greeks was made by soldering together and so building up the gold, rather than by chiseling or engraving the material. The art may be said to consist in curling, twisting and plaiting fine, pliable threads of metal, and uniting them at their points of contact with each other, and with the ground, by means of gold or silver solder and borax, by the help of the blowpipe. Small grains or beads of the same metals are often set in the eyes of volutes, on the junctions or at intervals at which they will set off the wirework effectively. The more delicate work is generally protected by framework of stouter wire. Brooches, crosses, earrings and other personal ornaments of modern filigree are generally surrounded and subdivided by bands of square or flat metal giving consistency to the filling up.

The Egyptian jewelers employed wire, both to lay down on a background and to plait or otherwise arrange *à jour*. But, with the exception of chains, it cannot be said that filigree work was much practised by them. Their strength lay rather in their cloisonné work and their molded ornaments. Many examples, however, remain of round plaited gold chains of fine wire, such as are still made by the filigree workers of India, and known as Trichinopoli chains. In ornaments derived from Phoenician sites such as Cyprus and Sardinia, patterns of gold wire are laid down with great delicacy on a gold ground, but the art mas advanced to its highest perfection in the Greek and Etruscan filigree of the 6th to the 3rd century B.C.

It is probable that in India and various parts of central Asia filigree has been worked from the most remote period without any change in the designs. Indian filigree workers retain the same patterns as those of the ancient Greeks, and work them in the same way. Very fine grains or beads and spines of gold, scarcely thicker than coarse hair, projecting from plates of gold are methods of ornamentation still used.

Passing to later times we may notice in many collections of medieval jewel work reliquaries, covers for the gospels, etc., made either in Constantinople from the 6th to the 12th century, or in monasteries in Europe, in which Byzantine goldsmiths' work was studied and imitated. These objects, besides being enriched with precious stones, polished, but not cut into facets, and with enamel, are often decorated with filigree. In the north of Europe the Saxons, Britons and Celts were, from an early period, skillful in several kinds of goldsmiths' work.

The Irish filigree work is more thoughtful in design and more varied in pattern than that of any period or country that could be named. Its highest perfection must be placed in the 10th and 11th centuries. The Irish National museum in Dublin contains a number of reliquaries and personal jewels, of which filigree is the general and most remarkable ornament. The "Tara" brooch has been copied and imitated, and the shape and decoration of it are well known. Instead of fine curls or volutes of gold thread, the Irish filigree is varied by numerous designs in which one thread can be traced through curious knots and complications, which, disposed over large surfaces, balance one another, but always with special varieties and arrangements difficult to trace with the eye. The long thread appears and disappears without breach of continuity, the two ends being generally worked into the head and the tail of a serpent or a monster. The reliquary containing the "Bell of St. Patrick" is covered with knotted work in many varieties. A two-handled chalice, called the Ardagh cup, found near Limerick in 1868, is ornamented with work of this kind of extraordinary fineness.

Much of the medieval jewel work all over Europe down to the 15th century. on reliquaries. crosses, croziers and other ecclesiastical goldsmiths' work, is set off with bosses and borders of filigree. Filigree work in silver was practised by the Moors of Spain during the middle ages. The Spanish filigree work of the 17th and 18th centuries is of extraordinary complexity, and silver filigree jewelry of delicate and artistic design is still made throughout the country. The manufacture spread over the Balearic Islands and among the populations that border the Mediterranean. It is still made all over Italy and in Malta, Albania, the Ionian islands and many other parts of Greece. That of the Greeks is sometimes on a large scale, with several thicknesses of wires alternating with larger and smaller bosses and beads, sometimes set with turquoises, etc., and mounted on convex plates, making rich ornamental headpieces, belts and breast ornaments. Silver filigree brooches and buttons are also made in Denmark, Norway and Sweden. Some very curious filigree work was brought from Abyssinia after the capture of Magdala — arm guards, slippers, cups, etc. *See* also SILVERSMITHS' AND GOLDSMITHS' WORK; JEWELLERY.

FILIPPI, FILIPPO DE (1869–1938), Italian scientist and explorer who led an important scientific expedition to the Karakoram range in central Asia, was born in Turin on April 6, 1869. He graduated in medicine at Turin university, and published a number of papers on physiological and biological chemistry. In 1897 De Filippi went to Alaska as scientific observer with the duke of the Abruzzi (*q.v.*) and climbed Mt. St. Elias. Although he did not accompany the expedition to the Ruwenzori in central Africa in 1906, he wrote the report. In 1909 he joined the duke's expedition to the western Himalaya and Karakoram mountains and in 1913–14 organized and led his own scientific expedition to the Karakoram under the auspices of the Indian government. De Filippi died at Florence on Sept. 23, 1938.

FILLAN (FAELAN), SAINT, the name of two saints of Irish origin; Fillan is the Scottish form of the name, Faelan the Irish. Very little is known about either of them.

A St. Faelan of Cluain Moescna (unidentified place name. somewhere in County Westmeath, Ire.) is entered in 8th-century calendars with a feast on Jan. 9. This was the date of several Fillan's fairs in medieval Scotland, showing the same patron. His crozier, still in existence (at the National museum, Edinburgh), was present at Bannockburn, with a relic of his arm. as one of the sacred battle ensigns of Scotland. His biography, as found in the medieval Breviary of Aberdeen, is unreliable.

The other St. Fillan, whose feast has been kept on June 20 from the 8th century onward, had churches dedicated to him at Kilwhelan (in the parish of Ballyroan, County Leix, Ire.) and in the district of Strathearn (in Perthshire, Scot.).

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(PL. GN.)

FILLMORE, MILLARD (1800–1874), 13th president of the United States, came of a family of English stock which had early settled in New England. He was born on Jan. 7, 1800, in a log cabin built by his father and an uncle in a clearing made by them in the heart of the forest in the township of Locke, Cayuga county. in central New York. At 15 he was apprenticed to a wool carder and. except for intermittent brief attendances in a local one-room school, he had no formal education until he was 18 years of age. He then managed to secure six consecutive months of schooling and shortly after obtained his release as an indentured apprentice and started work in a law office. He was admitted to the bar in 1823 and, after a short time in Buffalo, practised law in and near the village of East Aurora until 1830 when he settled permanently in Buffalo.

Within 15 years he became one of the recognized political leaders of New York state; within 20 years he rose to the stature of a national figure and at the end of 30 years Fillmore became the president of the United States upon whom rested the burden of what proved to be one of the most fateful decisions in the history of the nation. In 1828 he was elected to the state assembly where he served three terms and secured the passage of a law abolishing imprisonment for debt. In 1833 he was elected to the U.S. congress as an anti-Jackson (antiadministration) man; he served 1837–43 as a Whig. During this period he had become one of the outstanding leaders of the northern wing of the Whig party and in his last term he was chairman of the all-powerful ways and means committee. In 1844 he was nominated as the Whig candidate for governor of New York. He was defeated by a narrow margin, but in 1847 was elected by a large plurality as the first comptroller of the state.

In 1848 the Whig national convention, which nominated Zachary Taylor for president, nith the strong support of Henry Clay nominated Fillmore for vice-president On the death of President Taylor (July 9, 1850) Fillmore became president.

Throughout the preceding decade agitation over the threatened extension of slavery into new territory had been steadily growing in intensity and reached its climax after the Mexican War when congress was confronted with the proposed admission of California to statehood. In his last speech, the dying Sen. John Calhoun sternly demanded recognition of the southern point of view favouring the extension of slavery into California and the southwest. His warning that the southern states might not remain in the union if these demands were denied, together with equally extreme demands by antislavery leaders. precipitated a crisis in the affairs of the Whig party as well as in the nation at large. To meet this, Senator Clay proposed a set of resolutions subsequently substantially embodied in legislative measures known as the Compromise of 1850.

President Taylor strongly opposed the adoption of these measures but Fillmore, becoming president upon his death, approved them. He reorganized the cabinet making Daniel Webster secretary of state, Thomas Corwin secretary of the treasury and John J. Crittenden attorney general. Fillmore had had nothing to do with the framing of the controversial measures and, while presiding over the senate, had scrupulously refrained from expressing any opinion. At heart, as he wrote to Webster, he detested slavery but viewed it as an evil which must be endured and given the protection of the constitution until it could be gotten rid of "without destroying the last hope of free government in the world." The alarm caused by the violent expressions of conflicting opinion, together with threats of secession, aroused his lifelong devotion to the cause of preserving the union. Joining with Webster, he exerted his influence openly in favour of Clay's proposals.

One of these measures was the Fugitive Slave law, introduced by Sen. James Mason of Virginia. making it the affirmative duty of the federal government to aid in the capture and return of slaves to their lawful owners. The attorney general advised that this statute was constitutional and, together with Webster, urged Fillmore to sign it, which he did. Fillmore publicly announced that if occasion required he would call upon the military to aid in the enforcement of the statute. In a real sense it was the enactment of this law, together with Fillmore's announcement, which disintegrated the Whig party. Throughout its history the party had been handicapped by the intrigue of ponerful discordant factions, the most extreme of which had been the radical abolitionists in the north and the equally radical leaders in the south seeking the extension of slavery.

For a year or more after the adoption of the compromise. agitation died down somewhat but the attempts as well as the failures of the federal government to enforce the Fugitive Slave law soon made slavery the one dominant political issue. In 1852, Webster became a candidate for the presidency along with Fillmore and Gen. Winfield Scott, with the result that the vote of the northern Whigs was split. Scott was nominated and defeated; Clay and Webster both died. Fillmore retired as president on March 4, 1853. In the next presidential contest of 1856, while traveling abroad, he was nominated by the new American party which sought to capitalize upon maintaining nativism and was nicknamed the "Know Nothing" party. Overnhelmingly defeated he never again sought public office but retired to Buffalo.

Several times in his career Fillmore had shown egregiously poor judgment: first, at its outset, in identifying himself with the political use of the anti-Masonic issue and later in accepting the nomination of the American party. both of these groups being saturated nith intolerance and prejudice. When the Republican party emerged in 1856 he viewed it as an insignificant group of northern extremists; but when the war came, consistent with his lifelong devotion to the union. he loyally supported Lincoln until 1864 nhen, discouraged by the failure to achieve victory. he voted for George McClellan.

In a very real sense Fillmore's support and defense of the Fugitive Slave law proved to be his political death warrant. At heart a consistent opponent of the extension of slavery, it is reasonably clear that in supporting the Compromise of 1850 he was dominated solely by his conscientious desire to preserve the union. His policies and decisions delayed for a decade the outbreak of the Civil War.

Throughout his career he was a constant advocate of expanding the internal development of the country, seeking particularly to unite the east with the far west. Equally important, he was one of the first national leaders to appreciate the importance of extending U.S influence in the Pacific. As president he sent Commodore Matthew C. Perry with a fleet to Japan in 1853, which resulted in the Japanese government altering its attitude and entering into trade and diplomatic relationships with the U.S.

Fillmore's successes in public life resulted from qualities of personal character. Although he mas not a dramatic or spectacular figure and throughout his public career he was handicapped by the jealousies and divisions in the Whig party, he consistently maintained an attitude of dignity, magnanimity, high-minded integrity and intense earnestness. In Buffalo he was a leader in founding the university, the general hospital. the Society of Natural Sciences, the Fine Arts academy, the Historical society and many other cultural institutions.

In domestic life he married (1826) the friend and counselor of his youth. Abigail Powers, by whom he had a daughter and a son. His first wife died in March 1853. and in 1858 he married Caroline C. McIntosh. Fillmore died at Buffalo on March 8. 1874. Most of his official papers were destroyed at the direction of his son.

See William E Griffis, *Millard Fillnzore* (1915); *Millard Fillnzore Papers,* Buffalo Historical Society, vol. x, xi (1908); Robert J. Rayback, *Millard Fillmore* (1959) (J L. O'B)

FILMER, SIR ROBERT (d. 1653), English political writer, champion of the divine right of kings, was born at East Sutton, Kent, and studied at Trinity college, Cambridge. where he matriculated in 1604. Knighted by Charles I at the beginning of his reign, he was an ardent supporter of the king's cause, and his house is said to have been plundered by parliamentarians ten times during the Civil War and he himself to have been imprisoned at Leeds castle in Rent. He died on May 26, 1653.

Filmer mas already a middle-aged man uhen the great controversy between the king and the commons roused him into literary activity. His writings afford an exceedingly curious example of the doctrines held by the most extreme section of the divine right party. His theory is founded upon the statement that the government of a family by the father is the true original and model of all government. In the beginning of the world God gave authority to Adam, with control over his descendants, even as to life and death From Adam this authority was inherited by Noah, and Filmer quotes as not unlikely the tradition that Noah sailed up the Mediterranean and allotted the three continents of the old world to the rule of his three sons. From Shem, Ham and Japheth the patriarchs inherited the absolute power which they exercised over their families and servants; and from the patriarchs all kings and governors derive their authority.

The difficulty that a man "by the secret will of God may unjustly" attain to power which he has not inherited appeared to Filmer in no way to alter the nature of the power so obtained, for "there is, and always shall be continued to the end of the world, a natural right of a supreme father over every multitude." The king is perfectly free from all human control. He cannot be bound by the acts of his predecessors, for which he is not responsible; nor by his own, for "impossible it is in nature that a man should give a law unto himself"—a law must be imposed by another than the person bound by it.

With regard to the English constitution, he asserted. in his *Freeholder's Grand Inquest touching our Sovereign Lord the King and his Parlianzent* (1648), that the lords only give counsel to the king; the commons only "perform and consent to the ordinances of parliament." and the king alone is the maker of laws, which proceed purely from his will.

The most complete expression of Filmer's opinions is given in the *Patriarcha,* which was published in 1680, many years after his death. His position, however. was sufficiently indicated by other works uhich he published during his lifetime.

Because of the circumstances of the time, Filmer's theory obtained a recognition which it is now difficult to understand. Nine years after the publication of the *Patriarcha,* at the time of the revolution uhich banished the Stuarts from the throne. Locke singled out Filmer as the most remarkable of the advocates of divine right, and thought it worth while to attack him expressly in the first part of the Treatise on Government, going into all of his arguments in order. He pointed out especially that even if the first steps of Filmer's argument are granted. the rights of the eldest born have been set aside so often that modern kings can claim no such inheritance of authority as he asserted.

FILMY FERN: see FERNS AND FERN ALLIES.

FILTERABLE VIRUSES: see VIRUSES.

FILTERS, LIGHT. Light filters are used in optics and photography to change the light which passes through them by absorbing some part of it. If they absorb the same fraction of all wave lengths, they are known as neutral density filters, and they change the intensity of the light, but not its colour. Most filters are coloured, because they absorb some parts of the spectrum selectively, and their uses are determined by the nature of this absorption.

Filters are made in several forms: (1) liquid filters in which solutions of dyes or coloured salts are held in shallow glass troughs with parallel sides; (2) solid filters of coloured glass; (3) dyed films of gelatin, cellulose esters and other plastics — these are frequently cemented between flat plates of optical glass; (4) gaseous filters. Still another type, the Christensen filter, consists of a liquid in which is a suspension of small transparent particles having the same refractive index as the medium but different dispersion. The greatest variety of filters, of high reproducibility and precise transmission characteristics, are in the form of gelatin film. They are prepared by coating a previously determined thickness of gelatin containing the necessary dyes upon plate glass, and after drying, stripping the gelatin film off the glass.

The colour of a filter is determined by the light it absorbs. Thus, a filter which absorbs blue from white light is yellow; a red filter absorbs blue and green; a green filter, blue and red; and a blue filter, green and red. The spectral absorption characteristics of a filter are best expressed by absorption or transmission curves (see figs. 1 and 2). They are measured on an instrument known as a spectrophotometer, which combines the properties of a spectroscope and a photometer

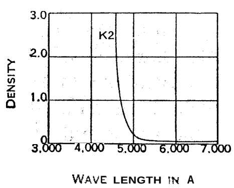

FIG. 1.—ABSORPTION CURVE OF YELLOW K2 FILTER

Filters are classified into several types according to their uses: (1) selective filters, which absorb much of the spectrum and transmit a narrow spectral region; (2) subtractive filters, which transmit most of the spectrum and absorb only a narrow spectral region (for every selective filter there can clearly be theoretically a subtractive filter of complementary colour); (3) compensating filters which transmit in greater or less intensity most of the spectrum, and which have gradual absorption characteristics.

Application of Light Filters. — Filters used in optics or photography may be classified according to their use as:

1. Compensating or correction filters. These are used to alter the response of a film to a particular light source so that the photograph appears more nearly in the relative tone values as perceived by the eye. For black and white photography they are yellow or pale green in colour, while for colour photography they may be pale blue, yellow, magenta or cyan. When colour film intended for use with daylight is used with tungsten filament lamps, or vice versa, a special blue or orange filter respectively must be used. Photometric filters are designed to change the effective quality of a light source and are used for visual photometry and photography.

2. Contrast filters. These are used to modify the brightness of a particular colour visually or in a photograph. If the colour is to appear lighter in a black and white photograph than in the original it is photographed through a filter of its own colour; if it is to appear darker, a filter of complementary colour is used.

3. Selective or separation filters are used for making two- or three-colour separation negatives for colour photography, and for projection in the additive colour processes (see fig. 2, and PHOTOGRAPHY: *Colour* Photography).

4. Haze filters are used to reduce or eliminate the effects of atmospheric haze in photography. They absorb ultraviolet and violet light, which are preferentially scattered by haze, and they are generally yellow. As greater haze penetration is desired, the filters shift to deeper yellow or red. Orange filters are used to increase visibility of distant objects through telescopes, binoculars, etc.

5. Monochromatic filters have sharp transmission bands, and are used to isolate particular lines from the spectra of gaseous-discharge lamps, such as the mercury arc.

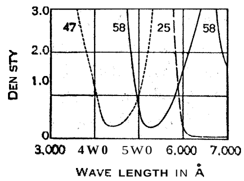

FIG. 2.—ABSORPTION CURVES FOR BLUE (47), GREEN (58), AND RED (25) FILTERS FOR THREE-COLOUR PHOTOGRAPHY

6. Ultraviolet and infrared filters are concerned with the invisible spectrum. Ultraviolet filters are generally made of glass, and usually have a narrow transmission band about the mercury line at 3,650A., and are opaque to visual light. Infrared filters are made to absorb most or all of the visual spectrum and to transmit the near infrared freely.

7. Safelights embody special filters designed to illuminate photographic darkrooms when used in conjunction with tungsten filament lamps. They are made for use with films, plates and papers of different spectral sensitivities, so that they may be handled in the safelight without being fogged in a reasonable time of exposure.

8. Polarizing filters polarize light very efficiently in the visual spectrum, and are used for producing polarized light effects, and reducing glare and reflections in photography.

9. Neutral density filters are gray in colour, and are made to absorb all visual wave lengths sensibly to the same extent. In photography they are used for reducing light intensity without changing its quality.

Filters which are made of dyes may be unstable, although the majority of the most commonly used filters are made of quite stable dyes. The manufacturer's specifications should be consulted. Gelatin filters cemented in glass, or solid glass filters, to be of the best quality, should have flat surfaces which are parallel. They are usually available in two degrees of quality: those which are useful in general photography with short focus lenses, and those for use with long focus lenses or in making separation negatives in photomechanical reproduction. In the case of the latter, a very high degree of optical quality is required.

(W. CK.; X.)

FILTRATION. In many industrial processes it is necessary to separate finely divided solid materials from liquids. The process of filtration consists in passing the liquid through a porous medium, which retains the solid particles. In some cases the recovery of the solid material is the main object; in others the filtration is done for the sake of purifying the liquid. Many types of filter are in use, differing in respect to (1) the various porous materials which are available for filtration; and (2) the construction of the apparatus in which these are applied.

Filter Materials. — The following are the main types of material which are in use:

1. Sheets of woven or felted material. These comprise porous filter paper, cotton, woolen or linen cloth, felt and woven metal.
2. Unwoven fibrous material, such as cotton, wool, linen fibre, cellulose pulp, metal fibres, sponge.
3. Granular or powdered materials, such as gravel, sand, earth, coke, sawdust, cork.
4. Porous plates of stone, porcelain, carbon, silica, etc.

The choice of material depends upon (a) the fineness of the substances to be filtered, (b) the chemical nature of the liquid, (c) convenience in collecting the solid material after filtration.

Laboratory Filtration. — Porous paper is generally used as the filter medium, being resistant to most of the liquids which require filtration. The commonest method of filtration is to fold a circular filter paper twice at right angles, and open it out to a cone with three thicknesses of paper at one side and one at the other. This is placed in a conical glass funnel. and the liquid is poured into it. In some cases. the filter funnel is provided with a hot-water jacket to keep the liquid warm during filtration. Filter paper is also manufactured in the form of thimbles, for extractions with solvents, such as alcohol and ether, in special apparatus. The Buchner funnel is made of porcelain and has a flat, perforated bottom on which a circular filter paper is placed. This form of filter has the advantage that the filtration may be assisted by the application of suction below the filter. The Gooch crucible is a porcelain cup with a perforated bottom. A thin layer of asbestos serves as the filter, and the crucible can be ueighed, after drying, to ascertain the weight of solid material collected. Filters are now made for laboratory use in which the porous material consists of a fritted mass of hard glass, which has been ground and sieved to a definite degree of fineness. This is made into disks, which are fused into various types of glass apparatus, and are resistant to almost all chemical reagents.

Filtration of Drinking Water. — Domestic filters are usually supplied in the form of earthenware vessels with filter beds of charcoal; in some cases filters of paper, asbestos or stone are used. It was originally thought that charcoal filters would unfadingly remove microorganisms, but the action was subsequently found to be less complete than had been believed. Indeed, if the filter material be not removed at intervals, it may become the seat of organic growths.

Large-scale filtration of town supplies of water is generally effected in sand filters.

Industrial Filtration — When possible, it is advantageous to allow the solid precipitate to settle in the liquor for some time, and to run off as much as possible of the clear liquid. The sediment may then be stirred up with water, allowed to settle and the liquid again decanted, so as to minimize the bulk of liquor to be filtered, and to facilitate the subsequent washing. The design of industrial filters varies according to the requirements. The chief considerations are that the filter shall present a maximum available surface without occupying too much factory space, that it shall withstand the required pressures, that it shall not be easily clogged, but shall be readily cleaned and easily controlled at all points. In some cases filters are designed to work continuously. Simplicity and economy of construction often outweigh all other considerations; thus for many purposes it is sufficient to filter through a bed of sand, or through a simple sheet of cloth resting on a flat, perforated support. Suspended bags of cloth are also frequently used, and have the advantage that the bag can be squeezed or wrung out after filtration to remove as much liquor as possible from the solid material.

Vacuum and Pressure Filters. — As in laboratory filtration, suction is frequently applied to accelerate the flow of liquid. A filter cloth is spread on a perforated plate of earthenware or other material, and the receiver into which the filtrate flows is connected with a vacuum pump. Conversely, pressure may be applied to the surface of the liquid in the filter. In place of cloth filters, porous plates are sometimes used; these may be either flat plates or cylindrical candles of porous material, presenting an increased filter area. Leaf filters may be used either for suction or pressure. A typical form of leaf consists of a rectangular frame of perforated pipes to which is attached a stiff, corrugated coating of coconut matting or other material, and the whole enveloped by a cloth bag. The liquid passes from the exterior to the interior of the leaf, and is assisted either by external pressure or by internal suction. A filtering unit consists of a number of parallel leaves, thus presenting a large filtering surface.

Filter presses are somewhat similar in principle. In one form, recessed plates are supported on a framework, so that they can be firmly pressed together by a screw press. Sheets of cloth are placed between the plates, and thus. when the filter press is assembled, it forms a series of narrow partitions separated by cloth filters. Channels are provided so that the sludge to be filtered can be forced under pressure between the cloth sheets, and the filtered liquid is collected from taps at the bottom of the plates. After filtration and washing, if necessary, the plates are separated. and the cake of solid material is removed. In place of recessed plates. some filter presses have alternate plates and distance frames. In centrifuges the filtration is assisted by the rapid rotation of a circular pan. The periphery of the pan is perforated, and covered on its inner side with a filter cloth, supported by a basket of metal. The rapid rotation (up to about 1,000 r.p.m.) uhizzes the liquid through the filter, with a force several hundred times greater than in gravity filtration.

Continuous Filters. — In the above-mentioned filters. the solid material has to be collected at intervals. and this necessitates interrupting the filtering operation. Continuous filtration can be effected by rotary filters. A hollow drum is supported in such a way that it can be rotated on a horizontal axis. The periphery of the drum is perforated and is covered with a filter cloth, and the drum dips into the liquid to be filtered. By suction, the liquid is drawn through the filter cloth to the interior of the drum, and the solid remains on the outside. The drum rotates slowly, and a scraper is fixed in such a position that it scrapes off the solid material continuously. In some cases, rotating discs are similarly used. A recent advance in filtration methods is the streamline filter, which permits the separation of very finely divided solid matter, which would pass through ordinary filter cloths. The liquid is forced through the edge of a pack of sheets of paper pressed tightly together. The channels between the sheets are so minute that the finest precipitates are retained. The filter is made in various forms to permit of continuous filtration, etc.

Coagulation as an Aid to Filtration. — The greatest difficulties in filtration are presented by slimy substances, which clog the filter. Increased pressure only accentuates the difficulty, and considerable importance attaches to methods whereby the slimy material may be caused to clot together and settle out. This can be effected by the addition of kieselguhr, fuller's earth, clay, talc, silica gel and various carbonates. Another procedure is to coat the filter with a layer of finely divided kieselguhr. boneblack, sawdust or some other finely porous material, which retains the slime and prevents it from penetrating into the filter material.

(R. C. F.)

FIMBRIA, GAIUS FLAVIUS (d. 84 B.C.), Roman soldier, partisan of Marius. He was sent to Asia in 86 B.C. as legate to L. Valerius Flaccus, but quarreled with him and was dismissed. Taking advantage of the absence of Flaccus at Chalcedon Fimbria revolted and slew Flaccus at Nicomedia. He then took command of the army and obtained several successes against Mithridates, whom he shut up in Pitane on the coast of Aeolis, and would undoubtedly have captured him had Lucullus cooperated with the fleet. Fimbria treated most cruelly all people of Asia who had revolted against Rome or sided with Sulla. Having gained admission to Ilium by declaring that, as a Roman, he was friendly, he massacred the inhabitants and burnt the place to the ground. But in 84 Sulla crossed over from Greece to Asia, made peace with Mithridates, and turned his arms against Fimbria, who committed suicide.

Fimbria's troops were made to serve in Asia until the end of the third Mithridatic War.

See MARIUS, GAIUS; ROME: Ancient History; SULLA, LUCIUS CORNELIUS.

FINALE, a term in music for the concluding movement in an instrumental composition, whether symphony, concerto or sonata, and in opera of the older type the concluding section of each act. Among instrumental examples the great choral finale to Beethoven's Ninth Symphony, and, among operatic finales, that of Mozart's *Nozze di Figaro*, to the second act, are famous.

FINANCE is that part of practical affairs which is concerned with money taken in a broad sense, to include not only that which is legally money (such as coin and paper money) but also bank credit or "credit money." Without suggesting that a word of such extensive practical application can be adequately defined by any simple formula. we may indicate its significance by saying that finance is "the art of providing the means of payment." The immediate aim thereby assigned to finance in any business is simply that of maintaining at all times an adequate cash balance (in money or bank credit). But the means employed include all the multifarious methods of borrowing money and of exchanging one sort of pecuniary right against another.

Subdivisions of Finance. — The following are the principal categories of finance in commercial enterprise:

(1) *Banking.* Banks create credit money by lending, and supply their customers with the means of payment.

(2) *The Money Market.* Closely associated with the banks, but distinguishable from them: is the money market, an organization for dealing competitively with short-term lending in the form of bills of exchange or day-to-day loans.

(3) *The Investment Market,* viz.:

(a) *The Stock Exchange,* where stocks, shares, bonds and debentures are bought and sold,

(b) *New Capital Issues,* or the raising of funds from investors for the promotion of new capital enterprises.

(4) The Foreign Exchange Market, where the means of payment in one country are exchanged for the means of payment in another.

(5) *Insurance,* including life insurance, which is a form of investment, and insurance against risks (such as fire or shipwreck).

Public Finance. — This is in a class by itself. Governments raise the means of payment:

(a) by taxation,
(b) by borrowing.

Taxation means compulsory contributions of money taken by authority of law from members of the community.

Governments have other resources. On the one hand they obtain money from state-owned enterprises, such as posts, telegraphs, telephones, railways or from state-owned property, such as forests or mines. On the other hand they exact services in kind, such as compulsory military service. But in any highly developed community taxation is the principal resource.

If revenue fails to meet expenditure, the deficiency has to be made good by borrowing.

Financial policy has to decide (1) how much revenue is to be raised and by what taxes, (2) how much public expenditure there is to be, and in what directions it is to be limited, (3) whether any of the expenditure is to be met by borrowing, and, if so, how much, and on what terms the money is to be borrowed.

The generally accepted principle is that revenue ought to meet expenditure, except

(1) expenditure of a clearly capital character, such as public buildings or income-yielding plant;

(2) emergency expenditure, so large in amount that to cover it by taxation would be unduly burdensome or even entirely impracticable; *e.g.,* war expenditure.

Control of Public Expenditure. — In order to secure a balance between revenue and expenditure outside these exceptional cases, some control over expenditure is needed.

This control takes several forms:

(1) *Parliamentary Control.* Parliaments are given the right of voting the public expenditure under a number of separate categories (sometimes elaborately and minutely classified), and the executive government is required to keep within the vote under every head.

(2) *Executive Control.* Every department is required to conform to the directions of the ministry of finance in regard to its expenditure. (A particularly drastic and searching control is exercised by the treasury in Great Britain).

(3) *Accountability.* To be effective, all forms of control require some system which will bring to light any cases in which the directions given have been contravened. There must be a thorough system of audit devised for this purpose.

In limiting expenditure it is necessary to weigh in the balance the advantages of the expenditure which is in question, against the disadvantages of the taxation which would have to be imposed to meet it. The ministry of finance, in exercising control over the various heads of expenditure and in determining what taxes are to be imposed, retained or remitted, should constantly keep that comparison in view.

It is also the function of the ministry of finance to consider what items of expenditure may be met from borrowing, what form the borrowing should take, what provision should be made for sinking fund to pay off debt, and what arrangements should be made for dealing with debt maturities and conversions. In all these matters, while it is for the ministry of finance to make proposals, the measures actually taken are usually regulated by statutory enactments.

A minister of finance also requires authority for temporary borrowing. Primarily temporary borrowing is needed to meet a temporary lag of revenue behind expenditure, or to meet emergency expenditure in the interval before a permanent loan can be issued. But there is a danger that it may extend beyond these limits. Temporary borrowing can be effected through banks, which create the credit money which they lend. An excessive floating debt is a great danger because it may lead on to inflation of the currency. Inflation may be regarded as a breakdown of public finance. The government, having failed to provide the means of payment by means of taxation and genuine borrowing, has resort to the creation of bank credit to fill the gap.

Governments and legislatures take responsibility for the provision of currency for the community. But sound principle generally requires this function to be kept as separate as possible from the finance of the public service. The administration of the currency is (or ought to be) directed to the provision of the means of payment for the community generally and not for the government in particular.

Public finance includes, besides the finances of governments, the finances of local authorities (municipalities, county councils, communes, etc.). Local authorities are usually given limited taxing powers by statute and their borrowing powers are also restricted and supervised. Sometimes they receive subsidies from the government out of the national tax revenue. (R. G. H.)

FINANCE, ARTICLES ON. The subject of finance is treated in so many articles that the suggestions listed here cannot be considered exhaustive. Thus in addition to the articles indicated here the index should be used as a guide also.

Basic to the problems of finance is the treatment of monetary problems. In the most general terms monetary problems are discussed in the following articles: MONEY; CAPITAL AND INTEREST; CURRENCY; INFLATION AND DEFLATION. The latter article is concerned with the value of money and different aspects of this same problem are discussed in the articles QUANTITY THEORY OF MONEY and INDEX NUMBERS. The historical development of currencies is discussed in the articles MONEY, MEDIAEVAL; CURRENCY. PRIMITIVE; and GOLD STANDARD. The last named of these articles also treats some aspects of international monetary relations. Special articles are devoted to the main currencies; *e.g.,* DOLLAR; POUND STERLING; FRANC; MARK; KRONE; PESO; and others. Problems of coinage and the genuineness of money are treated in the articles MINT; ASSAY OFFICE; SEIGNIORAGE; and COUNTERFEIT MONEY.

Next in importance to money, as concerns private financing, are the articles on banking. Chief among this group are BANKING; MONEY MARKET; CEKTRAL BAKK; SAVINGS BANKS; CLEARING HOUSE; MERCHANT BANKERS; DISCOUNT; DISCOUNT HOUSE; INVESTMENT BANKING; and TRUST COMPANY. Banking instruments are discussed in many articles, the most important of which are CHECK; BILL OF EXCHANGE; and COMMERCIAL PAPER. Some historical aspects of banking are discussed in the articles BANKING; MONEY-LENDING; and PAWNBROKING. There is also a series of articles on several important banking institutions of national importance; *e.g.,* FEDERAL RESERVE SYSTEM, THE; BANK OF ENGLAND; BANQUE DE FRANCE; and of international standing; *e.g.,* EXPORT-IMPORT BANK OF WASHINGTON; BASK FOR INTERNATIONAL SETTLEMENTS, and BANK FOR RECONSTRUCTION AND DEVELOPMENT, INTERNATIONAL.

On the subjects of the stock market and financial investment consult: STOCK EXCHANGE (BOURSE); INVESTMENTS: INDIVIDUAL; ARBITRAGE; FUTURES; and CURB MARKET.

On persons engaged in handling stock exchange business consult the articles: STOCKBROKER; JOBBER (STOCK EXCHANGE); and BROKER. On securities traded on stock exchanges or related to the exchange consult: STOCK; SHARE; CONSOLS; BEARER SECURITIES.

International monetary problems are discussed in the following articles: INTERNATIONAL PAYMENTS; EXCHANGE, FOREIGN; EXCHANGE CONTROL; CAPITAL. EXPORT OF.

The taxation of international transactions is discussed in the articles CORN LAWS; TARIFFS; COUNTERVAILING DUTIES. Some discussion of the exchange value of various currencies is contained in the articles on individual currencies (POUND STERLING; DOLLAR, etc) mentioned above.

Articles on insurance will be found listed in a special article entitled INSURANCE.

Articles in the field of public finance may be classed under three headings. Those dealing with general budgetary controls are under BUDGET, GOVERNMENTAL; EXCHEQUER; FINANCE; and SUPPLY.

Articles on public revenues embrace, among others, the following: TAXATION; TAXATION, LOCAL; REVENUE; TARIFFS; INCOME TAX; ESTATE AND INHERITANCE TAXES; EXCISE TAX; INHERITANCE; LAND TAXES; SALES TAXES; LUXURY TAXES; EXCESS-PROFITS TAX; and CAPITAL LEVY. Some historical aspects of taxation are treated in the articles GABELLE; and WINDOW TAX.

Finally, on the public debt, the following articles are most important: DEBT. PUBLIC: and INTER-ALLIED DEBTS.

(B. F. H.)

FINANCE ACT: see BUDGET, GOVERNMENTAL.

FINANCIAL STATEMENTS, broadly speaking, are any statements that report the financial condition or the operations of a business, a government, or a not-for-profit organization devoted to some charitable, religious or educational purpose. The term is commonly used, however. in a more limited sense in trade and financial circles to refer to the balance sheet. statement of income, and statement of retained earnings of a business. The balance sheet shows the amount and kinds of assets (properties), liabilities (debts), and the owners' investment (excess of assets over liabilities) as of a certain date. The reader examines the balance sheet to discover the liquidity of the concern and probable solvency. Liquidity is a matter of convertibility of the assets into cash; solvency, of ability to meet debts when due.

Comparative balance sheets showing the financial condition of a business for two or more years reveal financial tendencies, changes in response to varying business conditions, and policies on such matters as debt retirement and expansion of the ownership investment by retained earnings.

The earnings statement summarizes those transactions which have brought gain or loss to the owners during a period of time, usually a year, between two successive balance sheets. Accountants ordinarily divide this statement, which serves as an explanatory link between the amounts of the ownership interest in succeeding balance sheets, into a statement of income or profit and loss statement and a statement of retained earnings or earned surplus. The latter recounts items that are not strictly profit or loss, such as dividends which distribute net income to the stockholders, or arbitrary reductions in the valuation of fixed property, or sometimes items that relate to the earnings of an earlier period, such as the revision of the tax liability of an earlier year. Some accountants regard it as improper to place these latter adjustments of prior years' gains or losses in this surplus section lest the unskilful reader overlook them in studying the earnings over a period of years; they prefer to show such adjustments in the regular income statement suitably segregated.

Earnings statements are useful in portraying the elements of profitability when details are given on sales or gross revenues, cost of goods sold, and certain expenses such as depreciation, maintenance, taxes, interest and rents. Good form calls for the separation of income and expenses derived from the main operations, such as the trading activities of a merchant, from similar data related to sidelines. Extraordinary and nonrecurring gains and losses together with any related income taxes should be separately stated. Where the total earnings are summed up in the single figure of "earnings per share of stock," many prefer a figure that excludes extraordinary terms. They want a representative or "normal" measure of earnings. Good practice requires the reporting of figures that both include and exclude such items. Whether a particular unusual item is likely to recur in the future may depend upon whether a short or long run point of view is taken.

The earnings statement is ostensibly a mere record of the past. But, as in other fields, the reader projects this historical experience in judging the probable future. Debates over proper form often hinge upon the debaters' ideas as to the probable way in which the reader is likely to think or react. Because statements are read for a variety of purposes, no single form can satisfy all persons. Adequate disclosure of material details enables informed and competent persons to derive the kinds of information that will serve their various needs. The past record of earnings has the greatest utility in gauging the future where the business offers goods or services that are bought frequently and habitually. Demand and earnings fluctuate most where technology changes, style alters frequently, raw materials vary greatly in cost, or durability or luxury character causes irregular buying.

Users of Statements. — The more important users of financial statements are (1) short-term creditors, (2) investors, (3) business management, and (4) government agencies. Commercial banks and trade creditors extend short-term credit. They may rely heavily upon a personal estimate of the ability and character of the prospective debtor and his previous record of paying his bills rather than upon precise financial information. Experience has shown. however, that such credit can be extended more freely and with less risk, especially to small businesses when statements are available. Attention of the short-term creditor centres on the balance sheet, especially on the current assets, consisting of cash and liquid investments, stocks of merchandise (inventories), and amounts owing by customers (accounts receivable) as they relate to short-term debts.

Investors in bonds or stocks tend to place primary emphasis upon the earnings statements and less upon the balance sheet, save as the latter suggests risk because of unliquidity and insolvency. When commercial banks extend term loans that are to be repaid systematically over a period of years, they too have an interest in the statement of income because they depend for repayment more upon future earnings and less upon existing current assets. A widening ownership of large business corporations makes fuller disclosure through financial statements a natural development.

Business management finds detailed statements valuable. Comparison with the statements of other members of the industry is used to discover conformity to customary practice and to study relative operating achievement.

Standardized financial statements are the essential basis for many phases of governmental regulation and the taxation of business. When prices are regulated. especially as for public utilities, financial statements disclose the level of earnings and how they conform to the standard set by policy. Statements permit the study of a corporation's finances to determine the suitability of its securities for acquisition by regulated investment institutions, such as insurance companies and banks. Where securities are widely owned by individuals who are not in a position to enforce adequate statement information, the government may set up requirements for the disclosure of material financial information.

Differences Related to Function. — Figures compiled under rules for meeting one need may be inadequate to meet other needs. Merchandise inventories shown in a balance sheet at a very low cost figure of the distant past will not tell a banker how valuable they are currently for paying debts. Regulatory bodies when dealing with a financial institution like a bank, may look with favour on an understatement of asset values that increases the margin of safety of that institution in a crisis. A stockholder, however, who wishes to value his shares for sale, would prefer fuller information on current values. Income tax regulations may specify certain maximum allowances for depreciation expense, but business management may find that rapid teclinological change justifies larger allowances. Or, management may elect the highest permissible depreciation rates for income tax purposes when less would appear adequate, lest possible tax savings for shareholders be lost. Considerable changes in the price level create many problems for all classes who use conventionally prepared statements. Radical accounting adjustments were suggested by German accountants in the price inflation after World War I and in the U.S. after World War II.

Accounting Terminology.— The conditions prerequisite to the interpretation of financial statements are an understanding (1) of the information required by the particular user. (2) of the terminology and (3) of the rules or conventions employed by accountants in their preparation of financial statements. The needs of the various major groups who use statements have been suggested. As for terminology, perhaps the two areas most baffling for the ordinary reader, but essential to the understanding of the balance sheet, are the items that state the ownership interest and the "reserves."

The ownership interest of a proprietorship or partnership may be stated in amounts belonging to the one or several owners (thus, John Doe, Capital. . . . $25,000) or merely as the net worth. The total amount is the excess of the assets over the debts of the concern. When added to the debts, the sum equals the assets by definition. Custom places both items on one side of the balance sheet headed liabilities or, more correctly, liabilities and owners' capital. The latter and more precise heading recognizes the legal difference between the creditors, who have claims to fixed sums of money as of certain dates, and the owners, who are the residual claimants to assets and income.

In a corporation's balance sheet, the interest of the owner-stockholders should be broken down as between paid in investment and subsequent accretions from earnings left in the business. The former appear as so much capital stock, often at an arbitrary par or stated value, and any excess as excess paid in by stockholders, paid-in surplus or capital surplus. The other portion of the ownership equity may appear as earnings retained in the business, profit and loss, earned surplus, or. as the Bank of England terms it, the rest. Recognition that this amount is merely a balance of value and represents the residual claim of the owners, which may be represented as invested in nonliquid assets, should prevent a not unusual layman's misconception that surplus is a pot of money readily available for dividends or debt payment.

"Reserves" popularly means cash or liquid investments available to meet some specific purpose or a general emergency. The accountant may use the term quite differently. In the balance sheet it may be employed in three different ways: (1) as an allowance for loss in value of some asset (valuation "reserve"), (2) as an estimated liability, or (3) as an "appropriation" of the retained earnings or surplus.

Valuation *Reserves.*—Instead of merely showing such an asset as plant and machinery at its net book value, it is customary to show its original cost with a separately stated amount of allowances for depreciation or, more confusingly, a reserve for depreciation. Similarly, allowances for losses on customers' debts to the business may show as a deduction either for allowances for bad debt losses or a reserve for bad debts. Such "reserves" allow for possible loss of value and are not cash or funds.

Liability Reserves.–Occasionally a liability, especially where the amount is uncertain, appears as a "reserve." Thus, income tax liability may be called reserve for income taxes.

Appropriated *Surplus.*—Some accountants who wish to show that retained earnings are not available for dividend distributions transfer a portion of such surplus to a "surplus reserve." such as reserve for contingencies, sinking fund reserve. or merely general reserves. Others prefer to show this point by merely stating these amounts as appropriated surplus: for contingencies, or for bond retirements, or for plant expansion. Still others regard both forms as likely to mislead by implying that all of the remainder of the retained earnings account is available for dividend payments. Actual availability can be determined only by examining (1) the remainder of the balance sheet to see whether cash or other liquid funds exist in excess of what is required to satisfy creditors. (2) reported plans for the future that will use up existing cash, and (3) earnings prospects that will provide cash to pay dividends.

Originally, these "reserves" were sometimes grouped in the balance sheet between the liabilities and the ownership equity. As time passed, they were more commonly placed with the asset, liability, or ownership accounts to which they were more closely related. An even later tendency was to abandon the term "reserve" for more accurately descriptive account titles.

Accounting Rules.— The significance and limitations of financial statements arise in part from the rules or principles of accounting which determine their construction. These rules grew from customs found most generally useful in trade and finance. One basic principle is that assets should reflect cost rather than current market value in order to avoid showing unrealized profits from appreciation. This rule is modified by allowances for value losses where some systematic basis for estimate exists, as in the case of depreciation of machines and buildings, bad debt losses, and the depletion of oil wells and mines. This cost rule is commonly suspended when current assets have a market value below cost at the date of the balance sheet. The current assets are those assets that turn into cash in the course of ordinary operation within a year (longer in a few industries) and typically include cash, marketable securities, customers' indebtedness and inventories. Marketable securities and inventories are commonly valued at whichever is the lower, cost or market, partly as a matter of conservatism, which is itself almost an accounting principle. This practice is also a matter of recognizing a value loss that reduces current debt-paying power. The measurement of this ability is a central object of statement analysis. Fixed assets, such as plant or long-term security investments not likely to be sold to meet debt, are commonly shown at cost and ignore market value fluctuations on the assumption that such fluctuations are not important to the "going concern." Appraisal and revaluation of the fixed assets are not common practice.

Many special accounting rules arise from trade customs, governmental regulations and tax laws. They often apply only to the statements of special kinds of businesses, such as manufacturing, merchandising, railroads, public utilities, commercial banks, life, fire and casualty insurance, and holding companies.

FINANCIAL STATEMENT ANALYSIS

Balance sheets and earnings statements may be analyzed comparatively or internally. In comparative analysis, changes in successive balance sheets or earnings statements, yearly, quarterly, or monthly, are studied for tendencies and trends. These changes may reflect long-term growth or decline of the particular business or the industry of which it is a part or they may represent cyclical, seasonal, or special fortuitous factors. Correct understanding of the nature of the influences at work is as important as the facts of change.

Internal analysis examines the relationships or ratios between various items in the statements. The simplest devices are the percentage balance sheet, which compares each of the assets and liabilities as a per cent of total assets and the percentage income statement where the various operating income and expense items are shown as percentages of the gross revenues or sales Ratios are studied to discover probable liquidity or solvency and profitability or efficiency. Two common liquidity tests are the current and quick ratios. The former is the ratio of current assets to current liabilities; the latter is the ratio oi cash and equivalent plus customers' debts (receivables) to the current liabilities. Comparisons of annual sales volume to the customers' debts and to inventories give an idea as to their liquidity and also how efficiently the capital invested in those forms is being used to produce profits. Comparisons of indebtedness to the owners' investment indicates something of the risk of insolvency that is being assumed. Comparisons of the cost of goods sold and the various expenses to revenues may be studied from year to year and between companies in the industry to ascertain relative efficiency and profitability. The amount of earnings relative to the investment of creditors and owners provides another measure of profitability, which, however, requires greater care in interpretation because of changing prices and the failure of the balance sheet to reflect current property values.

Although financial statements find their most vital significance for those immediately concerned with the financial fortunes of the particular business, they are read and used by others. They are used for economic analysis; for studies of business conditions; for shaping political and legislative policies; for governmental regulation and for background information for settling labour disputes. Misinterpretation is easy here as it is in all forms of statistical abstraction. Price level changes are an especially disturbing factor. In spite of such limitations, financial statements perform a useful economic service by making possible a more intelligent assumption of business risks, directing capital into more economic channels, and improving the quality of business management and of competition. They also serve a wider social purpose in providing one more kind of information useful in evaluating political and social policies.

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2nd ed. (1952); W. A. Paton (ed.), *Accountants'* Handbook, 3rd ed. (1943). (H. G. Gn.)

FINCH, a name, usually in combination, as bullfinch, chaffinch: etc., for birds of the largest avian family Fringillidae. Generally speaking finches are small songbirds with a short, stout, conical bill for crushing seeds, and are characteristic of Europe, Asia and North America, where most of the numerous species live. *See* also Brambling; Bunting; Bullfinch; Canary; Chaffinch; Crossbill; Goldfinch; Greenfikch; Grosbeak; Hawfinch; Liknet; Redpoll; Siskin; Sparrow.

FINCHLEY, a municipal borough (1933) of north Middlesex, Eng.. forming with Friern Barnet a borough constituency returning one member to parliament. It lies northwest of London, with Hampstead to the south, Hendon to the west, Barnet to the north and Hornsey to the east. Pop. (1951) 69,991. Area 5.4 sq.mi. The glacier which covered much of the British Isles in one of the ice ages came as far south as Finchley. At the time of Domesday Book Finchley was a part of the manor of Fulham which belonged to the bishop of London. The area was agricultural, producing much hay, and Finchley common. traversed by the Great North road, was later notorious for its highwaymen, Jack Sheppard being captured near there in 1724. Gen. George Monck camped on the common on his march on London in 1660 and in 1745 a force to resist Prince Charles Edward, then at Derby, encamped there and inspired William Hogarth's painting "The March of the Guards Towards Scotland . . ." also known as the "March to Finchley." The common or glebe land now occupies 46 ac. The parish church of St. Mary, largely 15th century, was restored in 1872–73 and subsequently; damage from World War II was repaired in 1953. Finchley owned about 420 ac. of open spaces and playing fields in 1956. The borough is largely residential, much of the southern part lying in Hampstead garden suburb (Golders Green).

FINCK, FRANZ NIKOLAUS (1867–1910), German philologist, whose major studies were in types of language structure; was born on June 26. 1867, in Krefeld. He concentrated more on Armenian than any other single language, publishing a grammar in 1902 and some works on Armenian literature and manuscripts in 1903 and 1907. He also published studies of the German and Armenian Gypsy languages (1903, 1907), of the noun accent in Baltic languages and Slavonic languages (1895), of the Irish dialect of the Aran Islands (1899), of the Bantu languages (1908) and of the Polynesian languages (1909).

Finck's work in structural typology, which mas in the tradition of W. von Humboldt and H. Steinthal, first appeared in a study of German in 1899, then in *Die Klassifikation dev Sprachen* in 1901 and in *Die Haupttypen des Spvachbaus* in 1910. When he died, on May 4, 1910, in Berlin, he was professor of the Oriental seminar at Berlin university. He is perhaps best remembered for *Die Sprachstämme des Erdkreises* (1909). (E. P. H.)

FINDLAY, a city of northwestern Ohio, U.S., the seat of Hancock county, lies in a rich agricultural area: and is the trading centre for the surrounding community. Industries include the manufacture of ditching machines, beet sugar, tires and rubber goods and radio and television equipment. The Blanchard river, which flows through Findlay, is the scene of "Down by the Old Mill Stream" written by Tell Taylor, who lived there. The original settlement developed out of Fort Findlay, built during the War of 1812 by Col. James Findlay, for whom it was named. The town was laid out in 1821, incorporated as a village in 1838 and chartered as a city in 1887. It is the seat of Findlay college (Church of God), chartered in 1882. For comparative population figures *see* table in Ohio: *Population.* (L. M. C.)

FINE, a pecuniary penalty imposed by a court of law upon a person convicted of a criminal offense. Fines constitute in whole or in part the punishment for many common law and statutory offenses in both the United States and Great Britain. Unless the amount of a fine is specified by statute, it may be fixed by the court in the exercise of its discretion. The U.S. constitution and many state constitutions prohibit the imposition of excessive fines.

Several methods are employed in attempting to recover unpaid fines. Under the common law and by statute in many states, an execution may be levied against the defendant's property. In many jurisdictions, statutes also enable the court to order a defendant to work out his fine by manual labour. Moreover, in most states a defendant may be imprisoned until the fine is paid or otherwise settled in accordance with law. He may be imprisoned indefinitely in some jurisdictions. but statutes commonly limit the amount of time he may be compelled to serve. Usually, imprisonment for such a fixed period does not cancel the fine itself; however, some statutes provide that the fine is discharged by imprisonment for a fixed period, and others allow a credit on the fine for each day served in prison.

The term is also applied to payments formerly made to the lord of a manor on the alienation of land by a tenant, and to a fictitious legal action, abolished in England in 1833, dealing with the conveyance of land. *See* also Criminal Law. (C. R. Se.)

FINE ARTS. In classical Greece the association of the arts, and more especially sculpture, with the temples of the gods and the great athletic festivals, gave them dignity and sanctity, though work as exquisite as any of these official commissions was produced in such arts as white-figured vase paintings and engraved gems. In the Roman empire the glorification of the emperor and the individual was added to the functions of art and when such mass industries as Arretine ware and industrial bronze casting were developed a certain distinction of status between the artist and the craftsman was achieved. In the more simply organized life of the middle ages, however, great painters were employed by their patrons to paint fine religious pictures and to stain cloths for tournaments, indifferently. and no distinction of status was made between artist and craftsman in the medieval guilds. Even in the 16th century Holbein was content to design jewels for Henry VIII and Raphael tapestries for the pope.

The conception of the fine arts as creation on a loftier level seems everynhere to have accompanied the establishment of academies of painting and sculpture. The earliest such institution was the Académie Royale de Peinture et de Sculpture founded at Paris by Louis XIV in 1648. It hardly made the scission complete, for all through his reign royal buildings, and those imitated from them, were so richly decorated with painting and sculpture that his academicians mere as much occupied with decoration as with the creation of easel pictures and free-standing sculpture.

In the 18th century a change of taste in western Europe made the division between the fine and the decorative arts more stringent. François Boucher takes an intermediate place; many of his pictures are independent of their setting, but an almost equal number are (or were) part of a larger decorative scheme, either as tapestries or as pictures built into paneling. A *dessus de porte* is not an easel picture and has not the same claim in academic eyes to an independent existence in the realm of creation. Gradually, however, the fashion changed, and by the middle of the century it was easy to put the carvers and plasterers who decorated rooms and the artists who painted creative pictures that might chance to adorn their walls into different categories. At this time verbal usage closely confirmed the association of the idea of the fine arts with academic foundations. The phrase "fine art" was, according to the Oxford English dictionary, first used in 1767; the Royal academy was founded in the following year. In France M. J. Chénier used "les Beaux Arts" in his *Charles IX* in 1789; the Académie des Beaux-Arts was refounded under that title in 1795.

The distinction between the fine arts and all other arts continued through the 19th century, the great age of academies. It was encouraged by the rise of the middle classes, who were more apt to move house than the territorial magnates, and consequently preferred mobile pictures to elaborate and immovable decorative ensembles, and liked to give an enhanced status to their possessions. Two wars have, however, begun to modify the idea, for men of taste may no longer have room to display pictures in their homes. It is significant that by the middle of the 20th century Jean Lurçat was designing tapestries and Pablo Picasso pottery. Nonetheless the public—if not the artist—is still prepared to consider as "fine," art that fulfills no other purpose than the artist's desire for creation. (J. Ev.)

FINFOOT or sun grebe, names for three species of medium-sized cootlike birds but brown above and whitish below, with lobed feet. They constitute the family Heliornithidae and suborder Heliornithes in the order Gruiformes and are related to the rails (*q.v.*) rather than the grebes (*q.v.*). The finfoot, a secretive bird, is a poor flyer which spends most of its time in shady, quiet rivers, half submerged near overhanging banks. None are more than two feet long; the olive-coloured American finfoot (*Heliornis fulica*), only half that size, with red bill and black-banded yellow toes, ranges from Veracruz to northeastern Argentina.

The African finfoot (Podica senegalensis) occurs from Senegal to the Congo and Ethiopia to the Cape. The Asiatic finfoot (*Heliopais* personata) is found in Burma, Assam, Malaya and Sumatra. (G. F. Ss.; X.)

FINGAL'S CAVE, a famous cave on the southern coast of Staffa, an island of the Inner Hebrides, Scot. Visited in 1772 and first described by Sir Joseph Banks, it can be entered only by boat. It is 227 ft. long, 42 ft. wide and lined by a series of hexagonal basaltic pillars similar to the Giant's Causeway in County Antrim, Ire. It is a haunt of sea birds and seals.

FINGER: see SKELETON, VERTEBRATE: *Appendicular* Skeleton.

FINGER-AND-TOE, CLUBROOT or ANBURY, a destructive plant disease due to fungus organism known botanically as *Plasmodiophora brassicae,* which attacks cabbages, turnips, radishes and other cultivated and wild members of the family Cruciferae. It is caused by one of the simple alga-like fungi of the order Chytridiales. The presence of the disease is indicated by nodules or warty outgrowths on the root, which sometimes becomes swollen and ultimately rots, emitting an unpleasant odour. The disease is contracted from spores present in the soil which give rise to motile spores which enter the root. The parasite develops within the living cells of the plant, forming a mass of living material known as the plasmodium, the form of which alters from time to time. The cells which have been attacked increase enormously in size and the organism spreads from cell to cell. Ultimately the plasmodium becomes resolved into numerous minute round spores which, on the decay of the root, are set free in the soil. The disease is more frequent in acid soils. Lime in various forms has been used, but a dressing of 1,500–2,000 lb. per acre of hydrated lime will give commercial control. To prevent the organism from passing in a living state into the manure, diseased plants should be burned or, if thoroughly boiled, they may be fed to animals.

More details on control practices are found in F. Heald's Manual of Plant Diseases, 2nd ed., pp. 464–466 (1933).

FINGERING, a term used to describe the methods for the use of fingers in playing keyboard, stringed and wind instruments. Research has shown that early systems of fingerings on the chamber organ, the clavichord and the harpsichord which originated in England influenced the systems of François Couperin, J. S. Bach and C. P. E. Bach, which have been generally taken to be the foundation of keyboard technique. These systems were based on the relative strength of the five fingers. The choice of fingers was also governed by considerations of sonority, touch and phrasing associated with one keyboard instrument or another. Later systems of pianoforte fingering were an expansion of these principles.

Fingering on stringed instruments is based on the principle of stopping the strings at varying lengths and on the movable positions of the hand along the finger board. In wood-wind instruments systems of fingering depend on the stretch between the fingers in regard to the uncovering of holes which, cut into the wall of the instrument, vary the size of the vibrating column of air.

See E. Halfpenny, "Fingering," in Grove's Dictionary of Music and Musicians, vol. 3 (1954).

FINGER NUMERALS, the representation of numbers by positions of the fingers, a method used by early peoples in the absence of inexpensive material upon which to write. The use of such symbols survived into modern times, particularly in international trade in the orient. In the system inherited from the Greeks and Romans small numbers were usually represented on the left hand, the right hand being used for hundreds. When Juvenal wrote (Satire X), "Happy is he indeed who has postponed the hour of his death so long and finally numbers his years upon his right hand," he referred to one who lives to be more than 100 years old. The finger numerals are related to the finger computations in use in the middle ages, referred to in various early printed books and still familiar in certain parts of the world. The operation of multiplication was the one in which they played the most important part, computation being carried as far as 10×10. For example, to multiply 8 by 6, turn down $8 - 5$ fingers on one hand and $6 - 5$ on the other. There are then 3 turned down and 2 standing on one hand and 1 turned down and 4 standing on the other. Add the fingers down $(3 + 1 = 4)$ and multiply those standing $(2 \times 4 = 8)$, and the result is 4 tens + 8 units, or 48; the operation follows the formula, $ab = [(a - 5) + (b - 5)]\,10 + (10 - a)\,(10 - b)$. Numerous variants of the plan were in use, some having been brought to Europe from the Arab schools. See also NUMERALS. (D. E. S.)

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FINGERPRINTS. The use of fingerprints as a system of identification is of very ancient origin, and was known from the earliest days in the east when the impression of his thumb mas the monarch's sign manual. The permanent character of the fingerprint was first put forward scientifically in 1823 by J. E. Purkinje, professor of physiology, who read a paper before the University of Breslau, adducing nine standard types of impressions and advocating a system of classification which attracted no great attention. Sir Francis Galton, who laboured to introduce identification by fingerprints, was the founder of our present system of fingerprint identification. Sir William Herschel, who in India employed a simple form of fingerprint identification, is regarded as the first who devised a feasible method for the regular use of fingerprint identification. The Bengal police, under the administration of Sir E. R. Henry, afterwards chief commissioner of the London metropolitan police, usefully adopted fingerprints for the detection of crime. The prints depend upon the ridge formations in the bulbs of the end joints of the fingers. The skin is traversed in various directions by the depressions and friction ridges, thus forming the fingerprint patterns which continue unchanged from birth to death. The constancy of the markings of the fingerprints has been proved beyond question and this universally accepted fact has permitted the predication of the present system of identification. The fingerprint patterns lend themselves to convenient classification according to the types and patterns and the number of ridges appearing between designated points in the patterns. The patterns are catalogued according to four main types: arches, loops, whorls and composites. There are subclasses of these types, all of which are identifiable by symbol or number according to the system, which permit the expert to read each print as a distinct classification.

One of the first methods of scientific identification was the adoption of the Bertillon system which was devised by the French savant A. Bertillon. Based upon the anthropometry measurements of the body the system is obsolete in all countries with the exception of France. The first authentic record of the use of fingerprints in the United States reveals that Gilbert Thompson of the United States Geological survey utilized his thumb impression to prevent the forgery of commissary orders during his supervision of a survey in New Mexico in 1882. The Federal Bureau of Investigation (FBI), United States department of justice, maintains the world's largest collection of fingerprint records and is the chief repository for criminal fingerprint data mutually interchanged among the nation's law enforcement agencies. By 1952 it was co-operating with 81 foreign countries and territorial possessions in the international exchange of criminal identifying data. The identification division of the FBI was established in 1924, when collections previously maintained by the United States penitentiary, Leavenworth, Kan., and by the International Association of Chiefs of Police were given to the FBI. The 810,188 cards received formed the nucleus of a constantly increasing collection, which in 1958 exceeded 149,000,000 criminal and noncriminal fingerprint cards. More than 23,000,000 of the cards comprised the arrest records of more than 9,300,000 individual criminals or suspects. During the 12-month period which ended June 30, 1958, more than half of all persons whose arrests were reflected on fingerprint cards received at the FBI identification division were found to have previous criminal histories, and 15,534 fugitives from justice were identified.

Separate from the criminal records are files containing more than 100,000,000 fingerprint cards of members of the armed forces, civilian personnel of the federal government, aliens and law-abiding citizens who volunteered their fingerprints as a precautionary measure. About 70% of the more than 1,500 fingerprint cards of unknown dead persons submitted annually to the FBI have been identified through cards previously on file.

In the operation of its system the Federal Bureau of Investigation employs the Henry method, with current extensions, utilizing all ten fingers as a unit for the classification and filing of fingerprints. It also created a classification method which permits the separation of the impressions of the ten fingers into a single fingerprint system. (*See* also INVESTIGATION, CRIMINAL.) (J. E. H.)

FINIAL, in architecture, the decorative upper termination of a pinnacle, gable end, buttress, canopy or spire; especially in the Romanesque and Gothic styles. It usually consists of a vertical pointed central element surrounded by four outcurving leaves or scrolls. When the form it decorates has crockets (*q.v.*) the finial may be formed of four or more crockets surrounding the central uprights. Finials in the form of candelabrum shafts occur frequently in early Renaissance work. The term is also applied loosely to any small pinnacle, knob or other decorative feature terminating a verticle motive. *See* also SPIRE.

FINIGUERRA, MASO (i.e., *Tommaso*) (1426–1464), goldsmith, draftsman, and engraver, was born in Florence in 1426, and died there in 1464. He is recorded as the first Italian master of the early Renaissance to specialize in engravings. But owing to lack of documentation, all conclusions as to his activity remain speculative.

As a young man Maso is believed to have worked with Lorenzo Ghiberti; later he associated himself with Antonio Pollaiuolo. His own style seems grounded on theirs. None of his productions as a goldsmith is known, save perhaps the Thewalt cross of about 1464, decorated with niello plaques, in the Metropolitan museum, the design of which may be his.

Before 1450 he had been producing nielli. A niello is made by engraving a design on a flat surface of silver and filling the engraved lines with a black enamel-like substance. Before applying this substance Maso frequently made casts in sulfur of the engraved silver, and some of these are still preserved, notably the British Museum's Coronation of the Virgin of about 1459–1464. He also made niello prints, which are impressions from the silver on paper; some of these also still exist. Sulfur casts and niello prints now give us our most complete picture of Maso as niellist.

From the niello print it was only a step to the copperplate print, and shortly after 1460 Maso seems to have been busy turning these out. Perhaps most famous of the engravings attributable to him is the series of the seven Planets.

The art of copperplate engraving is, however, a German development, and Giorgio Vasari erred in hailing Finiguerra as its inventor. Even in Italy he seems not to have been the first. Pollaiuolo's Battle of the Naked Men of about 1460 may antedate any of Maso's works. But Finiguerra remained the great popularizer of the new medium.

As draftsman his name is sometimes connected with the Florentine Picture-Chronicle of about 1464 in the British Museum, a work containing more than a hundred lively drawings. He is also believed to have produced designs for the intarsia woodwork in the sacristy of the Cathedral of Florence. The extent of his contribution there also remains a matter of conjecture.

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FINISTÈRE, the most western *département* of France, formed from part of the old province of Brittany. Pop. (1954) 727,847; area: 2,714 sq.mi. It is bounded west and south by the Atlantic ocean, east by the *départements* of Côtes-du-Nord and Morbihan, and north by the English channel. (For history *see* BRITTANY.)

Finistère is the west end of the worn down ancient fold region, axes of which still emerge slightly as the Monts d'Arrée (1,282 ft.) in the north and Montagnes Noires in the south. These run east and west, with the Aulne basin between them. Small streams flow north from the Monts d'Arrée and south from the Montagnes Noires. The Aulne and Elorn, and the other streams in lesser degree, have estuaries because of coastal sinking, and these estuaries form the harbour of Brest and other navigable entries. Off the promontories prolonging the Monts d'Arrée are the Ushant Islands and off that prolonging the Montagnes Noires the Îles de Sein in the south, with Batz off the north coast and many others. Between islands and mainland are famous tide races which make navigation difficult. The coasts are often steep and rocky.

The climate is oceanic, average temperature 52° F., rainfall heavy. Though more than a third of the *département* is covered by heath, wasteland and forest, it produces oats, wheat, buckwheat, rye and barley. The neighbourhood of Roscoff and the borders of the Brest roadstead are extremely fertile and yield large quantities of asparagus, artichokes and onions, besides melons and other fruits. The cider apple is abundant. Hemp and flax are also grown. The farm and dairy produce is plentiful, and cattle and horses are largely bred. Honey and wax are produced. The great pilchard fishery makes this *département* a nursery of seamen for the French navy. Coal, though found in Finistère, is not mined; there are quarries of granite, slate, potter's clay, etc. The lead mines of Poullaouen and Huelgoat, which long yielded silver, are no longer worked. The preparation of sardines is carried on on a large scale at several coast towns. The manufactures include ropes, agricultural implements, paper, leather, earthenware, soap, candles and fertilizers and chemicals derived from seaweed. Brest has important foundries and engineering works, and shipbuilding is carried on there and at other seaports. Brest and Morlaix are the most important commercial ports. Trade is in fish, vegetables and fruit. Coal is the chief import. The *département* is served by the Orléans and Ouest-État railways. The canal from Nantes to Brest traverses the *département.*

Finistère is divided into the following *arrondissements* of Brest, Châteaulin, Morlaix and Quimper (43 cantons, 294 communes), the town of Quimper being the capital of the *département* and the seat of a bishopric. The north of the *département* belongs to the region of the 10th army corps (Rennes), and the south to the region of the 11th army corps (Nantes) and the whole to the archiepiscopal province and *académie* (educational division) of Rennes, where its court of appeal is also situated.

The more important places are the ports of Quimper, Brest, Morlaix, Quimperlé, Douarnenez, Concarneau, Roscoff and, inland, Landerneau and Châteaulin. Finistère abounds in menhirs and other megalithic monuments, of which those of Penmarc'h, Plouarzal and Crozon are most noted. The two religious structures characteristic of Brittany—calvaries and ossuaries—are frequently met with; *e.g.,* the calvaries of Plougastel-Daoulas, Pleyben, St. Thégonnec (17th century) and Guimiliau (16th century), and the ossuaries of Sizun and St. Thégonnec (16th century) and Guimiliau (17th century).

Daoulas has the remains of a Romanesque church and cloister. Locronan and St. Jean du Doigt have interesting churches and are among many centres of famous folk ceremonies called pardons. St. Pol de Léon has a fine granite Gothic cathedral. Kerjean has a 16th-century château.

FINITE DIFFERENCES: *see* CALCULUS OF DIFFERENCES.

FINK, MIKE (1770?–1823), U.S. frontiersman and legendary hero, was born at Fort Pitt, Pa. As a youth he won fame as a marksman and Indian scout around the fort. Later, when keelboats were the chief vessels of commerce on the Ohio and Mississippi Rivers, he became "the king of the keelboatmen," renowned as the best marksman, most energetic roisterer, and champion rough-and-tumble fighter in perhaps the toughest group in the west. In 1822, he joined the Ashley-Henry trapping expedition to the Rockies; the next yenr, he died a violent death at Fort Henry on the Yellowstone river. Stories about him told orally and published by writers of many sorts in greatly varied publications spread his fame widely between 1828 and the Civil War, though thereafter it declined. In tall tales, sketches, short stories, romances, plays and even poems, he was a symbol of the boastfulness, the playfulness, the might, and the violence of frontiersmen. The picturesque nature of his death had imaginative appeal, and greatly varied versions of his murder were published.

See Walter Blair and Franklin J. Meine (eds), *Half Horse Half Alligator: The Growth of the Mike Fink Legend,* (1956). (W. BL.)

FINLAND, called in Finnish SUOMI, is an independent republic of northern Europe. Through most of the early centuries of development (A.D 1155–1809) it was dominated culturally and politically by the Swedes; from 1809 to 1917 it was a Russian grand duchy. The Finns took advantage of World War I, and the Russian revolution of 1917, to win their independence, legalized by treaty of Tartu (Dorpat) with the Soviet Union, Oct. 14, 1920.

Geography.— Finland extends from 59° 48' to 70° 6' N. lat. and 19° 2' to 31° 35' E. long. It is 700 mi. from north to south, bordering Norwegian Lapland and the Arctic ocean on the north, the U.S.S.R. on the east, the Gulf of Finland on the south, the Gulf of Bothnia and Sweden on the west. It includes the numerous rocky Ahvenanmaa (*q.v.*) or Åland Islands in the southwest, part of Lapland, and, by the treaty of Tartu and until 1940, the ice-free fjord of Petsamo (Pechenga) in the north.

The area (1920–40) was 147,799 sq.mi. of which 60% was forest, 11% lakes, 3% arable and 5% grassland, and the rest largely swamp. The area of 130,119 sq.mi. determined in 1953 included inland waters (12,206 sq.mi.) but excluded territory ceded or leased to the U.S S.R. The chief lakes are Saimaa. Kallavesi, Paijanne and Näsijärvi; there are about 55,000 other lakes, many with rapids such as the Imatra. The chief rivers (none large) are the Muonio between Finland and Sweden, the Kemi and the navigable Oulujoki. The surface of the country is tableland 400 to 600 ft. above sea level. with a few elevations to 2,000 ft., and in the northwest, in the Haltio Mount, to 4,344 ft. The coastline is low, but rising more than 3 ft. per 100 years.

Geographically Finland is like the Scandinavian peninsula, showing granite and archaean rock with glacial and postglacial deposits of both lacustrine and marine origin. The soil is largely morainic, silty gravel, but clays form the most important portion of the cultivated areas. The climate is halfway between maritime and continental, the long severe winters being moderated somewhat along the coasts by the prevailing winds from the southwest. Summer lasts only two to two and a half months.

Flora and Fauna.— The predominance of forest. chiefly coniferous. gives the Finnish flora and fauna a special character and is also economically important. The dominant trees are pine (*Pinus sylvestris*) and spruce (*Picea abies*). The undergrowth is usually scrubby and meagre. About 30% of Finland is covered with marsh and bog. Among the plants are about 1,140 species of flowering plants and ferns and more than 1,000 species of lichens. The species of fauna number about 12,000; many of the birds migrate south in winter.

The country can be divided, botanically and zoogeographically, into five zones. The narrow coast area or oak zone is the richest in plant and animal species because of its milder climate. Oak, the dominant tree, and ash and hazel grow there. The commonest mammal is the hedgehog. There are numerous birds and insects and many sea birds and seals along the coast.

North of the oak zone is the maple or south Finland zone. The maple and elm reach their northern limit there. and there are many marshes and swamps and much bare land. Only two kinds of bat, the mole and goldfinch are found there.

North again is the lime or central Finland zone. The climate is more severe and there are larger barren areas and more marshes. In this and the maple zone occur a few bears, wolves and, in winter, small herds of reindeer followed by gluttons (wolverines). Numerous seals live in the Gulf of Bothnia.

The north Finland zone is the northern limit of the alder (*Alnus glutinosa*). There are immense pine forests, swamps and bogs. In the swampy wastes lichens and the crowberry (*Empetrum nigrum*) abound and swans and wild geese nest. Bears, wolves, domestic reindeer, gluttons, the lynx and viper are all found there.

The Lapland zone is mostly barren land with huge watery swamps and bogs. In the north is an area of coniferous forest, mostly dwarf pines covered with lichen. The spruce and, still farther north, the pine find their limit there. A small belt of birch grows north of the conifers, beyond which lies the tundra. Many northern birds, reindeer, wolves and gluttons live in the Lapland zone. Mosquitoes swarm in the marshes. The rivers hold salmon and trout; in the birch belt lives the Lapland bunting and by the lakes the long-tailed duck. The tundra is the home of the arctic fox, lemming and reindeer (now dying out in the wild state), snow bunting, ptarmigan and golden plover. On the Arctic coast a variety of sea birds nest, and cod, haddock, herring and many other kinds of fish are found in the sea. (X.)

HISTORY

The first real settlements in Finland were probably made about A.D. 100 by people crossing over from the southern shores of the Gulf of Finland. These people were thus a northern offshoot from the Finno-Ugrian tribes whose story is shrouded in mystery, as is the early development of the groups in Finland. At first they wandered about, burning off the forest in order to till the soil. Weapons, implements and ornaments indicate continuing relationship with the tribes to the south. Gradually family homesteads were established, and settlement from the southwest reached Lake Ladoga about A.D. 700. Increasingly trade and cultural bonds were established with the Swedes to the west, and southeastern influence all but disappeared. The tribes increased in population, warred among themselves, and were fought over by Sweden and by the Russian principality of Novgorod.

Swedish Rule.— Crusades were stimulated by the pope to win the people from their pagan beliefs (in Ukko, god of the air; Tapio, of the forests; Ahti, of the water, etc.). King Erik IX of Sweden in such a crusade (about 1155) conquered the Finns and left the English-born Bishop Henry of Uppsala at Turku (Åbo). But the Finns relapsed into paganism, though Henry became later their patron saint. Thomas. another English bishop, resumed the missionary task in 1209, and almost separated Finland from Swedish control to establish it as a papal province. The famous Birger Jarl compelled the Tavastians, one of the subdivisions of Finns, to accept Christianity in 1249; Torkel Knutson conquered the Karelians in 1293 and built the castle of Viborg (Viipuri), which for centuries to come was the outpost of Swedes and Finns against the Russians.

The Swedes spread civilization and accorded to the Finns the same civil rights they themselves had. Swedes settled in the Åland Islands and in spots along the western and southern shores of Finland. About 1528, Gustavus Vasa introduced the Reformed religion, and King John III raised the country to the dignity of a grand duchy. Gustavus Adolphus II and his successors did much for learning, but the country suffered terribly from war, famine and pestilence. Many Finns were compelled to fight with the Swedes in Germany during the Thirty Years' War.

In 1710 Peter the Great set out to wrest Finland from Sweden, and six years later the whole country was in his power. Thousands perished in the wars of Charles XII, but by the treaty of Nystad in 1721 the Russians retained Ingermanland, the whole Lake Ladoga, Karelia and the province of Viborg. Twenty years later the Swedes attempted reconquest but suffered disaster. In 1788 war again broke out between Sweden and Russia, and was carried on for two years without result.

In Feb. 1808 Tsar Alexander's army invaded Finland without declaring war. By the treaty of Fredrikshamn, on Sept. 17, 1809, Sweden ceded Finland and the Aland Islands to Russia.

Russian Rule.— Finland did not enter Russia as a conquered province. Alexander I granted it a free constitution and fundamental laws, and it became a semi-independent grand duchy with the emperor as grand duke. A senate was created and a governor general appointed. The province of Viborg was reunited with Finland in 1811. Åbo (Turku) remained the capital till 1821, when the seat of government was transferred to Helsingfors (Helsinki). The diet, which had not met for 56 years, was convoked by Alexander II at Helsingfors in 1863; but it was only under his successor, Alexander III, that the imperialist Pan-Slav movement, with the motto "one law, one church, one tongue," acquired influence in official circles.

Politics in Finland were complicated by the rivalry between the Swedish party, hitherto the dominant minority, and the Finnish national party which was asserting itself linguistically and politically.

Nicholas II, by the "February manifesto" (Feb. 15, 1899), virtually abrogated the legislative power of the Finnish diet. A new military law, practically amalgamating the Finnish with the Russian forces, followed in July 1901; Russian officials and the Russian language were foisted on Finland wherever possible, and in April 1903 the Russian governor was invested with dictatorial powers. To the Russian system of spies, domiciliary visits; illegal arrests; banishments and the suppression of newspapers, the Finns carried on a dogged resistance which culminated in the famous "national strike" of Nov. 1905. After six days the tsarist government — already much shaken by the events in Russia and Manchuria— capitulated. An imperial manifesto of Nov. 7, 1905, restored the *status* quo anfe 1899. The new diet remodelled the constitution on the basis of universal suffrage with freedom of the press, speech, meeting and association.

After "two glorious years of peace" and internal progress, the tsar peremptorily fixed an annual contribution in lieu of military service (*ukaz* of Oct. 7. 1909). The Finnish diet, though ready to compromise. was twice dissolved. and its social reform measures already passed — prohibition, child welfare, insurance, old-age pensions. education and betterment of landless workers—were thus killed. Civil marriages, however, were instituted. better provision made for illegitimate children and the principle of "equal pay for equal work" applied in the teaching profession, in the printing trade and, in 1913, in the state service. The duma alone considered itself competent to decide the questions affecting the interests of the Russian empire. Accordingly it passed the Imperial Legislation act on June 30/17, 1910, amid shouts of "Finis Finlandiae." Two imperial laws were laid before the diet. which refused them both and was dissolved. In one, the duma affirmed the principle of an annual indemnity in lieu of service; in the other, full civil rights were accorded to temporary Russian residents in Finland. The last-named measure, apart from its injustice, caused the overlapping of two different codes of law. Judges resigned, high officials went into exile. and every provisional governor left voluntarily or under compulsion. The country was ruled by a packed senate, the diet was peremptorily dismissed. the press censored. The Russification inflicted by the duma mas as oppressive as that imposed by the tsar.

World War I and the Russian Revolution. — Finland escaped invasion, but its liberties were restricted and its merchant marine was bottled in the Gulf of Bothnia. The Allied blockade caused a 25% rise in living costs, but industries connected with military supply attained unexampled prosperity. The Russians, sporadically anxious to please, abolished the annual military indemnity and merely imposed a 5% tax on property and mortgages. Finland naturally feared that a victorious Russia would again turn oppressor. About 2,000 young Finns enlisted on the German side, ostensibly for service only on the eastern front.

Nicholas II abdicated on March 1j, 1917, and the provisional government restored representative government in Finland. The Russified senate was disbanded and a temporary body of 12 (half Social Democrats, half representing the bourgeoisie) assumed executive power. The Socialist speaker of the diet, Oskari Tokoi, was nominated president of the senate; Kullervo Manner; of the same party, speaker of the diet. The diet, resolving on July 18, 1917, that it alone could make laws relating to home affairs and finance. passed en bloc all bills previously held up by the tsar, including the eight-hour day and the total prohibition of alcohol. Yet it failed to relieve the food shortage. The intense industrial development had strengthened hooliganism, and the war had brought about 40.000 Russian refugees from food shortage and incipient riot. From March 1917 to Feb. 1918 repeated strikes threatened the existence of the nation. Meanwhile, the advent of the Bolsheviks to power in Nov. 1917 deepened the pro-Russian sympathies of the Social Democrats, while the propertied classes sought to cut adrift from the Soviet state. On Dec. 6, 1917, the diet and the now bourgeois senate drew up a declaration of independence. The soviet of people's commissars on Jan. 4, 1918, declared that the step conformed with their policy, whereupon Sweden and the other Scandinavian countries acknowledged the independence of Finland. France and other states followed. The treaty of Brest-Litovsk (March 3, 1918) confirmed Finland's independence, and four days later Finland concluded a treaty which made it Germany's ally. (See BREST-LITOVSK, TREATIES OF.)

"Red Guards," recruited from Finnish labourers and reinforced from Russia, began to overrun the country. A hurriedly organized Finnish national army, under Baron Carl Gustaf Emil Mannerheim, a former general of the tsarist army, proved insufficient to maintain order. Sweden refused to help, but at the request of the Finnish government, Germany sent about 12,000 troops under Gen. Count Rudiger von der Goltz. The Finns and Germans conquered the Reds and drove out the Russians. Mannerheim subdued Tampere on April 6 and Goltz entered Helsinki on April 14. After Mannerheim's decisive victory near Viipuri (Viborg), on April 28–29, the "White" counterterror took the lives of thousands.

The diet, which met in June 1918, was moderate, since the Socialists who formed 46% of the electorate mere excluded from the register. It authorized the Germanophile senator, Pehr Eyvind Svinhufvud, to exercise the supreme poner in so far as it had not already been conferred on the senate, which offered the crown to Prince Frederick Charles of Hesse, brother-in-law of the German emperor. Prince Charles accepted the crown, but never proceeded to Finland and the question was allowed to lapse.

The Germans demanded Finnish military co-operation against the Murmansk railway. which was guarded by a British expeditionary force. Their claims were becoming peremptory when. on July 18, the Allied offensive in the west diverted Germany's forces. Thus time nas gained *until* the Armistice of *Nov. 11, 1918*, turned Finland toward the democratic regime. On Dec. 12 Svinhufvud mas succeeded as regent by Mannerheim, who formed a coalition government composed of 6 Republicans and 6 Monarchists. In the general election of March 1. 80 Social Democrats. 42 Agrarians, 28 coalitionists, 26 Progressives, 22 Swedes and 2 Christian Labour members were returned. The Social Democrats lost 12 seats as a result of the disfranchisement of 40,000 voters for participation in the Red revolt.

The Republic, 1919–1939.—On June 17, 1919, the Finnish diet established a republic. The new constitution came into force on July 17. There is a single chamber, eduskunta, of 200 members, in which the sovereign power is embodied. The executive power is vested in a president who is chosen for a six-year term by 300 presidential electors nominated by the citizens. He ratifies new laws or withholds consent. dissolves the diet, orders new elections and conducts foreign affairs. All his powers are exercisable through the ministers and his decisions have to be taken in the council of state consisting of 10 ministers, who are responsible legally and politically. There are ten administrative districts, closely following the linguistic distribution. Both Finnish and Swedish are official languages. Amnesty bills of 1921 and 1927 freed the defeated opponents of the war years. Suffrage is universal for men and women above the age of 24.

A peace treaty was signed with Soviet Russia at Tartu (Dorpat), Estonia, on Oct. 14, 1920. Pechenga (Petsamo) was ceded to Finland, which thus obtained an outlet on the Arctic ocean. On Dec. 16, 1920, Finland was admitted to the League of Nations. As such it claimed sovereignty over the Åland Islands (see AHVENANMAA), which was disputed by Sweden. In June 1921 the League of Nations decided in favour of Finland. In Oct. 1921 the East Karelians, racially allied to the Finns, revolted against Moscow. but the rising was crushed.

In these years Finnish foreign policy remained in the hands of

R. Holsti. On March 17, 1922, Holsti signed in Warsaw a treaty which pledged Finland, along with Estonia, Latvia and Poland, to consultation in case of a Soviet aggression. The diet of Finland, however, on May 12 refused to ratify this treaty and enunciated a general policy of avoidance of military obligations.

In succeeding years all attempts to form a Baltic bloc came to nought, while Finland turned more and more toward co-operation with its Scandinavian neighbours. (W. L. B.; X.)

Internal politics between World Wars I and II had turned on the issues of townsmen v. countrymen, property owners v. wage earners and a new Finnish-speaking intelligentsia *v.* a Swedish-speaking upper class, but agreement had always been reached within the bounds of democratic procedure. The wave of extreme Rightist or Fascist movements which spread over Europe in the early 1930s got no farther in Finland than a feeble Lapua movement which was put down in 1932 without fighting.

The strongest single party had been the Social Democratic and its best-known leader was Vaino Tanner. After the war of independence of 1918 the Communist party was small at first, but its strength in a country bordering on the U.S.S.R., with a strong Finnish Communist centre there, caused such fears that the party and its newspapers were suppressed in 1923, which did not prevent the Communists from securing 18 seats in the diet elected in 1924. New difficulties led to tense situations and the passage in 1930 of anti-Communist laws.

The most important reform of the between-wars period, carried through without serious opposition, was the *Lex Kallio* (1927), which, by splitting up the big estates and bringing new areas into cultivation, turned Finland into a nation of peasant-proprietors.

World War II.—Relations with the Soviet Union were never good, but Finland did sign one of the U.S.S.R.'s network of non-aggression pacts (Moscow, Jan. 21, 1932) and also was a party to the treaty in which the Soviet Union and all its European and middle-eastern neighbours defined the aggressor (London, July 3, 1933). Neither of these treaties, however, prevented the Soviet aggression against Finland in 1939.

On Oct. 5, 1939, the U.S.S.R. invited a Finnish delegation to Moscow to discuss political questions. Finland sent Juho Kusti Paasikivi, minister to Sweden and one of the peace delegates of 1920. The Soviet government asked for a 30-year lease of the port of Hanko, for a Soviet naval base; it also asked for the cession of part of the Karelian isthmus, some islands in the Gulf of Finland and various other portions of Finnish territory, in all about 1,066 sq.mi. in strategic locations, Finland to receive as compensation about 2,135 sq.mi. north of Lake Ladoga. The Finnish fortified zone in the Karelian isthmus was to be dismantled; the two states were also to agree not to join any alliances directly or indirectly hostile to the other.

Finland agreed to the cession of most of the islands demanded and an adjustment of the frontier in the Karelian isthmus, against compensation in both cases; it undertook to supplement the non-aggression pact of 1932 with a political agreement such as requested by the U.S.S.R.; it refused, however, to dismantle its fortifications and rejected the Soviet claim to Hanko as not compatible with Finnish neutrality. No agreement was reached and the Finnish delegation left Moscow on Nov. 13.

The Soviet press and wireless now launched a violent campaign against Finland and on Nov. 30, 1939, the Soviet armed forces attacked the country by land, sea and air. Two days later it was announced from Moscow that a "people's government of Finland" had been set up in the sea resort of Terijoki, close to the Soviet border. This puppet government consisted wholly of Finnish Communists who had fled to Russia after the unsuccessful attempt to impose a Communist regime on Finland in 1918. The head of this "government" was Otto Willie Kuusinen, a member of the executive committee of the Comintern. Vyacheslav Molotov signed with Kuusinen a treaty of friendship and mutual aid in which the latter agreed to all Soviet demands presented to the legitimate Finnish government.

Once more Mannerheim, now 72 and a field marshal, took command of his country's forces. The Finns fought heroically and Soviet hopes for an internal revolution proved fruitless. Finland's able defense drew promises of aid from Great Britain and France, and on Dec. 14, 1939, the League of Nations expelled the U.S.S.R. from membership as an aggressor. Although sympathy for the Finns was widespread throughout the world, the neutrality of Sweden and Norway prevented any substantial practical help. After 105 days' fighting, superiority in manpower and material enabled the Soviet army to break through the Mannerheim line. On March 12, 1940, defeated Finland signed a peace treaty in Moscow ceding to the U.S.S.R. more than one-tenth of its territory, including the whole Karelian isthmus with the city of Viipuri (Viborg). the country's fourth largest industrial centre; Hanko became a Soviet base. Nothing was heard of the Kuusinen "government."

When the Germans invaded the U.S.S.R. on June 22, 1941, the Finnish temptation to recover the lost land was stronger than any other consideration. Risto Ryti, who in Dec. 1940 succeeded Kjosti Kalliό as president of the republic, announced on June 27 that "for the liberty of the motherland" Finland was going to war alongside Germany. For the third time Mannerheim led the Finns against the Soviet army. By the end of August all territory lost in 1940 had been recovered; to liberate the Karelian people the Finnish army invaded the region between the lakes of Ladoga and Onega and took Petrozavodsk on Sept. 30.

Since Finland, disregarding warnings by the British and the U.S. governments, persisted in clinging to its policy of fighting on the German side, Great Britain declared war on it on Dec. 6, 1941, and the United States broke off diplomatic relations on June 30, 1944. The Finns had started to discuss peace with the U.S.S.R. in Feb. 1944, Paasikivi, Finland's negotiator of 1920 and 1940, going first to Stockholm, where he met Mme. Aleksandra Kollontay, the Soviet minister, and, at the end of March, to Moscow, for talks. The U.S.S.R. insisted, however, on the re-establishment of the 1940 frontier and in addition asked for the cession of Petsamo (thus shutting off Finland from the Arctic ocean) and payment of a $600,000,000 indemnity, *i.e.*, the country's national income in 1939. Such humiliating terms were at first refused, but as the Soviet armies started an offensive in Karelia, Viipuri being captured on June 20 and Petrozavodsk on June 29, the Finns changed their mind. On Aug. 1, 1944, Ryti resigned and Mannerheim (from June 4, 1942, marshal of Finland) was elected president of the republic.

On Sept. 19 the armistice was signed. Finland agreed to the terms presented to it in February with two differences: first, the leased territory for a Soviet naval base was moved from Hanko to Porkkala, only 18 mi. from Helsinki; second, the reparations to be paid in five years were reduced to $300,000,000. A sequel to the armistice was an armed conflict between the Finns and a German army in the north under Col. Gen. Lothar Rendulic.

The Republic from 1945.—In Nov. 1944 Paasikivi formed a new government. Elections were held on March 17–18, 1945, and on the resignation of Mannerheim on March 4, 1946, Paasikivi succeeded him as president. The peace treaty between Finland and the Allied powers was signed in Paris on Feb. 10, 1947.

After the second Soviet-Finnish war the Communist party emerged again into the open. For election purposes it combined with leftist splinter groups in a Finnish Democratic People's league (S.K.D.L.). Before World War II the Social Democratic party was the strongest. but now the Agrarian (Peasant) party was equally important. Three other parties had been important throughout the history of independent Finland: the Union (Conservative) party, the Progressive (Liberal) party, which was reformed in 1951 as the People's party, and the Swedish party representing the interests of the Swedish-speaking minorities.

Between 1944 and 1952 the obligation of settling the transferred population and of paying reparations to the Soviet Union were paramount internal problems. When the U.S.S.R. annexed Finnish Karelia, the inhabitants decided to settle in what was still Finnish territory. The Finnish government was therefore faced with the task of finding homes, employment and, in most cases, land for more than 400.000 people. The reparations problem was even more difficult. Finland had to supply the U.S.S.R. with goods worth $300,000,000 at the price levels of 1938, and, accord-

TABLE I.—*Elections in Finland*

Parties	Seats				
	1939*	1945	1948	1951	1954
Conservative	26	28	33	28	24
Swedish	18	15	14	15	13
Agrarian	56	49	56	51	53
Liberal (or Progressive)	7	9	5	10	13
Social Democratic	85	48	54	53	54
S.K.D.L. (Communist)		51	38	43	43

*There were also 8 members of the Patriotic People's Movement (I.K.L.), a Fascist party.

ing to detailed stipulations, was to consist of about one-third each of timber and timber products, ships and cables and machinery. For the last category Finland lacked alike the materials, the plant and the skilled workers; its production involved a revolution in the national economy. Nonetheless, the total reparations bill was met by the closing date. Sept. 1952.

Finland was the only country under Soviet influence where democracy survived. Though Mauno Pekkala and Yrjo Leino, both Communists, were respectively prime minister and home secretary from 1946 to 1948, they failed to bring the army or the police under Communist influence. In 1948 the major event before the elections was the Soviet-Finnish treaty of mutual assistance (April 6), which bound Finland to fight in defense of the U.S.S.R., but only if the latter were attacked through Finland and even then only on Finnish territory. After the elections (July), K. A. Fagerholm formed a minority government comprising his own Social Democrats and some nonparty men. This, however, had the support of other non-Communist parties and survived the Communist-organized strike of Aug. 1949, which protested the government's first devaluation of the currency (July) ; but it had to resign on the presidential election of Jan. 1950 (which returned Paasikivi) and was replaced in March by a government of Agrarians, with some members from the two smallest parties, under Urho Kekkonen. The new government negotiated an advantageous five-year trade agreement with the U.S.S.R., a feature of which was the latter's promising to take quantities of Finnish industrial products (but for this, the industries created to meet the Soviet demand for reparations might have had no market after reparations were paid). In Jan. 1951 Kekkonen took seven Social Democrats into the government, to strengthen his hand for measures against the continuing inflation. The elections (July) had little effect on the representation of the parties, and Kekkonen maintained the previous coalition.

The export boom of 1951 was followed bv a trade recession which aggravated the economic problem; and-in 1953, after controversv between the parties on the means of lowering prices, the coalition government resigned (June). Kekkonen then formed a ministry of Agrarians, Swedes and nonparty economists. When this fell in November, a caretaker government under Sakari Tuomioja took office. Elections, held in March 1954, failed to clarify the situation, as neither Fagerholm nor Kekkonen could bring the other's party into a government under him; but in May an Agrarian-Social Democratic coalition was effected under Ralf Torngren, of the Swedish People's party. A law was passed to prolong the normal life of a parliament from three to four years. In October, however, the government resigned as the two major parties disagreed on the measures of reducing the cost of living; but Kekkonen formed yet another coalition between them. On Feb. 15, 1956, Kekkonen was elected president of the republic by the majority of 151 in the electoral assembly of 300.

On Sept. 19, 1955, an agreement was signed in Moscow by which the U.S.S.R. gave up its military base at Porkkala in return for a 20-year prolongation of the Soviet-Finnish treaty of mutual assistance of 1948. This abandonment had no strategic significance because from 1945 the U.S.S.R. had had other, better bases in the Gulf of Finland. Later in 1955 Finland was admitted to the United Nations and joined the Nordic council, thus taking part in international affairs for the first time after World War II.

POPULATION

The total population of Finland, reckoned to number about 421,500 in 1750 and about 1,661,000 in 1851, was returned as 3,147,600 in 1920, as 3,695,600 in 1940 and as 4,029,803 by the census of 1950—when almost all the Finnish-speaking population of the territories lost or leased to the U.S.S.R. had been transferred to Finland (423,759 persons in 1946). Racially this population is the result of a 1,000-year blending of Finno-Ugrian (*q.v.*) and Teutonic (Swedish) elements, which however are still to a considerable extent distinguishable: 8.55% of the population spoke Swedish, 91.26% spoke Finnish (see FINNO-UGRIAN LANGUAGES), and there was a small minority of Lapps. The average density of population was only 31.0 per square mile in 1950, but the distribution was uneven, as 40% inhabited the three southern provinces of Uusimaa, Turku-Pori and Häme, which constitute only one-sixth of the national territory.

The principal cities, according to the 1950 census, were Helsinki (Helsingfors), the capital, 369,380; Turku (Åbo) 101,824; Tampere (Tammerfors) 101,143; Lahti 44,652; Pori (Björneborg) 43,213; Oulu (Uleåborg) 37,910; Vaasa (Vasa) 34,999; Kuopio 33,353 and Jyväskylä 30,661.

Religion and Education.—The national church is the Evangelical Lutheran, to which 96% of the population adhere; the archbishop of Turku is its head, and it has five other bishops. The Orthodox church, which serves 1.8% of the population, has an archbishop at Kuopio. There are small communities of Baptists, Roman Catholics and Jews; and 2% of the population is described as of no religious affiliation.

Since 1921 attendance at school has been compulsory for children between the ages of 7 and 15 years. Secondary education is provided by the "middle" schools for children between the ages of 10 and 15; by other secondary schools from which pupils may pass to the universities at the age of 18; and by various types of vocational schools. Higher education is provided by degree-granting colleges which pupils enter after passing the matriculation examination at the secondary schools. Finland's first university, founded at Turku in 1640, was transferred to Helsinki in 1827. A Swedish university was opened at Turku in 1919, a second Finnish one in 1922.

In 1953–54 there were: 6,402 primary schools with 541,770 pupils and 22,817 teachers; 345 secondary schools with 114,901 pupils; 473 vocational schools with 31,054 pupils and 3,284 teachers: 179 "folk" high schools for adults with 52,374 pupils and 1,068 teachers; 14 primary teachers' colleges with 2,456 students and 201 teachers. There were 3 universities and 12 other institutions of higher education with a total of 15,355 students and a teaching staff of 1,210.

ECONOMICS AND FINANCE

Agriculture.—Agriculture is the chief occupation of the people although the arable land covers less than 8% of the country area. Arable land lies mainly on the coastal plains; hay occupies one-half and cereals one-third of the cultivated area. Oats are the dominant cereal but from 1930 quick-ripening spring wheat gained ground. Potatoes are the chief root crop. (*See* Table II.) Numbers of livestock are shown in Table III.

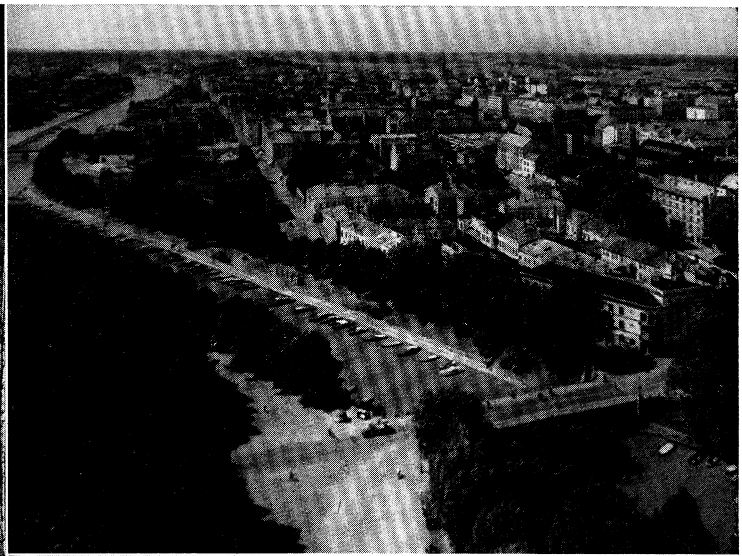
TABLE II.—*Agricultural Production*
(Annual averages, in thousands of metric tons)

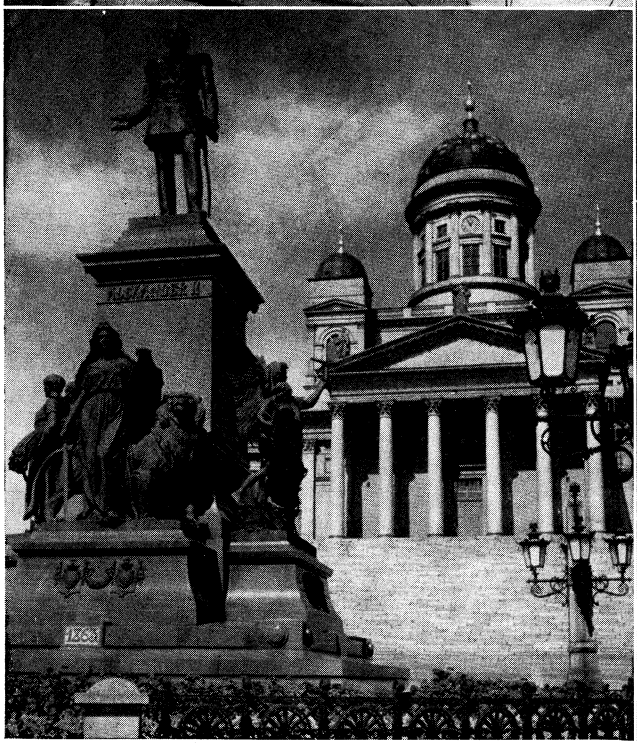
Crop	1927–31	1935–39	1948–50	1953	1954	1955
Oats	603	725	688	904	774	624
Rye		353	211	130	132	123
Wheat		191	295	218	235	179
Barley		185	190	314	262	254
Potatoes	816	1,323	1,519	1,379	1,090	1,067

TABLE III.—*Livestock*
(Thousand head, September)

	1933	1939	1948	1953	1954
Cattle	1,745	1,767	1,452	1,809	1,885
Sheep	973	923	999	998	908
Pigs	435	473	303	434	546
Horses	360	342	382	339	326
Reindeer	92	100*	...	151	...
Chickens	3,018	2,550	1,918	3,547	3,877

*1937.





BY COURTESY OF (TOP LEFT, TOP RIGHT, CENTRE RIGHT) EMBASSY OF FINLAND: PHOTOGRAPHS (BOTTOM LEFT) WALT SANDERS FROM BLACK STAR. (BOTTOM RIGHT) FERNAND GIGON FROM BLACK STAR

SCENES IN FINLAND

Top left: A grove of young birch trees in the winter. Birch is used widely in the plywood and furniture industries of Finland

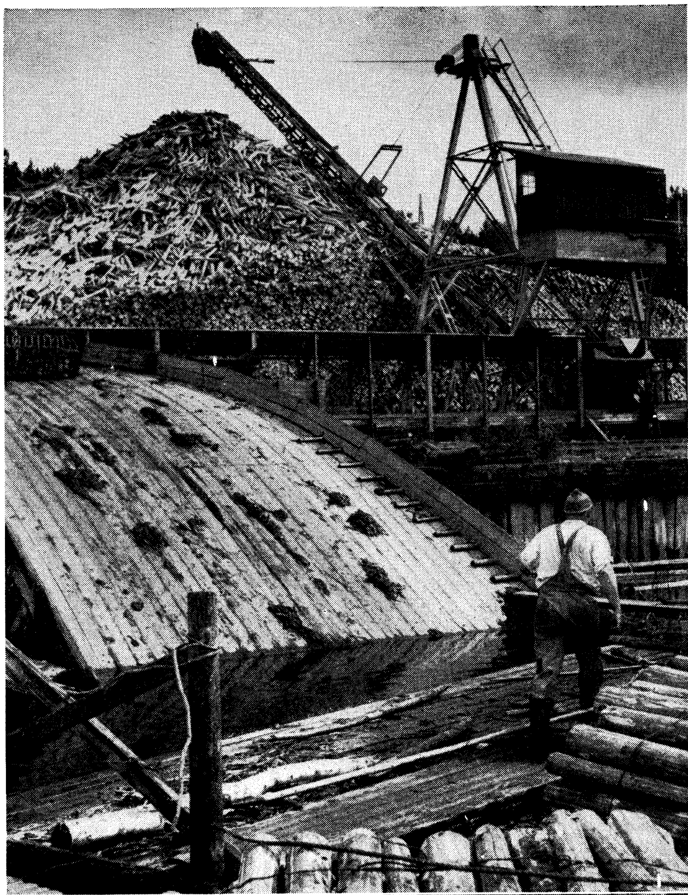
Top right: Aerial view of Turku, third largest city of Finland

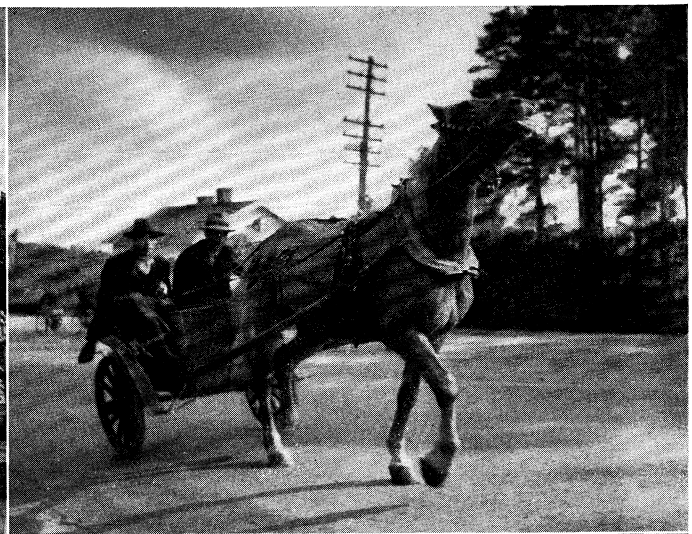
Centre right: Punkaharju ridge, a continuous strip of land winding between lakes near Laukansaari

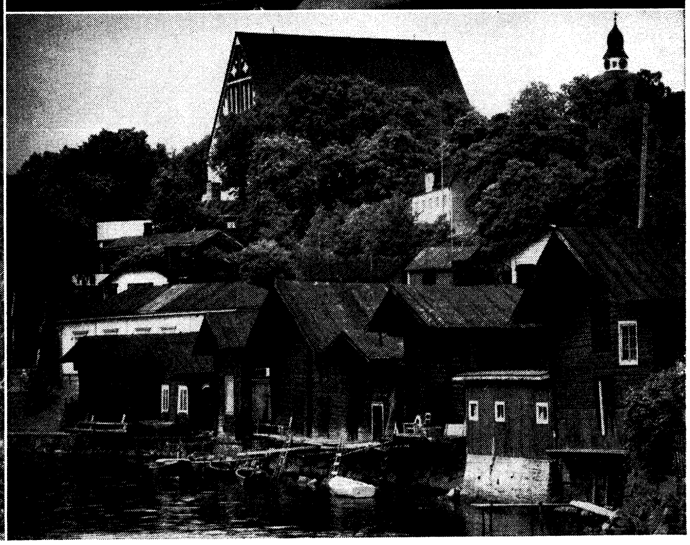
Bottom left: Statue of Alexander II of Russia, and the cathedral, Helsinki

Bottom right: Children feeding pigeons on the Esplanade, Helsinki

FINLAND







PHOTOGRAPHS, THREE LIONS

LIFE IN FINLAND

Top left: Lumber piled up for transport to a processing plant

Top right: Worse-drawn cart, still used in northern cities such as Sodankyla

Centre right: Laplander and child of the Lake Inari region. The cradle is covered with reindeer skin

Bottom left: Horse and sled used to drag cut timber from the woods

Bottom right: Water front houses, Porvoo. The tower of the cathedral is in the background, right

Industry.— Finland has few minerals. There is no coal or oil. At Outokumpu about 600,000 metric tons of sulphide ores are produced annually (4% copper. 26% sulphur, 27% iron, with some zinc, cobalt, silver and gold). Finland possesses extensive deposits of limestone, soapstone and red granite, but the country's main resources lie in its forests and water power. In the Finnish forest industry a continuous trend toward development of higher stages of manufacture was to be observed. Before World War I the greater part of output was sawn timber. The period between World Wars I and II was marked by a powerful advance in the pulp and paper industry. In the years following World War II the industry manufactured prefabricated houses; however, the greatest attention was devoted to processing wood pulp into paper, cardboard and packing material.

About one-fifth of the population is engaged in the manufacturing industry, mainly connected with forest products. In 1939 Finland had an installed capacity of electric energy amounting to 1,004,000 kw., including 492,000 kw. of hydroelectric generators. In the territories ceded to the U.S.S.R., Finland lost about one-quarter of its hydroelectric power plants. In 1938 production of electricity amounted to 3,108,000,000 kw.hr., including 2,456,000,000 kw.hr. from hydroelectric plants; after 1945 new power stations were built, and in 1954 the total production amounted to 5,643,000,000 kw.hr., mostly from hydroelectric plants.

Finance and Banking.—The Finnish markka was stabilized in relation to the U.S. dollar in 1922, and in 1925 a gold basis was adopted, the rate being 39.70 markkaa to the dollar and approximately 193.23 markkaa to the pound sterling. World depression forced the markka off gold in Oct. 1931; in 1933 it was stabilized again at 227 markkaa to the pound sterling. In Dec. 1938 its parity level with the dollar and the pound was again abandoned, and in 1939 the exchange rate was 49 markkaa to the dollar and 197 markkaa to the pound. Further devaluations followed World War II, and after Sept. 1949 the exchange rate was 231 markkaa to the dollar and 646 markkaa to the pound. The Bank of Finland, dating from 1811, is the state bank and bank of issue. There

Table IV.—*National Budget*
(In millions of markkaa)

	1938*	1951*	1952*	1953*	1954*	
Revenue . . .	4,960	181,000	196,000	192,200	198,600	196,320
Expenditure . . .	5,210	171,900	188,000	205,000	200,300	196,275

*Actual. †Estimates.

was a currency circulation of 2,300,000,000 markkaa against gold holdings of $28,900,000 and foreign exchange holdings of $48,500,000 in Dec. 1938 (when deposit money amounted to 2,800,000,000 markkaa); and a currency circulation of 48,300,000,000 markkaa against gold holdings of $35,300,000 and foreign exchange holdings of $188,900,000 in Dec. 1955 (when deposit money amounted to 43,300,000,000 markkaa). For the national budget *see* Table IV. In Sept. 1939 the foreign debt stood at 1,040,000,000 markkaa and the internal debt at 2,810,000,000 markkaa; at the end of 1954 the figures were 62,100,000,000 markkaa and 49,700,000,000 markkaa respectively.

Foreign Trade.—Before World War I Russia was the most important buyer of Finnish goods, but after the proclamation of its independence Finland turned its foreign trade westward. Great Britain became the largest export market (45.3% in 1937), followed by Germany (13.1%); and Great Britain was also the chief source of imports (22.1% in 1937), likewise followed by Germany (19.4%). In 1946 the Soviet Union took second place as Finland's customer and supplier, Great Britain maintaining its first place. By the end of 1953, however, the U.S.S.R. was taking 25.4% of the exports and Great Britain 22%, the same countries providing 21.4% and 15.8% of the imports respectively. In 1954 Great Britain recovered first place among Finland's customers and suppliers, taking 22.5% of the exports and providing 18.8% of the imports. (*See* also Table V.)

Metals and metal manufacture, machinery and apparatus, textiles, coal, oil and cereals headed the import list; exports consisted of timber and timber products (about four-fifths of the total) and agricultural products such as butter, cheese and hides.

Table V.—*Foreign Trade*
(In millions of markkaa)

Transport and Communications.—In 1953 there were 7,476 km. of railways on which 16,343,000 tons of goods were transported. The numerous lakes are utilized freely for transport and, joined by short canals, constitute continuous waterways. These waterways are navigable at a length of about 2,700 mi. and floatable at a length of about 26,500 mi. There were 63,460 km. of roads in Dec. 1953, when the number of licensed motor vehicles comprised 59,216 cars and 49,054 commercial vehicles. The merchant navy (vessels of 100 or more gross tons) amounted in April 1955 to 588 vessels, totalling 728,805 gross tons. Finnish air lines connect Helsinki with Stockholm, Copenhagen, Hamburg, Amsterdam, Paris and London, and with the chief provincial towns. In 1954 air transport amounted to 94,512,000 passenger-kilometres and 873,600 ton-kilometres of freight; kilometres flown (1953) 3,993,000. In 1954 there were 408,531 telephones and 970,798 radio licences.

Defense.—Under the treaty of Paris (1947) Finland was permitted to maintain an army of 34,400, an air force of 3,000 officers and men and 60 aircraft (bombers being forbidden) and a navy up to 10,000 tons and 4,500 officers and men. The president of the republic is commander in chief: with the minister of defense responsible to the council of ministers for the efficiency of the armed forces; there is also a high command and general staff. All male Finnish citizens are liable for military service from the age of 19 to the age of 60. The period of peacetime service is 350 days. All men conscripted belong to the reserve up to the age of 40 and can be called to attend periodical training courses. From 40 to 60 they belong to the second reserve.

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(J. H. Jn.; X.)

FINLAY, GEORGE (1799–1875), British historian. was born of Scottish parents at Faversham, Rent, on Dec. 21, 1799. He studied for the law in Glasgow, and about 1821 went to Göttingen. In 1823 he went to Greece, being interested in the struggle for Greek independence. and spent 14 months studying the country. At Missolonghi he met Byron. and for two months spent nearly every evening discussing Greek affairs with him. After a short visit to Scotland he returned to Greece, where he spent the rest of his life.

In 1827 Finlay took part in the unsuccessful operations of Lord Cochrane and Sir Richard Church for the relief of Athens. When independence was secured in 1829 he bought an estate in Attica, and tried, without much success. to introduce better methods of agriculture in Greece. He then turned to the systematic study of Greek history with which he occupied himself until his death in Athens on Jan. 26, 18;j.

The first part of his great work appeared in 1844, under the title of *Greece under the Romans*, and was followed by *History of the Byzantine and Greek Empires from 716–1453* (2 vol., 1854); *History of Greece under the Ottoman and Venetian Domination* (1856) and *History oj the Greek Revolution* (2 vol., 1861). From 1864 to 1870 he was correspondent of *The Times*.

Bibliography.—H. F. Tozer's edition of his *History of Greece from its Conquest by the Romans to the Present Time, 146 B.C.–A.D. 1864*, 7 vol. (Oxford, 1877), which includes the books mentivned above, contains also a fragmentary autobiography. Finlay's *Greece under the Romans* and *History of the Byzantine Empire from 716 to 1077* have been published in the Everyman Edition (1906).

FINLAY, ROBERT BANNATYNE FINLAY, 1ST VISCOUNT (1842–1929), British lawyer and politician, was born near Edinburgh on July 11, 1842. He was educated at Edinburgh academy and university and graduated in medicine. He was called to the bar in 1867 and became a queen's counsel and a bencher of the Middle Temple in 1882. He sat as a Conservative for Inverness Burghs from 1885 to 1892 and regained the seat and was made solicitor general in Lord Salisbury's government in 1895, when he was knighted. In 1900 he became attorney general, remaining in the government until the Conservative defeat of 1905–06.

From 1902 to 1903 he was lord rector of Edinburgh university. In 1910 he was elected M.P. for Edinburgh and St. Andrews universities, and in 1916, on the formation of David Lloyd George's government, he became lord chancellor and received a barony. He retired in 1918 and was created a viscount in 1919. In 1920 he was appointed British member of the Permanent Court of Arbitration at The Hague, and in 1921 he became a judge of the Permanent Court of International Justice.

Finlay died March 9, 1929.

FINNER, the name used by whalers to denote the rorquals (*q.v.*) (*see* also WHALE).

FINNEY, CHARLES GRANDISON (1792–1875), U.S "new measure" evangelist. theologian and college president, was born in Warren, Conn., Aug. 29, 1792, and grew to manhood in Oneida county. N Y. After teaching school for a few years he studied law privately and in 1818 entered the law office of Benjamin Wright, Adams, N Y. His religious training had been meagre, but references to Mosaic institutions in his law studies impelled him to study the Bible. With his conversion in 1821 he was convinced that he had been given a "retainer from the Lord Jesus Christ to plead His cause," so he immediately dropped his law practice to become an evangelist, and was licensed by the Presbyterians. Adopting some of the features of frontier revivals—especially the "anxious seat"—and addressing congregations as he used to plead with a jury, he fomented wild revivals in the villages of upper New York. These methods, carried into the Congregational and Presbyterian churches of the larger towns and cities, were soon dubbed "new measures" and aroused intense opposition, particularly among men trained in the New England schools and at Princeton. Such opposition lessened as Finney's methods became more polished, while his revivals carried into the larger cities continued to be spectacularly successful.

In 1832 he began an almost continuous revival in New York as the settled minister of the Second Free Presbyterian church Because he was at odds with Presbyterian theology and discipline, his supporters built the Broadway tabernacle for him in 1834. Two years later he withdrew from the presbytery, and the church became Congregational in polity. In 1835 he became professor of theology in the newly formed theological school at Oberlin. O., and for two years divided his time between that post and his New York tabernacle. In 1837 he severed his connection with the latter and became minister of the First Congregational church in Oberlin, which was closely related to Oberlin college. From 1851 to 1866, besides his other two posts, he was president of the college. He died Aug 16, 1875.

The changing modes and surroundings of Finney's career as a revivalist typify the development of revivalism during the period of his greatest activity. Beginning in raw frontier villages among lo er-class and poor people, he moved into the burgeoning urban centres of financial and social power, working among those of the rising middle class with its growing philanthropic interests. In making this change of locale, his revivals were metamorphosed from the largely unplanned fomenting of emotional outbursts leading to conversions, into rather carefully designed meetings in which he pleaded the cause of Christianity in sermons and lectures which resembled the lawyer's brief. When he settled as a minister and professor of theology his emphasis changed from concentration solely upon getting conversions to include concern for the perfection of the Christian life in the churches.

His theology was typical of all the revivalists, emphasizing common sense and man's initiative in conversion and ability to make himself a new heart by his own choice. As did other revivalists, he tended to make the test of the truth of the doctrine preached its effectiveness in getting results, namely converts. This emphasis, of course, played havoc with traditional standards of doctrine and polity in the churches, impoverishing the religious life by excessive emphasis on the conversion experience to the neglect of cultivation of the Christian life thereafter.

His life is best told in his *Memoirs* (1876), and his views expounded in his *Lectures on Revivals* (183j) and *Lectures on Systematic Theology* (1847). (S. E. MD.)

FINNISH LITERATURE. The earliest writer in the Finnish vernacular was Mikael Agricola (c. 1510–57), who published an A.B.C. book (*c.* 1542) and, as bishop of Turku (Åbo), religious and educational works. A Finnish version of the New Testament was printed by Agricola in 1548. and some books of the Old Testament in 1551–52. A complete Finnish Bible was published at Stockholm in 1642. The dominion of Sweden was unfavourable to the development of Finnish literature; not until 1835, when the Finnish epic, the *Kalevala* (*q.v.*), was published thanks to Elias Lönnrot (*q.v.*), was the Finnish language used for literary composition. A great work in the revival of interest in the Finnish language was done by Suornalaisen Rirjallisuuden Seura (the Society of Finnish Literature), founded in 1831.

Modern Finnish literature has its roots in the poetry, drama and fiction of Aleksis Kivi (1834–72), a genius whose original style inspired others to write in Finnish. *Nummisuutarit* (1864; "The Cobblers of the Heath") is one of his robust peasant comedies. His most famous work is the epic novel *Seitseman veljestä* (1870; "Seven Brothers"), in which Kivi gave full rein to his humour and rich fantasy. Realistic writing was further developed by the novelist and playwright Minna Canth (1844–97). Finnish cultural life received a vigorous impulse when Kaarlo Bergbom founded the Finnish National theatre and P. E. Cajander (1846–1913) translated the plays of Shakespeare.

The central figure in Finnish letters at the beginning of the century was Juhani Aho (1861–1921), a realist who, toward the end of his life, made big concessions to romanticism. His works include *Rautatie* (1884; "The Rail ay"). *Papin tytär* (1885; "The Clergyman's Daughter") and *Lastuja* (1891–1921; "Chips"), eight volumes of stories, memoirs, travel notes, essays, etc. A much-discussed author was the man whose pseudonym was Johannes Linnankoski (1869–1913); his best-known novel was *Laulu tulipunaisesta kukasta* (1905; "The Song of the Blood-Red Flower") and his best work stylistically *Pakolaiset* (1909; "The Fugitives"). Arvid Jarnefelt (1861–1932), after his remarkably mature first work *Isänmaa* (1893; "The Fatherland"). became strongly influenced by Tolstoy. Two skilful portrayers of peasant life are Joel Lehtonen (1881–1934) and Ilmari Kianto (1874–); their chief novels are, respectively, *Putkinotko* (1919) and *Ryysyrannan Jooseppi* (1924).

The third great master of Finnish prose after Kivi and Aho is the 1939 Nobel prizewinner F. E. Sillanpaa (*q.v.*; 1888–). Like most Finnish writers, he depicts country life, but none has caught its poetic undertones as well as he. Three of his novels are *Hurskas kurjuus* (1919; "Meek Heritage"), *Nuorena nukkunut* (1931; "Fallen Asleep While Young") and the lyrically beautiful *Ihmiset suviyössä* (1935; "People in the Summer Night"). The colourful novels of Unto Seppanen (1904–55) are a vivid portrayal of life in his native Karelia. The "proletarian" writer Toivo Pekkanen (1902–) began his career as a factory hand and became a member of the Finnish academy; *Lapsuuteni* ("My Childhood") is an uplifting account of his early years. Lauri Viita (1916–) is a gifted poet who has also written a novel, *Moreeni* ("The Moraine"). The versatile and prolific writer Mika Waltari (1908–) has great mental elasticity and artistic temperament. His historical novels are well known abroad. Pentti Haanpaa (1905–55) was a master of the short story; his pithy style was well suited to his portrayal of life in the backwoods. Oiva Paloheimo (1910–) is a polished stylist appreciated for both his poetry and prose. Two brilliant young writers of promise are Marko Tapio and Veikko Huovinen, the latter a satirist with a dry humour.

Of numerous women writers, the following deserve mention: Aino Kallas (1878–1956), Finnish by birth and Estonian by marriage, has always championed the cause of Estonia in her writings; these are mainly short stories. Maila Talvio (1871–1951) was a richly productive novelist for whom religion was the inner source of power and hope. Maria Jotuni (1880–1943) was a short-story writer with a ready humour and a piercing insight into human nature. One of the best of the younger women writers is Eeva Joenpelto.

The first great poet in Finnish was Eino Leino (1878–1926), whose most famous work was *Helkavirsia* (1916), strongly nationalist historic poems in ballad form. He also translated Dante's *Divine Comedy* into Finnish blank verse. One of the first to express the growing nationalist Finnish movement was the poet Kaarlo Kramsu (1855–95), and typically Finnish in feeling were Larin Kyosti (1873–1948) and Otto Manninen (1872–1950); the latter made excellent translations of Homer, Molière, Goethe, Ibsen and others. An outstanding poet, classical scholar and literary critic is V. A. Koskenniemi (1885–), former member of the Finnish academy, and another humanist, poet and critic is Lauri Viljanen (1900–). Lyric poets who did much to influence the development of Finnish poetry were Juhani Siljo (1888–1918), Aaro Hellaakoski (1893–1952), Uuno Kailas (1901–33), Kaarlo Sarkia (1902–45) and Saima Harmaja (1913–37). Important also are Martti Haavio (1899– ; pseudonym P. Mustapää), Yrjö Jylha (1903–1956), whose experiences as a soldier in the winter war of 1939–40 found expression in *Kiirastuli,* and the women writers Aale Tynni (1913–) and Helvi Juvonen (1919–).

Swedish-Finnish Literature.—Finland's most famous poet was Johan Ludvig Runeberg (*q.v.*; 1804–77), whose works, though written in Swedish, are truly Finnish in spirit; they not only laid the foundation for Finland's independence, but also influenced the work of later poets who wrote in Finnish. His patriotic cycle of poems, *Fanrik Ståls Sagner* (1848–60; "The Tales of Ensign Stål"), is world famous. The second great poet of this period, who also strongly influenced Finnish literature in general, was Zacharias Topelius (1818–98). Poems, essays, historical novels, fairy tales and plays poured from his pen. Of the many fine poets of the next generation—including Mikael Lybeck (1864–1925) and Hjalmar Procopé (1868–1927)—the most outstanding are Bertel Gripenberg (1878–1946), Arvid Morne (1876–1946) and Emil Zilliacus (1878–), who also translated the Greek classics into Swedish. Swedish-Finnish modernism's pioneer was Edith Sodergran (1892–1923); she had a deep influence on later writers as well as on contemporaries. Modernism's second great figure is Elmer Diktonius (1896–), followed by Rabbe Enckell (1903–), Goran Stenius (1909–), Walentin Chorell (1912–) and Ralf Parland (1914–).

One of the greatest humanists in Europe was Yrjö Hirn (1870–1952), essayist, aesthete and literary historian. Runar Schildt (1888–1925) was the most eminent writer of Swedish prose in Finland. His short stories and plays are characterized by a polished style, penetrating psychological insight and sympathy for the lonely and oppressed.

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(A. L. Br.)

FINN MAC CUMHAILL (fin mă-kōōl') was probably the general to whom Cormac mac Airt, king in Tara (*fl.* c. A.D. 250) entrusted the task of organizing a standing army, whereby he sought to establish a suzerainty over the whole of Ireland. But he has attracted to himself a vast body of popular legend, and has thus become a mythological figure which dominates the folklore of the Gaelic peoples, in Ireland, Scotland and the Isle of Man. It is difficult to trace the growth of the legend, owing to a paucity of early materials. The tales told of the hero were of a popular nature, transmitted by word of mouth, and did not assume a literary form so soon as the mythologies of the Tuatha DC Danann or the sagas of Cú Chulainn. In these tales Finn is represented as being the leader of a band of braves, of strongly contrasted characters—which the story-tellers generally manage to preserve with remarkable consistency and with no little humour. They wander about with a seeming lack of aim, but they are employed in defending Ireland against foreign invaders (as in the well-known tale of the *Battle of Ventry),* and in the intervals devote themselves to the pleasures of the chase.

They are not always united; they belong to opposing families; and the best-known tale of the cycle is that of Finn's pursuit and destruction of his lieutenant Diarmait, who had eloped with his destined bride, Grainne, the daughter of Cormac mac Airt.

(R. A. S. M.)

FINNO-UGRIAN, the designation of a division of the Ural-Altaic family of languages and their speakers. The term Finn is the name given by their neighbours, though not used by themselves, to the inhabitants of the eastern shores of the Baltic. It is probably the same word as the Fenni of Tacitus and *Φίννοι* of Ptolemy, though it is not certain that those races were Finns in the modern sense. It possibly means people of the fens or marshes, and corresponds to the native word *Suomi,* which appears to be derived from *suo,* a marsh. Finn and Finnish are used of the inhabitants of Finland and of similar tribes found in Russia and sometimes called Baltic Finns and Volga Finns. In this sense the Estonian tribes (Baltic), the Lapps, the Cheremiss and Mordvins (Volga), and the Permian tribes are all Finns. The Ostiaks, Voguls and Magyars form a separate subdivision called Ugrian, from Yura or Ugra, the country on either side of the Ural Mountains.

The name Finno-Ugric is primarily linguistic. The Finno-Ugrians form, with the striking exception of the Hungarians, a moderately homogeneous whole. They are nomads, but are hardly ever warlike and have no power of political organization. Those of them who have not come under European influence live under the simplest form of patriarchal government.

In Russia the Finno-Ugric tribes are widely spread in the wooded country, especially on the banks of lakes and rivers. They form a considerable element in the population of the northern, middle and eastern provinces of Russia, but are not found much to the south of Moscow (except in the east) or in the west (except in the Baltic provinces). The Finno-Ugric (or Palaeo-Arctic) people have black or even reddish hair, sparse beards, yellowish to whitish skin, short stature, flat heads, flat faces, high cheek bones, oblique eyes and straight or concave noses. The head index varies from long to round.

The following are the principal Finnish peoples. The *Permians* and *Syryenians* (Syrjenian, Sirianian, Zyrjenian, Zirian) may be treated as one tribe. They both call themselves Komi and speak a mutually intelligible language, allied to Votiak. The name Bjarmisch is sometimes applied to this sub-group. Both Permians and Syryenians are found chiefly in the governments of Perm, Vologda and Archangel. The Syryenian headquarters are at the town of Ishma on the Pechora, whereas the name Permian is more correctly restricted to the inhabitants of the right bank of the upper Kama. The *Votiaks* dwell chiefly in the south-eastern part of the government of Viatka. They call themselves Ud-murt or Urt-murt. The Cheremiss, who call themselves Mari, inhabit the banks of the Volga, chiefly in the neighbourhood of Kazan.

The *Mordvinians,* also called Mordvá, Mordvins and Mordvs, are scattered over the provinces near the middle Volga, especially Nizhni Novgorod, Kazan, Penza, Tambov, Simbirsk, Ufa and even Orenburg. Though not continuous, their settlements are considerable both in extent and population. They are the most important of the Eastern Finns, and their traditions speak of a capital and of a king who fought with the Tatars. They are mentioned as Mordens as early as the 6th century, but now call themselves after one of their two divisions, Moksha or Erza. Their language (two dialects) is derived from Early Finnish, and has constructions peculiar to itself.

The *Lapps* are found in Norway, Sweden and Finland. They call themselves Sabme, but are called Finns by the Norwegians. They are the shortest and most roundheaded race in Europe. The majority are nomads who live by pasturing reindeer, and are known as Mountain Lapps, but others have become more or less settled and live by hunting or fishing. From ancient times the Lapps have had a great reputation among the Finns and other neighbouring nations for skill in sorcery.

The *Estonians* are the peasantry of the former Russian province Estonia and the neighbouring districts. They have reddish flaxen hair with a tall element. They are practically a branch of the Finns, and are hardly separable from the other Finnish tribes inhabiting the Baltic provinces. They call themselves Mā mēs, or country people, and their land Rahwama or Wiroma (*cf.* Finnish, Virolaiset, Estonians).

Livs, Livlanders or *Livonians* is the name given to the old Finnish-speaking population of west Livland or Livonia and north Kurland. They were a warlike and predatory pagan tribe in the middle ages, and it is possible that they were a mixed Letto-Finnish race from the beginning. They have become almost completely absorbed by Letts, and their language is only spoken in a few places on the coast of Kurland, if indeed it still exists. It is known as Livish or Livonian and is allied to Esthonian. The *Votes* (to be distinguished from the Votiaks), are also called southern Chudes and Vatjalaiset. They now occupy only a few parishes in north-west Ingria The *Vepsas* or *Vepses,* also called Northern Chudes, another tribe allied to the Esthonians, are found in the district of Tikhvinsk and other parts of the former government of Old Novgorod.

The *Finns* proper or Suomi, as they call themselves, inhabit Finland and the Olonetz, Tver and governments of Leningrad. Formerly a tribe of them called Kainulaiset was also found in Sweden, whence the Swedes call the Finns Qven. At present there are two principal subdivisions of Finns, the Tavastlanders or Hämäläiset in the south and west and the Karelians or Karjalaiset in the east and north. The Tavastlander has a round head, a broad face, concave nose, fair complexion. frequently light hair and blue or grey eyes. The Karelians have broader heads and are shorter.

History. — Most of the Finno-Ugrian tribes have no history or written records, and little in the way of traditions of their past. In their later period the Hungarians and Finns enter the course of ordinary European history. For the earlier period we have no positive information, but from archaeological and philological data an account of the ancient nanderings of these tribes may be constructed. Barrows containing skulls and ornaments may mark the advance of a special form of culture. But clearly all such deductions contain a large element of theory, and. the following hypothesis has been proposed by Peake. (*J R.A I.* xlix. 1919.) In late Palaeolithic times various types of long-headed men occupied the plain of north Europe. Then came in Solutrian times a nomadic people from Eurasia, hunters of wild horses. Then a broadheaded race of perhaps Mongol affinities pressed to the Baltic. The Nordic Steppe folk spread north and about the middle of the Bronze Age came into touch with the Mongoloids who nere reinforced by later waves. "Thor must have led his red-haired followers from the banks of the Volga while Woden brought his fair-haired warriors from the Russian Steppes."

BIBLIOGRAPHY.—Harold Peake, "The Finnic Question," *J.R.A I* xlix. (1919). *See* A C Haddon, *Races of Man* (1924) ; *R.* B. Dixon, *Racial History oj Man* (1923) ; H J Fleure, *The Peoples of Europe (1922)*

FINNO-UGRIC LANGUAGES are a family of languages constituting much the larger of the two branches of a more comprehensive grouping, the Uralic languages. The Finno-Ugric languages are spoken by over 18 000,000 people distributed discontinuously over an area extending from Norway in the west to the environs of the Ob river in Siberia. and into the Carpathian basin In this vast territory. the Finno-Ugric peoples constitute enclaves, surrounded mostly by speakers of Germanic, Slavonic, or Turliic tongues. Formerly, their habitat was more restricted, essentially to a region between the Baltic and the Urals; it was under the pressure of their Indo-European and Turkic conquerors that they migrated, in successive waves, farther to the west and north in Europe and beyond the Urals into Asia.

The family is usually considered to comprise the following extant units.

The Ugric division. This is further subdivided into: (1) Hungarian (Magyar); and the two Ob-Ugric languages, (2) Vogul (Mansi), and (3) Ostyak (Khanty). Single Hungarian words are known from the 10th century and the first full text from the 13th, so that this is both the oldest recorded Finno-Ugric language as well as the one spoken by the largest population (about 13,000,-000). Vogul, the language of some 5,000 peasants, hunters and reindeer breeders, is spoken along the western tributaries of the Ob and the Irtysh; and Ostyak is spoken by over 20,000 fishermen, hunters and reindeer nomads along the Ob and several of its tributaries.

The two Permian languages. They are the closely related (4) Zyrian (Komi) and (5) Votyak (Udmurt). Attested since the 14th century by religious texts and inscriptions written in a specially constructed alphabet, invented by St. Stephen of Perm (1335–1396), Zyrian — also known as Syryenian — is now spoken by more than 360,000 people over an enormous territory between the Vychegda, Mezen, Pechora and Kama rivers, near the Arctic ocean, as well as in the Murmansk region and on both sides of the Crals. Zyrian has two literary forms, one of them based on the southernmost dialect, Permyak. Votyak is spoken between the Vyatka and the Kama, and smaller groups are scattered beyond both of these rivers; there are over 500,000 speakers.

There are two groups of (6) Mordvins (Mordva), the Moksha and the Erzya, who speak different dialects and possess separate literary standards. Mordvin is spoken by a population of approximately 1,500,000, in numerous enclaves south of the Volga bend, along both sides of the river.

The (7) Cheremis (Mari) divide into three dialect groups spoken, by a population of somewhat under 500,000, along the right bank of the Volga (the so-called Mountain Cheremis, of Kozmodemyansk); in the prairie region beyond the left bank (Meadow Cheremis); and in the Bashkir Republic (Ufa Cheremis).

The Finnic (or Balto-Finnic) division consists of eight more or less mutually intelligible dialects or languages: (8) Finnish (Suomi); (g) Karelian; (10) Olonets; (11) Vepse; (12) Lude; (13) Vote; (14) Estonian; and (15) Livonian. Finnish is the language of about 3,500,000 speakers in Finland (where it is the principal national tongue), and in adjacent regions of Scandinavia and the U.S.S.R. A'ritten Finnish dates from the 16th century and has been, since the middle of the 19th, the vehicle of a comprehensive literature. Karelian is a term used to designate a dialect spoken in the Karelo-Finnish Soviet Republic; Olonets is the dialect spoken on both sides of the boundary north of Ladoga. Lude is spoken farther to the east and it, in turn, shades into Vepse, spoken in small settlements along the southwestern edge of Lake Onega. Vote is spoken by a dwindling population—perhaps 500 peasants — in Ingria. Estonian is used by about 1,-250,000 speakers in the Estonian Soviet Socialist Republic and in scattered enclaves elsewhere in Russia. Its written form dates from the 16th century; modern literary Estonian is based upon the Tallin (northwest) dialect, but formerly the rather different Tartu (southeast) dialect was employed for this purpose. Livonian is almost extinct; it is spoken by perhaps 1,500 fishermen and peasants on the north promontory of Kurland.

The (16) Lapp languages, spoken by over 30,000 people, are usually divided into northern (sometimes, however, called central or western), southern and eastern groups. Northern Lapp is the language of the reindeer breeding Finnish Lapps, those of Norwegian Finnmark and Troms, and of Norrbotten, except that southern Lapp is spoken in the southernmost region of this Swedish province. Eastern Lapp is the language of the fishermen of Inari, and the Russian Lapps of Kolta and Kola.

The vocabulary of the Finno-Ugric languages contains an adequate common stock of terms to permit the reconstruction of the ancestor language. but also reflects a series of contacts with neighbouring peoples at different periods in their history. The Iranian loanwords seem to be the oldest. Finnish borrowed from Lithuanian in remote times, and later from Germanic languages and Russian. Cheremis, Votyak and the Ob-Ugric tongues are rich in Turkic loans. Hungarian has also borrowed, at different times. from several Turkic sources, as well as from Iranian, Slavonic. German, Latin and Romance.

The sound systems of the present day Finno-Ugric languages exhibit a variety of structures and practically no trait is common to them all. Vowel harmony, for instance, which is sometimes thought of as a characteristic of these tongues, is absent from Ostyak, Lapp and the Permian group. Consonant gradation — an intricate alternation between two classes of stem consonants—occurs in Lapp and the Finnic tongues, with only occasional traces in the sister languages. The grammar of Finno-Ugric languages typically operates by the addition of multifarious endings to different stem forms. The declension of some of these languages—for example, Hungarian and Finnish — includes a more or less elaborate case system. Lapp and the Ob-Ugric languages possess dual number as well as plural. The verb in the Ugric languages and Mordvin is marked by a distinction between subjective and objective conjugation, and the non-Ugric languages have a negative conjugation. A typical feature of Finno-Ugric syntax is illustrated by the contrast of these two Hungarian phrases: *a nagy* haz "the big house," and *a ház nagy* "the house is big": in the former phrase, the attribute precedes the head; in the latter, an equational sentence, the predicate comes after the subject.

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FINSBURY, a metropolitan borough of London, Eng., is the second smallest of the metropolitan boroughs. Pop. (1951) 35,370. Area 0.9 sq.mi. Because of the large number of offices, factories and warehouses within its boundaries, it has been estimated that the daytime population is about 150,000. One of the 28 metropolitan boroughs formed under the London Government act of 1899, it was created from the parishes of St. James and St. John, Clerkenwell; St. Luke, Middlesex; St. Sepulchre, Middlesex; the Charterhouse; and the liberty of Glasshouse Yard. It is bounded by Islington on the north, Shoreditch on the east, the City of London on the south, and Holborn and St. Pancras on the west. One member is returned to parliament by the constituency of Shoreditch and Finsbury. The Angel, once a famous coaching inn, lies in Finsbury and not Islington as commonly supposed; from there, Goswell road, the residence of Charles Dickens' Mr. Pickwick, and St. John street radiate through the borough. Rosebery avenue runs from St. John street southwestward to Clerkenwell road, which with Old street crosses the borough from west to east. The old distinctions of Clerkenwell on the west and St. Luke's on the east are still frequently used. Local industries are many and include light engineering, manufacture of optical, surgical and scientific instruments, clothing factories, printing, bookbinding; stationery, tobacco pipe manufacture, brewing and distilling. Watch and clockmaking, once the largest industry in Finsbury, has almost disappeared, but the borough is still the centre of the repairing trade and for the supply of parts and tools. The establishment of the British Horological institute in Northampton square in 1858 showed the importance of Clerkenwell as the centre of the trade, and the Northampton Polytechnic carries on the tradition by holding special classes in horology and optical work. The large parcels depot and inland section of the general post office (built in 1934) are at Mount Pleasant, Rosebery avenue; close by are the Finsbury town hall (1895) and the head offices of the Metropolitan Water board (1920), with the former reservoirs of the New River Mead.

It is probable that the name of the borough is derived from the family name of the Fiennes (also spelled Finnes or Fennes). who were the owners of the manor of Finsbury, the manor house of which stood in Finsbury fields or Fynnysberefelde. Two ladies of this family gave some land north of the city gates for the use of the citizens of London. The nature of this ground, which mas marshy and fenlike, has led to the belief that this was the origin of the name Fensbury or Finsbury. The ground was drained in 1527 and for several centuries was used for sports and pastimes, especially for archery. Chalybeate springs were discovered in Clerkenwell in the 17th century, the most famous being Sadler's well, Islington spa and the London spa. These were quickly made into popular resorts by their enterprising owners, who added tea gardens and other entertainments to attract custom. The Fortune theatre and Red Bull theatre were erected at the end of the 16th century. After the fire of London many refugees came from the city into Moorfields, and it mas from that time that the area really became residential. By 1901 its population had risen to 101,463.

The borough includes several buildings of historical interest. In the old parish of Clerkenwell (*q.v.*) is the gatehouse of the former priory of St. John of Jerusalem. West of Aldersgate street are the buildings of Charterhouse (*q.v.*), originally a Carthusian monastery, subsequently a hospital and school. Bunhill fields, City road, is the famous burial ground used by the dissenters from the middle of the 17th century until 1852; the graves of John Bunyan, Daniel Defoe and William Blake (*qq.v.*) are there. Facing Bunhill fields is Wesley's chapel and the house of John Wesley, which is now a museum. In Bunhill row John Milton died. South of Bunhill fields lies the Artillery ground of the Honourable Artillery company, so occupied since 1641, with barracks and an armoury house, started in 1734, completed in 1735.

Sadler's Wells theatre, Rosebery avenue, preserves the name of the fashionable medicinal spring discovered in the grounds of Sadler's Musick house in 1683. A new theatre was built on the site in 1765 and rebuilt in 1931, and it is now famous for ballet and opera. The Northampton Polytechnic, St. John street, was opened in 1898. Owen's school for boys was founded in 1613, and in 1886 a girls' school was opened. St. Luke's Hospital for Lunatics, Old street, erected in 1751, is now a Bank of England printing works.

The housing programs, after World War II, of Finsbury Borough council included Spa Green estate, Priory Green estate, Holford Square estate and the Stafford Cripps estate; the three blocks of the latter are 12 stories high. The borough is provided with only 15 ac. of open spaces, but it has a large memorial sports centre at Barnet, Herts, opened by Prince Philip, duke of Edinburgh, in May 1955. This comprises football, cricket and hockey pitches, bowling green, tennis and netball courts, putting green, running track and children's playground. (M. McD.)

FINSEN, NIELS RYBERG (1860–1904j, Danish physician, originator of the Finsen lamp for treatment of skin diseases, was born Dec. 1j, 1860, at Thorshavn, in the Faroe Islands. His. parents were Icelandic, and he went to school in Reykjavik. His interest in the contrasts in the light and darkness of the north led him to study the effects of light on living organisms. Graduated in medicine from the University of Copenhagen in 1890, Finsen conducted experiments on light and published (1893) a paper on treatment of smallpox with red light (excluding blue, violet and ultra-violet rays of ordinary light), thus preventing suppuration of pustules. Later he found actinic rays to be responsible for the bactericidal property of sunlight, and this enabled him to develop a method of treatment of lupus vulgaris by ultra-violet rays. In 1895 he published his general theory of the effect of light on living organisms. *The Treatment of Lupus Vulgaris by Concentrated Chemical Rays* was published in 1837. Finsen's Light institute was founded in Copenhagen in April 1896. He was awarded the Nobel prize in medicine in 1903. From the age of 23 Finsen was practically an invalid, and during the last few years of his life he directed the work of the institute from his home. He died Sept. 24, 1904. (A. U. D.)

FIORD (FJORD), a long narrow arm of the sea commonly extending far inland, resulting from the inundation by the sea of a severely glaciated valley. Many fiords are astonishingly deep; Sogne fiord in Norway is 4,078 ft. deep: Messier channel in Chile is 4,250 ft., and Scoresby sound in Greenland is deeper than 4.000 ft. It is the great depth of these submerged valleys, extending thousands of feet below sea level, that necessitates their glacial origin. It is assumed that the huge. thick glaciers formed in these valleys were so heavy that they could erode the bottom of the valley far below sea level before they floated in the ocean water. After the glaciers melted the waters of the sea invaded the valleys and formed the fiords.

Glacial erosion produces U-shaped valleys, and fiords are characteristically so shaped. Since the lower, slanting, part of the U is underwater, the walls of fiords may arise vertically for hundreds of feet from the water's edge. Similarly, just a few yards from the shore the water may be several hundred or even thousands of feet deep. In some fiords small streams in tributary valleys plunge hundreds of feet over the steepened edge of the fiord; some of the world's highest waterfalls are of this type. Valleys are normally winding and twisting, and so fiords commonly have the same attributes — winding channels and occasional sharp corners. The U-shaped valley floored with glacial debris in many cases extends inland back into the mountains, and in a few cases still has a small glacier at the head of the valley. The river that formed the original valley commonly re-establishes itself on the upper valley floor after the disappearance of the ice and begins to build a delta (*q.v.*) where it enters the sea at the head of the fiord. In many cases this delta is the only place on the fiord nhere villages and farms are located. Fiords commonly are deeper in the middle and upper reaches than at the seaward end. This results from the greater erosive power of the glaciers closer to their source, where they are moving most actively and vigorously. All such valleys are not the result of glacial erosion, however.

See D. W. Johnson, *Shore Processes and Shoreline Development* (1919); Andre Guilcher, *Coastal and Submarine Morphology* (1958). (W. C. C.)

FIORE, PASQUALE (1837–1914), Italian jurist and leading authority on international law, was born at Terlizzi, Puglia, on April 8, 1837. He studied at Urbino, Pisa and Turin and, after a period of teaching philosophy at a school at Cremona, during which he published *Elementi di diritto pubblico constituzionale e amministrativo* ("Elements of Public Constitutional and Administrative Law," 1862), he was appointed professor of constitutional and international law at Urbino in 1863. He then occupied similar chairs at Pisa, Turin and finally, from 1881, at Naples, where he died on Dec. 17, 1914.

Although a prolific writer on a wide range of legal topics, Fiore's international reputation rests on his writings on public and private international law, which were translated into many languages. Since they reflect the spirit and political conditions of his time they have tended to become out of date, but he made a lasting contribution by realizing the need for dividing international law into new categories, in his *Trait6 de droit pénal international et de l'extradition* ("Treatise on International Criminal Law and the Law of Extradition," 1880), and by meeting the need for a more precise statement of the law in his *International Law Codified* (1890; Eng. trans., 1918).

Fiore's *Elementi di diritto internazionale privato* ("Private International Law," 1901) is one of the principal statements of the doctrines of the so-called Italian or neostatutist school which, inspired by P. S. Mancini, has exercised profound influence, especially in Latin and Latin-American countries. (J. U.)

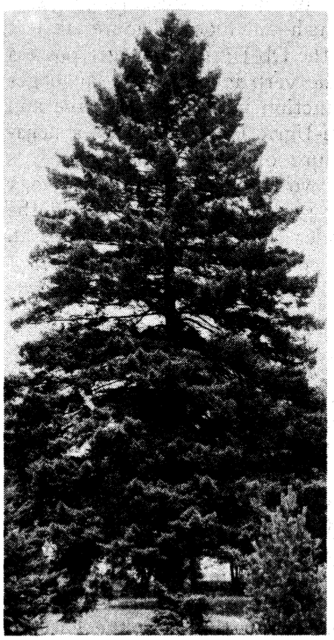
FIORELLI, GIUSEPPE (1823–1896), Italian archaeologist, was born at Baples, June 8, 1823. In 1845 he was made inspector of the Pompeiian excavations, which position he retained until 1848, when he was discharged and imprisoned for his political views. After the unification of Italy in 1860, however, he returned to favour and was chosen to fill the positions of professor of archaeology at the University of Naples and superintendent of the excavations in Pompeii and southern Italy. In 1875 he was put in charge of all excavations in Italy. He was founder of the first archaeological school in Italy, located at Pompeii.

Fiorelli published a number of works on his archaeological findings, including *Osservazioni sopra talune monete rare di città greche* (1843); *Monete inedite dell' Italia antica* (1845); *Notizia dei vasi dipinti rinvenuti a Cuma dal conte di Siracusa* (1853); *Pompeianarum Antiquitatum Historia* (1853); and *Descrizione di Pompei* (1875). He died Jan. 28, 1896, at Naples.

FIORILLO, JOHANN DOMINICUS (1748–1821), German painter and historian of art, was born at Hamburg on Oct. 13, 1748. He studied at Bayreuth, Rome and Bologna, and in 1769 was admitted to the Bologna academy. Returning to Germany, he obtained the appointment of historical painter to the court of Brunsnick. In 1784 he became keeper of the collection of prints at the university library at Gottingen. He was appointed professor extraordinary in the philosophical faculty in 1799 and ordinary professor in 1813. He died at Gottingen Sept. 10, 1821. The most notable of his paintings is perhaps the "Surrender of Briseis." His writings include *Geschichte der zeichnenden Künste* (5 vol., 1798–1808) and *Geschichte der zeichnenden Künste in Deutschland und den Vereinigten Niederlanden* (4 vol., 1815–20).

FIR, the Scandinavian name originally given to the Scotch pine (*Pinus sylvestris*), but now used to designate members of the genus *Abies* and a few other coniferous forms.

The firs are distinguished from other genera in the pine family by their sessile needles, which develop conspicuous circular leaf scars upon falling. Their cones, which are erect at maturity, are composed of many thin, rounded, closely overlapping scales, each bearing two broadly winged seeds, and enclosed by a bract carrying the ovules. The cones disintegrate soon after ripening, and leave the erect, naked central axis attached to the supporting branchlet.



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SCOTCH PINE (*Pinus sylvestris*)

The trees usually have a straight trunk, and a tendency toward conical or pyramidal growth, throning out each year a more or less regular whorl of branches from the foot of the leading shoot. while the buds of the lateral boughs extend horizontally.

There are about 25 species of the true firs (*Abies*), widely distributed in the northern hemisphere.

The silver fir (*A. alba*), a representative of the old world, is a lofty tree, sometimes 150 ft. high. with large spreading horizontal boughs curving upward toward their extremities. The fiat leaves are two ranked, deep green above but with tuo broad white lines beneath; as the foliage in large trees has a tendency to curl upward, a silvery appearance is observed from below. The large, erect cones are cylindrical in shape, and have long bracts, the curved points of which project beyond the scales. When the tree is young the bark is of a silvery gray, but becomes roughened and darkened with age. The tree is abundant in most of the mountain ranges of southern and central Europe. but is not found in the northern parts of that continent. In Asia it occurs on the Caucasus and Urals, and in some parts of the Altaic chain. Extensive forests of this fir exist on the southern Alps. where the tree grows in elevations up to nearly 4,000 ft ; in the Rhine countries it forms a great part of the extensive forest of the Hochwald and occurs in the Black Forest and in the Vosges; it is plentiful likewise on the Pyrenees and Apennines. The wood is inferior, but, being soft and easily worked, is largely employed in the countries to which it is indigenous for all the purposes of carpentry. Deficient in resin, the wood is more perishable than that of the spruce, although it is said to stand well under water. The bark contains a large amount of a fine. highly resinous turpentine, which collects in blisters on the trunk during the heat of summer. After purification by straining, it is sold as "Strasbourg turpentine," much used in the preparation of some of the finer varnishes. Burgundy pitch is also prepared from it by a process similar to that used on the exudations of the Norway spruce. A fine oil of turpentine is distilled from the crude material; the residue forms a coarse rosin. Introduced into Great Britain at the beginning of the 17th century, the silver fir has become a common exotic, although, like the Nonvay spruce, it rarely comes up from seed scattered naturally. It is also planted as an ornamental tree in eastern North America.

Several other old world firs are successfully grown for ornamental purposes in Europe and North America. Among these are the Spanish fir (A. *pinsapo*); the Greek fir (A. *cephalonica*); the Algerian fir (A. numidica); the Cilician fir (A. *cilicica*), of Asia Minor; the Nordmann fir (A. *nordmanniana*), of the Caucasus; and the Momi fir (A. *firma*), the Nikko fir (A. *homolepis*) and the Veitch fir (A. veitchii), of Japan.

In North America there are ten native species of fir, found chiefly from the Rocky mountains westward and attaining their maximum development in the Sierra Nevada and Cascade ranges. Of the two firs occurring in the eastern states and Canada, the best known is the balsam fir (A. *balsamea*), which is found from Newfoundland to Virginia and northwestward to Labrador and the Yukon. It is a widely branching tree, 40 ft. to 60 ft. high, with fragrant resinous leaves; it is extensively used for pulpwood, sparingly for lumber, and yields the valuable oleoresin known as Canada balsam (*q.v.*). The smaller southern balsam fir or she-balsam (A. *fraseri*) is confined to the southern Appalachian mountains. Several firs of the western United States attain immense size. The white fir (A. concolor), sometimes 250 ft. high with a trunk diameter of 6 ft., ranges from Wyoming to the Sierra Nevada and southward to Mexico. The lowland white or grand fir (*A.* grandis). occasionally 300 ft. high, is a valley species found from Montana west to Vancouver Island and south near the coast to central California. The Pacific silver fir (A. amabilis). a beautiful tree native to the Cascade and Olympic ranges from Oregon to British Columbia, reaches a height of 250 ft. and a trunk diameter of 4 ft. to 6 ft. The red fir (*A. magnifica*), often zoo ft. high, is a handsome tree of the northern Sierra Nevada and the southern Cascade mountains. The noble fir (A. *nobilis*), usually 150 ft. to 200 ft. but sometimes 250 ft. high, with a trunk 6 ft. to 8 ft. in diameter, forms large forests in Washington, Oregon and northern California. The smaller alpine fir (A. lasiocarpa), commonly 80 ft. to 100 ft. high. is found in the Rocky mountains from New Mexico to Alaska, and westward to Oregon, Washington and British Columbia. With the exception of the noble fir, the wood of most western firs is inferior to that of pine or spruce, but is used for lumber and pulpwood. Noble fir is occasionally used as a substitute for spruce in aircraft fabrication. See DOUGLAS FIR; HEMLOCK; SPRUCE. (E. S. HR.)

FIRDAUSI (FIRDUSI, FIRDOUSI) (*c.* 935–*c.* 1020), Persian poet, was the author of the celebrated *Shah-Nama* ("Book of Kings") in which the Persian national epic found its final and enduring form. His real name was Abul Qasim Mansur (or Hasan or Ahmad), Firdausi being a nom de plume. He was born c. 935 in a village on the outskirts of the ancient city of Tus (near the city of Meshed in northeast Iran). In the course of the centuries many legends have been woven around the poet's name but very little is known about the real facts of his life. Something can be gathered from the personal references scattered here and there throughout his poem, but otherwise the only reliable source is the account given by Nizami-yi-'Arudi, a 12th-century poet who visited his tomb in 1116 or 1117 and collected the traditions that were current in his birthplace less than a century after his death. According to Nizami, Firdausi was a *dihkan* or landowner, deriving a coinfortable income from his estates. He had only one child, a daughter. and it was to provide her with a dowry that he set his hand to the task which, in the event, was to occupy his attention for 35 years.

The *Shah-Nama* of Firdausi, a poem of nearly 60,000 verses, is based mainly on a prose work of the same name, compiled in the poet's early manhood in his native Tus. This prose *Shah-Nama* was for the most part the translation of a Pahlavi (Middle Persian) work, the *Khwatai-Namak*, a history of the kings of Persia from mythical times down to the reign of Khosrau II (590–628), but it also contained additional material bringing the story to the overthrow of the Sassanians by the Arabs in the middle of the 7th century. The first to undertake the versification of this chronicle of pre-Islamic and legendary Persia mas Dakiki, a poet at the court of the Samanids, who came to a violent end after completing only 1,000 verses. These verses, which deal with the rise of the prophet Zoroaster, were afterward incorporated by Firdausi, with due acknowledgments, in his own poem.

The *Shah-Nama*, finally completed in 1010, was presented to the celebrated sultan Mahmud of Ghazni, who by that time had made himself master of Firdausi's homeland, Khurasan. Information on the relations between poet and patron is largely legendary. According to Nizami-yi-'Arudi, Firdausi came to Ghazni in person, and through the good offices of the minister Ahmad ibn Hasan Maimandi was able to secure the sultan's acceptance of the poem. Unfortunately Mahmud then consulted certain enemies of the minister as to the poet's reward. They suggested that Firdausi should be given 50,000 dirhems, and even this, they said, was too much, in view of his heretical Shiite tenets. Mahmud, a bigoted Sunnite, was influenced by their words and in the end Firdausi received only 20,000 dirhems. Bitterly disappointed, he went to the bath and, on coming out, bought a draft of *fuka'* (a kind of beer) and divided the whole of the money between the bath attendant and the seller of *fuka'*. Then, fearing the sultan's wrath, he fled first to Herat, where he remained in hiding for six months, and then, by way of his native Tus, to Mazanderan, where he found refuge at the court of the Sipahbad Shahriyar, whose family claimed descent from the last of the Sassanians. There Firdausi composed a satire of 100 verses on Sultan Mahmud, which he inserted in the preface of the *Shah-Nama* and read out to Shahriyar, at the same time offering to dedicate the poem to him, as a descendant of the ancient kings of Persia. instead of to Mahmud. Shahriyar, however, persuaded him to leave the dedication in Mahmud's name, bought the satire from him for 1,000 dirhems a verse and caused it to be expunged from the poem. Nizami adds that Firdausi also destroyed his rough copy of the satire and that in his day only six verses remained extant. This is of course inconsistent with the fact that the whole text, bearing every mark of authenticity, has survived to the present day.

It was long supposed that in his old age the poet had spent some time in western Persia or even in Baghdad, under the protection of the Buyids, but this assumption was based upon his presumed authorship of *Yusuf* and Zulaikha, an epic poem on the subject of Joseph and Potiphar's wife, which, it later became known, was composed more than 100 years after Firdausi's death. For an account of his last days it is necessary to fall back upon the narrative of Nizami-yi-'Arudi. Sultan Mahmud was returning from one of his campaigns in India when the minister Ahmad ibn Hasan Maimandi, by means of an apposite quotation from the *Shah-Nama*, reminded him of his shabby treatment of Firdausi. He determined to make amends and. upon returning to Ghazni, gave orders that 60.000 dinars' worth of indigo should be given to Firdausi and that it should be transported to Tus on the royal camels. The indigo reached Tus in safety; but as the camels were entering the town by one gate Firdausi's bier was being carried out through another. A fanatical preacher had denied the poet burial in the Moslem cemetery and his body was being taken to its final resting place in a garden that belonged to the poet outside the walls of the town. He was survived by his daughter, who proudly refused the sultan's gift; and in the end the money was spent on repairing a resthouse on the boundaries of Tus Nizami does not mention the date of Firdausi's death. The earliest date given by later authorities is 1020 and the latest 1026: it is certain that he lived to be over 80.

The Persians regard Firdausi as the greatest of their poets. For nearly 1,000 years they have continued to read and to listen to recitations from the *Shah-Nama*, nhich. though written before the Norman conquest, is as intelligible to the average modern Persian as is the Authorized (King James) version of the Bible to a modern Englishman. The language. based as the poem is on a Pahlavi original, is pure Persian with only the slightest admixture of Arabic. European scholars hdve criticized the monotonous metre, the constant repetitions and the stereotype similes of this enormous poem; to the Persian it is the history of his country's glorious past, preserved for all time in sonorous and majestic verse.

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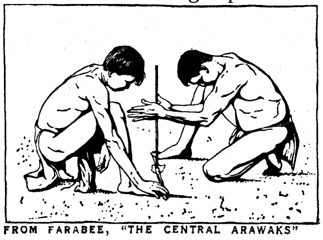
FIRE is so familiar that it scarcely needs definition. Its extraordinary usefulness and equally extraordinary dangers impress practically every human being from infancy onward. Ordinary fire is the rapid chemical combination of oxygen with the carbon and other elements of organic substances in such a way that heat, flame and light are produced. In a broader sense fire is the process whereby the combination of one chemical element with another, when reduced to a gaseous condition, produces heat and flame.

Among all the discoveries and inventions made by men, only a few, such as speech, writing and agriculture, have borne such momentous fruit as has the discovery of how to make and use the type of combustion commonly known as fire. The use of fire is the basis of practically all forms of modern manufacturing and transportation; it has been a powerful agent in determining the spread and present distribution of mankind and of civilization; it has perhaps been a major, although indirect agent in causing racial differences in mentality. It is the background and basis of our modern industrial life.

Universality of Fire.—Traces of fire appear among the earliest human relics, far back at the beginning of Paleolithic times. During historic times it is doubtful whether any race or tribe has ever been completely without knowledge of fire. Early travellers, to be sure, have brought back tales like that of the missionary Krapf in East Africa. He heard from a slave that a tribe in southern Shoa lived like monkeys in the bamboo jungles and were totally ignorant of fire. That was in the middle of the 19th century, but no competent observer has yet seen such a tribe. In the same way Wilkes of the famous United States Exploring Expedition in the Pacific reported that no sign of places for cooking, nor any appearance of fire was found in Bowditch Island (Fakaafo), but Hale, the ethnographer of the same expedition, reports the native word for fire. We now know that these people not only talked about fire, but have a legend as to its origin and could kindle a blaze. Since other reports of fireless people fare in the same way, Sumner and Keller seem justified in saying that "it is certain that over the whole earth no fireless tribe of men has been found. . . . Man is scarcely man till he is in possession of fire."

Original Use of Fire.—Although we have no real knowledge as to the original use of fire or as to man's discovery of the art of kindling a flame, primitive legends, the usages of primitive people and ancient religious ceremonials give some clue to the major facts. One of the most important conclusions derived in this way is that fire was used long before it could be artificially generated. Lippert even goes so far as to argue that the use of fire enabled man's ape-like progenitor to descend from the trees and walk erect because it gave him protection from other animals. Even if this idea is untenable, as it probably is, one of man's earliest discoveries must have been that he could make profitable use of the fires engendered naturally by lightning, falling meteors, the materials ejected from volcanoes, friction developed by avalanches and boulders and other natural occurrences. He probably soon realized the value of a blaze not only for warmth, but for cooking food, warding off wild beasts and driving game out of the jungle. Thus early man presumably cherished fire long before he learned how to make it.

Preservation of Fire.—Even in modem times many tribes have been observed which carefully preserve their fire year after year and suffer serious loss if it is extinguished. The people of the Andaman islands, who are said to be ignorant of the art of producing fire, take a smouldering stick with them and keep it burning if they go away from their huts for more than a few hours on a hunting or fishing expedition. Among certain Papuans who have no means of kindling a blaze, live coals of a very slow-burning wood are constantly preserved in the huts. If by chance the fire goes out, these coast dwellers have to go to the mountains where the inhabitants understand the art of fire-making, and bring thence some live coals. Even where the art of kindling a fire is understood, the technique is often so crude or the difficulties because of damp weather are so great that the fire is preserved with extraordinary care. The Australian aborigines prefer to make long journeys to get fire from another tribe rather than undertake the labour of making it themselves. Among the Herero, to cite one of the many examples given by Sumner and Keller, the difficulty of making fire by friction was formerly so great that the daughters of the household were regularly charged with the care of the flame. If the fire went out, it was regarded as an evil omen.



FROM FARABEE, "THE CENTRAL ARAWAKS"

WAPISIANA BOYS OF SOUTHERN BRITISH GUIANA MAKING A FIRE
The device employed is that of rotating a stick in a round hole in the piece of wood lying on the ground

Fire and Religious Rites.—A great number of facts of this kind agree with some of the most widespread and primitive legends and religious practices. According to the familiar Greek legend, Prometheus brought fire to earth. Sometimes he is said to have lighted a torch at the sun's chariot, and sometimes to have gone underground. In the Cook islands near New Zealand, the Polynesian hero Maui is said to have obtained fire for man by going down to hell where he learned to generate a spark by rubbing two pieces of wood together. Perhaps the multitudinous legends of this sort are reminiscent of the period when the art of making fire was unknown. In such circumstances there must have been repeated periods when prolonged rainy spells or other accidents put out all the fires among the very scanty population of a large area. In such a case no fire may have been available for many years, and the bringer of new fire would be a hero. Perhaps a late relic of the periodic loss of fire is found in certain ceremonies of both the Roman Catholic and Greek Orthodox churches. According to the traditional method, all the lights in the churches are gradually extinguished during Passion Week. When the last light has been extinguished, "new fire" is made; formerly this was done by some primitive means, such as friction of wood, long after flint and steel were understood. From this "new fire" all the lights to be used throughout the next year are supposed to be kindled. At Jerusalem the rush of the Eastern Orthodox pilgrims to light their candles at the newly created blaze has often made it necessary to employ soldiers to preserve order. Another reminiscence of the early necessity for extreme care in preserving fire is found in the Vestal Virgins who tended the undying fire in Rome. Elsewhere, as in ancient Peru, a similar custom is reported.

Worship and Sentiment.—While ceremonies connected with fire play at least a subordinate part in almost every religion, they sometimes become dominant. In the ancient Jewish religion and many others fire is the means whereby offerings are transmitted to the deity or to departed souls as among the Greeks. In many cases fire itself is worshipped, and often the worship of the sun can scarcely be distinguished from that of fire. The ancient Mexicans had a fire-god Xiuheuctli, closely related to the sun-god; the Kamchadals and Ainus of north-eastern Asia make fire their chief deity. Among more civilized people the ancient Assyrians, Chaldaeans and Phoenicians practised fire-worship; Abraham was perhaps a reformer who refused to sacrifice his son Isaac in the consuming fire; the Israelites of later times were often scourged by their prophets for offering their children as sacrifices to Moloch, the god of fire. Among the ancient Aryans, if we may use so indefinite a term, Agni (Latin *ignis*) was the chief god. Even to-day fire-worship is a notable feature of Hinduism, which is an offshoot of the old Aryan cult, and is the dominant factor in the religion of the Zoroastrians or Parsees. Among the oppressed remnant of the Parsees who still survive in the parts of Persia near Yezd and Kirman, and among many more primitive people, it is considered most irreverent to throw into the fire anything impure or disagreeable or to spit into it. The modern Parsees do indeed regard fire as merely a symbol, but in the beginning fire itself was probably the real object of worship. This is not surprising for there is probably no agency more powerful for good and ill, and motives of both gratitude and fear must have mingled in the minds of the early worshippers.

Although the worship of fire has largely disappeared in our day, its symbolism is still widely spread. The fire of love, the fire of ambition, are common similes.

Discovery of the Art of Fire Making.—In many of the legends which centre around the origin of fire, the interesting figure of the serpent-fighter occurs. The native Australians of Victoria say that a certain Karakorok, the good daughter of the good old man Pundyil, went abroad to kill the serpents which filled the land. Before she had killed them all, her staff snapped and a flame burst out of it. According to the ancient *Shahnama* of Persia, a hero called Hushenk hurled a prodigious stone at a snake; the snake escaped, but the stone struck a rock whereupon "light shone from the dark pebble, the heart of the rock flashed out in glory, and fire was seen for the first time in the world."

A North American legend states that the buffalo gave fire to man; as he raced in great herds across the plains at night, he lighted up the darkness with sparks and set the brush ablaze as his hoofs hit the rocks. The Dakota Indians replace the buffalo by a friendly panther which struck fire from its claws as it scampered up a stone hill. In South America the Quichés claim to have received fire from Tohil who produced it by shaking his sandals. His sign, like that of the Mexican god, Quetzalcoatl, is a flint. The vital point in all these legends is that the movements of men or animals cause stones to crash together, thus producing a spark which gives rise to fire. Such occurrences, together with his own experience in breaking rocks in order to discover which make the best tools, may have led some savage genius to discover that when flint and iron pyrites are struck together they produce sparks which will ignite dry grass or leaves. That mode of making fire is especially likely to originate in regions where rocks and dry grass are abundant.

In moist regions where the soil is so deep and the vegetation so dense that rocks are rare, or in places where flinty rocks are not present, another kind of natural occurrence is more likely to have helped in the discovery of fire. Now and again in the dry season two dead branches, rubbing together in the wind, become so hot that they ignite. Such accidents are not common, but during the hundreds of thousands of years of man's early development they presumably occurred often enough to be observed by men who possessed not only the ability and vision to see their significance, but also the curiosity and energy to make experiments.

Methods **of** Making Fire.—These two methods, percussion and friction, have always been the chief ways of making fire, but concentration of the sun's rays and the electric spark have also come into use. Friction has been by far the most widespread method among primitive people. In one of the simplest frictional methods the blunt end of a stick is rubbed back and forth along another piece of wood lying on the ground. The stick makes for itself a groove, and ultimately a spark is developed. This method formerly prevailed among the savages in New Zealand, Hawaii, Tonga, Samoa and elsewhere. In Tahiti Charles Darwin saw a native produce fire thus in a few seconds, but he himself succeeded only after long effort. In a somewhat more advanced frictional method the movable stick is rotated as rapidly as possible in a stationary piece of wood that lies on the ground. Such a fire drill, as it is commonly called, is sometimes rotated by rubbing the vertical stick between the palms of the hands. This device in one form or another has been observed among the primitive people in Australia, Kamchatka, Sumatra and the Caroline islands. It is common among the Veddahs of Ceylon and in much of southern Africa as well as in large parts of both Americas. Various improvements have been devised in order to increase the speed of rotation. On the Pampas of South America the Gaucho formerly took an elastic stick about 18in. long, placed one end in a hole in a stationary piece of wood, pressed the other to his breast, leaned dcwn to bend the stick, and then rapidly turned the curved part like a carpenter's bit. A better method is to wind a string around the rotating stick or drill and pull it back and forth. In order to make it possible for one man to do this effectively, the Eskimos place the upper end of the drill in a socket of ivory or bone which can be held firmly in the teeth. Other Eskimos, as well as some Indians, fasten the two ends of the string to a bow and saw the bow back and forth. In our own day a device of this kind, with sawdust or some such material in the bottom of the hole to make the sparks catch quickly, is one of the first things taught to boy scouts. Still more ingenious than the bow drill is the pump drill of the Onandaga Indians. Here a string is fastened in such a way that when a small board is repeatedly pushed down the drill stick twirls rapidly, first one way and then the other. Many modifications of these methods are described and illustrated in the works of Tylor and Pauschmann.

In all the simpler frictional methods the two great difficulties have always been to create a spark and then to bring it into immediate contact with a sufficient amount of easily combustible tinder. In the most modern method—the match—both of these were first obviated by coating the ends of the movable stick with sulphur, which ignited at low temperature, and tipping the end with phosphorus which can be still more easily ignited by a single stroke. By the substitution of potash and non-poisonous forms of phosphorus for the earlier ingredients the modern safety match has at last been evolved as the latest successor of the two sticks rubbed together.

The method of making fire by percussion does not appear to have been of great importance until the Iron Age was so far advanced that steel was available. Its development was delayed by the difficulty in finding natural products such as pyrites which can be relied on to produce a spark when struck with a flint. After iron became common, the flint and steel became the best method of creating a fire. This method, however, was dominant for only a short time compared with the frictional method, for as soon as matches tipped with sulphur and phosphorus came into use (soon after 1830), it ceased to be of importance except in more backward regions. There it survives widely; in Central Asia flint-lock guns are still common.

Another method of making fire, namely, the concentration of the sun's rays by means of a lens or mirror, also belongs to a fairly high stage of civilization, but has never been used to any great extent. Aristophanes mentions a burning-lens in *The Clouds*; although the mirrors of Archimedes may not actually have set fire to the ships of the Roman besiegers of Syracuse, they show that the art of generating fire in this way was well understood. In Peru the sacred fire is said to have been kindled by means of a concave cup set in a great bracelet. In China the burning-glass has long been well known.

The latest important method of making fire is by means of the electric spark. According to one common device, a gas jet is arranged so that when it is opened an electric circuit is closed and then broken, and a spark passes through the escaping gas and ignites it. It should be noted in this connection that the intense heat generated by the electric current is beginning to displace fire not only in cases where an extremely high temperature is desired, but in various household appliances and elsewhere. This is only a partial displacement, however, for in most cases the electric current itself is generated by means of a fire in which coal is burned.

Fire and Material Progress.—When once the art of using and making fire became established, it must have altered human development in at least three ways. First, it must have stimulated the inventive faculty, thereby leading to material progress; second, it must have led to an increase in the density of population; third, it must have enabled primitive man to inhabit areas which had previously been too cold. These three changes must have had a profound effect upon the location of the centres of civilization and progress, and perhaps upon the mental development of the various human races.

One invention commonly leads to another. Fire must have been peculiarly important in this respect. Although no exact knowledge is possible, we can infer with considerable certainty that after people once mastered what was then the extremely difficult art of using fire, it required only a moderate degree of inventiveness to make many other important discoveries. The primitive fire-users must soon have learned that sticks which are partly burned in the fire become pointed and hardened, thereby becoming more serviceable as weapons. Even if the effect of fire on food was not previously known, bits of flesh, green fruit, edible roots or other kinds of food must inevitably have fallen accidentally into the fire and been cooked as soon as fires became common. Their improved flavour and tenderness when rescued must have led persons with the keener type of mind to make experiments. The range of opportunities thus opened is enormous, for practically every growing thing which had the least semblance of edibility must have been subjected to the process of roasting. As time went on, and it became possible to heat water in skin bags by means of hot stones or in earthen vessels, the art of boiling food must have been discovered. At some time or other an earthenware jar which boiled dry, or some other accident must have suggested the possibilities of baking food by enclosing it within non-combustible receptacles. In our own day experiments in the use of fire for cooking are perhaps more numerous and vigorous than ever before.

Food is only one of the ways wherein fire obviously stimulated experiments. During the long period when the use of fire was known but the art of generating it unknown, the desire to create a blaze must have stimulated men's inventive faculties even more persistently than we are now stimulated by the desire to secure new and better sources of power. Again, having seen that animals are so averse to a blaze, he must have asked himself: "How can I best use fire to keep away animals during the night?" Then he presumably found that a flaming torch is a most effective weapon when thrust into the face of a wild animal. Thus the stimulus to invention must have gone on so that men discovered that firebrands hurled into the huts of their enemies are a good weapon, or that when a patch of jungle is burned, the wild animals can be driven out and easily caught. In later days when civilization had advanced far higher, similar reasoning and experiment showed that flaming pitch, red hot balls of metal or explosive projectiles are effective ways of lighting fires in the midst of the enemy.

In connection with metallic ores fire has been a main agency in stimulating the inventive faculty. The first inkling as to the possibility of smelting presumably arose from the accidental melting of bits of ore in a hot fire. When once the significance of that fact was grasped by some genius, and when the highly valuable qualities of the resultant metals were realized, the stimulus toward melting all sorts of stones must have been enormous. Here, too, we see a line of experiments which has continued with increasing intensity to our own day. Thousands upon thousands of skilled inventors have worked upon the problem of making hotter and hotter fires. Thus we have melted more and more refractory stones, thereby enormously increasing the number of available metals and other valuable compounds. In this respect, as in many others, fire and its possibilities are still among the greatest agencies in stimulating human progress.

Greater perhaps than any of the preceding—or at least later and more striking in its effect—is the relation of fire to power. As soon as the first savage saw a yam or other bit of vegetation pop in the fire because steam was escaping, the principle of the development of power from fire was brought to man's attention. For hundreds of thousands of years thereafter many a boy presumably experimented by holding the lid down over a boiling vessel of water until the steam puffed it violently up. Many a man in addition to Hero, who made what was really a steam engine more rhan 2,000 years ago, must have realized that the expansive force of steam possesses energy which might be of high value. But only in modern times did progress along other lines finally make the steam engine a practical invention. Then the attempt to use the energy liberated by fire suddenly gave an almost incredible stimulus to the world's inventive faculties. Our whole modern system of manufacturing, transportation, lighting and heating is based on the utilization of fire.

Pyrotherapy **and** Sterilization.—One of the most extraordinary features of fire is the way in which its use continues to increase even in our own day. This is especially true in the field of health. The value of cauterization in preventing harm from poisonous bites like those of snakes or mad dogs, and in preventing the spread of infection from wounds or sores has long been known, and was practised by the ancients. The value of hot baths in skin disease and in those of the joints has also been appreciated, at least since rhe days of the Romans. Only in modern times, however, have two other therapeutic uses & fire become known. One is the process of baking whereby a limb or other member is kept for a while at a temperature as high as it can endure with results which are said to be highly beneficial. The other is the use of fire for sterilization. The knowledge that heat, either in the form of flame or through the medium of steam or hot water, will kill bacteria has been one of the most revolutionary discoveries of modern times. To it, perhaps, as much as to any other single factor, is due the wonderful progress of modern surgery.

Dangers of Fire.—In spite of all the benefits derived from fire, the mere word "Fire!" is one of the most dreaded expressions in every language, for fire is as dangerous as it is useful. Some of the greatest disasters in all history have been fires such as those in Rome in the time of Nero, and the one which ravaged London for four days in 1666 and gave Sir Christopher Wren a chance to plan many important improvements. Chicago suffered a similar fire in 1871 and 100,000 people were rendered homeless; San Francisco experienced a similar fate after the great earthquake of 1906. Earthquakes have been the cause of some of the most terrible fires, as in Tokyo in 1923. There the style of architecture renders fires especially dangerous, for the houses are constructed of wood with paper walls and heavy thatch of straw. At Tokyo the fire killed 60,000 or 70,000 people. burned 25 sq.m. and drove away nearly 1,000,000 persons. In all countries the annual losses by fire are enormous. In England they amount to about £12,000,000 annually. In the United States, partly because wooden houses are more common than in Europe, the losses are far greater, amounting to over half a billion dollars every year from 1922 onward, and to $560,000,000 in 1926. or approximately $5 per person. In that same year the fear of fire led the people of the United States to pay $635,000,000 in premiums to fire insurance companies, while $352,000,000 was returned to cover losses. Forest fires are amazingly frequent and some of them lay waste thousands of square miles. From 1916 to 1925 the average number of such fires in the United States alone was about 51,000. Nearly half of these devastated at least ten acres; the average damage to trees and property amounted to about $21,000,000, but the real damage was enormously greater because the fires kill the young growth, expose the soil to erosion, and alter the character and density of the new growth. In 1825 one of the greatest forest fires burned an area of 3,000,000ac. in Maine and New Brunswick, while fires that burned more than 1,000,000ac. in the United States and Canada occurred in 1853, 1871 (two totalling 3,280,000ac.), 1881 and 1910. Such fires may still occur in regions like Siberia, but are impossible in the more advanced countries because of the improved methods of fire-protection.

The Effect of Fire on Density of Population.—One of the most noteworthy facts in the history of civilization is the way in which many of the greatest inventions increase the density of population. Inventions connected with fire are pre-eminent in this respect. One of the first effects of the original discovery of the art of using fire must have been to increase the available food supply. It did this directly through the art of cooking, whereby many previously inedible or indigestible products became good articles of diet, and also by making it possible to smoke and preserve food that otherwise would have been wasted. Indirectly the use of fire still further increased the food supply by improving man's tools. It not only enabled him to use sharpened sticks as described above, but helped him to break up the stones from which he procured flint implements, and kept him warm and dry so that he could work more effectively in cool weather. It enabled him to smelt metals and ultimately to make machines of all sorts. Thus fire has been a major agent in the process whereby man has multiplied his labour so that one man with the help of fire-made and fire-driven machinery can do as much work as scores or hundreds who have only their naked hands and no help from fire. In recent centuries no factor has exceeded the use of coal in fostering the growth and concentration of population; in earlier times the use of fire in other ways produced similar although less obvious results.

Fire and the **Coldward** March **of** Civilization. — One of the most extraordinary results of the use of fire is the way in which it has enabled the centres of human progress to move from warmer to cooler regions. According to the most recent studies the best climate for primitive savages without fire, clothing or shelter, is one where the temperature averages not far from 70° at all seasons, but yet has a fair degree of variability. The nearest approach to such a climate is by no means found in equatorial regions but at a distance of 25° or more to the north or south. Even there, however, although the winters are admirable, the summers are much too long and warm for the best health and greatest efficiency. Now man is so constituted that up to a certain point he can endure too much heat more easily than too little. Among naked savages, for example, a temperature of 90° is far less uncomfortable than one of 60°. Therefore unless people possess artificial means of warming themselves they tend to live in regions that are too warm rather than too cold. This retards progress, for people usually overcome the adverse effect of high temperature by inactivity rather than activity.

The introduction of fire changed all this. In conjunction with discoveries as to clothing and shelter, it enabled people to be comfortable in cool climates. Each new discovery meant a step away from low latitudes. The invention of the hearth to replace the bare ground as a place for a fire was one of the earliest reasons for such a step. The invention of a protected opening in the roof to carry off the smoke was another. Still another was the combination of the hearth with a chimney in such a way as to give an efficient draft, eliminate smoke and throw the heat out into the room; then came the enclosed oven or stove of mud as in China; later the stove of metal; then central heating by means of furnaces supplying hot air, steam or hot water and heated first by wood, then by coal, and lately by oil or gas. Each of these improvements in the use of fire, together with the corresponding advances in clothing and architecture, reduced the difficulties due to low temperature, for they helped to create an artificial climate in which people were approximately as comfortable, healthful and energetic as in the ideal climate. Thus to-day we can live comfortably and in good health in climates so cold that people without fire would perish.

One of the greatest benefits of man's conquest of fire has been that the human race has gradually been able to migrate into the cooler and hence more healthful and energizing parts of the world. At every stage of this process of expansion there has been a definite zone of highest comfort, best health and greatest activity. Beginning not far beyond the tropics, the zone shifted to Mediterranean lands, and then to higher latitudes. To-day it is coincident with the zone of greatest progress, highest civilization and world dominance, a condition which also appears to have been true in the past. A further advance in the use of fire may possibly carry the zone of greatest progress as far north as southern Scandinavia and southern Canada, but not beyond, for there the summers as well as the winters become too cool. The ultimate location of this most favoured zone will doubtless be the regions where the following three conditions are most nearly fulfilled: (1) the summer climate is ideal for civilized people who wear clothes and live in houses; (2) the use of fire creates ideal atmospheric conditions within doors during the rest of the year; and (3.) the degree of variability arising from the weather on the one hand and the use of fire on the other produces the maximum stimulus, but does not injure health. With our present skill in the use of fire a climate like that of London comes as near as any to satisfying these three conditions, but the regions surrounding Paris, Berlin, New York and Chicago do not lag far behind.

From all this it appears that the "coldward course of progress" as GilFillan has called it, or the "northward course of empire" to use Stefansson's phrase, has depended upon the use of fire more fully than on any other factor that is yet clearly defined. It has involved a migration of the centres of power from regions where the *winter* climate is ideal but the summers debilitating, to those where the summer climate is ideal, and the disadvantages of the winter can be obviated by the use of fire together with clothing and shelter.

Fire and **Racial** Inheritance. — The possible biological effect of fire upon mankind ought not to be overlooked, although it is highly speculative. At first, and perhaps for many generations, the users of fire probably comprised only a small group of unusually intelligent, competent and progressive people. The first persons to use almost any revolutionary discovery are usually of that sort, no matter whether the discovery be the aeroplane, the electric motor, the art of weaving or the alphabet. During the long period when the technique of fire was new and crude its users must have had great need of intelligence, skill, patience and material prosperity, for otherwise they would not and could not have devoted to the art the many hours each day that must inevitably have been required. Among primitive hunters who are constantly obliged to change their abode it is by no means easy to maintain a fire that must never be allowed to go out, and the new arts of cooking and drying food and making fire-hardened weapons must also have been difficult. But the people who were sufficiently wise, active and patient to master all these difficulties must have reaped great advantages. Their food supply, as we have seen, became more abundant, more reliable and more nutritious, their improved weapons lessened the danger from both beasts and men, and their children must have enjoyed a freedom from hunger, exposure, disease and danger hitherto unknown. Such advantages, in a day when there was no such thing as birth control, must have caused the descendants of the fire-users to increase in number faster than did the people who lacked the wit, energy or resource to use the new invention. Thus, if there is any truth in the inheritance of mental traits, the inherent intelligence and progressiveness of the population must have been improved.

The degree of improvement must have differed from place to place. Near the equator the people presumably made little use of fire; the warmth of their climate not only prevented them from feeling much need of it, but made them loathe the necessary exertion. Thus in such regions fire had little effect in causing the intelligent people to increase in numbers. In the cooler parts of man's primitive habitat, on the contrary, the use of fire presumably caused the descendants of the more intelligent and progressive people to be numerous in proportion to those of the more stupid and indifferent, thus altering the average level of innate intelligence. Beyond the limits of the old inhabited area the use of fire enabled people to migrate into regions previously too cold for occupancy. Since all the migrants must have been of the intelligent fire-using class, whatever innate superiority they may have possessed must have been segregated and thereby perpetuated. Thus there must have been a gradation of innate ability from the unaltered people of the hottest regions to the selected new settlers in cooler regions. If such a differentiation occurred once, it must have occurred repeatedly when further progress in the mastery of fire enabled mankind to move into still cooler regions. The result would correspond exactly with the temperamental differences which now seem to be innate in the people of tropical as compared with temperate regions. All this is indeed speculative, but it ought not to be overlooked in considering the part played by fire in the development of mankind.

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NOTABLE FIRES OF HISTORY

Of many of the early fires of history, there are only fragmentary records. In the middle ages many of the towns of Europe consisted of small buildings of wood construction, crowded closely together, which lent themselves to ready destruction by fire both in war and peace. In the accompanying list of notable fires, some are included which would be relatively unimportant compared with the destruction of cities in later conflagrations which are listed. A limited selection of later fires had to be made in preparing a representative list and only those of particular significance could be included. Fire destruction of World War II dwarfs all the rest.

Great Britain and Ireland

Year
798. London. Nearly destroyed.
982. London. Greater part of the city burned.
1137. York. Totally destroyed.
1212. London. Greater part of the city burned.
1292. Carlisle. Destroyed.
1544. Leith. Burned.
1612. Cork. Greater part burned, and again in 1622.
1614. Stratford-on-Avon. Burned.
1666. London. "The Great Fire," Sept. 2. It began in a wooden house in Pudding lane, and burned for three days, consuming 13,200 houses, with St. Paul's church, 87 parish churches, 6 chapels, the guildhall, the royal exchange, the custom-house, many hospitals and libraries, 52 companies' halls, three of the city's gates, four stone bridges, and the prisons of Newgate, the Fleet, and the Poultry and Wood street Compters. The fire swept from the Tower to Temple church, and from the northeast gate to Holborn bridge. Six persons were killed. The total loss of property was estimated at the time to be £10,730,500. The fire is credited with founding the institution of fire insurance.
1675. Northampton. Almost totally destroyed.
1694. Warwick. More than half burned; rebuilt by national contribution.
1700. Edinburgh. "The Great Fire."
1731. Blandford, Dorset. Town largely destroyed; 13 killed.
1824. Edinburgh. High street, Tron Kirk and Parliament square fires, Nov. 15 and 17; 10 killed, loss £200,000. This fire led to modernization of the Edinburgh fire engines and draft of rules for conduct of police, firemen, magistrates and property owners in event of fire.
1834. London. Houses of parliament destroyed.
1861. London. Cotton's and other wharves, Tooley street shops, steamer, boats and barges destroyed. Loss £2,000,000. This fire led to the passing of the Metropolitan Fire Brigade act of 1865, which combined the London Fire Engine establishment and the Voluntary Society for the Protection of Life from Fire into one body, and the establishment by the Fire (Insurance) Offices' committee of the London Salvage corps.
1866. London. First Crystal palace fire. Loss £150,000. Subsequent fires in 1923 (loss £5,000), 1936 (almost complete destruction) and 1950 (last building destroyed).
1915. London. Second Zeppelin raid by Germans, Sept. 8, caused 29 fires and £530,000 damage (air raids of World War I caused 224 fires in London).
1940. London. First large air attack of World War II by Germans, Sept. 7, hit docks area, causing great fires. On Dec. 29–30, 1940, area around St. Paul's destroyed; 1,472 separate fires.
1940. Coventry. Air raid fire destroyed city centre, Nov. 14. This attack is credited with revealing the destructiveness of incendiary bombs. Lesser raids April 8 and 10.
1941. London. Heaviest single German attack of war, April 16 and 17, 457 tons incendiaries and high explosive bombs dropped. May 10, house of commons destroyed.
1949. Bootle, Lanc. Gladstone dock fire, Nov. 9. Loss £2,000,000.
1950. Treorky, Rhondda. Factory fire. Loss £1,000,000.
1951. London. Broad street warehouse fire, 3 firemen killed.
1951. Bristol. Avonmouth docks oil tank fire; 12,000,000 gal. of oil destroyed.

France

59. Lyons, Lugdunum. Burned to ashes. Nero made an offer to rebuild the city.
1118. Nantes. Greater part of city destroyed.
1862. Marseilles. Destructive fire.
1871. Paris. Suppression of the Commune (*q.v.*). Property destroyed £32,000,000.
1938. Marseilles. Destruction of large part of Cannebière, 75 people killed.
1949. Landes district. 355 fires devastated 600 sq.mi. of forest and heathland.

Germany

1491. Dresden. Destroyed.
1758. Pirna. Burned by the Prussians; 260 houses destroyed.
1811. Forest fires in Tyrol destroyed 64 villages and hamlets.
1842. Hamburg. A fire raged 100 hours, May 5–7. During the fire the city was in a state of anarchy; 4,219 buildings, including 2,000 dwellings, were destroyed. One-fifth of the population was made homeless and 100 persons lost their lives. Total loss £7,000,000.
1943. Hamburg. British air force wreaked terrible havoc by a series of attacks, principally those of July 24–25, July 27–28 and July 29–30. Fires were set, respectively, over 18.5, 17 and 10 sq.mi., with 1.;, 5.1 and 2.2 sq.mi. of concentrated fire. The first attack killed 2,000, but the second produced a great mass fire or fire storm which killed 60,000–100,000 people. The thousands of fires started great air movements, similar to those in a storm or cyclone, which produced gales (fire storm) in the streets at the edge of the burning area and made raging flues in the streets in the fire area. More than 300,000 dwellings were destroyed in the series of attacks on Hamburg and 750,000 people were made homeless.
1945. Dresden. In the closing days of World War II, Dresden was subjected to air attack which probably dwarfed all previous attacks of the war on German cities. No detailed evaluation of damage was published but estimated deaths of more than 35,000, and development of fire storm conditions, suggest it was the greatest fire of World War II.

Central and Southern Europe

548 B.C. Delphi, Gr. Temple of the oracle of the Pythian Apollo destroyed by fire.
64. Rome. Burned during 8 days. Ten of the 14 wards of the city were destroyed.
1106. Venice. Greater part of the city was burned.
1379. Memel was in large part destroyed, and again in 1457, 1540, 1678 and 1854.
1883. Vienna. Loss £1,000,000.
1910. Brussels. Brussels exhibition. Loss £1,750,000.
1922. Geneva. Northern railway station destroyed. Loss £400,000.
1926. Bacau, Rum. Loss £1,000,000.
1939. Warsaw. Devastation of city by Germans, Sept. 24.
1940. Rotterdam. German air raid fires killed thousands, May 14.

Northern Europe

1624. Oslo. Nearly destroyed.
1728. Copenhagen. Nearly destroyed; 1,650 houses burned.
1794. Copenhagen. Royal palace burned.
1751. Stockholm. 1,000 houses destroyed.
1790. Karlskrona. 1,087 houses, churches, warehouses, etc., destroyed.
1858. Christiania. Loss estimated at £250,000.
1865. Carlstadt, Swed. Almost entirely destroyed, 10 lives lost.
1940. Norway. Elverum destroyed in May, and fires in a number of other cities after German bombings.

Russia and Siberia

1752. Moscow. 18,000 houses burned.
1786. Tobolsk. Nearly destroyed.
1812. Moscow. Russians fired city on Sept. 14 to drive out the army of Napoleon. The fire continued five days. Kine-tenths of the city was destroyed; 30,800 houses burned; loss £30,000,000.
1812. Riga. Partly destroyed.
1850. Cracow. Large part of city burned.
1862. St. Petersburg. Loss £1,000,000.
1879. Irkutsk. Loss £4,500,000.
1941. Russia. Many cities burned in face of German invasion; the extent of damage was very great but was not revealed.

Turkey and the Near East

1750. Constantinople. In Jan. 10,000 houses burned; in April property destroyed estimated from £1,000,000 to £3,000,000; later in year 10,000 houses were destroyed.
1756 Constantinople. 15,000 houses destroyed. During the years 1761, 1765 and 1767 great havoc was also made by fire.
1772. Smyrna. 3,000 dwellings burned; 3,000–4,000 shops, etc., consumed. Loss £4,000,000.
1782. Constantinople. Fire burned three days; 10,000 houses, 50 mosques and 100 corn mills destroyed; 100 lives lost. In Feb. 600 houses burned; in June 7,000 more.
1784 Constantinople. Fire destroyed 10,000 houses, most of which had been rebuilt since the fires of 1782. In the same year a fire in Pera destroyed two-thirds of that suburb. Loss estimated at 2,000,000 florins.
1870. Constantinople. Suburb of Pera swept by a fire which destroyed more than 7,000 buildings, including the residence of the foreign legations. Loss estimated at nearly £5,000,000.
1871 *et* seq. Constantinople. Fires of greater or lesser severity continued to be of almost annual occurrence until the 1920s, great fires being reported in 1908, 1911, 1912, 1915, 1918, 1919 and 1922.
1922. Smyma. Conflagration attributed to the war between the

Turkish and Greek armies. Loss £20,000,000.
1954. Istanbul. Fire destroyed ancient covered bazaar Nov. 27; loss $178,000,000.

India, China and the Far East

1799. Manila. Vast storehouses burned.
1803. Bombay. Loss £600,000.
1822. Canton, China. Nearly destroyed by fire.
1923. Tokyo and Yokohama, Jap. Following earthquake, about seven-tenths of Tokyo and most of Yokohama destroyed by fire; loss estimated at £200,000,000.
1924. Canton. Conflagration as a result of insurrection; loss £4,000,000.
1925. Kumagaya, Jap. Central portion of town burned out.
1932. Tokyo. Department store fire; loss £1,000,000.
1938. Canton. Great fires set by Japanese air attacks May 28 and subsequently.
1938. Changsha, China. Fire set by authorities burned five days; almost complete destruction of city.
1940. Chunking, China. Japanese air raid caused great fires, Aug. 19–20 and loss of 4,572 lives.
1944. Bombay. Explosion on steamship "Port Stikine" and resultant fires destroyed docks and spread into a residential area, April 14; more than 700 deaths; damage estimated at £20,000,000.
1945. Tokyo. Attack by U.S. bombers with incendiaries on March 9 burned over 17 sq.mi. and killed nearly 84,000. Probably more persons lost their lives by fire at Tokyo in a 6-hr. period than at any one time in the history of man.
1945. Osaka, Jap. Air attack of March 13; 8 sq.mi. burned.
1945. Tokyo and Yokohama. Attack with incendiary bombs by U.S.A.A.F., April 15, burned over 7 sq.mi.
1945. Nagoya, Jap. Air attack of May 17, nearly 4 sq.mi. destroyed.
1945. Yokohama. Air attack of May 28; approximately 9 sq.mi. burned over.
1945. Hiroshima, Jap. Atomic bomb attack, Aug. 6; 68,000 of 75,000 buildings destroyed. A fire storm which developed after the blast contributed to the large life loss of 70,000 to 80,000.
1945. Nagasaki, Jap. Atomic bomb attack, Aug. 9; 20,000 out of 52,000 buildings destroyed. Fire damage was extensive but no fire storm developed. Loss of life more than 35,000.
1948. Hong Kong. Warehouse burned, Sept. 22; about 150 died.
1952. Tottori, Jap. Conflagration destroyed 5,287 houses; loss, 19,300,000 yen.
1955. Yokohama, Jap. 100 persons killed in fire-swept home for aged.
1958. Kiem, Vietnam. Fire destroyed town; 10,000 left homeless.

Australia and New Zealand

1888. Brisbane. Loss £400,000.
1897. Melbourne. Flinders lane fire; loss £1,000,000.
1921. Kirribilli. About 32,000 bales of wool burned; loss £750,000.
1925. Melbourne. Knitting mills fire; loss £1,000,000.
1926. Adelaide. Sugar refining company fire; loss £700,000.
1943–44. Victoria. Bush fires, Dec. 1943–Feb. 1944, 51 dead; loss £5,000,000.
1947. Christchurch, N.Z. Department store destroyed, with 41 deaths, Nov 18. This fire prompted adoption of plans long discussed for a fire brigade administration covering all New Zealand.

South Africa

1902. Cape Town. City chambers; loss £250,000.
1942. East London. Loss £1,000,000.

United States

1760. Boston. Fire caused a loss estimated at $500,000.
1835. New York. Great fire of New York began in Merchant street, Dec. 16, and burned 530 buildings in the business part of the city; area burned over was 52 ac.; loss $15,000,000.
1845. Pittsburgh. Large part of the city burned April 11; 1,100 buildings destroyed.
1849. St. Louis. 23 steamboats at the wharves and whole or part of 1j blocks of the city burned, May 17.
1851. San Francisco. Fire destroyed 2,500 buildings, May 4–5; more than three-fourths of the city destroyed.
1851. St. Louis. More than three-quarters of city and 2,500 buildings burned, May 4; loss $11,000,000.
1866. Portland, Me. Great fire on July 4 involved 1,550 buildings, 200 ac.
1871. Chicago. Great fire began in a barn on the night of Oct. 8 and raged until Oct. 10. The area burned over was 2,124 ac.. or $3\frac{1}{3}$ sq mi in the heart of the city; 250 lives were lost, 98,500 persons were made homeless, and 17,450 buildings were consumed; loss estimated at $168,000,000.
1871. Peshtigo, Wis Forest fires, Oct. 8, destroyed 1,280,000 ac. and many buildings; 1,500 killed.
1872. Boston. Great fire of Nov. 9–10 destroyed richest quarter of Boston. Fire commenced at the corner of Summer and Kingston streets; 65 ac, burned over; 776 buildings burned; loss $75,000,000.
1882. Leadville, Colo. Loss $10,000,000.
1900. Hoboken, N.J. German steamships in dock fire, June 30; 326 killed.
1901. Jacksonville, Fla. Conflagration destroyed 1,700 buildings; loss $11,000,000.
1903. Chicago. Iroquois theatre fire, Dec. 30; 602 killed. This fire led to more stringent regulations for theatres all over the world.
1904. Baltimore, Md. 80 city blocks involved, Feb. 7; loss $150,000,000.
1904. New York. Excursion steamer "General Slocum" burned June 15; 1,030 killed.
1906. San Francisco. Great fire following earthquake, April 18; total loss of life about 1,000; total damage about $350,000,000.
1908. Atlanta, Ga. Conflagration of May 8; loss $11,500,000.
1908. Collinwood, O. Lakewood Grammar school fire and panic, March 4; 175 children killed.
1911. New York. Factory fire, March 25; 145 women killed.
1916. Jersey City, N.J. Warehouses and steamers, "Black Tom disaster"; loss $22,000,000.
1916. Paris, Tex. Conflagration, March 21; 1,440 buildings burned; loss $11,000,000.
1917. Atlanta. Conflagration of May 21 destroyed 1,938 buildings.
1917. Kingsland, N.J. Munitions factory; loss $12,000,000.
1918. Minnesota. Forest fires, Oct. 12; Colquet and 25 other towns involved; 559 killed.
1923. Berkeley, Calif. Fire destroyed 600 buildings; loss $12,500,000.
1929. Cleveland, O. Hospital fire, May 15; 125 killed.
1930. Columbus, O. State penitentiary fire, April 21; 320 killed.
1934. Off New Jersey coast. Steamship "Morro Castle" burned Sept. 8; 125 killed.
1937. New London, Tex. Natural gas explosion in school building, March 18; 294 killed.
1940. Natchez, Miss. Dance hall fire, April 23; 207 killed.
1942. Boston. A night club fire, Nov. 28; 493 killed.
1944. Hartford, Conn. Circus fire, July 6; 168 killed.
1946. Atlanta. Hotel fire; 119 killed.
1947. Texas City, Tex. Ship loaded with ammonium nitrate fertilizer exploded April 16; 468 killed; loss $67,000,000.
1951. West Frankfort, Ill. Coal mine explosion, Dec. 21; 119 killed.
1957. Warrenton, Mo. Fire in home for aged Feb. 17; 72 killed.
1958. Chicago. Elementary school fire, Dec. 1; 94 killed.

West Indies

1873. Havana, Cuba. Loss £600,000.
1882. Kingston, Jamaica. Loss £6,000,000.
1948. Castries, St. Lucia. Commercial section of town wiped out; loss £2,000,000.

Lanada

1825. New Brunswick. Tract of 4,000,000 ac., more than 100 mi. in length, including many towns, burned over; 160 persons killed.
1837. St. John, N.B. 115 houses and nearly all the business part of the city burned, Jan. 13.
1877. St. John. Fire extended over area of 600 ac.; loss $15,000,000.
1892. St. John's, Nfd. Loss $15,000,000.
1904. Toronto, Ont. General conflagration; loss $13,000,000.
1917. Halifax, N.S. About 75 ac. of city burned following explosion of munitions ship; 1,000 buildings levelled; 1,500 persons killed.
1923. New Brunswick. Forest fires; loss $20,000,000.
1949. Toronto, Ont. Steamer "Noronic" burned, Sept. 17; 120 killed.
1950. Rimouski, Que. Lumber yard fire destroyed 346 buildings, May 6; loss $16,000,000. (Ho. B.; X.)

FIREARMS: see PISTOL; SMALL ARMS, DEVELOPMENT OF.

FIREBACK, the ornamented slab of cast iron protecting the back of a fireplace. The date at which firebacks became common probably synchronizes with the removal of the fire from the centre to the side or end of a room. They never became universal, since the proximity of deposits of iron ore was essential to their use. In England they were confined chiefly to the iron districts of Sussex and Surrey, and appear to have ceased being made when the ore in those counties was exhausted. They are, however, occasionally found in other parts of the country, and it is reasonable to suppose that there was a certain commerce in an appliance which gradually assumed an interesting and even artistic form. The earlier examples were commonly rectangular, but a shaped or gabled top eventually became common.

English firebacks may roughly be separated into four chronological divisions: those moulded from more than one movable stamp; armorial backs; allegorical, mythological and biblical slabs with an occasional portrait; and copies of 17th- and 18th-century continental designs, chiefly Netherlandish. The fleur-de-lis, the rosette and other motives of detached ornament were much used before attempts were made to elaborate a homogeneous design, but by the middle of the 17th century firebacks of a very elaborate type were being produced. Thus there are representations of the Crucifixion: the death of Jacob. Hercules slaying the hydra, and the plague of serpents. Coats of arms were very frequent, the royal achievement being used extensively; many existing firebacks bear the arms of the Stuarts. About the time of Elizabeth the coats of private families began to be used, the earliest instances remaining bearing those of the Sackvilles, who were lords of a large portion of the forest of Anderida, which furnished the charcoal for the smelting operations in early British iron fields. To the armorial shields the date was often added, together with the initials of the owners. The method of casting firebacks was to cut the design upon a thick slab of oak, which was impressed face downward upon a bed of sand, the molten metal being ladled into the impression.

Firebacks were also common in the Netherlands and in parts of France, notably in Alsace. At Strasbourg and Metz there are several private collections, and there are also many examples in public museums. The museum of the Porte de Hal at Brussels contains one of the finest examples in existence. with an equestrian portrait of the emperor Charles V, accompanied by his arms and motto. When monarchy was first destroyed in France the possession of a *plaque* de *cheminée* bearing heraldic insignia was regarded as a mark of disloyalty to the republic, and on Oct. 13, 1793, the national convention issued a decree giving the owners and tenants of houses a month in which to turn such firebacks with their faces to the mall, pending the manufacture by the iron foundries of a sufficient number of backs less offensive to the instinct of equality. Very few of the old plaques were removed, however. and to this day the old châteaux of France contain many with their backs outward.

FIREBRAT, a wingless insect (*Thermobia domestica*) of the order Thysanura, so called because of its occurrence about fireplaces and bakehouses. It feeds on starchy material.

FIREBRICK. Another descriptive term for this product is refractory brick, which includes a variety of shapes made from nonmetallic minerals and intended for service at high temperatures. The largest consumers of firebrick are the metal and glass industries.

Ran· materials for firebrick include fire clays, of which the essential mineral components are hydrated aluminum silicates having the general formula $Al_2O_3.2SiO_2.2H_2O$; minerals of high aluminum oxide content, such a; bauxite. diaspore and kyanite; sources of silica, including sand and quartzite (commonly known as ganister); the magnesia minerals. magnesite, dolomite, forsterite and olivine; chromite, a solid solution of chromic oxide with the oxides of aluminum, iron and magnesium; carbon in the form of graphite or coke; and vermiculite mica. Minor raw materials are zirconia, zircon, thoria, beryllia, titania and ceria and other rare earths.

Manufacture. — Refractory shapes are formed by the following processes used in building brick manufacture: dry press, stiff mud and soft mud (see BRICK), as well as casting and hot pressing. The soft mud process of forming firebrick is a hand operation in which a slug of plastic clay is thrown into a steel-lined wooden mould. The casting process employs a suspension of finely ground raw material in water, which is poured into absorbent plaster moulds to form the desired shapes. Hot pressing consists in subjecting the dry mix to moderate or high pressures in a heated die, causing bonding and densification to occur more readily than would be the case without pressure application. This method has been utilized in the preparation of specialized refractories for very high temperature service.

Drying of firebrick shaped by conventional methods is commonly performed in continuous tunnel driers in which temperature and humidity are carefully controlled. In the burning of firebrick oil- or gas-fired tunnel kilns or periodic kilns are ordinarily used. Some ram materials, including magnesite and dolomite, require an additional firing in rotary kilns to bring about sintering and densification before the crushed and sized material can be fabricated into refractory shapes and refired. Grog for firebrick is also made by burning fire clay or aluminum oxide minerals in a rotary kiln. Electric furnace fusion of raw materials, followed by casting of the melt in special moulds, is important. Fused alumina, mullite and zirconia brick have no porosity and great resistance to attack by molten glasses. Silicon carbide, a widely used refractory, is formed by reaction of petroleum coke with sand in electric or resistance furnaces. The resulting crystalline product is crushed and graded. After incorporation of a bonding material it is formed into the desired shapes which are then fired in a tunnel kiln.

Properties. — Desirable properties of firebrick are: (1) refractoriness; (2) resistance to attack by such corrosive materials as glasses, metals, slags and salts; (3) high strength at ordinary temperatures and resistance to deformation under loading at high temperatures; (4) resistance to spalling (surface fracture of the brick resulting from stresses which are usually induced by uneven heating or cooling); (5) ability to withstand abrasion; and (6) thermal conductivity suitable for the conditions of use.

Firebrick may conveniently be grouped into three categories: (1) acid, (2) neutral and (3) basic. The neutral classification is not widely used, however. since some refractories, such as those made from mixtures of chrome ore and magnesite, have both acid and basic characteristics. Silica brick is typical of acid firebrick and magnesite brick of the basic group.

Refractoriness of firebrick is often evaluated in terms of pyrometric cone equivalents. These provide an index number corresponding to a given temperature at which the material undergoes marked softening and deformation. Low-duty fire-clay bricks have cone values ranging from 19 to 26 (1,520° to 1,595° C.), and superduty fire-clay bricks have values of 33 to 34 (1,745° to 1,760° C.). High-alumina firebricks have cone values that Increase from 34 to 42 (1,760° to 1,990° C.) as the aluminum oxide content is raised from 50% to 99%. For very high temperature service, graphite and other carbon refractories, as well as silicon carbide, are available. These have the disadvantage of poor resistance to oxidation, although this condition can be improved by incorporation of additives designed to form a protective glaze at operating temperatures.

In the majority of uses, firebrick must be able to resist corrosive chemical reactions, particularly those which result from contact with molten slag. It is a general rule that the refractory should be of chemical nature similar to the material with which it will come in contact; *e.g.*, a basic refractory should be used when it will come into contact with a basic slag, for example in basic open-hearth steelmaking. Silica brick might seem ideal for lining a glass tank in which a high-silica glass is to be melted. but this is not the case; such bricks are porous and would permit the melt to penetrate within the grains and destroy the bond, resulting in early failure. Therefore it is customary to use a very dense firebrick made from fire clay and ganister, or a fused cast refractory with zero porosity.

The ability of firebrick to withstand loading at high temperatures is closely related to the melting behaviour of the refractory, since the greater the amount of liquid formed within the material, the greater the deformation under load. Knowledge of the load-bearing capacity of firebricks is important in furnace design. particularly where the refractory is rather uniformly heated to a high temperature, as in well-insulated furnace roofs and interior parts of the furnace structure.

The loss of fragments of material from a fire-clay brick or from the face of a panel of fire-clay brick masonry under service conditions is known as spalling. This type of failure usually results from thermal stresses which occur when the material is subjected to rapid temperature changes. Firebricks having uniform and low coefficients of thermal expansion are least susceptible to spalling. At temperatures above 650° C., silica brick is very resistant to spalling, but below that temperature a marked volume change occurs, resulting from crystalline inversion of the cristobalite modification of silica; spalling is likely to result unless heating and cooling in this temperature range are very slow. The fact that open-hearth furnaces in steel mills have silica brick roofs is one of the reasons why interruption in operations involves considerable lost time and much expense.

Uses.—The greatest use of firebrick is in the production of iron and steel. Vast quantities of refractories are used in blast furnaces, open hearths, Bessemers, electric furnaces and ladles.

Fire-clay brick has been most commonly employed in the lining of blast furnaces. but carbon refractories are also widely used for bosh and hearth linings. It is in the open hearth. however, that the greatest variety of lining materials is employed, including magnesite, chrome, silica, fire-clay and insulating brick. The front and back walls of the furnace as well as the roof are made of silica brick, and it is usual practice to introduce a layer of chrome brick between the silica and magnesite brick. Chrome firebrick is compatible with both silica and magnesite. whereas the two latter types of firebrick, if in immediate contact, would fail through chemical reaction at high temperatures.

In the foundry industry, cupolas are used for melting gray iron. Since the charge consists of pig iron and scrap, together with limestone and steel, it is necessary to line the cupola with dense firebrick that will withstand abrasion. Sudden temperature changes require that the brick be resistant to spalling, and slag attack is also generally severe. Fire-clay brick best meets these conditions. The nonferrous metal industry is likewise a large consumer of firebrick for the production of copper, zinc, lead, nickel and melting of aluminum.

Firebrick is vital to the production of glass. Glass furnaces or tanks, as they are called, are elaborate refractory structures in which high rates of melting can be maintained. Glass may be considered as a special and extremely corrosive type of slag. Several materials used in its manufacture, such as soda ash, sodium sulphate, lime and borax. react vigorously with many refractories at high temperatures. For this reason highly siliceous, dense, fireclay bricks, known as flux blocks, are much used in the portion of the tank that is in contact with molten glass. Mullite firebricks. prepared from the mineral kyanite, have excellent durability, as do also fused alumina bricks, since these allow no penetration of the glass and are comparatively inert chemically.

Firebrick linings must be employed in lime and cement kilns. Dense fire-clay blocks give good service. hfagnesite is an excellent material for lining rotary kilns used in portland cement manufacture, since the refractory and the clinker are both highly basic and do not react with one another.

Electric power generation is heavily dependent upon the utilization of firebrick. Large quantities are employed in the furnaces of steam-generating plants. although the water cooling of furnace walls eliminated part of the need for high-temperature linings.

Industrial Trends.—The history of the firebrick industry shows a continuous change from manufacture of a few types of all-purpose materials to a high degree of specialization. Initially, iron and glass manufacture provided the impetus for firebrick development. Near the close of the 19th century the great variety of lining materials used in the steel industry, including silica, magnesite and chrome firebrick. was introduced.

For most processes where firebricks are employed as a lining material, the production rate and efficiency are augmented by increases in operating temperatures. Thus, there has been a continued incentive for the firebrick manufacturer to improve the refractoriness and general quality of his products as well as to diversify them for many new applications.

Special types of refractories are required in the construction of power plants based on the utilization of nuclear energy; the materials must have outstanding chemical and physical stability at high temperatures. These specifications resulted in intensive study and use of various high-melting oxides, carbides, sulphides and nitrides that were not previously widely employed as refractories.

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FIRE CONTROL: see GUNNERY, NAVAL.

FIREDAMP, the most prevalent of the noxious and inflammable gases found in mines. The chief constituent of this gas is methane (*q.v.*), also known as marsh gas. Firedamp is commonly termed "gas" by the coal miner, and a mine in which its occurrence is common is known as a "gassy" or "fiery" mine. Firedamp is never found as pure methane in mines. Analyses in seams in the north of England made by Sir H. de la Beche and Lyon Plaqfair in 1846 showed the gas to contain:

	Per Cent
Methane	77.j to 98.2
Nitrogen	1.3 to 26.1
Carbonic acid	0.3 to 2.1
Oxygen	0.0 to 3.0
Hydrogen	0.0 to 3.0

Sometimes. besides methane. firedamp contains a small quantity of another highly inflammable gas. ethane (*q.v.*). Thus samples of mine atmospheres taken in a working place (a dip drift) at the Glückhilf colliery at Waldenburg in 1881 and analyzed by Poleck for the Prussian Firedamp commission, showed its composition to be as follows:

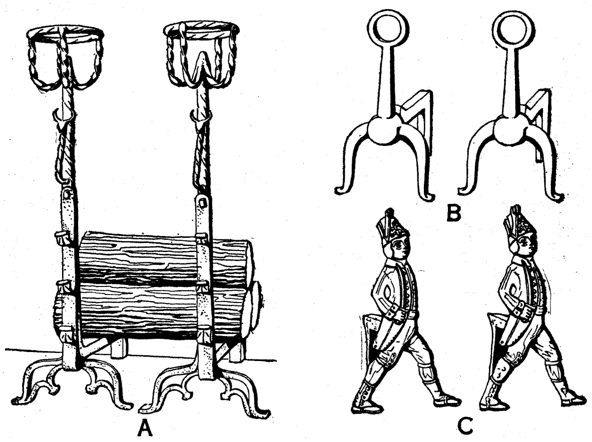
	1. Per Cent	2. Per Cent
Methane (CH_4)	34.93	32.65
Ethane (C_2H_6)	2.89	3.99
Carbonic acid (CO_2)	41.49	41.49
Carbon monoxide (CO)	...	1.87
Nitrogen (N) Oxygen (O)	20.69	20.00
	100.00	100.00

The considerable quantity of carbon dioxide points to the sample being the result of decomposition. The carbon monoxide was discovered by the aid of the spectroscope. Methane is odourless, colourless and tasteless. It burns with a bluish flame forming carbonic acid and water. As it is lighter than air it rises upward to the roof and is found in the higher parts of the workings. When mixed with air to the extent of 6.1%, the atmosphere becomes just ignitable. so that 6.1% is spoken of as the lower limit of inflammability; the most explosive mixture, however. is that which contains 9.47% of methane; that is, where there is present just sufficient methane to consume all the oxygen in the air. Eight to 14% may be regarded as the high explosive range. At 22% the mixture ceases to be explosive. Though firedamp is found chiefly in coal mines, where it exudes from the pores and cavities in the coal, its occurrence is not restricted thereto. In 1886 two explosions of firedamp occurred in the Mill Close Head mine 'at Darley Dale in Derbyshire. by which five persons lost their lives; its occurrence in metalliferous mines has also been reported. It probably occurs in all coal mines. though some are commonly described as exempt (*e.g.,* the coal mines of the Forest of Dean), but is probably generated in such small quantity as not to be detectable on the flame of a lamp or candle.

The usual way of determining the presence of firedamp in the mine atmosphere is by the pale violet-blue cap above the flame of the safety lamp. It is detectable by this means when present to as low as ½% (see SAFETY LAMP).

In some seams firedamp exists in a state of considerable pressure, as determined by Lindsay Rood in experiments conducted by him in 1880 for the royal commission on accidents in mines. For this purpose holes were driven into the solid coal, plugged and fitted with a pressure gauge. when pressures as high as 461 lb. per square inch were obtained after some days. The greatest volume of gas given off was equivalent to 5,927 cu.ft. per hour. These, however. are abnormal figures. Sudden outbursts of firedamp. the *dégagements instantanés* of the Belgian miner, are an infrequent occurrence in British coal mines. usually taking place in the neighbourhood of a fault. Blowers of gas, the *soufflards* of the French miner, are more common, a blower being a stream of gas frequently accompanied by water, continuing at a constant pressure sometimes for years. (See also COAL AND COAL MIXING.) (R. R.)

FIREDOG, or andiron, one of a pair of supports for wood that is burned in an open fireplace. It has an upright standard to which is attached a horizontal bar which raises the logs above the hearth level. The spreading base gives the support an appearance similar to that of a dog, hence firedog. Various materials are used, such as cast iron, wrought iron, steel, brass and cast brass. Wrought-iron firedogs, with little or no ornament, were used in the simple homes, whereas the more expensive materials, with every conceivable adornment, belonged to the élite. The 17th century was noted for its rich and elaborate andirons, some of



BY COURTESY OF (A) MUSÉE DE CLUNY, (B, C) METROPOLITAN MUSEUM OF ART

FRENCH AND AMERICAN FIREDOGS OF THE 18TH CENTURY
(A) French firedogs, (B & C) American firedogs

which stood 4 ft. high and were tipped with such decorations as bronze disks, shields of arms and statuettes.

FIRE ENGINES. The modern fire engine or pumper is a motor-driven vehicle used when fighting fires. It is specially built to (1) carry a crew of firemen and equipment that will be required for fire extinguishment and (2) to provide the required volume of water at proper pressure for the hose lines.

The equipment usually carried is fire hose, nozzles, water (100 gal. or more), ladders, pike poles, electric lanterns, axes, forcible entry tools, gas masks and portable fire extinguishers.

The power to propel the fire engine and operate the pump is provided by an internal combustion motor of heavy duty design. Fast acceleration and good hill climbing ability are essential features. The motor must have adequate power to enable the pump to deliver a rated volume of water at specified pressures for good fire streams.

Fire engines are built in several sizes to meet the operating requirements of standardized pump performance ratings.

Other types of vehicles also used by the fire service include (1) the ladder truck which carries a large assortment of ground ladders of varying lengths; (2) the combined fire engine and ladder truck, making a "quadruple" which performs the functions of both vehicles; (3) the aerial ladder truck which carries a power-operated aerial ladder to reach heights or locations not possible with ground ladders, and which is used for rescue operations, access to upper floors of buildings, and as a water tower; (4) the "quintuplet," a combination in one vehicle of the fire engine, ladder truck and aerial ladder truck.

History. — The earliest method of fighting fires consisted of throwing water on the fire from buckets or other vessels. It is not known what fire-fighting facilities were available at the time of the burning of Rome in A.D. 64. The first use of a device for applying water to a fire in the form of a stream dates back as far as the 2nd century B.C. The science of fire extinction was still in a very elementary stage in 1666, when the great fire of London occurred. The only fire engines used at this fire were those of the hand-operated type. The early squirting devices were usually in the form of a mammoth syringe. This later developed into a receptacle for holding water which was filled and replenished during the fire by a bucket brigade, the water being withdrawn and ejected by means of an early form of pump.

The pumps on the early fire engines were hand-operated and the range and force of the stream were poor. In many instances the engine was destroyed by the fire because of the fact that the short range of the stream made it necessary to take the apparatus close to the flames. This led to the development of better pumps which could squirt a much longer distance. Subsequently, the development of a flexible pipe or hose made it possible to locate the engine well away from the fire and to convey the water under pressure from the engine to the fire. A still later development was the employment of suction hose to enable the pump to feed from sources other than its own suction.

Steam Fire Engines. — The first mechanically operated fire engines appear to have been developed early in the 19th century when steam was first used for operating a fire pump — the vehicle on which the pump and steam boiler were mounted being drawn to the fire either by the firemen or by horses. About 1860 steam fire engines were being made in England and the United States. Public interest in steam fire engines was greatly stimulated by competitions held in England at the Crystal palace in 1863, in which engines from the United States took part.

Steam fire engines were used almost exclusively at the Chicago, Ill., conflagration in 1871. Toward the end of the 19th century horse-drawn steam fire engines had been brought to a state of high perfection both in Europe and in the United States, when engineers began the development of the self-propelling vehicle.

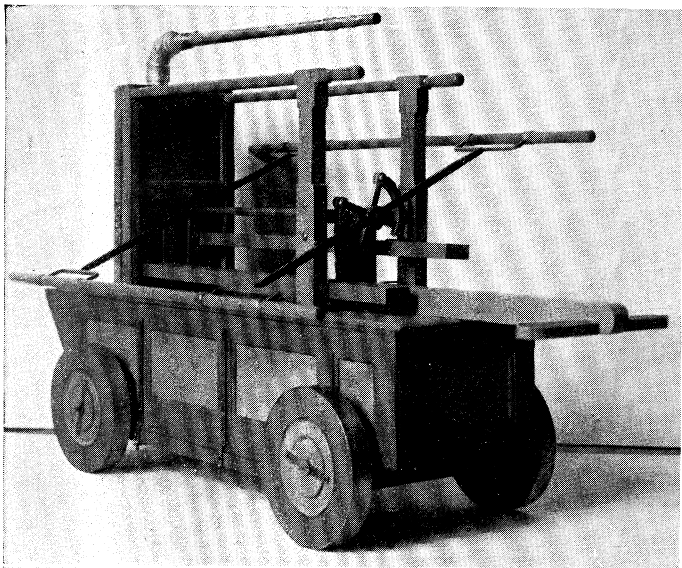
The earliest self-propelled machines were those of steam fire engines.

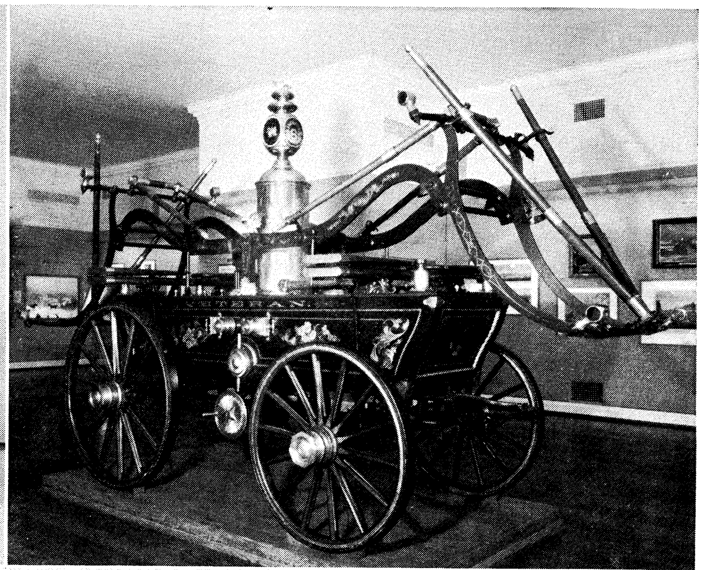
Motor Fire Engines. — The first self-propelled fire engines employing an internal combustion motor (other than as a tractor) were built about 1903. By 1910 a considerable number of motor fire engines were in successful service in various parts of the world, and by 1920 practically every large city had discarded horse-drawn and steam fire engines in favour of self-propelled engines.

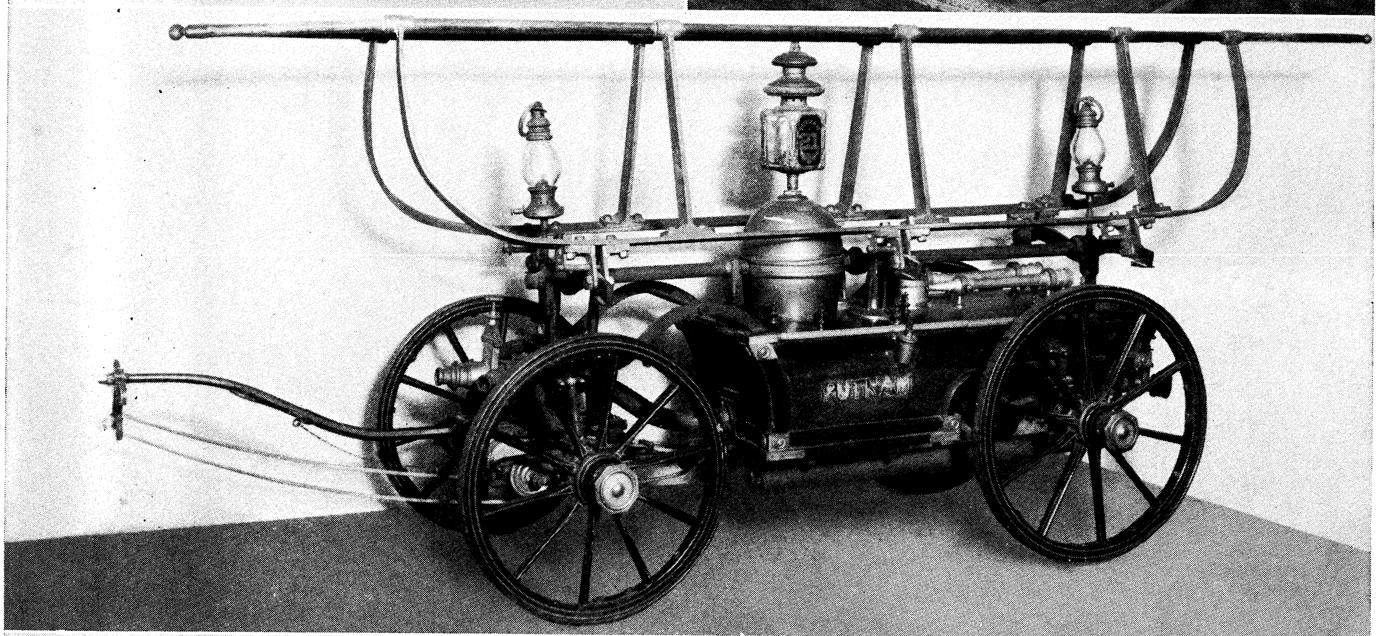
Three types of fire pumps — piston, rotary gear and centrifugal —were used in fire engines for about 30 years after fire engines were motorized. During this period, the efficiency and performance of the centrifugal pump improved so greatly that it superseded other types in the medium and larger sizes of pumps. The piston and rotary gear types came to be used only for small stream ($\frac{3}{4}$ in. and 1 in.) hose lines and nozzles. The centrifugal pump is not self-priming and requires an auxiliary device to exhaust the air from the pump and the suction lines when the pump is to operate at draft. When operating from a hydrant the use of a primer is not required.

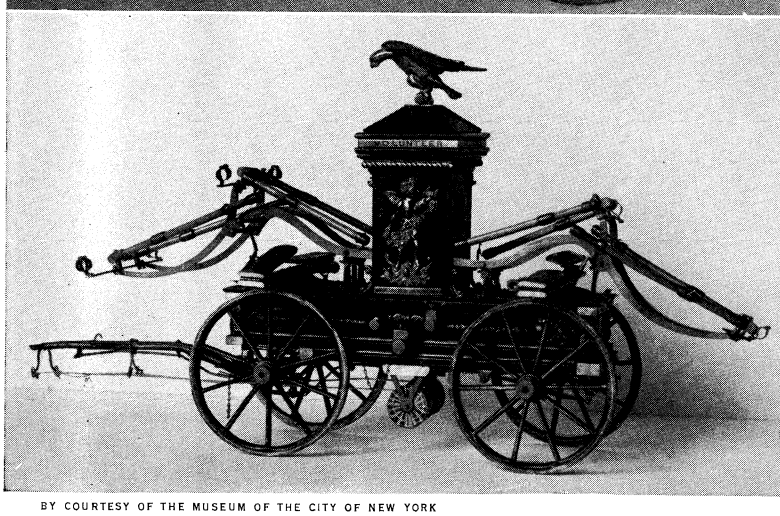
Chemical Fire Engines. — Chemical fire engines are large-capacity chemical fire extinguishers usually mounted on two wheels for portability; they are principally used in industrial organizations and at airports. These units are built in four different types: soda acid, foam, carbon dioxide and dry powder. The soda acid and foam types were mounted on fire engines and used on small fires. The mounting of these units on fire engines was discontinued by 1930 and water tanks were substituted. The types used for industrial fire protection usually have a capacity of 40 gal. for either the soda-acid or the foam type. The carbon dioxide type carries one or more cylinders of carbon dioxide. Cylinders hold 50 lb., 75 lb., or 100 lb. of carbon dioxide in liquid form. The dry powder extinguishers have 150 lb. or 350 lb. capacity. The soda-acid engine consists of one or more cylindrical vessels charged with a solution of bicarbonate of soda dissolved in water. Enclosed in this cylindrical vessel is also a receptacle for holding a quantity of sulphuric acid. A hose line generally $\frac{3}{4}$ in. or 1 in. in diameter is connected to the outlet of the cylindrical vessel, and when the chemical engine is required for use, the sulphuric acid is caused to be discharged from its receptacle into the bicarbonate of soda solution. This admixture of the acid with the soda solution within the cylindrical vessel forms carbonic acid gas under pressure, which forces the solution through the hose. In the soda-acid machines various methods for causing the acid to be discharged into the soda solution are employed: (1) inverting the acid bottle by means of an operating handle; (2) revolving the cylindrical vessel on its trunnions, thus inverting the acid receptacle.

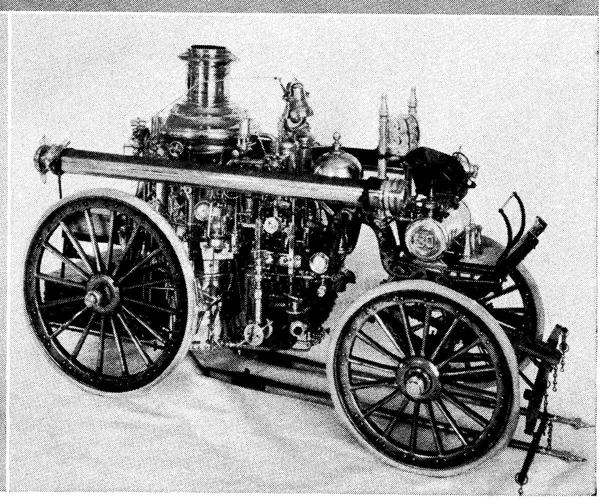
The foam type of machine is somewhat similar to the soda-acid except that the acid ingredient is a solution of aluminum sulphate dissolved in water. To make the bubbles tougher and more stable a stabilizing ingredient is added to the bicarbonate of soda solution. The discharge from a foam chemical engine is therefore a tough and tenacious foam made up of minute bubbles containing











EARLY U.S. FIRE ENGINES

Top left: Hand-operated model built in England and put into service in New York city in 1731

Top right: An engine of the 1850s. One of the largest of its day, it weighed about 4,500 lb. when loaded and required 16 men to operate its brakes

Centre: Crane neck type of engine, built about 1863, which was capable of throwing a stream of water 150 ft. into the air

Bottom left: The "Philadelphia" or "double deck" style of engine first introduced in 1840. Photograph shows a replica made in 1885 from an original engine

Bottom right: Steam fire engine first put into service about 1905. About 1913 it was converted from horse to tractor-drawn and remained in active service in New York city until 1932

carbonic acid gas. This foam has the property of adhering to any solid surface upon which it is thrown and will even adhere to a vertical wall or to a ceiling: it also floats on any flammable liquid. This foam completely excludes air from the surface which it covers and deprives the fire of the oxygen which would otherwise feed the flames, thus extinguishing the fire by sufiocation. Foam is also used in the fire service in the form of a dry powder which employs a foam generator to mix the powder with water being discharged by the fire pump. The foam powder is poured into the hopper on the generator as required for foam production. As the stream of water passes through the base of the generator, the dry foam is automatically drawn into the water stream resulting in chemical action producing foam for discharge from the nozzle.

The carbon dioxide extinguisher contains a quantity (by weight) of carbon dioxide in liquid form. The liquid changes to a gas at −39° F., and the pressure increase in the cylinder expells the gas when a seal is punctured at the outlet valve.

The dry powder type extinguisher uses bicarbonate of soda with additives to prevent caking. A nitrogen gas cylinder is used to provide an inert gas to expel the powder when required. A relief valve controls the discharge pressure.

Fire Boats.—An important feature of the fire-fighting equipment in large river, lake and sea ports is the fire boat. They are essentially large tugboats equipped with fire pumps of 3.000 to 12,000 gal. capacity. The older boats were steam-propelled and the pumps steam-driven. The newer boats are propelled by internal combustion motors. such as the efficient diesel engine, which are not only employed to propel the boat but also utilized to drive the fire pumps when required. A typical later boat has a pumping capacity of 12,000 gal. of water per minute at about 100 lb. pressure, is 123½ ft. long, 26 ft. beam and 73 ft. draught, designed to travel at a speed of about 14 knots.

Fire Extinguishers.— Fire engines usually carry two or more of the following types of small fire extinguishers: soda acid (2½ gal.); foam (23 gal.); carbon dioxide (15 Ib.); dry chemical (25 to 30 lb.); carbon tetrachloride (1 qt. to 1 gal.); water type (j gal.). The type and number of extinguishers will vary according to the hazards that exist in the area covered by a particular department, each type being particularly suited for specific risks.

(J. H. Os.; C. B. R.; Ht. W.)

FIRE ESCAPES in England refer to constructing ladders mounted on wheels which are intended to be used exclusively for the purpose of enabling people to escape from burning buildings. Abraham Wivell invented the first portable fire escape ladder of this kind about 1837. Before Wivell's time, however, various smaller fire escapes were in use. There is in existence a very interesting drawing by C. Geissler, dated 1789, showing three types employed in Geneva at that date, consisting (1) of the cloth or canvas chute, (2) the rope and basket (or sling), and (3) sectional ladders fitted with sockets so that several could be joined together to make one long length. the top section having running wheels to travel easily up the walls of a building. Sectional ladders of somewhat similar build were the first fire escapes to be used in London, when John Braidwood, the famous first chief of the London Fire Engine establishment, put them into service there in 1832. They were made in short lengths of about 6 ft. for carrying upon the fire engines of the period.

Wivell's wheeled fire escape was not officially adopted, though it was put into service in London by the Royal Society for the Protection of Life from Fire. A few years later another type of wheeled escape known as the fly-ladder was evolved and this, being an improvement upon Wivell's machine, gradually superseded it. The fly-ladder had a main ladder about 3j ft. in length mounted upon a spring carriage. with large wheels. At about 10 ft. from the top of the main ladder a folding ladder of about 20 ft. was joined by hinges, and was raised when required for use by ropes attached to projecting levers. It was possible also to detach this folding ladder when required; and in the event of greater heights having to be negotiated than the combined height of the main and fly-ladders, a separate short ladder was placed at the top of the folding ladder, and by this means a height of about 60 ft. could be reached. At the underside of the ladder was affixed a canvas chute protected externally by copper wire netting; this was used to pass persons down when it was possible to get the top of the chute upon a suitable window sill. For greater heights the persons had to be carried down the ladders in the same way as is done in the present day.

Telescopic Escapes, 1890.—The fly-ladder escape held the field in England until about 1890 when telescopic escapes were introduced embodying the sliding body principle, which enables the ladders to be carried in a horizontal position and elevated to the vertical on arrival at a fire. These ladders were arranged to slide in a framework attached to the axle, and were held in position by means of hand-driven gear arranged on the backfly. They could be pitched at any angle to the building, thus enabling a wide forecourt to be bridged. which could not be done with the older types of fire escapes; but it was found that for service of this kind it was necessary to strengthen the sides of the ladders: and in 1896 J. C. Merryweather patented a system of bowstring girder trussing which also formed a convenient handrail on each of the ladders. Other makers, notably Shand Mason & Co., introduced other forms of trussing to achieve the same object. Soon after these sliding carriage escapes were introduced the motor system began to make headway in service: and it became customary to arrange brackets at the rear of the motor vehicles to carry fire escapes, which could then be dismounted upon the arrival of the engine at a fire, and wheeled by hand to any convenient position for use. This is still the practice in most large British fire brigades. Before arriving at this stage of development. however, there had been an intermediate stage when sliding carriage fire escapes were carried upon horse vehicles, some being of the dog-cart pattern, and others being four-wheeled horse-drawn vehicles generally known in the service as tenders. Many fire brigades now carry light trussed ladders (35 to 40 ft. dismounted ladders) in an overhead position on their motor vehicles; these are very serviceable where buildings of moderate height are concerned.

Another form of escape which, although introduced many years ago, is still popular, is the pompier ladder; as its name indicates, it is of French origin. It is an exceptionally light ladder usually from 16 to 18 ft. in length. and at the end an iron or steel hook is fixed for the purpose of reaching over and holding on to window sills. In expert hands the pompier ladder is very useful, but it can only be safely worked by trained firemen. It is not always employed in the ordinary way as a fire escape. but is used for the purpose of enabling firemen to scale walls of burning buildings, and persons to be saved are lowered to the ground by ropes which the firemen carry.

Recent Methods.—In Great Britain and on the continent of Europe, the most modern type of fire escape is that known as the turntable ladder. It is mounted upon an automobile chassis, and the ladders can be slewed around to any required position. A good example is a machine built at the end of 1927 for the Leicester fire brigade. The chassis has a six-cylinder engine of 60 b.h.p., which not only provides the power for road travelling but also. through special gearing, elevates, extends and revolves the ladders, so that they can be moved into any desired position. The movements of the ladders are controlled by three levers. and a graduated quadrant shows automatically the angle of elevation, while an indicator gives the height of extension. Plumbing gear is provided to enable the ladders themselves to remain vertical even when the carriage is standing on uneven ground. At the top of the ladders is fitted a swivelling monitor nozzle, for use as a water tower, from which a jet can be sent in any direction. Upon the turntable platform is a powerful searchlight which will throw a beam up the ladders whatever their position may be, thus lighting up the man who is controlling the jet or effecting a rescue; and this man is in communication, by means of a loud speaker telephone, with his comrades on the ground. In the centre of the chassis is fixed a Hatfield fire pump. capable of delivering 250 gal. per minute, and at the top of this pump is mounted a monitor swivelling nozzle from which a jet can be thrown direct upon a fire. The delivery of the pump is also arranged in such a way that the water can pass up through hose carried up the ladders for the purpose of attacking the fire from above, by means of the water tower just mentioned. It will be seen that it is possible for this machine to be used as a water tower and fire engine simultaneously, since the pumps can be working on the main monitor which is mounted upon the pump itself, while the ladders are being used for rescue purposes.

Every possible precaution has been taken to secure safety in operation. Trussing is employed to increase the strength of the ladders, and an ingenious device insures that when either of the three controlling levers are released by the operator, no matter at what angle or extension the ladders may be, the power is cut off and the ladders remain absolutely secure. Again, if either of the levers is pulled down, or kept down too long, overelevation or overextension is automatically prevented by a device which forcibly returns the levers to the free position before the point of danger is reached. The outstanding feature of this machine is that, contrary to the practice in some of the earlier types, the one engine performs every operation. Motor turntable ladders are built in various lengths, but as they are expensive machines it is the general practice to construct them to command very considerable heights. The longest ladder of this type built up to the year 1953 was made by the Magirus company of Germany. It is 170 ft. in length. Ladders of 45-m. length (150 ft.) are also constructed by this company. The common heights made by all manufacturers are from 75 to 100 ft. (J. H. Os; X.)

United States.—The term fire escape in the United States is usually restricted to those means of escape added to an existing building and designed only for emergency use. The most common type is the open iron stairs with railed balconies extending from roof to street and usually required by a local regulation in order to bring a building up to an improved standard of egress established after the building was first designed. or where a definite standard is required because of a change in the type or number of occupants.

This type of escape has serious limitations. In areas subject to winter exposure they must be kept clean of ice and snow. Unless installed against a blank wall, smoke and fire from lower story windows may render them impassable. Many people are affected by height and are likely to be timid and descend at a much slower rate than on inside staircases. Because these fire escapes are for emergency use only their proper upkeep may be neglected.

Many escapes of this type must extend over public walkways and the lower section is a counterweighted flight, usually with some type of locking device so prowlers cannot pull it down from the street. In other cases the escape may have a fixed ladder or a balcony where ladders are added after arrival of the fire department. In spite of these limitations, however, many lives have been saved by this type of installation. the LaSalle hotel fire in Chicago, Ill., on June j 1946, being one of the outstanding examples.

Another type of escape for existing buildings is the simple iron-railed balcony which leads around a fire wall or fire exit partition. In this type a person must leave one section of a building, usually through a window, onto the balcony pass the fire wall and enter another building or another section of the same building and then use the regular means of egress.

A third type of fire escape is the slide escape—a chute which may be installed in a vertical spiral or straight and may be either open or enclosed. The straight chute may be parallel to the building or at right angles. Access to the chute is through openings at floor level, from which persons slide to ground level. They are usually approved for new industrial buildings having high hazard occupancy such as manufacture of explosives, grain elevators. etc. On existing buildings they are limited to schools, orphan asylums and hospitals. One distinct advantage of their use in hospitals is that patients may escape on a hospital pad or mattress.

The best escapes. however, are those which are planned in the design of the building—enclosed staircases, fireproof towers or other approved means of egress.

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FIREFLY, a term popularly applied to luminous, winged beetles of the family Lampyridae. The family contains about 2,000 described species and is world-wide in distribution. In the temperate zone, the beetles are a familiar sight on warm summer nights. when they may be seen flashing their lights in woodlands, over meadows, lawns, marshes and along lakes and streams. The flashing. which is believed to facilitate the meeting of the sexes, is sometimes synchronized, with thousands of individuals lighting up rhythmically and in unison. The commoner North American species belong to the genera *Photinus* and *Photuris; Luciola* is a well-known European genus. In many lampyrid species, the female may be wingless, larviform and luminous, while the males are beetlelike. capable of flying and either feebly luminous or nonluminous; the females of these species are known as glowworms (*q.v.*). Click beetles (family Elateridae) of the genus *Pyrophorus* emit a brilliant greenish light from a pale spot situated on each side at the base of the pronotum; they are sometimes referred to as fireflies but are more properly called fire beetles. They range from southern United States to Argentina and Chile. Other luminous click beetles (genus *Photophorus*) occur in New Caledonia, New Hebrides and Fiji. (See BEETLE.)

(R. L. WL.)

FIRE INSURANCE as now transacted all over the world was evolved in England in the 17th century. Until then any one suffering loss of house or goods by fire was dependent upon charity or the assistance of members of his guild to recoup his loss. The charitable principle was put into effect largely through church briefs or king's letters nhich entitled the sufferer to beg. Many proposals for a more systematic provision against fire losses failed to obtain support until after the great fire of London (1666). The principles already established in marine insurance were then applied to the insurance of houses. The basic principles were that the house owner should make a fixed annual contribution as premium to the insurers or underwriters who entered into a contract with him to make good fire loss or damage. In 1680 a fire office was formed to insure houses in London at a premium calculated at $2\frac{1}{2}\%$ of the yearly rent for brick houses and 5% for frame houses. Forty years later lire insurance had become established not only for houses but for goods, merchandise, furniture and wares of every description, and over the next 100 years numerous fire offices were formed all over the country.

In its development. fire insurance in Great Britain was particularly free from restrictive legislation. Apart from an iniquitous stamp duty. which often cost the insured more than the premium, there was little interference by the legislature. and not until 1909 were fire-insurance companies made subject to special legislation designed essentially to ensure their solvency.

A sound reputation for the fulfilment of contracts was early established by the British companies, and this was due in no small measure to their co-operation in establishing adequate rates of premium, particularly in respect of hazardous risks. Some agreements of this kind existed as early as 1826 and led eventually to the formation of the Fire Offices' committee in 1868 the members of which, known as tariff companies, regulate their business in the light of their pooled experience. By penalizing features of fire hazard and allowing discounts when the property is suitably protected, the companies have done much toward the prevention of fire.

The fire-insurance companies also initiated fire brigades; the company-maintained brigades which operated in London at the beginning of the 19th century eventually formed the nucleus of the metropolitan fire brigade. When it was recognized that the protection of property and lives against fire was a public duty to be discharged by the government or local authorities. the fire-insurance companies became free to concentrate on the technical aspects of risk improvement. They also established and still maintain at their own expense salvage corps in London, Liverpool, Glasgow and Belfast, the function of which is to minimize loss nhen a fire occurs. More recently the Fire Protection association, instituted by the Fire Offices' committee. was formed to give specialized advice on all fire-prevention problems.

Fire insurance is now transacted in the United Kingdom by nearly 140 companies as well as by underwriters at Lloyd's.

World-wide operations produce more than £200,000,000 in fire premiums each year. There was a tenfold increase in the first half of the 20th century.

The essential principles of fire insurance evolved in Great Britain have been widely followed in other countries. The governments of many countries have, however. intervened in the conduct of fire insurance by stringent legislation and have thus greatly restricted freedom of development and underwriting. State monopolies or privileged state companies, state reinsurance banks, state controllers and superintendents of insurance, with intervention in investments, reserves, policy conditions, rates and loss settlements, are widely established. In some countries the law governing fire insurance forms part of the civil or commercial code.

There are certain fundamental principles which govern all fire insurance contracts:

Good Faith.—Sound underwriting requires that insurers charge a premium commensurate to the risk involved, and for this purpose they require particulars which will enable them to assess the premium. Insurance contracts are contracts *uberrimae fidei; i.e.*, of the utmost good faith. It is not sufficient that a proposer for fire insurance answers truthfully such questions as may be asked of him by the insurer; the higher duty of full disclosure of all material facts applies. Contracts of insurance are therefore different from ordinary commercial contracts to which the doctrine of *caveat emptor* (let the buyer beware) applies. If the representations made by the proposer are not true, or if he fails to disclose everything that ought to be made known to the underwriter as material for a proper assessment of the risk. then the contract is rendered either voidable or void. In general, it is sufficient if the information given by the proposer is substantially correct, but any fact that appears on the policy as a warranty must be literally correct.

Indemnity.—A policy of fire insurance is a contract of indemnity against loss and not a contract to produce gain. The insurer undertakes to make good to an insured person, either by money payment or reinstatement, the loss he has suffered within the limits and terms and conditions of the policy. The insurers are liable only for the material loss; they cannot be called upon to pay for sentimental value. The peril causing the loss must have been accidental (*i.e.*, not caused intentionally by the insured).

A corollary of the principle of indemnity is the doctrine of subrogation. It sometimes happens that the insured is in a position to recover the amount of his loss, or part of it, from a third party as well as from his insurers. The insured may proceed against either or both, but the principle of indemnity means that if he claims from his insurers he automatically transfers to them his rights to recover from the third party.

Insurable Interest.— A policy of fire insurance covers the insured person's interest in the subject matter. An insured person must stand in such a relationship to the property insured as to suffer from its damage or destruction. This interest must exist at the inception of the policy and at the time of the loss.

There are many kinds of insurable interest: (1) Absolute ownership. This is probably the commonest form of interest. The insured need not be the sole owner; he may be a joint owner or partner in a firm. (2) Limited ownership (*e.g.*, tenants for life). (3) Mortgagors and mortgagees. The insurance is usually effected in the joint names, but each party has a separate insurable interest and may insure separately. (4) Lessors and lessees. These possess a joint interest, but each party may insure separately. (5) Trustees. These are legal owners of property and may insure in their own names. (6) Bailees. These are persons holding goods of another on trust, such as carriers! innkeepers, pawnbrokers, warehousemen and wharfingers. Some classes of bailees have their liability limited by statute.

It is not essential that the insured disclose the nature of his interest or for this to be stated in the policy. An exception is made in respect of goods held in trust or on commission, which are not covered unless specially mentioned.

Who Grants Insurance.— Fire insurance in Great Britain is conducted in rhe main by joint-stock limited-liability companies, mutual associations, and underwriters at Lloyd's. In the case of the companies the insured parties' contributions are restricted to the premiums they pay; they cannot be called upon to make good a deficiency in the fund. Operations of mutual associations are usually confined to a particular trade or business, but the mutual system is not regarded as entirely satisfactory, since a proportionate contingent liability rests on each insured to make good any general excess of losses over the general premium contributions. An insurance "written" at Lloyd's is divided among members of a syndicate, and the proportionate responsibility of each member is detailed in the policy. A proposer for fire insurance has no direct approach to underwriters at Lloyd's. All business is conducted through the medium of a Lloyd's insurance broker.

The Policy.— The standard form of policy now in use by most companies in the United Kingdom provides that if the property insured is destroyed or damaged by certain means the insurers will pay to the insured the value of the property at the time of the happening of its destruction or the amount of the damage. The causes covered are:

1. Fire (whether resulting from explosion or otherwise) not occasioned by or happening through: (a) its own spontaneous fermentation or heating or its undergoing any process involving the application of heat; (b) earthquake, subterranean fire, riot, civil commotion, foreign enemy, military or usurped power, rebellion or insurrection.
2. Lightning.
3. Explosion of boilers used for domestic purposes only.
4. Explosion of gas used for domestic purposes or used for lighting or heating the building, the building not being part of any gas works.

There are certain conditions which are implied in every policy of fire insurance, irrespective of specific inclusion in the contract. They are based on common law and. in general, have reference to the principles of good faith and insurable interest. Conditions expressed in the standard form of policy are:

Misdescription. Any material misdescription of the property insured or concealment of material fact invalidates the policy.

Alteration and Removal. Increase of risk, transfer of interest or removal of the property must be notified to the insurer and his consent to the alteration endorsed on the policy The clause as to removal mar be modified by an extension clause in the household-goods policies.

Excepted Goods and Perils. Certain classes of property, such as money, stamps, securities and documents, plans and patterns are not covered by a general description but must be specially mentioned. Explosives. and goods in trust must also be specified and damage by explosion (except as stated in the policy) is not covered. (This must not be confused with fire damage caused by explosion, which is covered.)

Claims Procedure. Notice of loss must be given immediately and a detailed claim submitted within 30 days. The insured must, if required, furnish reasonable proof of loss.

Fraudulent Claims. If the claim is in any respect fraudulent, all benefit under the policy is forfeited.

Reinstatement. Should the company elect to reinstate, the insured must give them reasonable assistance in the form of plans, specifications, etc. Reinstatement need not be exact but only reasonably sufficient and is limited to the sum insured.

Right of Entry. The company may enter and take possession of premises which have been the scene of a fire likely to give rise to a claim and may take possession of and deal with insured goods in a reasonable manner.

Contribution. If there is any other insurance effected for the same interest on the property destroyed or damaged, liability under the policy is limited to its rateable proportion of such destruction or damage. The condition is based on the fundamental principle of indemnity. The methods of achieving contribution vary according to circumstances.

Subrogation. This condition sets out the rights of the company under this heading (see *Indemnity* above).

Permanence of Warranties. This emphasizes that warranties to which the policy may be subject apply throughout the whole currency of the policy. Without this requirement, it would be necessary to obtain from the insured at each renewal an agreement that the warranties applied.

Arbitration. All differences arising out of the policy must he submitted to arbitration and an award made before action in the courts is taken.

Purchaser's Interest Clause. It is provided that property which is the subject of a contract to purchase shall be covered jointly for the benefit of the vendor and purchaser up to the date of the completion of the purchase, provided that the property covered is a building. The clause gives a concession in regard to condition 2 (alteration and removal).

Individual policies are subject to special conditions designed for each particular case and mostly for the convenience and advantage of the insured. In addition to the normal fire cover, the excluded perils of earthquake, subterranean fire, riot, civil commotion can usually be insured on payment of an additional premium. Insurance against a foreign enemy, military or usurped power, rebellion or insurrection is not obtainable. A comprehensive form of policy granted to house owners or householders conveniently embodies in one form insurance against fire and many additional risks.

Reinsurance.— By a system of reinsurance the company accepting the fire risk, known as the original or ceding company, gives off so much of the sum assured as is in excess of the amount it desires to retain. The amount given off is distributed among other companies, known as the reinsuring companies. Reinsurance cover is effected (1) by treaty arrangements, or (2) facultatively, in which case, unlike the treaty method, each request for reinsurance is accompanied by sufficient information to enable the reinsuring company to judge its acceptability. The system enables insurers to limit their liability on any one risk to a figure proportionate to the funds available and is based on one of the underlying principles of insurance (*i.e.*, the distribution of loss).

Consequential Loss.—Common law has laid down that ordinary fire insurance protects the insured only in respect to material loss or damage. Loss consequent upon fire is not included, but can be made the subject of consequential loss insurance, also known as profits insurance. The protection thus afforded is now as essential as that against material loss to most business concerns. There are three items to be considered: net profit; standing charges; increased cost of working. Insurance of any one or any combination of these three can be effected.

Net profit is defined as the residual profit from which dividends and allocations to reserve are normally provided; *i.e.*, the amount remaining after all charges have been met.

Standing charges are those charges which have to be met after a fire, and of necessity vary with individual circumstances. Any desired range may be specified when the insurance is effected. but they are usually made up from rent, rates and taxes; interest on loans and debentures; directors' fees; salaries and wages; advertising contracts; auditors' fees; and insurance premiums.

Increased cost of working is intended to cover abnormal expense incurred in keeping the business going after a fire.

An important factor is the period of indemnity; *i.e.*, the period in respect of which compensation is payable after a fire. A maximum period is chosen by the proposer (not the insurer), and should represent his estimate of the time needed to restore the business to full production after a fire. The period may vary from three months to three years, the most commonly selected period being from one to two years. After a fire, the indemnity period is the time during which there is actual interruption of normal trading or production.

The usual basis for the sum insured is the net profit and standing charges for the last financial year, or for the ensuing year, should the previous year's trading not afford a reliable guide. The premium calculation is related to the rates charged for insuring the ordinary fire risk and the period of indemnity.

The method employed for adjustment of losses varies according to the nature of the trade or industry. The usual method compares trading after the fire with that of the corresponding period in the previous 12 months and is known as the turnover standard. The settlement of loss of profits claims is largely a matter for accountants, and insurers instruct assessors with specialized knowledge whenever an important claim arises.

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FIRE INSURANCE IN THE UNITED STATES

The insurance of property against loss by fire was one of the first forms of insurance to be provided in the United States by purely domestic companies. The first incorporated company, in fact, was formed during the colonial period, the Philadelphia Contributorship, a mutual company patterned aiter the Amicable Contributorship of London and organized by Benjamin Franklin in 1752. The first stock company, the Insurance Company of North America, was organized in 1792 to do a marine-insurance business but was extended to include fire insurance during its first year of operation It was early recognized that the business of insurance so affected the public interest that special forms of regulation were required. Because of its prior origin, fire insurance was subject to regulation much earlier than other forms, and in no case, with the possible exception of life insurance, has regulation, historically, been quite so detailed. While control is vested in the states, there is considerable uniformity in regulatory laws and practices. The chief supervisory official in each state is termed the superintendent or commissioner of insurance. He is charged with administration of the financial requirements imposed upon new companies desiring to enter the business, or existing companies seeking admission to the state. He also receives and reviews the annual statements required by law; makes periodic examinations, determines if reserve, investment and other requirements are being met; and appoints conservators or liquidators when conditions require.

The making and promulgation of fire-insurance rates is an activity carried on in the US. by state rating and inspection bureaus supported by the companies doing business in the state. In behalf of their member companies, these bureaus file with the insurance commissioner of the state class rates by areas for dwellings and a few other types of structures In addition, schedules for the determination of rates on commercial and industrial properties are filed. By application of the schedule, specific rates for such properties are developed by the inspection bureau. Factors taken into account in schedule rating include, in addition to a rating on the community in which the property is located, construction, occupancy and exposure to possible fire from adjoining properties. State bureaus usually operate in co-operation with regional bureaus which compile statistics and perform other functions related to the measurement of the fire hazard, as well as with the National Board of Fire Underwriters. The latter, in addition to technical and statistical functions, is concerned with the establishment of standards for and the rating of towns and cities to reflect the relative community fire hazard.

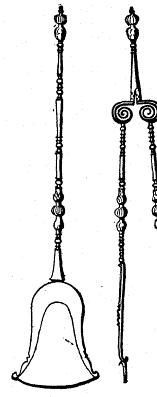
Fire insurance policies as issued in the United States consist of two parts, the agreement or contract and the stipulations or conditions. The agreement or contract is sufficiently complete so that it could stand alone as a contract of insurance. It includes space for description of the property and for the attachment of various endorsements which may be used to modify or supplement the terms of the contract. The stipulations set out certain requirements imposed on the insured both before and after a loss has occurred, circumstances which void or suspend the contract, property and perils not covered, permission for certain types of modifications, etc., and are added to make the contract more definite and specific.

The risk assumed is all direct loss by fire, lightning and removal from premises endangered by fire, of the property described in the contract, which property may be either real or personal. To be covered, loss by fire must be due to a "hostile" fire. The measure of damage is actual cash value, or replacement cost, new, less depreciation. No consequential losses, such as loss of use, are covered by the fire policy itself, but fire insurance companies insure such hazards separately under the title of business interruption insurance. Fraud or misrepresentation void the policy, and coverage is suspended if the hazard is increased by means within the knowledge or control of the insured. Intangibles such as money and securities are not covered, nor are bullion and manuscripts unless specifically described. A variety of financial interests in addition to ownership may be insured, such as those of a mortgagee, one legally liable, a lessee or a representative of the owner. Interest at the time of loss is sufficient, existence at the inception of the contract not being required.

In order to place a contract in effect, a form is usually added, containing a standard description of the type of property concerned, as well as a number of standard modifications. The form designed for dwellings and their contents, for example, permits application of 10% of the building insurance to apply to other buildings on the insured premises. A similar amount may be used to cover rental value, limited to $\frac{1}{12}$ of the amount per month. Ten per cent of the contents insurance may be used to cover personal property away from the premises. In no case, however, do these provisions increase the amount of insurance beyond that specified. In forms applying to property other than dwellings, coinsurance or reduced rate contribution clauses are sometimes used for the purpose of inducing the insured to purchase insurance more closely approaching the value of his property than might otherwise be the case. A reduced rate is charged, in return ior which the insured agrees to insure his property up to, say, 80% of its value. If he fails to do so he recovers irom the insurer, in case of a partial loss, only in the proportion which the insurance bears to the amount required by the clause.

During the 1930s, fire insurance companies began the issuance of supplementary contracts in conjunction with fire-insurance policies, covering such hazards as windstorm, smoke, riot, aircraft and vehicles, for which such companies already were offering separate insurance. Within a period of 15 to 20 years such extensions of the fire insurance policy had become well standardized under the terms of a form called the extended-coverage endorsement. This endorsement does not increase the amount of insurance but merely extends the coverage to additional hazards. In the 1950s further extensions were introduced under multiple-line insurance powers granted by the state legislatures, permitting fire companies to insure hazards formerly the exclusive province of casualty companies. At the same time, casualty companies were permitted to insure hazards formerly reserved to fire companies, and some uniformity was beginning to appear in the comprehensive policies issued by either or both types of companies. (J. E. Hs.)

FIRE IRONS, the implements for tending a fire. Usually they consist of poker, tongs and shovel, and they are most frequently of iron. steel or brass. or partly of one and partly of another. The more elegant brass examples of the early part of the 19th century are much sought after for use with the brass fenders of that date. They were sometimes hung from an ornamental brass stand. The fire irons of our own times are smaller in size and lighter in make than those of the best period. 4 typical example of the fireplace furnishings of the 18th and 19th centuries is shown in the accompanying illustration. In addition to the above, the bellows, the various cooking utensils, the hearth broom, etc, as well as the containers and receptacles about the mantel, make an interesting collection of fireplace furnishings.



BY COURTESY OF THE METROPOLITAN MUSEUM, N.Y. CITY

ENGLISH FIREPLACE SHOVEL AND TONGS OF THE 19TH CENTURY

FIRENZUOLA, AGNOLO (1493–*c.* 1545), Italian poet and littérateur, was born at Florence on Sept. 28, 1493. He studied law at Siena and afterward at Perugia, where he became the associate of the notorious Pietro Aretino, and copied his licentious way of living, though he is stated to have worn the monastic habit for a time. Firenzuola practised for some time as an advocate at Rome, and eventually settled at Prato as abbot of San Salvatore. His writings are of great importance in the history of Italian literature because they are written in Tuscan just as the literary style began to emerge from popular speech. He wrote *Discorsi degli animali,* imitations of oriental and Aesopian fables: *Dialogo delle bellezze donne* (Eng. trans., 1892); *Ragionamenti d'ainore,* a series of short tales in the manner of Boccaccio (Eng. trans.. 1889) ; *Discacciamento delle nuove lettere,* a controversial piece against Trissino's proposal to introduce new letters into the Italian alphabet; a free version of the popular *Golden Ass* of Apuleius; and two comedies, I *Lucidi,* an imitation of the *Menaechmi* of Plautus, and *La Trinuzia,* which in some points resembles the *Calandria* of Cardinal Bibbiena. His poems are chiefly satirical and burlesque.

The best edition of his collected works is that by Bianchi (Florence, 1848).

FIREPROOFING. This term is applied to methods of making normally combustible materials fireproof as far as may be, but in practice the most that can be done with them is to subdue or retard inflammability. The subject is one of great importance, especially in connection with the construction of theatres and other buildings where large numbers of people are collected together and where special illumination is required. The nature of or disposition of materials used in theatres has become the subject of public regulation in many countries and it is usual to provide that no combustible scenery shall be employed unless it has been treated with flame-retarding solutions. The London County council regulations. for instance. provide that in theatres materials such as wood. canvas, textiles, etc.. must be rendered noninflammable by impregnating them with solutions, and names the following as having been found suitable: (1) for scenery and coarse fabrics, a solution of 1 lb. of phosphate of ammonia and 2 lb. chloride of ammonia (sal ammoniac) in $1\frac{1}{2}$ gal nater; (2) for delicate fabrics and cotton wool, 10 oz. borax and 8 oz. boracic acid in 1 gal. of water. Stage woodnork must be thoroughly impregnated with phosphate of ammonia. It is. however, quite imoossible to make woodwork really fireproof and the council therefbre insists, as far as possible, upon the use of incombustible materials such as asbestos.

Such precautions have only been taken in comparatively recent times, the London County council's regulation requiring stage woodwork to be rendered noninflammable having first come into force in 1901. In 1923 special conditions were laid down with regard to the use of plywood, and by 1928 the construction of theatres was governed by a long series of safety regulations which experience had shown to be necessary. Floors. tiers and roofs. fittings in dressing rooms, all floors and linings to scene stores, workshops, etc., have to be formed of fire-resisting material; soft wood or other inflammable wall linings, decorations, partitions. screens or barriers must not be used, and cavities must not be left behind any linings or decorations. No fireplace may be used and no heating system involving use of a naked flame may be installed in any portion of the auditorium or stage; the stage and cellars below must not be congested with scenery and properties, and the regulations do not stop at fireproofing. There are stringent rules as to hydrants, fire appliances, fire drills, light installations. etc., and it is required that a competent fireman with practical experience in fire prevention and extinction should be on the staff. (A. F. H.)

United States.—The building code recommended by the National Boerd of Fire Underwriters is commonly used as a basis in the preparation of building ordinances of many cities. A solution which has been widely recognized for the fireproofing of fabrics is one made of 3 parts of ammonium phosphate. 2 parts of ammonium chlorate and 1 part of ammonium sulphate and about 40 parts of water. Lumber impregnated with fire-retardant chemicals is termed fireproof wood. The industry had its beginning in the United States in 1895. The principal market for fireproof wood has been in New Tork city. Its building code prohibits the use of wood for floors and interior trim for buildings in excess of 150 ft. in height unless fireproofed in accordance with rules prescribed by the superintendent. The treatment of the wood is commonly done by impregnating it with fire-retardant chemicals in closed cylinders under artificial pressure. *(See* TIMBER PRESERVATION.) (C. T. B.)

FIRE PROTECTION. Every fire involves a permanent and absolute loss of capital, but the loss is usually so well distributed by the existing system of insurance that its incidence is not often seriously felt. Fire losses, in reality, are borne by the community, insurance offices being merely the medium by which the loss is distributed. There are individual fires in property every day, the sum total of which adds up each year to an enormous wastage. The imagination is moved more, however, by the occasional fire in which there is great loss of life or by the conflagration which sweeps out hundreds of buildings in a city.

CONFLAGRATIONS

There is no universally accepted definition of a conflagration. Some authorities list as conflagrations all fires causing more than a specified amount of loss. irrespective of the extent of spread or the number of buildings involved. Perhaps the best practice is to apply the term only to fires extending over a considerable area and destroying numbers of buildings. A large fire in a group of buildings such as those belonging to a single industrial plant is not considered a conflagration even though the area and values involved map be considerable. Neither is a fire in a closely exposed group of mercantile or warehouse properties classified as a conflagration unless the fire crosses natural or prepared exposure barriers, such as streets and fire walls.

For certain fires the term "group fire" is more closely descriptive. These include fires within the limits of an industrial plant property even if several buildings are involved, and fires in a group of mercantile buildings, particularly within a single city block. In both cases, buildings may be so close together that a fire may spread from some of the buildings to adjoining ones, but it is unlikely to spread outside the plant area, or beyond the block or group of mercantile buildings because of fire wall barriers, streets or other open spaces.

The conditions described as "fire storms" in cities attacked with incendiaries in World War II were conflagrations in the sense of fires burning over large areas, but they differed from peacetime conflagrations in certain respects and were also different from the conflagrations which resulted from the incendiary attacks on most of the Japanese cities.

The fundamental circumstances of a fire storm occur in any fire: a column of burning gases and hot air rises over the fire and air is drawn in at the sides. This may be observed at many peacetime fires; for example, where a large oil tank is burning. In such cases there is a strong air movement in toward the centre of the fire. Natural wind tends only to incline the column of rising and burning vapours.

In a fire storm, destruction is usually complete within the area. In a conflagration, some buildings escape because of irregular convection currents, fire barriers or fire-fighting efforts.

Peacetime Conflagrations. — Peacetime conflagrations have been of four general types:

(1) Fires starting in congested sections which spread in one or more directions before effective resistance is organized to bring them under control. These fires usually spread first to near-by properties, cross streets because of radiated heat, and spread chiefly in the direction in which the wind is blowing. Failure to control such fires is due almost entirely to lack of sufficient heavy stream devices on the part of the fire department and lack of protection against fire spreading between buildings. Buildings equipped with automatic sprinklers, adequately supplied by mater, have been notably successful barriers to the spread of such fires.

(2) Fires occurring in primarily residential sections which spread beyond control because of closely built combustible construction and wooden shingle roofs. Such conflagrations are probable where fire protection forces are weak and water supplies are inadequate.

(3) Conflagrations resulting from extensive forest and brush fires entering a city over a wide frontage at a point where the water distribution system is weak and limited fire-fighting resources are overtaxed.

(4) Conflagrations caused by explosions with resulting fire over a wide area.

Wartime Conflagrations. — In World War II, great fire destruction was visited on the cities of Germany and Japan. British cities suffered severe fires in the early days of the war, but few were conflagrations in the strict definition of the word. German cities. for the most part, were so built that conflagrations in the technical sense were not possible, though the magnitude of destruction by fire far exceeded that of most conflagrations. Attacks with incendiaries, principally by the royal air forces, started thousands of fires, but they burned in individual buildings with little spread from building to building.

On the basis of incomplete assessments, at least 54 of the largest cities in Germany had their central zones destroyed, destruction varying from 10% to 70% in individual cities with a median of 40%, principally caused by fire. In Hamburg, Kassel, Darmstadt, Stuttgart, and possibly Dresden and a few other cities, fires of conflagration proportions occurred with great loss of life. These resulted from the merging of thousands of individual fires.

The U.S army air forces had practically destroyed 65 Japanese cities before the atomic bombs were dropped. Many of these fires were true conflagrations as the cities were predominantly of low wood-frame construction. Fire storms also occurred in a number of cases where incendiaries alone were used, and at Hiroshima as a result of the mass fire started by the atomic bomb. As in Germany, the centres of the Japanese cities were destroyed by fire, total destruction varying from 12% to 96% in individual cities, with a median of 50%, wholly the result of fires.

FIRE PREVENTION AND PROTECTION

Building Construction and Arrangement. — Buildings constructed of fire-resistive materials and effectively divided to avoid spread of fire are essential to adequate fire protection. The danger of fire either outside or inside a building must be considered in relation to the occupation involved, type of construction, the floor area covered and the height of buildings. In the case of large industrial structures used for hazardous manufacturing nork or containing combustible stocks, constructional details are naturally of even greater significance than they are in private houses or other buildings used for nonhazardous purposes. The fire-resistive qualities of walls, roofs, floors and steel girders then require consideration, while the number and nature of floor openings likely to aid the spread of a fire (hoists, shafts, stairways) become factors of great importance.

The study of fire prevention leads naturally from a consideration of the building itself to a survey of its supply of light, heat and power and an investigation into the use to which the building is put.

All methods of obtaining light, heat and power involve obvious dangers of fire, but special mention may be made of electricity, which, though apparently the safest source, presents perils of its own and causes many fires. Short circuits, leaks and contacts are a constant danger, unless the installation is carefully made and periodically inspected and overhauled; and by a strict observance of established rules the risks are reduced to a minimum.

The use to which a building is put is a factor which introduces a variety of potential causes of fire, and much work is done by scientists and engineers in combating the hazards inherent in particular industrial processes. Examples of such hazards are: friction in machinery, flammable vapours and dust. liquid and powdered fuels, paint spraying, static electricity and the propensity of certain products to ignite spontaneously.

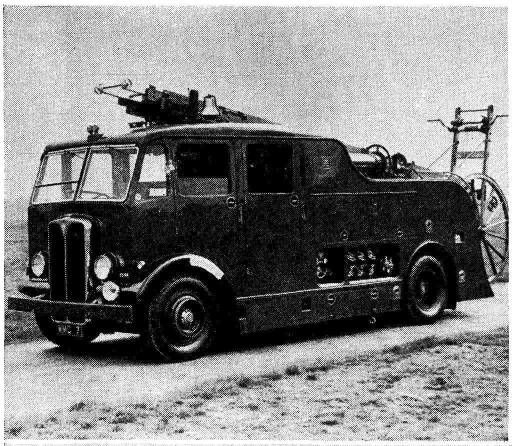
Every material which will burn gives off heat, and the rate at which it develops heat is an important factor in deciding on the particular measures for fire prevention and protection. The contents of an ordinary living room in a home may be made up of ordinary combustibles which would give off an estimated 40.000 B.T.U. per square foot. In such occupancies, and a great many others, the principal combustible material is wood or similar substances. The calorific value for wood can be taken on the average at 80.000 B.T.U. per pound. By contrast, the contents of an ordinary warehouse would give off heat of the order of 240.000 B.T.U. per square foot. The amount of heat generated for materials in some storage areas might be ten times that figure or more. This factor is known as "fire loading" and must be taken into consideration in the design of buildings as well as other loads which are imposed on the structure.

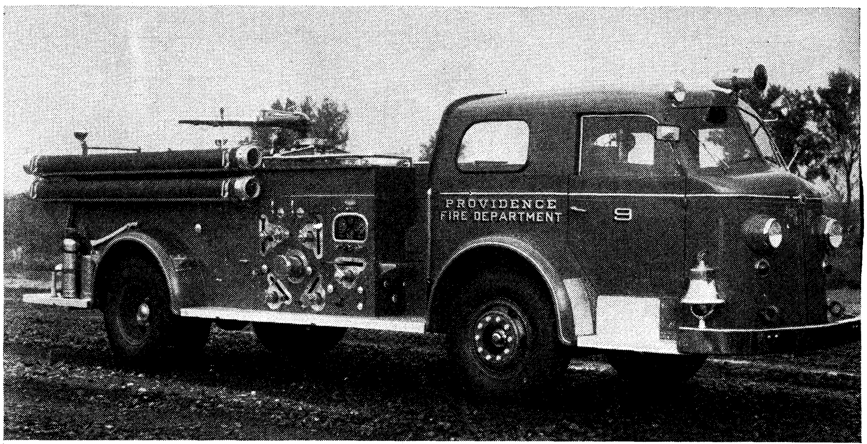
It must be obvious that if a material is combustible and is all stored in one place. total loss in a fire can result. The most important fire prevention measure is to store valuable material in units no larger than one can afford to lose in a fire at one time. This can be done by providing spaces between piles of goods so that fire in one pile cannot spread to the next; or by storing parts of the supply of goods in different buildings or at completely different locations. Areas of individual buildings should be kept to a reasonable maximum to accomplish this same objective and even with elaborate measures for fire protection, such as fire brigades, automatic sprinklers and ample water supplies, it is not prudent to concentrate values unnecessarily in combustible materials or buildings.

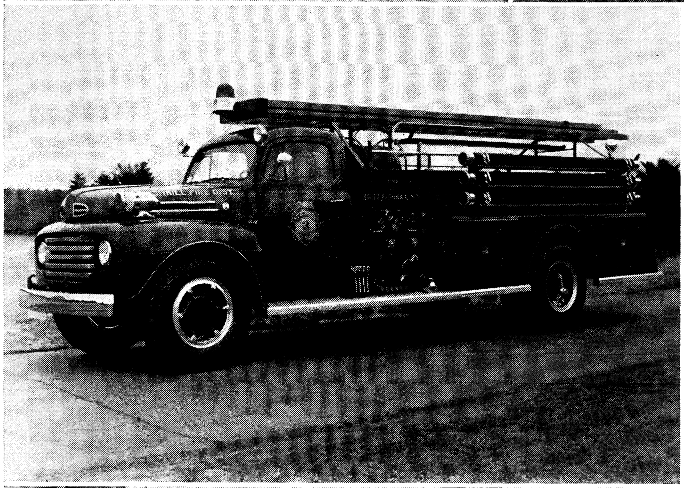
Fire Exits. — The protection of life from fire is quite as important as the saving of property. Certain building acts provide for owner maintenance of means of escape in case of fire. Such regulations apply more particularly in connection with public buildings, which are usually treated under municipal building bylaws or under acts applying to industry such as the Factory and Workshop act in Britain. Each individual tenant or occupier of a building has, however, a duty to perform in making provision for the escape of those employed by him or under his care.

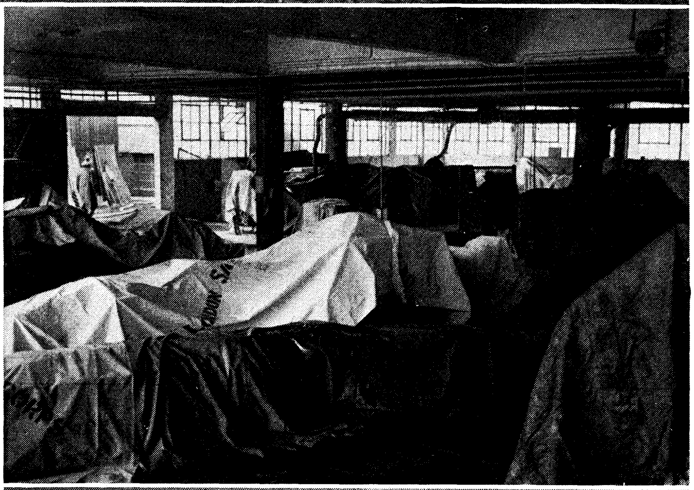
Fire departments or brigades in large towns are usually provided with fire-escape ladders, but these have much more limited use than is popularly supposed. Only a relatively few people can be taken out of a burning building over fire department ladders. Since a fire is likely to fill a single stairway with smoke or flames, it is axiomatic that at least two ways out should be provided from all areas.

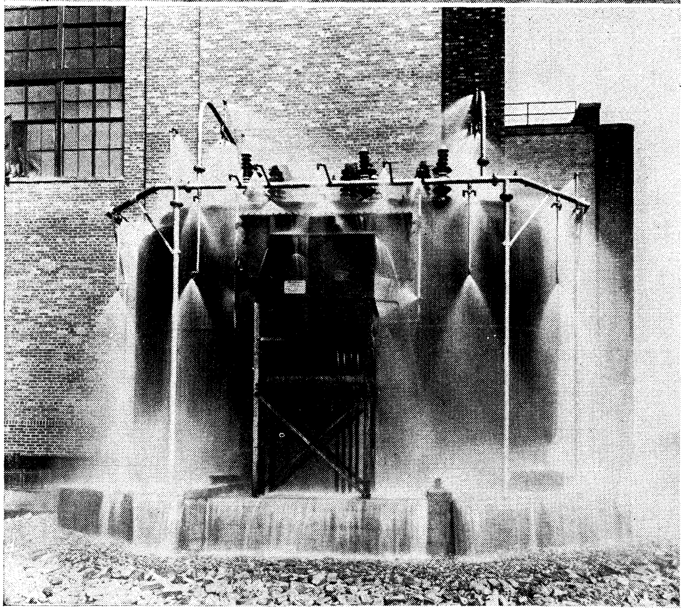
In the United States, the matter of safe exits from buildings came under continuous study, beginning in 1911, by the National Fire Protection association. The problem of deciding what meas-

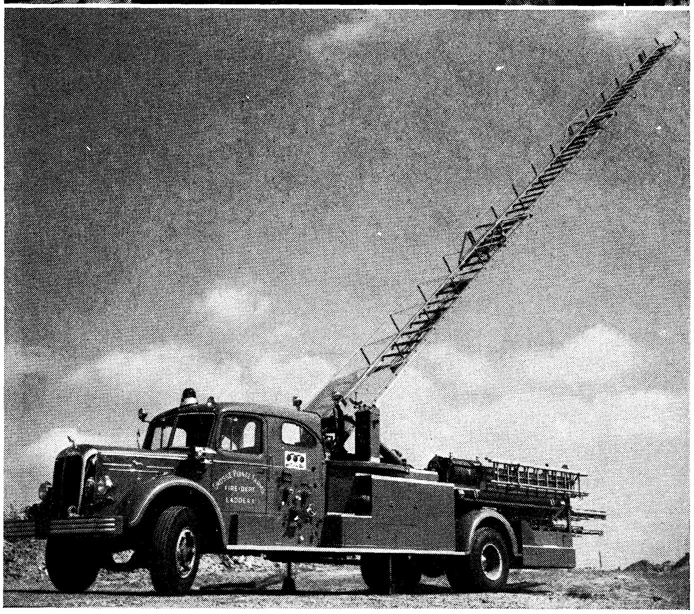












BY COURTESY OF (TOP LEFT) MERRYWEATHER & SONS LTD. (LONDON), (TOP RIGHT) AMERICAN-LA FRANCE-FOAMITE CORPORATION, (CENTRE LEFT) MAXIM MOTOR CO., (CENTRE RIGHT) LONDON SALVAGE CORPS, (BOTTOM LEFT) GRINNELL COMPANY, INC., (BOTTOM RIGHT) MACK TRUCK CORP.

MODERN APPARATUS FOR FIRE PROTECTION AND CONTROL

Top *left:* British pump-escape, used with variations by fire brigades throughout the world. It includes cab for five or six men, pump, hose, ladder and frequently ladder extensions

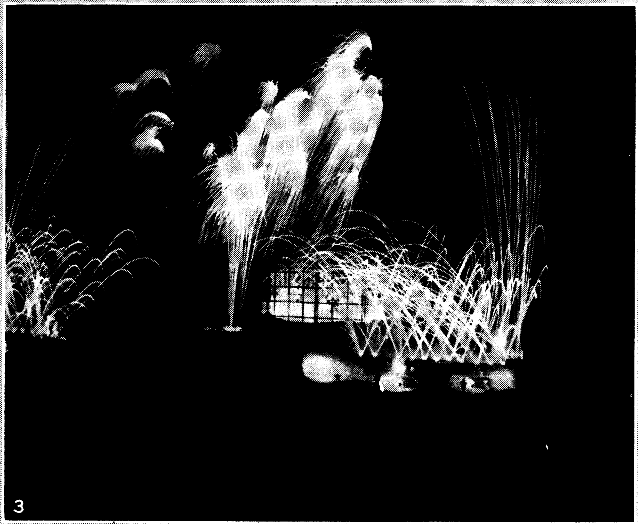
Top right: A U.S. pumper, similar to the pump-escape but without the carriage wheel assembly (the escape) on the end of the ladder. The pumper is used for large-city heavy-duty service and has a monitor nozzle for producing a large stream of water mounted above the bed of the truck in which hose is stored

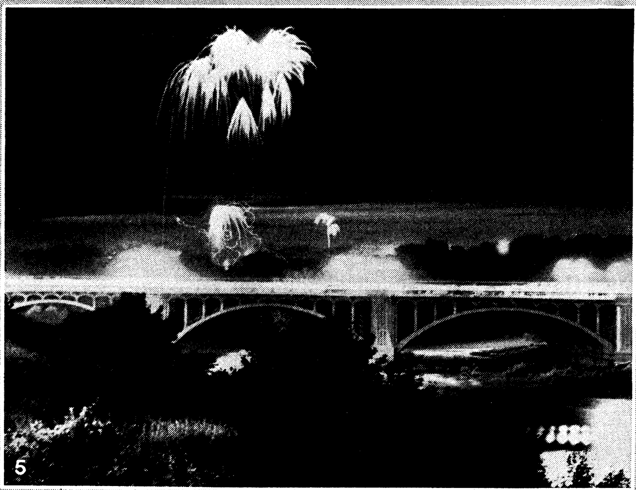
Centre left: A rig, typical of the arrangement of fire appliances in the majority of U.S. and Canadian fire departments. It is similar to the pumper, but has a smaller capacity pump, larger capacity water tank and smaller cabs, the latter because many firemen use their own cars

Centre right: Waterproof sheets spread to reduce water damage, one of the Protective measures which in the largest cities (London, New York, etc.) is done by fire brigades sponsored by insurance companies, and in most cities with modern fire brigades by regular units of the brigade

Bottom left: Water spray (or water fog) system for deluging a transformer installation in case of fire. Similar systems are in common use for a wide variety of electrical equipment, chemical engineering processes, etc.

Bottom right: Long power-operated extension ladders used by fire departments throughout the world. In the U.S. and Canada the vehicles also carry a full assortment of other rescue equipment (as shown here). In England and continental Europe the ladders are on vehicles used for that purpose alone





BY COURTESY OF (1, 2, 3, 4) C. T. BROCK AND COMPANY'S "CRYSTAL PALACE" FIREWORKS, LTD.; PHOTOGRAPHS, (5) PUBLIX, (6) EWING GALLOWAY

MANUFACTURE AND DISPLAY OF FIREWORKS

1. Fireworks display near the Serpentine in Hyde park, London
2. A display at the Crystal palace, London. The displays at the Crystal palace became world famous, having been instituted in 1865. They were an important factor in the development of modern fireworks. The Crystal palace was destroyed by fire in 1936
3. View of a modern fireworks celebration in which rockets, shells and Roman candles are used. The rocket, as shown in this display, is the most elaborately constructed of any firework. It is driven into the air by the recoil produced by a jet of fire thrown out from its burning composition
4. "Fountains of Fire," a Roman candle display at the Crystal palace
5. A fireworks display at Milwaukee, Wisconsin
6. Girl workers making firecrackers in Macao

ures are required in individual buildings becomes very complicated, depending on the occupancy and the arrangement of the building. One factor is the rapidity mith which fire may be expected to develop and spread in a particular building; another is the travel distance to a safe place. The N.F.P.A. embodied the results of its work in a document issued on an advisory basis, The *Building Exits* Code, revised periodically.

The ordinary fire escape, a relatively flimsy, narrow and badly arranged outside stair reached through windows, is frowned upon. Rope escapes, chutes and ladders are also considered vastly inferior to proper stairs or ramps. The arrangement of stairs to be used in an emergency is particularly important to prevent jamming in panics. Stairways, corridors and other means of exit can be made safe if proper attention is given to the details of moving people along such exit ways without introducing the likelihood that they will stumble or be jammed.

FIRE EXTINCTION

Important to fire suppression is the early discovery of the outbreak and an immediate application of the means of putting it out. There are automatic appliances for the purpose but, in many cases, manual appliances must be used. A pail of water is the most primitive fire extinguisher known and is valuable if available during the first few minutes. The popular stirrup pump, familiar to millions of British wartime civil defense workers, is an effective appliance. In the home, a large and substantial metal cover is excellent for confining a fire when a pan of cooking fat takes fire on the stove in the kitchen.

Plans for dealing with fires should be made in detail beforehand. Even with primitive fire-fighting equipment many small fires can be readily extinguished, but persons must have had some training and experience in the use of fire-fighting tools. The best guarantee of efficient first measures against fire is widespread training in fire extinguishment.

Fire Extinguishing Appliances.—So-called chemical extinguishers are effective in the early stages of a fire. There are many satisfactory types and their cost is not excessive. The successful use of extinguishers depends on their accessibility. They must receive periodic attention, some kinds requiring recharging annually.

The principal chemical extinguishers are water-solution types. A chemical reaction. if any, is provided principally to expel the water solution; it is the water which cools the burning material and extinguishes the fire.

Some extinguishers, however. work on other principles than cooling. The foam type spreads a layer of tough foam over the burning material and extinguishes the fire by eliminating its contact with oxygen. Extinguishers using carbon dioxide gas or dry chemical (inert gas), and also extinguishers using various vaporizing liquids (of which carbon tetrachloride is the commonest), depend on this smothering action.

Extinguishers, such as the carbon dioxide, dry chemical and vaporizing liquid types, produce an inert stream which does not conduct electricity and so may be used on electrical equipment mith reasonable safety. When extinguishers are subject to freezing temperatures, they should be kept in heated cabinets, or in some types water solutions may be replaced with antifreeze solutions to which, for example, calcium chloride has been added. Carbon dioxide, dry chemical and vaporizing liquid types will not freeze at ordinary temperature ranges.

The principal extinguisher required in a home is one of the water-solution types because these are most effective on the ordinary combustibles, wood, paper and the like. In industry, there are many situations requiring specialized types of extinguishers. Most of the devices used, other than water, are designed primarily for manual or small-scale use. They can be used in some cases to deal with fairly large fires under controlled conditions such as can be provided at a specific location.

In buying fire extinguishers and appliances, it is alnays well to get experienced advice to avoid acquiring a type with too limited extinguishing capacity, or a type which presents toxic or other dangerous effects in the hands of an unskilled operator.

Automatic Fire Alarms.—There is a great variety of useful automatic fire-alarm devices; the simplest types ring an alarm gong fixed outside the building or convey a danger signal to a fire station.

The alarms are brought into action whenever the temperature in the room is raised to a point well above what may be regarded as the highest natural temperature to be expected or, in another variety, when the temperature increases at a dangerously rapid rate. The actuating apparatus is a thermostat of the "fixed temperature" or the "rate-of-rise" type. The thermostats are placed in parts of the rooms, such as ceilings, where they are best affected by the heat of a fire. The signal is transmitted, in simple types. to a point where a bell may be set ringing or where the position of the fire may be shown on an indicator board, or both.

In the most comprehensive automatic fire-alarm systems, signals are sent to a central station operated by a company which specializes in this work. There has been a long history of poor performance of fire-alarm systems when individual property owners depend on their own day to day interest in keeping the system operative. Where fire-alarm service is purchased on an annual basis from a company which makes the giving of such service its primary business, the performance of automatic fire alarms has been very good. The central station services include not only receiving fire alarms but furnishing a central point to which watchmen must report as they make their rounds, receiving signals when water flows in an automatic sprinkler system or when a valve in water-supply piping provided for fire purposes is opened or closed, and providing a variety of other protective services.

Automatic Sprinkler Installations.—The most effective system for automatic fire alarm and extinction is the sprinkler installation, various details of which were first developed both in Great Britain and in the United States about 1880. Sprinkler installations mere successfully applied to almost every kind of building. They averted much destruction of property and considerably reduced the cost of fire insurance in buildings so protected. Insurance companies grant substantial premium rebates for properly installed and maintained systems.

The protected building is provided with a system of pipes containing water under pressure and fixed near the ceiling of every room. Into this piping sprinkler heads or orifices are inserted at such intervals that every part of the area will be commanded and drenched. The sprinkler heads are constructed to open at a temperature of 155° F. (68° C.) and discharge water directly on the fire. While heads designed to operate at the temperature mentioned are the usual ones, the systems can be arranged to delay and not operate until higher temperatures are reached. It is always possible to greatly accelerate the discharge of water when this is desirable through installing the systems in sections, each section having heads which are normally open. Through a system similar to that used in "rate-of-rise" fire alarm devices, water may be turned into the system by remote control and the area promptly drenched. This is a special type of installation, but there are many situations in industry where it is useful.

In the ordinary sprinkler system there is an alarm bell fitted outside the building which operates simultaneously with the sprinkler head, thus giving the alarm locally. One purpose of this alarm is to keep water damage at a minimum. Water damage is a much less serious problem with automatic sprinklers, however, because the water applied to the fire is more effectively employed than when firemen have to apply large quantities of water with hose streams in what is a relatively inefficient operation.

The safety secured by sprinkler equipment for buildings fully justifies the expenditure. Without such systems it would be necessary to strictly limit the size of buildings or the total arnount of combustible material which may be brought together in one place.

Sprinkler equipment is most commonly used in industrial or mercantile buildings where the presence of piping on ceilings is not objectionable from the point of view of appearance. Sprinkler protection has also been provided for many historic shrines, churches, and other locations nhere the necessary piping and heads can be so located as to be practically unnoticeable.

Fire Departments (Brigades).—Organized fire brigades existed in civilized communities many centuries before the Christian era and were familiar to the citizens of the Roman empire. In England. fire preventive measures are traditionally associated with William the Conqueror's couvre-feu or curfew. but the custom of ringing a bell to order the extinguishment of fires and candles can be traced back to the days of Alfred the Great. References to organized fire fighting, which was probably not on efficient lines, are occasionally encountered in the history of the middle ages.

The establishment of fire insurance companies in Great Britain naturally brought about the question of minimizing loss by fire by preventing its spread. Because the public authorities had been diffident in this connection the offices set about establishing brigades of their own. Probably the first insurance office to possess fire engines was the Royal Exchange, which announced in

*TABLE I.—Fire Losses, United Kingdom and Ireland**
(War damage excluded)

*Published estimates of Fire Offices' Committee Fire Protection Association.

1722 that it had provided several engines with firemen and watermen and their implements for extinguishing fires. They were followed by many other offices who placed fire marks on the buildings they insured. and no doubt each particular brigade gave special attention to any premises insured by their own company. In 1833 the London fire engine establishment was formed by a combination of offices; this consisted of 76 officers and men who took upon themselves the fire protection of London. A year later the houses of parliament were destroyed by fire, and in 1861 the great fire in Tooley street occurred, with damage estimated at £2.000.000. In the following year a parliamentary committee was formed "to enquire into the existing state of legislation, and of any existing arrangements for the protection of life and property against fires in the metropolis." This inquiry showed a total inadequacy of appliances, and in 1865 the fire offices handed over to the metropolitan board of works the fire protection of London which for more than 30 years they had carried on at their own expense.

Various statutes were subsequently passed by parliament, not only in relation to London but to other towns throughout the country. by which parliament recognized as a public duty the maintenance of proper equipment to local authorities. the cost to be borne from the rates. The Metropolitan Fire Brigade Act of 1865 provided for the handing over of the fire stations, engines and property of the London fire engine establishment, together with the force of firemen, to the board of works and this formed the nucleus of the new metropolitan fire brigade. The insurance companies. being relieved from the burden of extinguishing fire, not only handed over their freehold and leasehold properties and valuable appliances worth many thousands of pounds, but consented to an arrangement whereby they became liable to contribute to the upkeep of the brigade.

Brigades in Great Britain apart from London exhibited considerable variety in conditions and regulations until the act of 1938 imposed a recognized standard of efficiency. Prior to 1938 there was no duty at common law for local authorities to maintain fire brigades, and the statutory authority invoked for the organization of a brigade—the Town Police Clauses act in 1847, the Burgh Police (Scotland) act in 1892 and other local government statutes—was invariably permissive only. The act of 1938 substituted compulsion for permission, repealed the enactments under which the existing brigades had been constituted and established government control. Thus, at a single stroke, the multitude of independent brigades, which had previously had little opportunity for co-ordinating their activities and experience, became in effect welded into a single body. The eventual result was an all-round improvement in fire protection.

Power of entry was safeguarded by a section of the act which authorized any member of a brigade to enter or break into any premises where a fire had or was reasonably supposed to have started. Consent of the owner or occupier was not required and obstruction or interference by any person became a punishable offense.

The senior officer present was empowered with sole charge and control of all operations and the police were given authority to divert the traffic at their discretion.

During World War II, by the act of 1941, the traditional responsibility of operating a fire brigade was taken away from local authorities and vested in the national fire service. By the Fire Services Act of 1947, the fire brigades were returned to local authorities but not, in all cases, to the same local authorities which operated them in the prewar period. Approximately 1,400 local authority fire brigades had been consolidated into one organization under home office control as a wartime measure. The 1947 act transferred these back to only 140 authorities.

The 1947 act left the determination of the local authorities to be handled on a basis of consultation between the home office and local authorities. The latter could suggest schemes for reorganization, but home office approval assured that the reorganized fire brigades be large enough so that they did not revert to the prewar position, when the average fire brigade was a small, weak organization.

The weakness of the wartime organization was perhaps principally that of a top-heavy administrative setup. For operating convenience, the fire service was broken up into approximately 30 fire forces: each of which constituted a substantial fire brigade organization.

The postwar schemes approved by the home office generally resulted in the formation of substantial fire forces also. One of the largest postwar units was, of course, that of the county of London brigade, serving an area of 117 sq.mi.

The terms of the Fire Services Act of 1947 established county boroughs, county councils and joint authorities as fire authorities in England and Wales. Scotland was divided into ten joint areas, plus Glasgow. The act did not alter responsibility for fire prevention, restricting the spread of fire, or means of escape in case of fire.

Under other provisions of the act of 1947, the home office established a fire service department and a Fire Service college near Dorking, Surrey. for advanced training of members of fire brigades. The fire service department operates an inspectorate as a means of checking on conditions in the various brigades but the administration is in the hands of the local authorities designated as fire authorities. Another important provision of the 1947 act was the system of grants by the secretary of state to local fire authorities. The act limited the grant to 25% of expenditure, with payment being conditional on the authority's fulfilling its obligations.

A number of associations were established in the United Kingdom for the furtherance of the science of fire fighting. the welfare of fire brigade personnel and kindred objects, including the Chief Fire Officers' association, Fire Brigades union, Fire Offices' committee, the Institution of Fire Engineers, Junior Fire Officers' association, National Association of Fire Officers, National Fire Service Association of Great Britain, Industrial Fire Protection Association of Great Britain, and the Society for the Protection of Life from Fire.

United States and Canada.—In the United States and Canada, and in most of the rest of the world, the operation of fire brigades is traditionally a municipal function. Usually when a fire brigade is organized it comes under the direction of a particular local authority.

From early times, when public authorities did not act to provide some sort of fire brigade, citizens organized volunteer fire departments. These were alternately encouraged and discouraged by the authorities. The Roman emperor Trajan is believed to have disapproved the proposal of one of his provincial governors to form a company of firemen for the city of Nicomedia because such bodies could be expected to engage in revolutionary activities no matter how noble the public purpose for which they were originally founded. It was perhaps not strange that the pure volunteer form of fire department became established in the British colonies in America where local government machinery was rudimentary.

The pure volunteer department is basically a volunteer association of citizens, the members of which not only are not paid for their fire-fighting services but may be expected to contribute to the general support of the brigade. This form of organization was recognized by the statutes of many of the states in the United States and became a common form of fire department organization even in cities as large as Reading and Harrisburg, Pennsylvania. The states in which this form of organization was commonest at mid-20th century were Pennsylvania, New Jersey, Delaware and Maryland, but volunteer departments were to be found in almost all the states of the U.S. and in Canada.

The history of these organizations in the United States and elsewhere is that they are sooner or later recognized by local ordinances and state statutes and they frequently become formally incorporated with power to own property and otherwise act as any incorporated body. Eventually, they become responsible to local governmental authorities. Usually the local authority is allowed

TABLE 11.—Fire Losses in the United States*
(Fires in buildings only)

Year	Property Loss	Year	Property Loss
1943	$395,600,000	1949	$672,500,000
1944	450,000,000	1950	699,600,000
1945	476,700,000	1951	739,550,000
1946	569,300,000	1952	793,500,000
1947	703,000,000	1953	889,120,000
1948	714,800,000	1954	875,450,000

*Published estimates of National Fire Protection Association.

to audit the financial operations of the volunteer fire department organization or corporation in return for money collected by taxes which may be used to buy fire apparatus. A common pattern is for the fire company or department to have a large number of dues-paying members, relatively inactive as far as the performance of fire-fighting duties are concerned. In many cities, the fire station becomes a club house for the members, providing a bar, restaurant, and recreation facilities for a neighbourhood area.

The traditional fire department unit in the United States and Canada is the individual fire company in its most rudimentary form, consisting of one piece of fire apparatus, usually a pumping engine with a few short ladders, and enough men to operate it. Even in towns which may have more than one piece of fire apparatus. each piece of equipment has organized around it a "fire company," which works for the most part on its own. Except in large cities it is rare to find an officer directing more than one piece of fire apparatus at a fire.

In larger cities a number of fire companies occasionally have to work together. U.S. and Canadian practice is to group 8 to 15 individual fire companies into a battalion. A battalion of ten companies might, for example, consist of six pumping engines, two ladder trucks and two companies performing ancillary services such as salvaging operations, providing lighting equipment, rescue or other special equipment. The battalion force of a North American fire department is essentially the same grouping of apparatus and men found in a fire company in the practice of British and continental fire brigades. Large departments have divisions made necessary by the geography of the protected area, and some have marine and forest divisions.

Except in cities where all or part of the firemen are on call, fire companies are manned 24 hours a day. This requires a system of shifts, details of which differ. In the U.S. and Canada, work weeks 56 to 72 hours are representative. All members of the department, including battalion and division commanders, work on a shift basis. Headquarters staff officers are the exception to this rule. While always on call, they work usual office hours.

The duties of the fire headquarters staff indicate some of the functions performed by a large department. In small departments the chief officer would be the only one who does not work on a shift basis. He is the "staff," as distinguished from company officers or battalion or divisional commanders on shifts.

In a large fire staff, for example, the chief fire officer has reporting directly to him a first assistant chief as executive officer of the department, a public relations officer, an officer in charge of investigations and fire reports, a finance and budget officer and a research officer.

The first assistant chief has reporting to him a personnel officer, a training officer, a staff chief officer for each division of the force which works on a shift basis, and another chief officer to be in charge of the service bureaus of the headquarters staff.

The service bureaus of the staff include the fire prevention bureau, which handles explosives and flammables and matters of building protection, a communications bureau, a water bureau responsible for regular and emergency water supplies, a maintenance bureau with facilities for caring for apparatus and buildings and a bureau for procuring, storing and issuing supplies.

The transition from the small local fire company to larger and more effective fire forces is a process of integration. For example, in Nassau county, New York, there were still a great many small fire departments in the 1950s, many of them of the volunteer type. These were being gradually integrated through the operation of a county fire commission. Usually the first step in integration is to provide a message centre at which calls for assistance are received and whose orders on dispatching are recognized by the respective fire companies in the area. Another is the administration of a program for the training of members of fire companies. A third is the operation of a fire marshal's branch to investigate fires.

The process of integration became notable in the United States and Canada. A number of strong, well-organized county fire departments arose, good examples of which are the county fire departments of Los Angeles and Kern counties in California. Integration through the state and provincial governments also proceeded. In certain states (for example, Massachusetts and Ohio) the state established a civil service system for the recruitment, admission and promotion of firemen in fire departments. In nearly all the states and the Canadian provinces. the state fire marshals were originally set up to provide means of investigating incendiary fires, but they were also given responsibility for various other functions, such as educating the public in fire safety measures

TABLE 111.—Fire Losses in Canada*
(Figures exclude forest and federal government losses)

Year	property Loss	Year	Property Loss
1943	$31,464,710	1949	$65,159,044
1944	40,562,478	1950	81,525,298
1945	41,903,020	1951	76,919,357
1946	49,413,363	1952	80,902,205
1947	57,050,461	1953	84,270,896
1948	67,144,473		

*Reports of Dominion Dept. of Insurance.

and in the supervision of fire safety conditions in schools and public buildings. Later, most of the states set up state-wide programs for the training of members of municipal fire departments. In numerous states, notably New York, Oregon and California, legislation has been passed empowering the governors to place all the fire departments under state control in emergency.

Australia and New Zealand.—The advantages of administration of fire brigades over a substantial area is well illustrated in Australia. In most of the states there is a state fire brigades' board which has certain advisory powers with respect to local fire brigades. There are also state-wide fire departments, operated by the state government rather than the municipalities, in New South Wales, South Australia and Western Australia. In Victoria there are two fire brigades' boards, one serving the metropolitan area of Melbourne and the other a country fire authority supervising fire brigades in the rest of the state. As an example, in South Australia there is a state-wide fire department and a fire staff with headquarters in Adelaide.

In New Zealand, the Fire Services Act of 1949 set up a scheme of supervising fire brigades similar to the British arrangement. This was brought about by a disastrous fire in a department store at Christchurch on Nov. 18, 1947, in which 41 persons lost their lives.

Water Supply at Fires.—The supply of water for extinguishing fires has, of course, a large bearing on the efficiency of the fire department or brigade. Pipes should be laid in such a manner as to secure the best practicable supply of water in case of fire. Where there is no mains supply, firemen necessarily look for natural supplies of the means of extinguishment. Water supplies in rural areas are frequently inadequate and fire damage to farm produce and property is heavy in consequence.

FIRE RESEARCH

United States.—Underwriters' Laboratories, Inc., in Chicago. Ill., was established in 1894 by the capital stock fire insurance companies of the United States, members of the National Board of Fire Undernriters. In 19jo, Underwriters' Laboratories of Canada was established by the stock fire insurance companies of the dominion.

There are a number of other laboratories, each making substantial contributions to fire research. The most important in the United States, other than Undenvriters' Laboratories. Inc., is the Factory Mutual laboratories. established and operated by the Associated Factory Mutual Fire Insurance companies, with a large testing station at Nornood. Massachusetts. Mention also should be made of the fire testing station of the Swedish Government Testing institute. In addition to these laboratories. with substantial test facilities, much fire research is conducted at numerous laboratories in schools and colleges throughout the world.

U.S. and British standard methods of making fire tests of building construction and materials are similar. The U.S. technique is described in *Standard Methods of Fire Tests of Building Construction and Materials,* prepared by a joint committee of the National Fire Protection association, the American Society for Testing Materials. the National Bureau of Standards, the Associated Factory Mutual Fire Insurance companies, the National Board of Fire Underwriters. and Underwriters' Laboratories, Inc., operating under procedure of the American Standards association.

One important development of fire research activities in the United States is the labelling of fire protection equipment and the reporting on hazardous devices by Underwriters' Laboratories. Inc. It has long been a recognized principle of fire protection nork that a degree of reliability should be required in connection with devices for protection against fire that goes beyond what would be provided in devices for other purposes. One method of accomplishing this has been the development of standards for extinguishers, sprinklers. fire pumps, fire doors, and other items of fire protection equipment. Standards as such are not self-policing. A method proposed to insure that purchasers get equipment which meets a specific standard is to ask for a certification from the manufacturer to that effect. This arrangement has been tried out in various places and is a practice in some European countries and in other parts of the world. Even such a certificate falls short of an ideal system of policing the devices.

It was this need for a more dependable system of policing that prompted the fire insurance companies, through Underwriters' Laboratories in the United States, to begin the practice of checking to see that certain standards were met with respect to fire-protective equipment. The Fire Offices' committee, in the United Kingdom and for its foreign activities, has a similar but less comprehensive procedure.

By the 1950s U.S. practice for many devices, labelled by Underwriters' Laboratories, was approximately as follows: a manufacturer submitted a product to conform with some general standard of fire protection service. (It may! for example, have been an extinguisher which conformed to the standards of the National Fire Protection association for first aid fire appliances.) Underwriters' Laboratories also prepared detailed standards for the construction of the commoner types of devices on which it was asked to pass. The pilot model of the item passed Underwriters' Laboratories' initial review. and a procedure was set up whereby subsequent production of the item was checked under terms convenient both to Underwriters' Laboratories and the manufacturer. This usually embodied an arrangement for the testing of the manufacturer's product in the factory or making appropriate checks at that point. Some items were further checked by purchasing them in the open market.

In return for subjecting their product to Underwriters' Laboratories' examination and supervision, the manufacturer was allowed to place on his device a label which identified the product as having met certain specified standards. This, of course, was of great practical importance to insurance men who from time to time were called upon to recognize various items of fire protection equipment as a basis for credits or rebates in insurance charges. The label of Underwriters' Laboratories, however, had an importance far beyond its use in insurance rating as it was widely used by property owners and by federal, state: and local authorities, particularly municipal fire and building departments, as a basis for identification and acceptance of the devices.

Great Britain.— Systematic studies of fire resistance were begun in England toward the end of the 19th century by the British Fire Prevention committee, the results of which were published in a series of "red books" well known in the fire world. About 260 of these reports were issued. the last one appearing in 1921. One of the results of this work was recognition of the need for a standard procedure in tests of fire resistance such as is described in the *British Standard Definitions for Fire Resistance, Incombustibility and Non-Inflammability of Building Materials and Structures,* published by the British Standards institution. In order to provide facilities for such tests. the Fire Offices' committee built and equipped a fire testing station at Boreham Wood, Elstree, opened in 1935.

At about the same time the Riverdale committee, reviewing fire brigade services in England and Wales. recommended attention to fire research. A fire-fighting research section was established at the building research station of the department of scientific and industrial research. The formation of this section practically coincided with the outbreak of World War II. At that time, there was a general expectation of severe damage by high explosive bombs and the air raid precautions department of the home office had set up a research and experiments branch. This became subsequently the research and experiments department of the ministry of home security. When it became evident that in many raids much more damage was caused by fire than by high explosive bombs, the expansion of the fire research work had to be considered. The ministry of home security carried on with the work during the war, after which responsibility was resumed by the department of scientific and industrial research. During the war, a great variety of agencies contributed to various phases of the special fire studies of the war.

At the war's close, the Fire Offices' committee proposed to extend its fire research work and it was decided to establish the Joint Fire Research organization, the cost of which would be shared equally by the Fire Offices' committee and the department of scientific and industrial research. Accordingly, a fire research board was appointed in Nov. 1946. The Fire Offices' committee placed the fire testing station at the disposal of the Joint Fire Research organization as a part of their contribution to the capital cost.

The Elstree fire testing station embodies some of the most modern furnaces for testing the structural components of buildings, a notable piece of equipment being a furnace in which building columns can be subjected to loading and fire temperatures at the same time.

Special Organizations.— Thereare a number of organizations, professional and technical, in the fire field within the United States and Canada which have kept up a steady pressure on property owners and public officials to bring natural fire hazards of the continent under control. The largest of these is the National Fire Protection association. The fire department organizations include the International Association of Fire Chiefs and the International Association of Fire Fighters (affiliated with the American Federation of Labor). National insurance organizations like the National Board of Fire Underwriters and fire insurance rating associations and organizations in each of the states and provinces are active in promoting fire prevention work.

In 1922 an important annual educational program of fire prevention education was introduced and came to be widely observed in both the United States and Canada — Fire Prevention week, held during the week each year in which the anniversary of the great Chicago fire of 1871 occurred (Oct. 8–10). The Chamber of Commerce of the United States awards prizes annually to local chambers for fire prevention activities. A home fire prevention campaign has been carried on since 1950 jointly by the National Fire Protection association and the Advertising council. "Sparky," the fire house Dalmatian, features this campaign of public education.

The complexity and technical character of fire prevention and fire protection work is illustrated by the existence of not only the technical organizations, like the Fire Offices' Committee Fire Protection association in Britain and the National Fire Protection association in the United States and Canada, but by two professional organizations. The Institution of Fire Engineers is a professional society, with many members not only in the United Kingdom but throughout the British Commonwealth. Membership in a professional grade in that organization is obtained through passing written examinations. and advancement to member is by vote of a board of senior fire brigade officers.

In the United States and Canada, interest in the professional aspects of fire protection work is not limited to members of fire departments or brigades but includes persons in the insurance business and individuals in the management of industrial enterprises who have decisions to make with respect to fire prevention and protection measures. In 1950, the Society of Fire Protection Engineers was organized as a section of the National Fire Protection association.

Bibliography.—Horatio Bond (ed.), *Fire and the Air War*, National Fire Protection Association (1946); Robert S. Moulton (ed.), *Handbook of Fire Protection,* National Fire Protection Association (1954); *Municipal Fire Administration*, International City Managers' Association (1956); *Fire Grading of Buildings,* Joint Report of the British Building Research Board and Fire Offices' Committee in "Postwar Building Studies." part 1. "General Principles and Structural Precautions," no. 20 (H.M.S.O.,London, 1946), part 2, "Fire Fighting Equipment." part 3, "Personal Saiety," and part 4, "Chimneys and Flues," no. 29 (H.M.S.O.,London, 1952). (Ho. B.)

FIRESHIP, a vessel laden with combustibles, floated down on an enemy's ships to set them on fire. Fireships were used in antiquity and in the middle ages. The highly successful employment of one by the defenders of Antwerp when besieged by the prince of Parma in 1585 brought them into prominent notice, and they were used to drive the Spanish Armada from its anchorage at Calais roads in 1588. In 1809 fireships designed by Lord Cochrane were used against French ships anchored in the Aix roads. In the Greek War for Independence fireships employed against Turkish crews were largely responsible for giving the Greek insurgents command of the sea. In April 1862, the Confederates sent fireships against the Union fleet and mortar-boats below Fort Jackson in the Mississippi river on five successive nights, but they were towed clear and caused no damage. On April 24, however, while Farragut's fleet was passing the Confederate forts during darkness his flagship the "Hartford" was set on fire by a fireship. The excellent discipline of the officers and men of the "Hartford" enabled them to put out the fire while using their guns against the Confederates to good effect.

Fireships were made by building a fire chamber between the decks from the forecastle to a bulkhead constructed abaft the mainmast. This space was filled with resin, pitch. tallow and tar. together with gunpowder in iron vessels. The gunpowder and combustibles were connected by trains of powder and by bundles of brushwood called bavins In using a fireship, a body of picked men steered her down on the enemy and when close enough they set her alight and escaped in a boat which was towed astern. As the service nas peculiarly dangerous a reward of £100 or a gold chain with a medal (to be worn as a mark of honour) was granted in the British navy to the successful captain of a fireship. A rank of *capitaine de brûlot,* next to the full captain, existed in the French navy of Louis XIV. (J. B. Hn.)

FIRESTONE, HARVEY SAMUEL (1868–1938), U.S. rubber manufacturer, was born at Columbiana, O., Dec. 20, 1868. After selling buggies in Detroit and solid-rubber carriage tires in Chicago, he went to Akron, O., (1900) and with a $10,000 investment formed the Firestone Tire and Rubber company. He pioneered the manufacture of pneumatic tires for the Ford model-T automobile, nonskid tire treads, low-pressure balloon tires, motor truck and farm tractor tires. He early supported the ship-by-truck movement which led to long-distance trucking. To break a monopolistic grip on rubber prices held by growers in southeast Asia, he started plantations in Liberia (1926).

When Firestone died Feb. 7, 1538, at Miami Beach, Fla., his company was a leading corporation, already experimenting with synthetic rubber and producing plastics.

See Alired Lief, *Harvey Firestone: Free Man of Enterprise* (1951) and *The Firestone Story* (1951). (A. Lf.)

FIRE THORN: see Pyracantha.

FIRE WALKING, a religious ceremony common to many peoples, and widespread in all ages. The details of the ritual and its objects vary in different lands, but the essential feature of the rite, priests, fakirs and devotees passing barefoot over heated stones or smouldering ashes, is always the same. Fire walking was usually associated with the spring festivals and was believed to ensure a bountiful harvest. Such was the Chinese vernal festival of fire.

In the time of Kublai Khan the Taoist Buddhists held great festivals to the "High Emperor. of the Sombre Heavens" and walked barefoot through a great fire, preceded by their priests bearing images of their gods in their arms. Though they were severely burned, these devotees held that they would pass unscathed if they had faith.

J. G. Frazer (*Golden Bough,* vol. iii, p. 307) described the ceremony in the Chinese province of Fukien. The chief performers were labourers who had to fast for three days and observe chastity for a week. During that time they were taught in the temple how they were to perform their task. On the eve of the festival a huge brazier of charcoal, often 20 ft. wide, was prepared in front of the temple of the great god. At sunrise the next morning the brazier was lighted. A Taoist priest threw a mixture of salt and rice into the flames. The two exorcists, barefooted and followed by two peasants, traversed the fire again and again until it was somewhat beaten down. The trained performers then passed through with the image of the god.

Frazer quotes Indian fire walks, notably that of the Dosadhs, a low Indian caste in Behar and Chota Nagpur. On the fifth, tenth, and full moon days of three months in the year, the priest walked over a narrow trench filled with smouldering wood ashes.

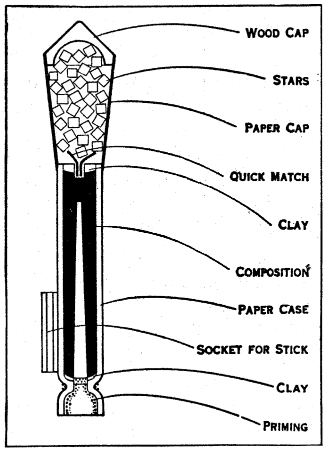
The interesting part of fire walking is the alleged immunity of the performers from burns. On this point authorities and eyewitnesses differ greatly.

FIREWEED, any of several weedy plants that spring up profusely after a forest fire, especially the great willow-herb (*Epilobium angustifolium,* family Onagraceae) which occurs throughout North America and in northern Europe and Asia. Less common are the American horseweed (*Conyza canadensis*), which is widely naturalized in Eurasia. and *Erechtites* hieracijoliu (both belonging to the family Compositae) also introduced into the Old World. All but the great willow-herb are annuals and hence difficult to eradicate on a scale sufficient to be effective, unless they are chemically destroyed. The most profuse, because of its windblown downy-tufted seeds. is the great willow-herb (*q.v.*). Spraying with 2,4-D in bright sun will kill it. (S. Tr.)

FIREWORKS. The history of pyrotechny may be said to have begun when a prehistoric firemaker first mixed saltpetre from his cooking with charcoal from his fire, to use as tinder. In subsequent ages other ingredients nere added as pyrotechnic mixtures developed. and eventually. when the principle of the gun was evolved by Berthold Schwartz in the 13th century, the pyrotechnic mixture most suitable for his needs was named gunpowder.

About the date of the introduction of artillery the military fireworker came into existence, whose business was to provide pyrotechnic engines of war, to which duty was subsequently added the provision of spectacular firenorks in celebration of victory or peace During the 17th and subsequent centuries most occasions of national rejoicing were celebrated by displays of fireworks; these were generally provided by the military fireworkers.

In earlier displays a limited number of pyrotechnic effects were eked out with others of a scenic or theatrical nature and the use of merely inflammable substances, in the form of torches and flares, which cannot, strictly speaking, be classed as pyrotechnics. It was not until the early part of the 18th century that displays of any considerable pyrotechnic merit were produced,



CROSS SECTION OF A SKYROCKET
The solid black portion represents the composition, which when ignited, produces a recoil that starts the rocket on its spectacular upward flight

During the 17th century there were two schools of pyrotechnic thought, that of northern Europe, with Nuremberg as its centre and Clarmer as its leader, and the Italian school. The former, although producing probably better results from a purely pyrotechnic point of view, could not vie with the southern school in artistic elaboration and the scenic accessories introduced. In the earlier part of the 18th century the brothers Ruggieri, Bolognese firework artists, attracted no doubt by the lavish expenditure of Louis XV., visited Paris and produced displays at Versailles and elsewhere on a hitherto unprecedented scale. One of the Ruggieris, in conjunction with one Santi, carried out the display in London which celebrated the Peace of Aix-la-Chapelle in 1749, an event which appears to have been celebrated in most of the capitals of western Europe. During the remainder of the century firework displays increased both in number and scale; in addition to official exhibitions celebrating national events, the popular places of resort, the tea gardens and bowling greens began to add fireworks to their list of attractions. Those in the London resorts, Vauxhall, Ranelagh and Marylebone gardens, are still remembered.

As yet no real advance had been made in pyrotechnic mixtures; no colour had been introduced, the art still relied on saltpetre, which had been its foundation. (The importance attached to this salt by early writers, such as Biringoccio, is reflected in the long and elaborate dissertation they give on its preparation and refinement.) Although some pyrotechnists claimed to produce various tints, there is no doubt De Frezier, in his two books published in 1707 and 1747, came nearest to the truth in describing the flame produced by his compositions as "reddish," "greenish," etc.

In the first quarter of the 19th century, however, the era of modern pyrotechny began with the introduction into the art of potassium chlorate, which had been discovered by Berthollet in 1788. Genuine colour effects were now possible and a field of research was opened which, even yet, has not fully been explored. The subsequent introduction of the two metals, magnesium (about 186;) and aluminium (in 1894) also gave a brilliancy never before attained, and added greatly to the variety of effects produced.

The famous displays at the Crystal Palace, near London, instituted in 1865, were one of the greatest factors in the development of the modern display. Old-fashioned limitations and scenic accessories were discarded and a scale and method, both in aerial and ground fireworks, were reached which had never previously been attained, eclipsing any official effort, with the exception of the "National Peace display" in Hyde park in 1919, which was probably the greatest display produced up till that time.

Firework Compositions. — The phenomenon we know as fire is produced by the combination of certain substances, which have a tendency so to do, with oxygen in so rapid a manner as to produce intense heat. When such inflammable substances are set on fire in the ordinary way they obtain the necessary oxygen from the air. The art of the pyrotechnist is in the production of mixtures of ingredients which do not depend on atmospheric oxygen for their combustion. These mixtures are known as pyrotechnic compositions. Every pyrotechnic composition contains at least one ingredient having a supply of oxygen with which it readily parts and others which receive and combine with that oxygen and in so doing produce the effect for which the particular composition has been designed. The most used oxygen-supplying ingredients are potassium nitrate (saltpetre) and potassium chlorate, Compositions may be divided into two classes, those designed to produce force and sparks and those producing flame, either white or coloured. There are also certain compositions which are designed to produce special effects such as noise, a dense cloud of smoke for military or other purposes, or a whistling sound as that produced by picrate of potash in the familiar whistling rocket.

Force and Spark Compositions. — The basis of these compositions is a mixture of potassium nitrate, sulphur and charcoal, ground to a fairly fine powder. In some cases "mealed," or finely ground gunpowder is added to give extra fierceness when required, as for sky rockets, turning cases (used to turn wheel devices) and similar fireworks. Additional ingredients are included to produce sparks of various forms. The nitrate of lead and barium are also used sometimes in these compositions; also aluminium in an extremely finely divided dust to produce a very brilliant white fire.

Flame Compositions. — In this class are included those compositions which give colour to pyrotechny, the "stars" in rockets, shells and roman candles, the decorations on revolving and stationary devices and set pieces and the outlines in pictorial, or (as they are technically called) lancework pieces. *White Fire,* which varies in its composition according to the purpose for which it is used, generally consists of the ingredients potassium nitrate, salts of antimony, or arsenic and sulphur. With the exception of white fire and a few others of little importance, such as the portfire and blue light used at sea, flame compositions rely for their combustion and their colour on the presence of potassium chlorate, or occasionally perchlorate. *Coloured Fires.* The combustion of potassium chlorate, or perchlorate, in combination with a metal salt has the effect of turning the metal present into a gaseous state and produces a coloured flame. The following are the salts used: — Red, the nitrate, carbonate or sulphate of strontium; green, the nitrate, chlorate or carbonate of barium; yellow, oxalate or carbonate of sodium, and for blue the carbonate, sulphide or arsenite of copper in combination with calomel, mercurous chloride. It is interesting that, although copper burnt in a blowpipe flame produces a green colour, in pyrotechny copper salts are only used to produce blue, as in the presence of chlorine, which must be present with potassium chlorate, the flame is blue; this is deepened by the addition of calomel, which produces still further chlorine.

Magnesium powder is used with colour compositions where extra brilliancy is aimed at. Most colour compositions have, in addition, some burnable substance which serves to increase the mass and effect without detracting from the brightness or colour. The most commonly used are shellac, sterine, sugar of milk, pitch and paraffin. Sometimes the burnable substance serves also as an agglutinant, as shellac and spirit, starch paste, gum water, linseed oil or dextrine.

Firework Cases. — The composition of each firework is enclosed in a "case" formed of paper, pasted and rolled round a cylindrical former; they are either "dry rolled," that is, only the edge of the paper is pasted, or "wet rolled" in which case the paste covers the whole surface of the paper. Generally the case used for force and spark compositions remains intact during the burning of the firework and that enclosing a flame composition is consumed as the firework burns.

Compositions are introduced into the cases in two ways, either by "charging" (when a succession of small quantities of composition are poured in from a scoop of suitable size, each scoopful being consolidated by a number of blows delivered by a mallet on a cylindrical wooden tool exactly fitting the bore of the case, known as a "drift"), or by "filling" with a small copper funnel having a spout of suitable size to fit the case and provided with metal rod of somewhat less diameter than the inside of the spout, having a knob for the hand at the upper end. Composition is placed in the funnel, the spout inserted in the case and a rapid up and down movement of the rod alternately releases a small quantity of composition and consolidates it in the case. This method is only used with cases of small diameter.

It may be as well to mention here that these manual methods have never been superseded satisfactorily by mechanical means, although many experiments have been made. In pyrotechny, as in some other crafts, hand work maintains its superiority.

Rockets.—The rocket, which is the most elaborate in construction of any single firework, also requires the highest degree of technical skill in manufacture. The sky-rocket (its most familiar form) is driven into the air by the recoil produced from a jet of fire thrown out by its burning composition. In order to make this jet as strong as possible the case, which is wet rolled, is choked, or constricted, by pulling in with a cord near one end before drying. In addition, the composition is so charged into the case that a conical cavity is left from the choke or vent, nearly to the top of the case; by so doing, when the rocket is ignited, as large an area as possible of composition is burning at the moment when it is required to give the rocket its initial impetus. This cavity is produced by charging the rocket on a tapering spindle and using drifts of varying lengths, pierced with a hole of suitable size. Above the composition in the body of the rocket is a diaphragm of compressed clay, bored with a central hole through which the fire from the top, or "heading," of the composition is communicated to the "garniture" contained in a case, usually in the form of a truncated cone, which forms an extension of the body of the rocket and is known as the "cap." The garniture consists of "stars" of colour, or other suitable composition, either contained in short cylindrical cases, when they are known as "pinched stars" from their method of manufacture, or compressed into cylindrical form without a case, when they are known as "pumped stars." *Gerbs* and *Fountains* are charged without a central cavity, the choke generally being formed by a clay diaphragm. The compositions are similar to those of the rocket, with the addition of spark-producing ingredients. The composition for gerbs (formerly known as Chinese fire) contains iron filings; for fountains (formerly known as brilliant fire) steel filings; and for flower pots, lampblack, producing remarkable sparks, which, from their form, gave to this composition the name of spur fire. *Devices and Set Pieces* consist of frameworks of wood on which are secured firework units which are connected together by quickmatch and take the form of wheels moving in the vertical or horizontal plane; stationary, or, as they are called, fixed devices, of various geometrical forms; waterfalls; tree pieces and "lancework" pieces. The outline of a lancework piece is constructed in cane on a wood lattice framework and the design picked out in appropriate colouring with lances (small cases of colour, or "bright" composition, about the size of a cigarette); by this means almost any pictorial design can be carried out. At the Crystal Palace, London, where this type of set piece has been most highly developed, pictures have been produced over 600ft. long and 50ft. high, carried out entirely in lines of fire.

See Vannuccio Biringoccio, *Pirotechnia* (Venice, 1540 and 1553); De Frezier, *Traité des Feux d'Artifice* (1707 and 1747); Ruggieri, *Elémens de Pyrotechnie* (1801 and 1821); Chertier, *Nouvelles recherches sur les feux d'artifice* (1843 and 1854); Websky, *Lustfeuerwerkkunst* (Leipzig, 1878); Kentish, *The Pyrotechnist's Treasury* (1878); Denisse, *Traitd pratique complet des feux d'artifce* (1882); A. St. H. Brock, *Pyrotechnics, The History and Art of Pyroteclzny* (containing *a* complete bibliography) (1922). (A. St. H. B.)

FIRMAMENT, the sky, the heavens. In the Vulgate the word *firmamentum,* which means in classical Latin a strengthening or support *(firmare,* to make firm or strong) was used as the equivalent of στερέωμα (στερεόειν, to make firm or solid) in the Septuagint, which translates the Heb. *rāqīya'*. The Hebrew probably signifies literally "expanse," and is thus used of the expanse or vault of the sky, the verb from which it is derived meaning "to beat out." In Syriac the verb means "to make firm," and is the direct source of the Gr. στερέωμα and the Lat. *firmamentum*. In ancient astronomy the firmament was the eighth sphere containing the fixed stars surrounding the seven spheres of the planets.

FIRMICUS, MATERNUS JULIUS, a Latin writer, who lived in the reign of Constantine. His *De erroribus profanarum religionum,* written *c.* 346 and still extant, attacks the false objects of worship among the oriental cults and discusses a number of formulae and rites connected with the mysteries. Its declamatory tone contrasts with his eight books on astronomy (Libri viii, *Matheseos)* written *c.* 336.

The best editions of the *De Erroribus* are those by C. Bursian (Leipzig, 1856); by C. Halm, in his *Minucius Felix* (*Corp. Scr. Eccl. Lat.* ii) (Vienna, 1867); and by K. Zeigler (1907). The astronomical work was first printed at Venice in 1499, the last edition being by W. Kroll and F. Skutsch (Leipzig, 1897–1913). *See* G. Ebert, *Gesch. der chr. lat. Litt.* (1889); O. Bardenhewer, *Patrologie* (1901).

FIRMINY, a town of central France in the *département* of Loire, 8 mi. S.W. of St. Etienne by rail. Pop. (1954) 17,834. It has important coal mines known since the 14th century and extensive manufactures of iron and steel goods.

FIRST AID TO THE INJURED. First aid is defined as the immediate and temporary care given the victim of an accident or sudden illness in order to avert complications, lessen suffering and sustain the person until the services of a physician can be obtained. Proper immediate care is sometimes necessary to save life, but the knowledge of what not to do as well as what to do is vitally important. The present article on first aid procedures is a compilation of instructions recommended by the American Red Cross, the Bureau of Health Education of the American Medical association, and the Detroit Industrial First Aid Advisory committee.

General instructions that apply to all first aid activity are avoidance of excitement or panic, correction of situations that might aggravate the original injury, and protection of the accident victim from unnecessary exposure to the elements or to new hazards such as accidents occurring while speeding to a first-aid station or hospital. For example, in motor accidents, the victim should be removed from the highway, if this is possible, or guards placed about the area to warn approaching traffic. Certain common conditions such as heart attack, stroke, fainting and epilepsy cannot be readily differentiated by the first aider. When these emergencies arise, they will be best cared for by applying the procedures of first aid for shock.

When the victim is prostrate he should not be moved until the proximate nature of the injury has been determined. The victim should be kept lying in a comfortable position, his head level with the body. If the victim is unconscious, he should be handled as for skull fracture or apoplexy. A smell of alcohol on the breath can be misleading.

First Aid Equipment.—A first aid kit (distinguished from a home medicine cabinet) should consist of a dust-tight durable case containing the following items: several packages of sterile gauze squares of two or more sizes, 2 in. x 2 in. to 4 in. x 4 in.; sterile gauze or muslin dressings about 1 yd. square; a roll of 1 in. adhesive tape; six bandages, 1 in., z in. and 4 in. widths; one pair bandage scissors; one package sterile cotton applicators; one pair tweezers; one package ready-made adhesive gauze compresses; one first aid bottle (1 oz.) mild antiseptic; one $2\frac{1}{2}$-in. elastic bandage; safety pins; and two ampules of aromatic spirits of ammonia that may be broken when needed. All medication and supplies should be plainly marked and labels read carefully before using.

In addition, the home and automobile should be equipped with wooden splints and the bandages to apply them, a blanket, flashlight, jackknife and a short pencil and pad for recording pertinent information.

Examination.—Look for serious bleeding, stoppage of breathing and poisoning. They must be treated immediately. Then look for evidence of wounds, fractures, dislocations and burns; feel the pulse; try to elicit response from the victim. Never try to have a patient stand or walk until you have determined there is no injury to the spine, pelvis or legs. Keep the injured person warm. He should have blankets under him, but the first aider in covering him must give consideration to the temperature of the environment. Keep the patient comfortable but not hot. Never give water or other liquids to an unconscious person. Do not let the patient see his own injury. Send someone to call a physician or ambulance.

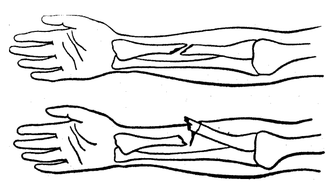
Shock.—In every severe injury shock is a serious condition and may result in death. Severe pain, loss of blood, extensive burns and accidents due to electricity cause a depressed state of all body functions, resulting in a failure of blood circulation. Shock may be more severe in the aged. The symptoms usually develop gradually. The skin is cool and clammy; perspiration is noted on the forehead, above the lips and palms of the hands; the pulse is weak and unconsciousness may occur. Shock is so serious that every effort should be made to prevent it. Elevate the lower part of the body. In chest injuries raise the head and shoulders slightly if breathing is difficult. Keep the patient comfortable but not hot. Fluids such as warm water, broth, tea or coffee may be given in small amounts unless the patient is nauseated, unconscious or has an abdominal wound. Alcoholic drinks are not advised. Avoid unnecessary moving. (See also SHOCK.)

Transportation.—In the handling of any seriously injured or prostrate person the transportation of the patient is of prime importance. Improper action might increase the damage at the site of the injury and cause harm to nerves and organs, thereby seriously complicating the original injury. Few cases require hurried or snap decisions. Determine by observation and questioning the approximate nature of the injury. Notify a physician as soon as you have essential information regarding the type of injury (head, back, limb, abdomen) and the age of victim (child, adult, aged). Request advice regarding immediate care and do not end the telephone conversation until you are sure the doctor's questions are answered and advice is given. Usually the physician will notify the hospital and call an ambulance. If this is not feasible, determine your transportation method. Exactly what is to be done? What materials are needed to move the patient? If the patient is to be carried to a vehicle, how must he be placed in it? Exactly what is the duty of each helper in carrying the patient to the vehicle? These questions should be answered by the first aider before getting started. The patient should not be bothered or worried by questions or discussion of the matter.

The stretcher is extremely valuable in short or long transportation. Stretchers may be improvised by the use of the following: (1) poles and blanket; (2) a blanket properly rolled; or (3) a door, ladder or screen covered with light board and blanket. If the patient is unconscious, his hands should be tied together with a bandage; if he is conscious, his hands may be left free. Few cases require breakneck speed; many are benefited by careful movement rather than haste. Seek advice and assistance at the hospital before moving the patient from the vehicle.

INJURY TO BONES AND JOINTS

A fracture is a break in a bone and is generally the result of violence such as a fall or a sudden blow. X-ray examination is the most positive way for determining the nature and extent of any bone injury. There are tno kinds of fractures, (1) closed (simple) where the bone is broken, but no connecting wound from the broken area through the skin; (2) open (compound) where the broken bone penetrates the skin or a crushing injury has broken the skin and muscle tissues to the depth of the broken bone (fig. 1). An open fracture, because of the entrance of germs, is much more serious than a closed fracture. A history of a fall or violence, pain on motion about the injured area, deformity, tenderness and swelling over the injured bone are characteristic of fracture.



FROM THE DETROIT INDUSTRIAL FIRST AID ADVISORY COMMITTEE UNIV OF MICHIGAN INSTITUTE OF INDUSTRIAL HEALTH, BY COURTESY OF FEBRUARY PUBLISHERS

FIG. 1—CLOSED (TOP) AND OPEN FRACTURES

For all fractures and possible fractures keep the broken ends and adjacent joints quiet. Splint the injured area when in doubt. If the fracture is open (compound) and bone or tissue protrudes through the damaged skin, special care must be exercised in the handling of the injury. (See also FRACTURES AND DISLOCATIONS; BONE, DISEASES AND INJURIES OF.)

Fracture of Long Bones (Arm, Leg) should be immobilized with a splint. In fractures of the leg, thigh or hip apply the splint before moving the victim. If it is necessary to move the injured person a short distance, someone should place his hand above and below the fracture area to keep it quiet while others support the weight of the body. Use a stretcher if one is available.

Splints should be padded and sufficiently long so that the joint on each side of the fracture is incorporated in the splint. Improvised splints can be made from thin boards of sufficient length covered with padding. Too small or unwieldy boards are likely to cause more harm than good.

Fracture of the Spine (Backbone) is caused by a fall or crushing accident. Backache, pain in the neck, paralysis of one or both lower extremities and shock are symptoms that the spinal cord may be damaged. Extreme caution is important in the handling of this type of injury because permanent paralysis or even death may result from improper first aid. Transport the victim on a rigid frame. This frame may be improvised by using boards or a door; support the head and neck carefully. If the patient is found on abdomen or side, roll him gently to the back, rotating the neck in line as the body rotates and bind him to the frame. Do not use a pillow, particularly if the injury is in the neck or upper back. Place pads on each side of the head to prevent rolling. Place a small padding under the small of the back. Do not permit the patient to sit up. Do not let the head tilt forward, sideways or backward. Do not move the patient from the frame to a stretcher or bed until he has been examined by a physician.

Fracture of the Hip is generally the result of a fall. Symptoms are usually shock, often severe; the foot is frequently turned outward; there is tenderness and pain over the hip. While on his back the patient cannot raise his heel although he can move his ankle and foot. Apply a splint on the injured side of the body from armpit to foot. If a splint is not available bandage the injured limb to the other limb. Give proper shock care. Transport on a stretcher.

Sprains.—Sprains result from a tearing and stretching of ligaments about a joint. There is pain, swelling and possible discoloration. It is often difficult to differentiate a sprain from a fracture; if there is doubt it is best to treat the injury as if it were a fracture. Rest and elevation of the affected area are desirable, as are cold applications.

WOUNDS

A wound (*q.v.*) is a break in the skin and is classified as an abrasion (scraped), incision (cut), laceration (torn) or puncture (stab) wound. The dangers that might complicate wounds are infection, hemorrhage and shock.

In the first aid treatment of wounds, cleanliness is essential. Do not touch the mound with the hands or fingers or any unsterile material. A minor abrasion or laceration should be cleansed thoroughly with bland soap and warm water, rinsed with warm water and treated with a mild antiseptic; the injury then may be dressed with a ready-made adhesive gauze bandage or sterile gauze and roller bandage. Do not use improvised bandages or dressings unless the material has been thoroughly washed with soap and hot water and freshly ironed. If the wound is of a nature that will require subsequent dressing, it is advisable to consult a physician. Wounds which cause hemorrhage have usually cut or torn a blood vessel. Most vessels close to the surface of the skin are veins and small arteries. All that is needed for control of the bleeding is direct pressure over the wound with sterile gauze from the first aid kit or a clean unused handkerchief. It is not harmful to allow fresh water to run over the bleeding wound before applying pressure with a square of gauze between the fingers and the wound. This is called digital pressure (fig. 2). Do riot apply a retaining bandage until the bleeding has been controlled. It is better to add another piece of gauze over the first section than to remove the first gauze from the mound. Contamination of the wound by contact with additional material should be avoided as much as possible. When bleeding is not severe, infection is the chief danger.

When arteries are cut or a number of large veins have been lacerated, severe bleeding ensues. Blood from the arteries is bright red and comes in spurts. The chief duty of the first aider is to stop the loss of blood; determine as quickly as possible the source of bleeding and apply digital pressure close to the wound, but not on the wound's edge. If digital pressure will not stop the flow of blood, it may be necessary to apply a tourniquet but this should be done only as a last resort. The tourniquet is a dangerous instrument. and it should be used only when profuse bleeding—such as that which occurs when a large artery or vein in one of the limbs has been cut—cannot be checked by direct pressure. In preparing the tourniquet, do not use rope, wire or any material that might cut into the flesh when drawn tight. Use flat material at least an inch wide, such as a necktie, belt or suspender. Place the tourniquet close to the wound where the skin is unbroken. but not on the wound edge. Wrap the tourniquet around twice and draw it tight enough to check the flow of blood. Tie the ends with a slipknot, so that if it is necessary to release the tourniquet it can be done very gradually by undoing the slipknot without removal of the tourniquet and movement of the injured limb. A properly applied tourniquet may be left in place for one to two hours without causing harm by pressure. It need not be reapplied unless severe bleeding occurs again; then it should be tightened until bleeding stops.

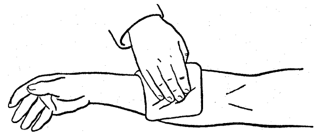


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FIG. 2.—USE OF GAUZE SQUARE OVER WOUND FOR CONTROL OF BLEEDING

Puncture Wounds caused by penetrating objects should always be regarded as serious because of the danger of tetanus (*q.v.*). Puncture wounds do not cause much bleeding unless a blood vessel has been injured. Frequently foreign material such as street dirt or clothing is carried into the nound. These wounds are difficult to clean out. The important care in first aid consists of thoroughly cleansing deep into the wound with bland soap and water, applying a first-aid dressing and sending the patient to a physician for the administration of tetanus antitoxin or toxoid. Do not wait to see nhat will happen even until the next day.

Gunshot Wounds generally penetrate farther than do other puncture wounds and may involve blood vessels or organs where internal bleeding would take place. Shock is a frequent symptom of internal bleeding. The need of a physician, ambulance and hospitalization is imperative.

Infected Wounds.—Infection is caused by germs entering a wound at the time of injury or subsequently. The symptoms are pain. swelling, redness and heat. Sometimes pus. red streaks, swollen lymph glands and fever are present. A physician's care is necessary. First aid until the patient can see a doctor is as follows: rest and elevate the infected part if possible; apply fomentations made with Epsom salts or boric acid and hot water. Do not touch the wound or attempt to squeeze out the pus.

Wounds of the Abdomen.—The danger of abdominal wounds is internal bleeding and rupture of intestines or some other abdominal organ. Operation is usually necessary. Sometimes injuries to the abdomen do not cause external wounds though the patient may have pain with signs of shock. If there is an external wound. apply a sterile dressing and binder and provide careful, immediate transportation to a hospital.

Wounds in Which Foreign Bodies Remain.—If a small foreign body protrudes from a wound, clean the area with soap and water; apply antiseptic; remove the foreign body with forceps boiled in water; and again apply an antiseptic and ready-made adhesive gauze dressing. If the foreign body is large or deeply embedded. do not attempt to remove it. Apply a sterile dressing and take the patient to a physician.

Eye Wounds.—Vision is sometimes seriously and permanently damaged by delayed or improper care of a foreign body in the eye. Do not rub the lid over the eye. Do not examine the eye with unwashed hands. Do not use a toothpick or other instrument in an attempt to remove the foreign body. Do not use an eye cup. Do not apply ointment or eyewash to the eye. Do not touch the eyeball. A sterile applicator or corner of a clean handkerchief dipped in boric acid solution may be used to remove a foreign body that is in the fold between the eyeball and the lid. If the foreign body is fixed on the eyeball, the patient should be sent to a physician. Retain a sterile dressing over the closed eyeball with a strip of adhesive tape. Wounds that penetrate the eyeball are serious. Do not remove any splinter that is partially embedded in the eyeball. Apply a sterile pad and loose bandage and take the patient to a physician or hospital immediately. (See also BANDAGES AND BANDAGING.)

Animal Bites.—Puncture wounds inflicted by pets or stray animals occasionally cause severe infection. Rabies (*q.v.*) may result from a mammal bite, especially a dog bite. Cats and squirrels may also be carriers of the rabies virus. The offending mammal should be kept under observation by a veterinary or police official until it is determined that it is not suffering from rabies. The wound should be cleansed with soap and water and a sterile dressing applied. Obtain medical attention for rabies immunization at once even though the wound is minor. One should never wait to see if trouble develops.

Snake Bites.—The fangs of a poisonous snake cause puncture wounds through the flesh of the person struck. Pain is immediate, and the skin about the bite takes on a dark purple discoloration. As the poison is absorbed into the system, more general effects are noted: weakness, rapid pulse, nausea and vomiting. Prompt first aid is imperative in order to remove as much of the venom as possible. Snake bites on the extremities require the use of a tourniquet, applied somewhat above the wound—that is, on the trunk side immediately after the wound is received. Several cuts should be made over the site of the puncture, mith a razor blade or sharp knife, sufficiently deep to cause bleeding. Apply suction with the mouth or, preferably, by means of a suction cup to extract the poison. The poison if swallowed is not harmful. Shock should be treated and the victim transported to medical care. Alcoholic drinks have no value in snake bites.

Insect Bites.—Some persons are more susceptible to insect bites than others. In the case of a bee, wasp or hornet bite, the sting is usually seen in the wound and should be removed by scraping. Do not pluck out with the thumb and forefinger because squeezing the sting empties the contents of the poison sac into the wound. Local application of baking soda paste, calamine lotion or ice cold compresses gives relief, and considerable benefit can be obtained by the use of antihistamine pills prescribed by a physician. (See also INSECT BITES AND STINGS.)

COMMON MEDICAL EMERGENCIES

Burns.—A burn is caused by dry heat or flame; a scald is caused by steam or hot liquid; chemical burns are produced by the chemical action on the skin; electric burns are caused by the electric flash which damages the skin. The dangers from burns are shock and infection. Small burns may be cleansed and first-aid ointment with sterile dressing applied. the wound being redressed after 12 hours. Do not apply butter, lard, vinegar or similar household items. For extensive burns, remove clothing except where it sticks to the burned area. Keep the patient warm and treat for shock. The outstanding signs of burn shock are thirst, complaint of cold and gray to purple colour of the lips. Cover the burned area with a thin layer of sterile gauze or dressing retained with loose bandage. Do not use absorbent cotton on a burn. Do not remove foreign substance from the burned area or open blisters; this should be done by a physician. Chemical burns should be washed immediately with a large amount of water so that the chemical will not burn deeper. Acid burns should be washed freely nith nater and a paste of bicarbonate of soda applied and covered nith a dressing. Caustic burns should be washed mith a weak vinegar solution and rinsed with nater. (See also BURNS.)

Frostbite.—Exposure of the body to cold results in a stoppage of the flow of blood to the frozen part. The terminal ends of the circulation such as ears, fingers, nose and feet are often frostbitten.

Experience in World War II and the Korean war indicated that the least damage results when thaning is accomplished by immersion of the frozen part in a water bath maintained at a temperature of 86° to 89° F. until a reddish colour is restored to the frozen part. Restore the general condition of the victim with warm drinks and blankets. After the circulation is restored in the frozen area. the victim should be encouraged to exercise the movable parts. Do not rub or massage the frozen part with snow or any other substance. The patient should not smoke during thawing of the frozen part. Blisters which develop over the frozen areas may be opened on the second day. (See also FROSTBITE.)

Nosebleed. — The patient should sit up, loosen collar, clear blood clots and mucus from the nostrils, press the nostrils together firmly or apply pressure on the upper lip just below the nose. If bleeding does not cease in a reasonable time, pack the nose gently with gauze. Be sure the ends of the gauze protrude so that it can be easily removed. Do not use cotton. (See also NOSEBLEED.)

Heart Attack. — Such cases generally resemble fainting with complaint of shortness of breath (air hunger) and pain in the chest or upper abdomen which sometimes radiates down the left arm. The patient is often apprehensive. Keep the patient quiet and lying down. loosen collar and tight clothing; coffee or tea may be given. Call a physician immediately.

Abdominal Pain is an early symptom of many disorders, some of which are serious. Disease of the stomach or bowel is generally evident by vomiting. constipation or diarrhea. Appendicitis may begin with pain in the upper abdomen or tenderness in the lower right side. little or no fever and generally some nausea. A laxative should never be given until the diagnosis is certain. If necessary give a one-pint soapsuds enema, apply an ice bag to the abdomen, give no fluids or food by mouth and have a physician come to the patient. After the age of 40, vomiting after meals, passage of dark blood from the bowels or any abdominal distress with distention indicates the immediate need of a thorough physical examination.

Apoplexy (Stroke). — The victim should be recumbent with head and shoulders raised and adequately covered. Cold applications should be applied to the head. Stimulants are harmful. The patient should not be moved at the time. (See also STROKE.)

Convulsions.—Onset is sudden, though sometimes the patient realizes an attack is coming on. The patient may cry out. lose consciousness and bite his tongue. An attack lasts a few minutes and is followed by drowsiness and mental confusion. Protect the patient from self-injury. Protect the tongue from being bitten by placing a pencil or small stick wrapped with a handkerchief between the teeth. Give nothing by mouth. Encourage the patient to sleep. (See also CONVULSIONS.)

Fainting. — Fainting generally results from a temporary lack of blood reaching the brain. Some healthy persons faint at the sight of their own blood, and for this reason first aid should never be rendered to a person unless he is seated or lying down. If the patient has fainted, keep him lying down with head level. Aromatic spirits of ammonia on a handkerchief held under the nose often restores circulation of blood to the brain. After consciousness returns. coffee, tea or cold water may be given.

Diabetic Coma. — Many diabetics carry special identification which indicates the possibility of sudden unconsciousness. Symptoms of diabetic coma are mild shock, confusion and history of insulin usage. The victim should be transported to the hospital or nearest clinic for insulin injection. (*See* also DIABETES MELLITUS.)

Insulin Shock is a condition resulting from administration of too much insulin. Symptoms are confusion and sometimes unconsciousness. Give sugar, candy or orange juice at once (an exception to the rule of not feeding an unconscious patient).

Dermatitis. — Dermatitis is an inflammation of the skin evidenced by itching, redness and various types of skin lesions caused by external irritants (poison ivy, nettle, turpentine, glass wool, chemicals, etc.). Allergic dermatitis occurs in persons who are particularly sensitive to substances that do not affect others. Persistent skin disorders of this type should be referred to a physician who specializes in skin disorders. Self-medication may result in serious complications and prolonged disability. (See also SKIN DISEASES; POISON IVY.)

Sunburn, Heat Exhaustion and Heat Stroke. — Extensive exposure to sun rays may cause violent reactions in the skin and in the heat regulating mechanism of the body. Light skins react more violently than dark ones. For mild sunburn apply soothing lotions or creams. Blisters should not be broken, but if they are accidentally broken they should be trimmed with scissors sterilized in boiling water. Then cover the blistered area with Vaseline dressings.

The symptoms of heat exhaustion are nausea, vomiting, headache. rapid pulse and excessive perspiration. Rest is imperative. Restore the salt balance in the body by administering salted fluids, one-fourth teaspoonful of salt in each glass of water or other liquid.

Heat stroke is a serious matter. The skin is dry and hot; there is no perspiration; the pulse is fast; cramps develop in the muscles of the arms. legs and abdomen; the temperature is high and should be lowered as quickly as possible by tepid baths and sprays. Massage the arms and legs and give salted fluids by mouth. Ice applications to the head and back of neck are advisable. Keep the victim at rest for 24 hours after the temperature reaches normal (98.6"). (See also SUNSTROKE AND HEATSTROKE.)

Poisoning by **Mouth.**—Swallowing a poison creates an emergency that requires immediate first aid. The poison should be evacuated from the stomach as quickly as possible, preferably by dilution and vomiting. If the patient is conscious, give large glasses of milk or water and then induce vomiting by tickling the back of the throat with the index finger or by administering an emetic (such as a tablespoonful of baking soda or a teaspoonful of table salt dissolved in a full glass of warm water). Use force if necessary. If the patient is unconscious, do not attempt to give an emetic, but with the patient lying on his side hold the mouth open with a stick or pencil wrapped with a handkerchief and induce gagging and vomiting by tickling the back of the throat with the index finger. In order to eliminate as much of the poison as possible. if the patient is conscious after vomiting give a drastic cathartic such as Epsom salts in a glass of warm milk. Keep the body warm; give hot coffee, tea or other warm drink. (See also POISON ; ANTIDOTES.)

Asphyxiation. — A person who has stopped breathing will die if his breathing is not restored immediately. Common causes of asphyxiation are carbon monoxide poisoning (*q.v.*), electric shock, suffocation from poisonous gases in the air, foreign body in the throat or air passage and overdose of sedatives. Start artificial respiration immediately after the person has been rescued and moved to fresh air. The rescuer should not enter a hazardous atmosphere without having a life line fastened securely to his body with adequate assistants present. (See ARTIFICIAL RESPIRATION.)

Drowning. — The immediate need in every case of drowning is the supply of an adequate amount of oxygen to the heart and the brain. This can be obtained only by first aid rendered promptly and intelligently. (See ARTIFICIAL RESPIRATION.)

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FIRST-FOOT, in folklore, especially that of northern England and of Scotland, the first person who crosses the threshold on New Year's day (or on Christmas or other days). Good or ill luck was believed to be brought the house by first-foot, and a female first-foot was regarded with dread. In Lancashire a light-haired man was as unlucky as a woman. In Worcestershire luck was ensured by stopping the first carol singer who appeared and leading him through the house. In Yorkshire it had to be a male who entered the house first, but his fairness was not considered an objection. In Scotland the custom of first-footing involving a subsequent entertainment was always more elaborate than in England. Customs associated with first-foot have been known in various other countries, including China.

FIRST INTERNATIONAL: see INTERNATIONAL, THE.

FIRST OF JUNE. The "Battle of the Glorious First of June" was so called because it occurred in the Atlantic ocean at a point 430 mi. W. of Ushant, Fr. (and could not therefore be named after a particular place) and reached a decision on June 1,

1794. It arose out of an attempt by the British to intercept, and by the French to protect, a large consignment of grain which the latter. faced by famine as the result of a bad harvest, had purchased from the United States.

This grain convoy, consisting of more than 100 vessels escorted by 4 line-of-battle ships, sailed from Chesapeake bay in April. The French commander in chief, Louis Thomas Villaret de Joyeuse. intended to meet it with the Brest fleet about 400 mi. from the coast. Lord Howe, commanding the British channel fleet, sailed from Spithead on May 2 with 34 sail of the line primarily to escort an outward-bound convoy, for the protection of which eight ships were detached! six of which were to rejoin on reaching the latitude of Cape Finisterre. He was also making one of his periodic sweeps of the Bay of Biscay by which he maintained an "open" blockade of Brest in the hopes of finding the French fleet at sea.

Howe's fleet was off Ushant on May 5. Finding that the French were still in harbour. he sailed west to put himself between the convoy and Villaret's battle fleet. Meeting with no one, he returned on the 19th to find that the latter had sailed on the 16th, having passed the British in foggy weather. On the 28th the French were sighted. Villaret, in accordance with his instructions to protect the convoy rather than seek a battle, detached the grain ships while he attempted to lure Howe away to the northward. On the morning of the 29th Howe ordered a chase of the French fleet, but soon afterward a heavy mist descended which prevented him from carrying out his plan of attack, though he did obtain the advantage of the weather gauge. During the next two days there was some sporadic fighting in which the British reduced Villaret's force to 26 ships. On the afternoon of the 31st the weather cleared and Howe found himself in an ideal position to attack from the windward position. Having placed his fleet in an exact line with that of the enemy. he drew off for the night. The next morning. Sunday, June 1, he put his plan into action. He aimed at overcoming the usual French withdrawing tactics of firing at the masts of the British in order to immobilize them. Instead of engaging the enemy on the same tack in the normal way, Howe intended to break their line at all points in order to re-engage from to-leeward, thus preventing their retreat. Only seven British ships got through, but the number was enough to disorganize the French line and achieve a notable victory with the capture of six enemy ships and the sinking of another. The duels between ships, particularly those between the flagships "Queen Charlotte" and "Montagne" and that between the "Brunswick" (Captain Harvey) and the "Vengeur," proved that the Revolutionary navy was still capable of hard fighting though most French officers had been exiled or executed.

Howe was criticized for allowing five ships to escape through his line, and, as Villaret later said, "while your admiral amused himself refitting his prizes, I saved my convoy and I saved my head." But Howe, aged nearly 70, was exhausted after five days and nights without rest, and the British people, depressed by their lack of success on land! forgave the shortcomings of the pursuit in their celebration of the first victory at sea over the navy of Revolutionary France.

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FIRUZABAD, a town of Iran, in the province of Fars, 72 mi. S. of Shiraz, in 28° 51′, at an altitude of 4,180 ft., in a fertile plain. 15 mi. long by 7 mi.. well watered by a river which flows through it from north to south. Pop. (1956) 5,746. The town is surrounded by a mud wall and ditch. The district has 20 villages and produces much wheat, and the rice of Firuzabad is famous. Northwest of the town are the ruins of the ancient city and of a large building, the palace of Ardashir; beyond them, in the gorge through which the stream enters the plain, are two Sassanian bas-reliefs. .The river leaves the plain at its southern end, and according to Persian history it was there that Alexander the Great, when unable to capture the ancient city, built a dyke across the gorge, thus damming up the water of the river, turning the plain into a lake, and submerging the city and villages. The lake remained until the beginning of the third century, when Ardashir, the first Sassanian monarch. drained it by destroying the dyke. He built a new city, calling it Jur or Gur, and made it the capital of one of the five great divisions of Fars. Firuz (or Piruz), one of Ardashir's successors, called the district after himself—Firuzabad—("the abode of Firuz"), but the name of the city remained Gur until Azud-ud-Dowleh (949–982) changed it to its present name. (P. z. C.; X.)

FIRUZABADI: *see* FAIRUZABADI.

FIRUZKUH, a district of Iran. equivalent to a township, with a population of 30,135 (1954 est.). Its chief place is a village of the same name situated in a valley of the Elburz, about 90 mi. E. of Tehran, at an elevation of over 5,000 ft. and in 35° 45' N. and 52° 30' E.

Firuzkuh town has a population of about 2,500. A cliff on the eastern side of the valley is surmounted by the ruins of an ancient fort popularly ascribed to Alexander the Great. It is an important railway station.

FISCAL POLICY: *see* ECONOMIC UNION; FAIR TRADE LAWS; FREE TRADE; IMPERIAL PREFERENCE; PROTECTION; and TARIFFS.

FISCHART, JOHANN (1546?–1590), the greatest German satirist of the 16th century, was born in Strasbourg late in 1546 or early in 1547. He received a good education there and at Worms. Before 1570 he traveled widely, visiting the Netherlands and probably England, and studying in Paris, Strasbourg and Siena, Italy. 4 later period of study in Basel ended with the degree of *doctor iuris* (Aug. 10, 1574), but from 1j70 to 1580 he lived mostly in Strasbourg, working for his brother-in-law Bernhard Jobin, the printer and publisher. In this decade his main literary works appeared. Three years in Speyer as advocate at the *Reiclzskamrnergericht* (imperial court of justice) were followed by appointment in 1583 as magistrate at Forbach, Lorraine. In the same year he married in Worth, Alsace, Anna Elisabeth, daughter of the Alsatian chronicler Bernhard Hertzog. He probably remained at Forbach until his death there, late in 1590. Of his main works, the earliest are attacks on the papacy. Franciscans and Dominicans: *Nacht Rab* (1570); *Der Barfusser Secten und Kuttenstreit* (1j71); and *Von S. Dominici . . . artlichem Leben* (1571), and two of the latest are polemical satires against the Catholic Church and especially the Jesuits: *Bienenkorb des heiligen romischen Immenschwarms* (1579, virtually a translation of a Dutch satire by Philipp Marnix); and the *Jesuitenhiitlein* (1580). Fischart is the principal German literary opponent of the Counter-Reformation. His Protestantism, however, was never rigidly sectarian. Beginning as a Lutheran, he came to defend Calvinist doctrines—the only major German writer to do so. His more general didactic and satirical writings include *Eulenspiegel reimensweis* (1j72), a moralizing version of the Eulenspiegel stories; *Aller Praktik Grossmutter* (1572), a parody of the farfetched prognostications in contemporary almanacs; and *Der Flöhhatz* (1573), where the hunted flea's lament develops into a satire on women. Well-established genres are represented in the comical *Podagrammisch Trostbüchlein* (1577) in praise of gout, and the more serious *Philosophisch Ehezuchtbüchlein* (1578, based on treatises by Plutarch and Erasmus), in praise of marriage.

Fischart's principal work is the *Affentheurliche und Ungeheurliche Geschichtsschrift* (1575)—renamed *Geschichtklitterung* in later editions (1582, 1590)—a free and greatly expanded prose version of Rabelais's *Gargantua*. Perhaps his most attractive work to the modern reader, however, is *Das glückhafft Schiff von Zurich* (1576), one of the most carefully constructed 16th-century narrative poems, commemorating the boatload of Zurich citizens who rowed to Strasbourg and brought a basin of porridge, cooked in Zurich in the morning, still warm to Strasbourg at night.

Fischart was a man of wide learning and experience, and his writings, with their exuberant wit and serious moral purpose, continue—and end—the didactic and satirical tradition of Sebastian Brant and Thomas Murner, combining it with that of Rabelais, and providing a detailed picture of the German culture of his day.

In subject matter, however, they are mostly adaptations of existing literary works, and their construction is often faulty and their versification sometimes rough-and-ready. Fischart's originality lies rather in the profusion of his ideas, his independent development of his subjects and, above all, in his style, especially in prose. With his vast vocabulary — much of it coined by himself — his delight in playing on words and his exuberant and sometimes grotesquely complex syntax, this "German Rabelais," although largely neglected until well into the 18th century, foreshadows at least some aspects of 17th-century style.

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FISCHER, EMIL (1852–1919), German chemist, awarded the Nobel prize for chemistry in 1902 in recognition of his services in connection with his synthetic experiments in the sugar and purine groups of substances, was born at Euskirchen, Rhenish Prussia, on Oct. 9, 1852. He studied at Bonn and at Strasbourg, where he graduated Ph.D. in 1874. He acted as assistant to A. von Raeyer at hfunich for eight years, after which he was appointed to the chair of chemistry successively at Erlangen (1882) and Würzburg (1885). In 1892 he succeeded A. W. von Hofmann as professor of chemistry at Berlin.

Fischer devoted himself entirely to organic chemistry, and his investigations were characterized by an originality of idea and readiness of resource which made him the master of this branch of experimental chemistry. The merit of his researches was recognized by all the important scientific societies in the world. In 1890 he was awarded the Davy medal of the Royal society and elected a foreign member in 1899. Under his control the laboratory at Berlin became one of the most important in existence and attracted to itself a constant stream of brilliant pupils. Fischer died at Wannsee, Berlin, on July 1j, 1919, and is buried there.

In 1875, he published his discovery of the organic derivatives of hydrazine and investigated their relation to the diazo compounds. Fischer's research concerned with compounds related to uric acid was on ground that had been broken, more especially by Baeyer, but almost all our knowledge of the purine group *(see* PURINES) is due to Fischer. In 1881–82 he established the formulas of uric acid, xanthine, caffeine, theobromine and some other compounds of this group.

His greatest work was instituted in 1894, when he commenced his great series of papers, wherein the forgoing compounds were all referred to a nitrogenous base, purine. The base itself was obtained after much difficulty, and an immense series of derivatives were prepared, some of which were patented in view of possible therapeutical applications. These researches were published in a collected form in 1907 with the title *Untersuchungen in der Puringruppe.* When the work on the purine group was progressing satisfactorily he attacked the sugar group. Here again Fischer may be regarded as the prime investigator in this field. His researches may be taken as commencing in 1883; and the results are unparalleled in importance in the history of organic chemistry. The chemical complexity of these carbohydrates, and the difficulty with which they could be got into a manageable form — they generally appeared as sirups — occasioned much experimental difficulty; but these troubles were little in comparison with the complications due to stereochemical relations. However, Fischer synthesized fructose, glucose and a great number of other sugars, and showed how to distinguish the formulas of the 16 stereoisomeric glucoses. The study of the sugars made it necessary to examine the nature, properties and reactions of substances which bring about fermentation. Fischer attacked the problem presented by ferments and enzymes, and although we as yet know little of this complex subject, to Fischer and his co-worker Abderhalden is due the credit of having laid the foundation of enzyme chemistry.

In addition to important research on proteins Fischer also made a number of investigations on the Walden inversion and on gallic acid derivatives of the sugars which were related to the tannins. During World War I he was very active in organizing German chemical resources. He increased the supply of ammonia available from coke ovens, encouraged the synthetic nitric acid industry, suggested camphor substitutes and new sources of glycerine. He was particularly concerned with the problem of conserving the food supply. He was concerned with methods of education, the training of chemists and the establishment of national research institutes. His autobiography *Aus meinen Leben* appeared in 1922.

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FISCHER, ERNST KUNO BERTHOLD (1824–1907), German philosopher, was born at Sandewalde, Silesia, on July 23, 1824. Educated at Leipzig and Halle, he became a *Privatdozent* at Heidelberg in 1850, and in 1856 a professor at Jena. In 1872 he succeeded Zeller at Heidelberg as professor of philosophy and of the history of modern German literature. In philosophy, where his attitude was mainly Hegelian, his part was that of a historian and commentator, his chief production being *Geschichte der neueren Philosophie* (1852–93). Fischer also made valuable contributions to the study of Kant, Spinoza, Schopenhauer, Bacon, Shakespeare, Goethe, Lessing and Schiller.

The Eng. trans. of his numerous works are: *Francis Bacon,* by J. Oxenford (1857); *Life of Benedict Spinoza,* by F. Schmidt (1882); *A Commentary on Kant's Kritik of Pure Reason, by J. P.* Mahaffy (1866); *Descartes and his School,* by *J. P.* Gordy (1887); *A Critique of Kant,* by *W. S.* Hough (1888). *See* also bibliography in Baldwin's *Dict. of Philosophy and Psychology* (1905).

FISCHER, HANS (1881–1945), German biochemist, best known for his researches on haemin and chlorophyll, was born in Hochst, July 27, 1881. He received his doctorate in chemistry from Marburg in 1904 and in medicine from Munich in 1908. After some years of medical work he took up chemical research in Berlin under Emil Fischer. In 1916 he became professor of medical chemistry at Innsbruck; in 1918 went to Vienna; and in 1921 returned to Munich as professor of organic chemistry and director of the Institute for Organic Chemistry of the technical high school. He died in Munich on March 31, 1945.

He was awarded the 1930 Nobel prize for chemistry for his researches into the constitution of haemin and chlorophyll, especially for his synthesis of haemin. Haemin is a crystalline product of haemoglobin. By splitting in half the molecule of bilirubin, the related bile pigment, Fischer obtained a new acid in which a section of the haemin molecule was still intact. Its structure was identified and found to be related to pyrrole. This made possible the artificial synthesis of haemin from simpler organic materials of which the structure was known. Fischer also showed that there is a close relationship between haemin and chlorophyll, and when he died had nearly completed the synthesis of chlorophyll. He also studied the yellow pigment carotene, which is a precursor of vitamin A, and the porphyrins, iron-free derivatives of haemin widely distributed in nature and secreted by man in certain diseases. (W. J. BP.)

FISCHER, THEOBALD (1846-I~IO), German geographer who gave the concept of the "Mediterranean region" to geography, was born at Kirchsteitz, Thuringia, on Oct. 31, 1846. Having been educated at the universities of Heidelberg and Halle, he pursued his geographical studies in many parts of Europe, and more especially in the Mediterranean lands including the Atlas mountain region of north Africa.

Fischer's thesis for the rank of *Privatdozent* in the University of Bonn (1877) mas entitled *Beiträge zur physischen Geographie der Mittelmeerländer . . .* His most important publications are a collection of *Mittelmeerbilder* (1906) and his work on the Mediterranean peninsulas of Europe in A. Kirchhoff's *Allgemeine . . . Länderkunde,* a masterpiece of methodology which much influenced future geographical studies. He held professorships of geography at Kiel (1879–83) and at Marburg from 1883 until his death on Sept. 17, 1910. (H. G. KG.)

FISCHER VON ERLACH, JOHANN BERNHARD

(1656–1723), Austrian baroque architect most noted for his work in Vienna, was born at Graz. July 20. 1656, and died in Vienna. April 5. 1723. While studying sculpture in Rome. he came under the influence of Francesco Borromini and turned to architecture. Returning to Austria about 1683, he was shon employed by the archbishop of Salzburg to design the grand entrance to the archepiscopal court stables. Then followed four important churches in Salzburg. including the large Kollegienkirche (1694–1707). He began rebuilding the great imperial palace of Schonbrunn about 1700, and erected the fine Clam-Gallas palace. Prague, in 1707. His largest work in Vienna is the magnificent Karlskirche (1715–37). Other buildings there were the Trautson palace (1710–12), the Schonborn palace (1700), the palace of Prince Eugen (1695–9;. enlarged 1707–10), afterward the ministry of finance, the Schwarzenberg palace (1696–172j) and work in the Hofburg (imperial palace) begun c. 1j22.

Many of his later buildings were completed by his son Joseph Emanuel (1693–1742). (M. S. B.; X.)

FISH, HAMILTON (1808–1893), U.S. statesman. was born in New Tork city Aug. 3. 1808. His father was a Revolutionary veteran and friend of George Washington, his mother a descendant of Peter Stuyvesant. Graduating from Columbia college. New York city, in 1827, he was admitted to the bar three years later but soon turned to politics. After service in congress (1843–45), he was elected governor of New York on the Whig ticket in 1848. Six years in the U.S. senate followed (1851–57). A moderate antislavery advocate. he opposed the Kansas-Nebraska bill. but resisted the merger of the northern Whigs in the new Republican party until 1S56, when he supported John Charles Frémont on the Republican platform. In the crisis of 1861 he laboured till the last for peace; in May, however, he became chairman of the powerful Union defense committee of New York, which did an indispensable work 1861–62 in raising money. organizing regiments, buying arms and providing home relief.

Fish's real career opened in ?*larch1869 when Pres. U. S. Grant appointed him secretary of state. For the next eight years he not only dealt with critical foreign issues but gave Grant sagacious counsel on many questions, lent the administration dignity and moderation, opposed corrupt elements within it and made his influence for decency and efficiency felt throughout Washington. On several occasions his threat to resign vanquished his enemies.

His chief diplomatic achievements were the settlement of dangerous difficulties with Great Britain and the preservation of peace with Spain despite troubles in Cuba. By skilful co-operation with Sir John Rose in Canada and Lord Granville in England, he brought about a conference which drafted the treaty of Washington (1871) for the settlement of the so-called "Alabama" claims (arising from the Civil War depredations of the British-built cruiser of that name) and the U.S.-Canadian boundary in Strait of San Juan de Fuca by arbitration. The ensuing Geneva tribunal awarded the United States $15,500,000 for the Alabama claims (*see* "ALABAMA" ARBITRATION). Simultaneously. Secretary Fish had to conduct a stirring battle with powerful groups who wished the U.S. to intervene between Cuban rebels and the Spanish government. When in 1873 hotheaded Spanish authorities seized the ship "Virginius" on the high seas and shot 53 Americans and Britons as filibusters, all of Fish's sagacity and patience were needed to maintain peace. He obtained the restoration of the "Virginius" with Spanish apologies and indemnities.

In an era of shockingly low political standards and much dishonesty among officials, Fish headed a group in the cabinet which worked to keep Grant vigilant against trickery and graft, to restrain him from improper appointments and to prevent gross infringements of civil liberties in the reconstruction of the south. Fish insisted that a corrupt secretary of war be punished, and he played a major part in forcing Grant to get rid of a private secretary, Orville E. Babcock. implicated in the Whiskey Ring scandal. Meanwhile Fish dealt effectively with the Canadian fisheries question, Mexican affairs and other problems. Particularly notable was his work in helping save Grant from the worst consequences of an ill-advised and abortive attempt to annex Santo Domingo.

Returning to private life in 1877, Fish devoted his remaining years to a variety of public-spirited activities, giving special attention to his work as head of the trustees of Columbiauniversity. (A N)

FISH, that class of vertebrate animals which lives exclusively in water, breathes through gills, and whose limbs take the form of fins (see FISHES and FISH CULTURE). The article FISHERIES deals with the subject from the economic point of view, and FISHING with the sport of fishing. The constellation and sign of the zodiac known as "the fishes" is treated under PISCES.

The fish was a symbol of Christ in primitive and mediaeval Christian art. The origin is to be found in the initial letters of the names and titles of Jesus in Greek, Jesus Christ, Son of God, Saviour, which spell the Greek word for "fish," ἰχθύς.

FISH AND WILDLIFE SERVICE. The U.S. fish and wildlife service was organized as one of the major bureaus of the department of the interior on June 30. 1940. It combined the bureau of biological survey, which had been transferred from the department of agriculture. and the bureau of fisheries, transferred from the department of commerce the previous year (July 1, 1939). By this reorganization, the principal work of the federal government on fish and wildlife problems was concentrated in one agency. The service has perhaps as many and as varied functions as any other organization of equal size in the federal establishment. The three major categories in which the activities of the service may be divided are service, research and management. Both of the bureaus from nhich it was formed were established as research agencies but, as the years passed. were charged by law with administrative and service activities.

The biological survey was originally established to study the relationship of birds and later of mammals to agriculture. It was largely a research agency dealing with problems created by wildlife as the agricultural development of the country progressed. It was founded in 188j and carried on research activities until 1900, when enactment of the Lacey act, which partially controlled importations and interstate commerce in wildlife, defined its first regulatory work. The bureau of fisheries was established in 1871 as the United States fish commission to study. the fisheries and to devise'means for increasing and maintaining production from this natural resource. It was given bureau status in 1903 in the newly organized department of commerce and labour; when that department was divided into separate commerce and labour departments, the bureau of fisheries remained in commerce until transferred to the department of the interior.

Administrative Staff Services — Under a recent reorganization program the director and two assistant directors were made responsible for the over-all administration and general policies of the fish and wildlife service, one assistant director handling all wildlife work, another fisheries. Routine administrative and technical staff services were concentrated in the director's office under two assistants to the director, and the solicitor and information officer were also attached directly to the director's office. The solicitor handles all legal work for the service, while the information officer informs the public of the results of investigations and research. An editorial office assumed responsibility for editing all technical bulletins and other official publications and the dissemination of the regulations on migratory waterfowl and Alaska fisheries, which are recommended and enforced by the service. It is also responsible for the mailing and distribution of numerous bulletins and leaflets, including popular rewrites of the technical work, designed to give the public usable information in simple language. One series, the "Conservation Bulletins." is distributed both by the service and by the congressional delegations in a manner similar to that used for "Farmers' Bulletins" of the department of agriculture. This office also assembles photographs and motion pictures for service use.

Supervision of the administrative staff services, which include the usual functions of budget and management, personnel, finance and procurement, and a section for handling foreign aid work under the various federal aid programs, was assumed by one assistant to the director; the other administrative assistant in charge of technical staff services became supervisor of river basin studies, federal aid work, lands and engineering.

Technical Staff Services.—River Basin Studies.—The primary responsibility of the office of river basin studies is to determine the effects of proposed federal and other impoundments and diversions of water on wildlife and fishery values and to recommend means for minimizing the damage that occurs when such proposed projects are actually constructed. It of necessity works closely with the corps of engineers and the bureau of reclamation in studying their various proposed programs.

Federal Aid.—Responsibility for administering the Pittman-Robertson and the Dingell-Johnson acts was delegated to the branch of federal aid. Funds to carry out the purposes of the act were derived from the 11% excise tax on sporting firearms and ammunition and a similar 10% tax on sport fishing equipment. These funds were set aside in the federal treasury for wildlife and fisheries work. The congress in the 1950s appropriated the full amount of the preceding year's receipts for distribution to the states. These acts provided that funds should be distributed to the states partly on the basis of the percentage which the area of each bore to the total land or water area of the United States and partly on the ratio which the number of hunting and fishing licence holders in each state bore to the total in the United States. There were minor differences in the two acts, but the basic philosophy remained the same. These two factors operate to equalize the distribution of funds between the smaller and more heavily populated states where the licence sales are high and the larger and more thinly populated states where licence sales are low.

After the allocation was made, the states were allowed two years in which to use the funds, which had to go for purposes outlined in each act. The federal aid branch of the fish and wildlife service thus was made a checking agency. The states originate the projects and submit them for approval. If they are approved as complying with the terms of the lam, the states proceed with them, subject to periodic inspection by representatives of the division. The states were entitled to a reimbursement of 75% of the costs of work satisfactorily performed on approved projects. On such projects they submit claims, either from time to time as the work progresses or in one account when it is completed. Thus the federal government paid 75% of the costs of these projects and the states contributed 25% from their iunds. Another provision of the acts was that a state which diverted money received from hunting or fishing licences to expenditures other than those of its consen-ation department would be ineligible to participate in the distribution of the fund. Each state also was required to pass specific enabling legislation accepting the terms of the acts before it could participate. All states complied with these provisions and were receiving funds from these sources in the 1950s.

Lands.—The branch of lands was assigned the task of acquiring all lands needed by the service. It appraises and buys lands for refuges, fish hatcheries and other purposes authorized by law. It also appraises lands which the states propose to acquire under the federal aid program administered by the service.

Engineering.—The branch of engineering prepares specifications for structures of the types used by the service, handles all of the cadastral surveying work and carries on all the normal functions of an engineering service for the operating branches.

Regional Offices.—In addition to the services of the administrative staff and the technical staff, six regional offices were established to administer the housekeeping functions of the service at Boston, Mass.; Atlanta, Ga.; Minneapolis, Minn.; Albuquerque, N.M.; Portland, Ore.; and Juneau, Alsk. Control was maintained in the central office where over-all policies and procedures were prescribed in accordance with laws and regulations. The regional offices, however, were permitted considerable discretion within these broad, general policies.

WILDLIFE

Wildlife Research.--Migratory Waterfowl.—The branch of wildlife research carries on the major studies of terrestrial wildlife that are performed by the federal government. This unit made extensive studies of wintering populations of migratory waterfowl and of their migrations and distribution on the major breeding grounds. These studies developed the methods used in determining trends in the populations.

In connection with these studies of migratory birds, a banding program with about 1,800 voluntary bird banders was carried on. From these banding studies it proved possible to work out the migration routes and wintering grounds for specific populations which breed in given areas. Out of this work came the understanding that the migratory waterfowl of North America moved in four rather well-defined flyways, a flyway being the composite of routes followed between the breeding and wintering areas.

Relation of Food Habits to *Agriculture and* Forestry.—The branch of wildlife research studies also the food habits of birds and mammals in relation to agriculture and forestry. Many problems in wildlife management are created by the development of new types of agriculture and the introduction of new crops which invite damage by species previously not harmful. Likewise, the cutting of commercially valuable timber and its replacement by other growth often bring changes in the wildlife populations which affect the forest for good or bad. These general studies of the relationship of wild things to agriculture and forests are carried on in many projects, some of significance in limited areas, others of nation-wide import. Taxonomic and distributional studies of birds and mammals are carried on both in the laboratories and in the field.

Ecology.—A third group of studies of growing importance pertains to the relationships of various species of wildlife to each other and to their environment. This research is aimed at setting the pattern for wildlife management on federal refuges and other areas. Studies are conducted to determine the procedures necessary to develop the kind of environment most productive of the beneficial forms of wildlife. Methods are devised and tested for establishing desirable vegetation and for the suppression or eradication of harmful kinds. The main laboratories for carrying out these studies are on the Patuxent research refuge, near Laurel, Md., and at Denver, Colo. Smaller laboratories were established on the Wichita Mountains wildlife refuge. Oklahoma. and the Bear River migratory bird refuge, Utah. In addition, numerous refuges were equipped with laboratory facilities sufficient to permit field investigations to be carried on as required.

Co-operative *Wildlife Research* Units.—These units, financed jointly by the fish and wildlife service, the Wildlife Management institute, the state game and conservation departments and state agricultural colleges, iunction in a number of states and Alaska. Personnel of these units study wildlife management problems of local and regional significance and train men to continue these investigations or to enter wildlife managerial work. The studies carried on by these units and by the laboratories maintained by the service are integrated so that the resulting information is correlated where possible on a nation-wide basis.

Diseases of *Wildlife*.—Another major subject of research is the diseases of wildlife and, where possible, their control. For example, the cause of western duck sickness was determined to be a botulinus organism, type C. As soon as that fact was known, the investigation was directed toward the discovery of means of prevention or at least of minimizing the outbreaks, which killed many hundreds of thousands of valuable waterfowl. Methods of controlling vegetation and water levels or of dispersing the poisonous toxins were developed and effectively applied in considerable areas. Of special interest in the subject matter of this division are the diseases affecting wildlife which are also transmissible to man.

Control of Destructive *Wildlife*.—Another type of service concerns methods of controlling mammals or birds which become so destructive to agricultural or other interests that their numbers must be reduced. This work was centred at Denver. Satisfactory progress was made in rendering control methods more specific for the animals which it was necessary to control, and to reduce the danger of accidentally killing other forms of life. The studies undertaken at Denver involved primarily the development of repellents, the perfecting of frightening devices, and the contriving of more effective and selective methods of killing. Repellent sprays or dips were developed which proved useful in safeguarding forest tree seedlings, at least for a time. Mechanical devices also were made which protect seed spots and trees and other vegetation irom certain types of rodents. Frightening agents of various types, including streamers to keep small birds from truck fields, automatic flash guns and flashlights or combinations of these have been worked out and applied successfully to many areas where birds were the destructive agency. A method of holding down the number of certain types of predatory birds was devised which, by reducing the reproduction, successfully limited colonies of herring and black-backed gulls and cormorants.

Fur *Resources*.—The problems of production, conservation, restoration and utilization of the fur resources of the United States also are studied. The general lines of investigation relate to methods and seasons of trapping, preparation and marketing of skins, and the variability of fur qualities.

Public Lands.—Still another function—partly research and partly service—of the branch of wildlife research is the study of wildlife problems and the development of wildlife programs on public lands. Most of the calls for assistance come from the bureau of Indian affairs, the national park service: the forest service and the bureau of land management. A small group of experienced biologists attempt to furnish adequate information on which sound administrative programs can be developed.

An important problem relates to the joint use of grazing and forest lands by big game and livestock. This affects tracts, chiefly in the west: which comprise nearly 15% of the total land area of the continental United States. The kinds and amounis of grasses, browse and other forage used by game animals are determined as guides to the carrying capacities of different types of range. The effect of rabbits, gophers and other rodents on range production is investigated, as are also means of controlling undesirable animals. Important also, from an economic standpoint, is the relation of predatory animals—chiefly coyotes! wolves, bears. pumas and wildcats—to livestock and game. In the Rocky mountain region the dual role of bears as predator and game animals is studied. Results from these investigation are quickly put into practical use by the various agencies that administer public lands.

Game Management.—The branch of game management is charged with looking after the welfare of all birds protected by the treaties with Great Britain (for Canada) and with Mexico, and with the enforcement of the Alaska game laws and such federal conservation acts as apply nationally. The most important of these, in addition to the Migratory Bird Treaty act. are the Lacey act, the Migratory Bird Hunting Stamp act, the Bald Eagle act and the Black Bass act. The treaty with Great Britain, signed in 1916, applying to species which migrate between Canada and the United States, provided that all migratory game birds. including the waterfowl. cranes, rails: gallinules. shore birds. doves and pigeons, were to be protected between March 10 and September 1, and migratory insectivorous birds. as well as other migratory nongame birds, at all times. The Mexican treaty, ratified in 1937, not only provided the same protection as the treaty with Great Britain but extended it to families of birds not included in the earlier convention and also contained provisions for control of the transportation of game mammals across the international boundary.

These two treaties provided the backbone of the program of protection of the migratory birds which inhabit two or more of the three countries at some time of the year. The Migratory Bird Treaty act, which implemented both treaties: closed the season on all birds protected by either treaty. The regulations promulgated thereunder established the open seasons and bag limits. The act also charged the secretary of the interior with making certain investigations into the abundance. distribution and migration of these birds, in relation to the zones of temperature and other conditions. If, after making these investigations, it appeared that there were enough of the game species to permit an open season, the secretary was authorized to open it for as long a period as he deemed wise, but not exceeding 3½ months.

This branch was charged with the responsibility of enforcing these regulations and also with looking after the welfare of the birds during the closed seasons. This involves such diversified activities as breaking up marketing and trafficking in birds, seeing that feed is provided where extraordinary conditions have reduced the natural supply, checking reports of damage to crops by migratory birds and applying corrective measures where necessary. As a part of its game-management work this branch conducts extensive surveys of wintering and breeding-ground populations. This information is developed by a wide co-operative program with the Canadian wildlife service and provincial game authorities, the states and with numerous private organizations and individuals. This information is used as a basis for regulating the length of the hunting seasons and for considering changes in other regulations.

The branch of game management issues permits to propagate wild waterfowl for food and restocking, to collect migratory birds for scientific purposes, to import foreign wild birds and animals into the United States. and to control migratory birds destructive to crops and other property.

The Lacey act passed in 1900, provided the first law-enforcement tasks for the biological survey, one of the predecessors of the fish and wildlife service. The act, in brief. and as amended, regulated the importation of wild animals and made it a federal offense to ship game or fur animals or parts thereof, illegally taken, possessed, sold or shipped in one state out of that state and into another. This act proved of tremendous assistance in breaking up market hunting, as well as in running down groups and individuals engaged in illegal traffic in furs. It was particularly useful in checking contraband trade in beavers and to a certain extent that in other furbearers.

The Alaska Game law, passed in 1925, created an Alaska game commission, the executive officer of which was the principal representative of the service in Alaska. It provided for commissioners from the four judicial districts in Alaska to sit with the service representative and to recommend to the secretary such regulations as might be necessary to protect the game and fur resources of the territory. Certain game fishes were added when the act was amended in 1943.

The Migratory Waterfowl Hunting Stamp act, popularly known as the Duck stamp act, passed in 1934, as amended. provided that everyone over 16 years of age who hunted migratory waterfowl must have a stamp costing $2 00. These are sold through the post office and the funds received are made available to the service. Fifteen per cent of these funds might be allowed for administration to cover the actual cost of printing and distributing the stamps and for enforcement of the act. Under the law, not less than 85% of the funds had to be used for the acquisition and maintenance of a system of refuges for waterfowl. The law was of material help in developing the great refuge system for the waterfowl population as it travels the flyways.

The Bald Eagle act, passed in 1940, protected the bald or American eagle, the U.S. national emblem, and charged the service with the enforcement of the act.

Wildlife Refuges.—This branch administers the national systetn of nildlife refuges. In 1954 there were 272 refuges embracing an aggregate of 17,409,968 ac.

The refuge program dates back to 1903, when Pres. Theodore Roosevelt, by executive order, designated Pelican Island on the east coast of Florida as a national wildlife refuge for the purpose of protecting breeding colonies of brown pelicans and assigned it to the bureau of biological survey for administration. There was no money for instituting a patrol, and protection was furnished for several years by the National Audubon society.

From this small beginning, the refuge system grew slowly as the result of various congressional acts. Four refuges were established by special legislation: the National Bison range. Montana, 1908, the Elk refuge Wyoming, 1912; the Cpper Mississippi River wildlife and fish refuge, Iowa, Illinois, Minnesota and Wisconsin, 1924; and the Bear River migratory bird refuge, Utah, 1928. An additional reservation, the Wichita Mountains wildlife refuge, Oklahoma, was established as a result of a special act of Jan. 24. 1905, permitting the president to set up forest preserves and game refuges. It was maintained by the forest service until 1935, when it was transferred to the fish and nildhfe service as a part of the national refuge system.

The American Bison society became alarmed at the serious threat of the extermination of the American bison or buffalo, and in 1907 inaugurated a campaign for the establishment of several government herds of these animals at widely separated points to assure the perpetuation of the species. The Wichita refuge herd was the first one established, to be followed later by those on the National bison range in Montana and the Niobrara refuge in Nebraska. Another special refuge is the National elk refuge at Jackson Hole! Wyo., for the winter care of the southern Yellowstone elk herd.

Various other refuges were established on public lands. many of them consisting only of small islands frequented by colonies of sea birds. The modern refuge system maintained by the service is based on the Norbeck-Andresen act, passed Feb. 18. 1929, commonly called the Migratory Bird Conservation act, which authorized the establishment of a nation-wide system of inviolate refuges and appropriation of funds for their acquisition and maintenance. Refuges were classified in four general groups: special-purpose refuges, largely for colonial nongame birds; big-game refuges; migratory waterfowl refuges; and general wildlife refuges.

Special-purpose refuges are usually created for the protection of a single colony or group of colonies of birds or mammals. They may also be for the protection of a single species. These refuges are mostly small and are usually composed of small islands, either in fresh-water lakes or along the coast. The principal types of birds for which these refuges furnish protection are herons, ibises, pelicans, gulls, terns, skimmers, auklets, murrelets, puffins, murres, shearwaters, fulmars. petrels and cormorants, although incidentally they may protect equally interesting associated species.

The big-game refuges and game refuges are for the primary purpose of protecting herds of big-game animals. Bison, antelope. mountain sheep and elk are the principal species on these refuges but deer and many other mammals are found on one or more.

Migratory waterfowl refuges provide breeding, feeding and nesting grounds for the birds as they pass through or reside within this country. Breeding ground refuges are developed and maintained in the northern states to furnish suitable nesting and feeding grounds to care for the young birds until they are on the wing. These refuges also produce food for transient birds in the fall and spring migrations. Wintering refuges are equally necessary to provide an adequate supply of food for waterfo l during the approximate half of the year when they are away from the breeding grounds. Refuges are provided also along the major migration lines as an aid in safeguarding the birds during their entire life cycle. In addition, there is considerable waterfowl usage of other types of refuges.

General wildlife refuges are comparatively few in number and have been set aside usually to protect areas that are especially significant for the combination of wildlife forms found there. Most important is the Aleutian Islands refuge which protects many varieties of sea birds, arctic foxes and the only remaining large colonies of the sea otter.

Predator and Rodent Control. — This branch carries on such predator and rodent control as may be necessary upon federal lands. In early days of the work, operations were entirely in the western United States, where there is a large percentage of the public domain. The enactment of additional laws and the development of new problems spread the activities of the branch into nearly every state in the union, although most of the operations continued to be carried on in the western range states and in Texas, Oklahoma, Arkansas, Missouri, Nebraska and the Dakotas.

Among the wildlife forms that have become most destructive are various species of rodents and certain predatory forms. The major rodent problems, aside from those occasioned by the introduced house rats and mice, developed in the western states, where green-vegetable and orchard farming and the growing of alfalfa and grains increased greatly the food supplies available to rodents.

As most of the farming in the west is in small areas surrounded by comparatively large acreages of public domain. the federal government was early called upon to co-operate in controlling the numbers of destructive animals. Ground squirrels, prairie dogs, pocket gophers and jack rabbits, in general, do most of the damage. although locally others may be of considerable importance. All these species are the objects of control projects carried on by state and local agencies in co-operation with the fish and wildlife service.

Various methods are used to reduce the numbers of the destructive forms and to hold them to levels at which the damage is not too great. Such control projects tend to develop and recede more or less in proportion to the abundance of rodents. Some species, especially rabbits, hares and field mice, exhibit cyclic phenomena, their populations tending to go up and down at comparatively regular intervals. Their numbers also respond locally to weather conditions. For example. ground squirrels and pocket gophers often are more successful in rearing a large percentage of their young during dry, warm springs than they are if the weather is cold and wet. As most control projects are designed merely to hold down the populations of species to the point where damage is nominal, once that point is reached, there tends to be relaxation of effort and the animals again increase to the point where damage becomes severe.

In addition to these western problems, there are numerous infestations of destructive mammals, which though smaller in geographical extent are equally important to the agriculturalists concerned. Most important are those of pine and meadow mice which girdle and destroy fruit trees in the orchard sections. Particularly intensive problems in this respect have developed in certain parts of New England, New York state, and the Shenandoah valley of Virginia.

The relationship of wild mammals to human disease became of increasing importance. Rodents of various types are carriers of diseases which can be transmitted to humans by ticks. fleas and other insects. Among such diseases the most serious are Rocky Mountain spotted fever, transmitted by ticks, and bubonic plague. by fleas. So far as was known by the 1950s, spotted fever is endemic among native rodents, and while it first came to attention in the Bitter Root valley of Montana, it was known to be carried by rodents in numerous localities in the west and also in some eastern areas. Bubonic plague was discovered among native rodents in California where for many years it seemed confined to coastal cities from San Francisco to Los Angeles, but later it was found among rodent populations in every western state. This spread fortunately was not accompanied by transmission of the disease to humans on an extensive scale, but there were a number of minor outbreaks. The situation, however, furnished an additional strong incentive for drastic control of the plague-carrying animals.

The predatory animal against which most effort is directed is the coyote; much attention is also given to the control of wildcats, mountain lions, wolves and bears. Since bears are regarded as game animals, the service limited its operations to taking individuals known to be stock killers or operated less selectively in areas where losses caused by bears were excessive.

These control operations are carried on in co-operation with many states and local agencies, which put approximately twice as much money into the predator programs as the federal government. Vast areas of public land in the western states furnish a breeding ground for these animals, and the federal government assists in holding don-n their numbers in areas where they occasion economic loss. The principal damage is to sheep and poultry, particularly in localities where they are raised in great numbers. In some localities losses of calves also are serious. There are also areas where predations on deer or other game stocks become so severe as to call for predator control.

Methods used include trapping, den hunting and destruction of the young. shooting and poisoning, the last being used under very rigid restrictions both as to locality and the types of poison. The work was successful in holding down the number of predators to a level where losses were considerably reduced.

FISHERIES

Fisheries Research. — The branch of fisheries research concerns itself with the Life history, habits and interrelationships of fish populations. It devotes a major part of its effort to studying the effect of commercial fishing on these populations and to acquiring adequate knowledge of interrelationships of various species of fish to each other, to other animal life and to the environment. This knowledge is necessary to provide a basis for adequate and intelligent management of this important natural resource. The fish and wildlife service has among its other duties the administration of the commercial fisheries of Alaska. Their chief value is in the salmon industry, and this division devotes a considerable proportion of its time to assembling information on the movements of the salmon, their spawning success and various other factors upon which are based to a large degree the regulations governing the Alaska fishery. The branch established at Little Port Walter a laboratory devoted entirely to work on the pink salmon. Similar but less extensive studies on red salmon were carried out at Karluk on Kodiak Island and at Brooks lake on the Alaska peninsula. These surveys furnish indexes for more accurate regulation of the fishery, both in the interests of maintaining an adequate spawning stock and in permitting the greatest practicable utilization of the runs.

Within the rest of the United States, the fish and wildlife service was given no regulatory control of fisheries, but from time to time congress awarded it special appropriations for studies of important fisheries. Extensive investigations into the Sew England ground fisheries, the most important single source of fresh and frozen fish in the country, also were carried on. Particular attention was paid to the cod and haddock, which are the historical basis of these fisheries and supply an enormous tonnage of fish. Special studies of oysters, crabs and other shellfish have also been conducted on both coasts. Oyster farming developed to a considerable extent, and with it arose many problems. Laboratories for studies of these problems were maintained at Milford, Conn.; Beaufort. N.C.; and Pensacola, Fla. Investigations of crabs were largely confined to Chesapeake bay, the source of most of the crabs on eastern markets. Investigators endeavoured to determine the reason for a decline in the production and to devise practical remedies for bringing the industry back to its former level. Studies on the Great Lakes were largely centred in the 1950s around the sea lamprey and methods for controlling its numbers. As a result of these studies, a joint control project by the United States and Canada was undertaken.

Angling. — The branch concerns itself also with problems involving sport fishing, a great source of recreation in streams, lakes and coastal waters. These studies revolve around three general problems, of which the most important undoubtedly is pollution. They seek to determine the types of pollution that are most destructive to fish life and what can be done to control them. It has been learned that certain pollutants which are dangerous to public health are not destructive to fish life, and, conversely, some which are not objectionable in relation to public health are great menaces to fish and other aquatic life.

The second most important subject of study in relation to angling is that of stream and lake management and improvement. There has been growing appreciation of the fact that waters can be rendered unproductive from many causes, just as land can be made unproductive, and that they are equally susceptible to improvement. The devices which have been used in stream management have been dams or partial dams, deflectors and other devices to create good spawning areas or good living conditions for the fish, or to remedy some of the ill effects of silting, stream channellization, construction of dams and other human interference with the stream. Improvement devices are not used so widely in natural lakes, but artificial impoundments and reservoirs can often be made more productive of fish life.

The third general subject with which this division concerns itself in dealing with sport fishing is the improvement of feeding and handling of fish in hatcheries and studies of diseases and parasites which often become more prevalent in hatcheries than under natural conditions.

Commercial Fisheries. — The branch of commercial fisheries also is largely a research and information collecting agency with no regulatory authority. An important part of its efforts was devoted to improving methods of canning or otherwise preserving fish and fishery products. Included in this work are studies to develop new medicinal, industrial and edible products from fishery resources. This division has been active in developing methods of extracting and testing vitamin-A oils and in finding new sources of this vitamin. It also is interested in developing industrial products from fishery wastes: having, for example, devoted much effort to devising economic and practical methods of utilizing wastes in the salmon-canning industry. It perfected canning processes and other preserving methods which make it possible to use fishes of kinds not previously marketable, thus opening new sources of food for the public. The division devotes considerable time to improving the methods of handling and transporting fish. Fish is a highly perishable product: and the chief drawback to its greater utilization, particularly inland, has been the poor condition in which it often reaches the consumer. Proper methods for packaging. preserving and handling the fish were thus studied by the branch.

Another general type of investigation by this branch relates to the improvement of fishing gear, vessels and methods. Efforts were directed toward the development of types of vessels for employment in the shrimp fishery and conversion for off-season use in some other food fishery or in the menhaden industry.

It operates several boats for finding and marking out new fishing waters. This work proved successful in extending commercial fishery operations into a number of new areas.

Studies also are made of the economic factors that affect the fisheries, including the processing and sale of fishery products. These include cost of transportation and of handling; competition with other foodstuffs; relative prices of fishery and other products; and numerous other factors directly affecting the welfare and productivity of the fishery industries. Means are also sought to develop and increase markets for domestic fishery products.

In connection with these studies. the division maintains a statistical section and conducts a fishery market news service which reports the daily landings. movements and sales of fish at many of the more important ports. The statistical section assembles and distributes information on the annual catch of fish and its value, employment. in the industry, gear and vessels operated and the volume and value of manufactured products. The fishery market news reports and the statistical data are widely used by the industry in day-to-day operations. They also furnish material which federal and state research units find essential for carrying on their programs.

Game Fish and Hatcheries. — This branch operated 92 fish hatcheries in the mid-1950s scattered throughout the United States. Hatcheries for trout and bass and other warm-water fishes are operated particularly for the purpose of stocking sport-fishing waters with game fish. In planting fish produced by these hatcheries, preference is given to stocking waters on federally owned land—a direct responsibility of the federal government. For this reason, priority was given to streams and lakes on national forests, national parks, wildlife reiuges and other public lands. In states having fish hatcheries in addition to the federal ones. co-operative arrangements are made so that the cost of hauling and liberating fish is reduced to a minimum, and hatcheries supply waters closest to them whether or not on federally owned land. In this way maximum results are obtained from both federal and state operations.

For trout propagation, a copious supply of cool water is essential; consequently, most of the trout hatcheries are located where spring or mountain-stream water of the right temperature and quantity is available. The original system of planting newly hatched fry was later largely replaced by a program of planting larger fish. In many instances best returns are obtained by planting trout 6 to 8 in. or more in length. This has been particularly true in the eastern states and in waters close to heavily populated centres where it is possible to grow enough fish to meet the fishing demand and where pollution or siltation of spawning beds may prevent natural reproduction, but where neither oi these detriments have progressed to the point where large trout cannot survive.

Warm-water fish hatcheries produce larger quantities of bass, bream, crappies and a smaller number of other types of fishes. These are planted in streams and lakes where water temperatures and food conditions are not suitable for trout. Much of the output has gone into ponds and lakes which have been impounded as a result of the activities of the soil conservation service and other agencies interested in developing a proper system of water control on stream headwaters. As a result of these operations, there arc now many thousands of such ponds affording good fishing to people in their localities. It is also a regular practice to stock impounded waters on wildlife refuges with the types of fishes most suitable to them.

Increasing attention is given to the productive capacity of the streams and lakes to be planted. Many states, and as far as possible the iederal service, conducted stream and lake surveys to learn the fish-food-producing capacity of those waters and consequently their carrying capacities for fish liie. It is now generally understood that any body of water in a certain stage of development can produce only so many pounds of fish. The maximum may be produced either as a great number of small individuals or as a much smaller number of large ones. Before this was generally known, many waters were overstocked rather than understocked, particularly with warm-water fishes

There are a number of federal hatcheries producing fish for commercial exploitation, the most important of which are the salmon hatcheries of the Pacific coast. The development of hydroelectric power and irrigation on such rivers as the Columbia and Sacramento created tremendous problems for those interested in maintaining the salmon runs. Development of Bonneville dam in Oregon and Grand Coulee dam in Washington, as well as other projected dams, threatened to destroy a large part of the Columbia river run. After careful studies, ladders were installed in Bonneville dam and successfully operated in getting the fish over the dam on the upstream migration. The Grand Coulee dam was so high that it seemed impracticable to build fish ladders, over it, and an alternate scheme oi taking care of a part of the run that iormerly spawned in the Columbia and its tributaries above this dam was developed.

The salmon that came to the Rock Island dam, a private dam some distance below Grand Coulee, were trapped and taken to hatcheries which were built by the reclamation service for this use, where they were spawned and the fish hatched and planted in streams which formerly had no salmon runs. Part of the adults were planted directly in streams to spawn naturally and held there by means of weirs which prevented them from going downstream and again seeking the old spawning grounds.

The continued development of dams on the Columbia led to the inauguration of an intensive program of developing the salmon runs in the tributaries below Bonneville dam. This was an effort to maintain the salmon runs in the lower Columbia to offset the adverse effect oi more dams above that point.

A shad hatchery on the Potomac river just below Washington, D.C., successiully hatched shad and released them. There was great difficulty, however, in determining the success of this operation because the young shad are so delicate that they can neither be handled nor marked as is usually done with salmon, trout and other species.

Another interesting development has been the effort to hatch and artificially rear young lobsters. These are free-swimming and surface-moving animals during the first four stages of their life, and at this time the greatest mortality among them occurs. The first attempts to raise young lobsters in captivity were not successful because some immediately proceeded to eat their fellows. Later they were handled more successfully by placing them in circular tanks in which strong jets of water run continually, keeping the young lobsters on the move and preventing them irom coming into close contact with each other.

Alaska Fisheries.—The branch of Alaska fisheries was charged with two primary assignments—the administration of the law which controls the commercial fisheries in Alaska, and the protection, care and handling of the fur seal herd on the Pribilof Islands. The service was made responsible for recommending regulations which will maintain the productivity of the fisheries. Careiul check is maintained upon the catch, both by personnel of the Alaska division and the division of fishery biology. Observations are made on the spawning escapement and the success of spawning of the various runs of fish.

The making of intelligent and effective regulations is greatly complicated by the fact that five species of salmon are involved, having liie cycles varying from two to five years. Since all of these fishes leave the sea to spawn and then die, the'adjustment of the take to the probable return of each kind to iresh water is difficult.

The fish and wildlife service also eniorces the Alaska fisheries regulations, for which purpose it maintains a fleet of boats and planes for the use of patrol officers. Fisheries are the greatest single resource of the territory, the salmon fishery alone yielding products of an average annual manufactured value for the five-year period ending in 1953 of more than $80,000,000, and producing more than half the income of the territorial government. Other fisheries, however, were growing in importance.

Next to the salmon, the herring fishery has been the greatest single industry administered by the Alaska fisheries branch. It has had a wide fluctuation in production, largely because of the erratic spawning success of the herring populations. These fish normally entrr the fishery three years aiter hatching, and a successiul year class usually furnishes the bulk of the catch for a period of several years. Additional Alaskan fisheries include those ior halibut, sablefish, cod, shrimp and clams. A study of the king crab carried out just before World War II indicated the presence of a sufficient number to justify the development of a U.S. crab-packing industry. Methods were worked out and activities begun in producing canned crabs.

The natives of the Pribilof Islands engage primarily in the harvesting of the seals for the government. receiving a stipulated amount for each skin preserved. They engage also in winter trapping of foxes for which they receive compensation. The iederal government provides medical, dental and school facilities and furnishes housing, fuel, food and clothing In addition, the natives operate a canteen on each island, stocking foodstuffs and other articles. The islands were uninhabited until the Russians took a number of Aleuts there; the modern population is largely a mixture of Aleut and Russian, with some other nationalities intermingled

The fish and wildlife service vessel "Penguin" makes regular trips from Seattle. Wash, to the Pribilof Islands, 2,000 mi, distant in the Bering sea, to transport supplies and personnel.

See also WILDLIFE CONSERVATION; FISHERIES; NATIONAL PARKS AND NATURE RESERVES. (I. N. G.)

FISH COOKERY. The term fish includes many water animals which are classed as "sea food" (*e.g.*, crabs. shrimps, lobsters, turtles, oysters. frogs) besides fish proper. Fish is sold whole. dressed. salted. dried, canned. frozen or alive. It is generally a cheap and wholesome source of nitrogenous food, though compared with meat, bulk for bulk, fish contains more water and refuse. There are three main classes of fish: oily, containing fatty oil dispersed throughout the flesh; white or nonoily (lean), containing oil secreted in the liver; and shellfish. Examples of oily fish are salmon and herring; flat fish and turbot belong to the lean kinds, while the shellfish include lobsters, crab, oysters and clams. Because of the shortness and flakiness of the muscle fibres, fish, with the exception of some shellfish, is easily digested, and should be eaten with vinegar or some form of acid. Oily fish are more nourishing than lean kinds but less easily digested and are best grilled or cooked by dry methods. Lean fish are usually supplemented by sauces, etc.

Preparation of Fish for Cooking.—Fresh fish should be scaled and cleaned. In skinning round fish, proceed from head to tail, and reverse for flat fish. To fillet flat fish place on a board, grasp the tail firmly with fingers dipped in salt (to prevent slipping) and cut an incision just above the tail. Slip the knife under the flesh and raise it gently, at the same time loosening the skin with the thumb and forefinger of the left hand. Round fish may be baked and stuffed. All trimmings should be placed in a pan and covered with water to make fish stock for sauces. Roes in large fish should be removed, cooked separately and served as savouries on toast.

Methods of Cooking Fish.—There are many ways of cooking fish. Boiling is the simplest. though the least nourishing, as much of the flavouring juices is lost. This method of cooking is suitable ior large. round fish or for thick pieces. The water should simmer, not boil. and only enough used to cover the fish. Sea water is excellent ior boiling sweet fish. Add lemon juice or vinegar to the water to keep the fish white and firm and add salt unless it is a salt fish. Boiling is the best method for cooking salt fish. Tasteless fish requires additional spices and flavourings added to the water. Allow five minutes to the pound for thin fish, ten minutes or more for larger fish. Steaming is better than boiling but takes a little longer. Small fillets of fish may be steamed on an oiled plate over a pan of boiling water. Sprinkle fish with lemon juice to keep the flesh white. Steaming is useful in fish cookery for invalids.

Certain fish are best baked and stuffed or baked au *naturel*. Fish may also be baked in a tin with spices and butter or in milk. Paper bags (oiled) are excellent for baking fish. Truss whole fish before baking. Broiling or grilling is suitable for oily fish, which should be placed on a greased gridiron. If thick, split the fish down the centre and grill the flesh side first. Remove head and tail for grilling. Planked fish is grilled and served on a board made for the purpose. Frying is one of the most popular methods of cooking lean fish and may take the form of frying in a bath of boiling fat or pan frying in a shallow pan. Oil is better than any other fat for frying fish, as it keeps the colour a clear golden brown. All fish that is fried must be perfectly dry. It can be served with a sauce, but this is not necessary unless the fish is fried in batter. Certain kinds of fish are tasty if stewed in the form of a *souchy* (in the United States, chowder); *i.e.*, slices of fish simmered in broth with vegetables and spices. A bouillabaisse is a special dish much eaten on the European continent and consists of a stew or chowder of several kinds of fish.

In cooking shellfish other than crabs and lobsters, be very careful not to boil them, as they then become tough. Periwinkles, snails, etc., are served *au naturel* with butter and chopped parsley. Raw oysters and clams may be served in their shells with accompaniments of vinegar, lemon, red pepper and various other relishes.

Sauces for fish are (1) those with a water white sauce (drawn butter sauce) or a fish stock white sauce as a foundation; (2) those with melted butter as a foundation; (3) those with mayonnaise, Hollandaise or other butter-egg yolk sauces. Sharp ingredients, such as capers, horseradish and pickles, are often added.

Roe.—This is a spawn or milt of fish. In the case of large fish the roe is removed and prepared for table separately in various ways. Soft roes, such as herring, etc., are served on toast as a savoury.

Shad roe is a delicacy in the United States. Hard roes. such as cod roes, are frequently dipped in batter and fried in deep fat. Caviar, sturgeon roes (salted), is served plain on sippets of bread and butter as hors d'oeuvres. *(See* also FOOD PREPARATION.)

FISH CULTURE in the broad sense can be considered a branch of animal husbandry, if the latter term is used to include both the rearing of domestic animals and the harvesting and management of wild game. The maintenance of fish indoors in aquariums is treated under AQUARIUM. This article, concerned with the culture of fish for food and sport, is divided into the following sections:

- I. Growing Fish for Consumption
  - 1. Pond-Fish Culture in Temperate Climates
  - 2. Tropical Pond Culture
  - 3. Brackish-Water Pond Culture
- II. Stocking Open Waters
  - 1. Release of Fry
  - 2. Release of Fingerlings and Larger Fish
  - 3. Rearing Warm-Water Fishes for Distribution
  - 4. Introduction of Yew Species
- III. Improvement of the Habitat
  - 1. Changes in Lakes and Streams
  - 2. Fish Passes and Screens
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- IV. Regulation of Fishing for Best Yield
  - 1. Best Exploitation of Existing Stock
  - 2. Obtaining Maximum Recruitment

I. GROWING FISH FOR CONSUMPTION

1. Pond-Fish Culture in Temperate Climates.—The most widely used fishes in pond culture are those of the great cyprinid or carp family, which is dominant throughout tropical and temperate Eurasia. In Europe the carp (*Cyprinus carpio*) is by far the most popular species because of its hardiness, its unfastidious food requirements and the relative ease with which its fry can be reared. As with other domesticated animals. several recognized varieties of carp have been bred by selection for such qualities as rapid growth, plumpness and resistance to disease. Moderate production can be achieved by maintaining carp as a wild population cropped annually. Much better yields are obtained by having specially designed brood ponds where the adults spawn. Young fry are removed at an early age and transported to nursery ponds in which suitable small foods are cultured or supplied. Later they are placed in the large rearing ponds, in numbers computed to give best yield. The fish are harvested after one. two or three years' growth, depending on the fertility and temperature of the pond, the length of the growing season and the density of stocking. Ponds should be fertilized to promote growth of animal foods for the carp; manure is excellent and even chopped vegetation is useful. Near time of marketing, the fish may be fattened by feeding coarse grains.

In continental Europe carp culture is widely distributed. but it is best developed in the central region, above all in Czechoslovakia, which has no sea fisheries. Fishponds were maintained in England during the middle ages, but have been largely abandoned.

Other species of fishes are sometimes reared in European fishponds. either intentionally or because they enter accidentally with the water supply. Among these are such cyprinids as the tench *(Tinca tinca)*, bream (*Abramis brama*), rudd *(Scardinius erythrophthalmus)*, roach (*Leuciscus [Rutilus] rutilus*) and ide *(L. [Idus] idus)*. These are useful only under special conditions—for example, the tench can survive very Ion-oxygen conditions, the rudd consumes a good deal of vegetation and so on. Only the tench compares in value with the carp, but it grows much more slowly. A noncyprinid fish of some importance in pond cultures is the pike *(Esox lucius)*; it sells well, and because of its predacious habits can be used to reduce the numbers of cyprinid fry when these are for any reason excessive. The perch *(Perca fluviatilis)*, sander *(Lucioperca lucioperca)* and the largemouth bass (*Micropterus salmoides)* have been used for the same purpose.

For centuries in Asia carp and crucian carp (*Carassius carassius)* as well as other species have been extensively used. The Chinese make much use of several cyprinids which are rarely bred artificially. Instead, fry about a third of an inch long are taken in fine nets from the large rivers and reared in small ponds until the various kinds can be sorted out. Then they are distributed to ponds and lakes over considerable distances. The most useful species are four. The grass carp or *huan yu* (*Ctenopharyngodon idellus*) is one of the few fishes which consume pondweeds and coarse vegetation. The fathead or *lien yu (Hypopthtalmichthys molitrix*) is valuable because it feeds largely on phytoplankton, the microscopic algae which produce green blooms in fertile waters. The *ching yu* (*Mylopharyngodon piceus*), the black amur of the Russians. has heavy grinding teeth in its throat and favours clams and snails as a diet. *Aristichthys nobilis* consumes zooplankton—the cladocerans, copepods and other small animals that live suspended in the water.

Along the Yangtze river alone there are about 1,800 shallow flood-plain lakes, totaling 8,000,000 ac., which are to varying degrees controlled for fish rearing, using combinations of these four noncompeting species. Each species also may be used separately, or two or more in rotation, depending on the nature and condition of the pond. For example, a pond full of weeds provides excellent food for grass carp for a season; when these are cropped down, a bloom of phytoplankton will probably develop, followed by abundant zooplankton—each of which can be used by the appropriate species.

In India similar use is made of wild cyprinid fry from rivers, especially in Bengal, Bihar and Orissa. Among the most used species are the catla (*Catla catla*), mrigal *(Cirrhina mrigala)* and rohu *(Labeo rohita)*, but several other species of *Labeo* and *Cirrhina* are also taken. Little exact information is available concerning these fisheries; they tend to be family affairs whose methods of operation are kept confidential. Certain fishery establishments having large catchment areas, called *bundhs*, are able to produce fry of these Indian cyprinids successfully.

Japan has an extensive pond culture which produced 5,700 tons each of carp and eels *(Anguilla* species) in 1957. Israeli ponds produced *7,600* tons, Formosa 9,700 tons; but none of the really large pond-fish countries report pond-fish statistics separately from wild fresh-water fish.

Rearing trout for market is a somewhat different industry; the fry, hatched artificially, require cool running water and must be fed. The most popular species is the rainbow trout *(Salmo gairdneri*), but brown trout (*S. trutta)* and the American brook trout (*Salvelinus fontinalis*) are also used. Horse meat. slaughterhouse wastes and scrap fish are used for feeding. Biggest producers are the United States. Denmark and Japan. Japan and Formosa also raise quantities of the tasty ayu or sweetfish *(Plecoglossus altivelis*), a salmonid which feeds on plankton and filamentous algae.

Trout fed on the various foods listed above do not, generally speaking, acquire the delicate flavour of wild trout, so as the time for marketing approaches the trout are given special diets or, if possible, a sojourn of a few weeks in ponds containing natural foods.

2. Tropical Pond Culture.—In the tropics large-scale pond-fish culture is complicated by high temperatures, rapid decomposition and rapid growth of floating vegetation, all of which make it difficult to keep a proper supply of oxygen in a pond. Particularly in Thailand, extensive use is made of air-breathing fishes on that account, for example, the gourami (*Osphronemus goramy)* and the murrel or snakehead (*Ophicephalus* species). Indonesia, particularly Java, has many ponds raising carp; crucian carp; a native cyprinid, tawes (*Puntius javanicus*); a catfish, lélé *(Clarius batra-*

chus); and air breathers. In the Celebes some use is made of Chinese cyprinids whose fry are imported annually—especially the grass carp.

A notable development in tropical pond-fish culture has been increased use of species of *Tilapia*—called mouthbreeders because in some species the female incubates the eggs and carries the young in her mouth. This genus may actually be the oldest object of pond culture: Pierre Chimits has published an illustration of a bas-relief from a tomb antedating zooo B.C. that shows an Egyptian angling for T. nilotica from an artificial pond. Extensive modern use of *Tilapia* began in the Belgian Congo during the 1940s, using T. *melanopleura* and T. macrochir. The most popular species has been T. *mossambica,* widely introduced throughout east Asia and Oceania and in some West Indian islands. This species breeds readily, grows rapidly, tolerates salt water and low oxygen and includes much detritus and algae in its diet.

A rapidly developing branch of tropical and warm-temperate fish culture is the use of rice fields for growing fish. Most rice paddies produce a few nild fish, grown from fry brought in with the irrigation water. By suitable stocking and fertilizing large yields can be obtained from various carps or Tilapia, but some strengthening of the dikes and provision of channels in the fields is recommended. Effects on the rice crop are variously estimated from a small decrease to a slight gain in yield. The potential fish production of the world's rice fields is enormous, and it is available mostly in regions where fish are the accepted major protein of the human diet.

3. Brackish-Water Pond Culture.— River deltas and other marshy areas are sometimes developed into fish-rearing establishments, for example, in southern France, along the upper Adriatic coast of Italy, in India, Indonesia, Formosa, the Philippines. Japan and Hawaii. Most of the fishes used are of marine origin; they breed in the sea, but the young seek brackish or even fresh water. Mullets (*Mugil cephalus* and others) are widely used, eels are popular in southern Europe, as are the gilthead (*Sparus* auratus) and sea bass (Morone labrax). In tropical countries the milkfish (*Chanos chanos*), called *bandeng* or *bangos,* is most popular, along with mullets, the Javan tawes, the ten-pounder (*Elops* saurus) and *Tilapia.* Shrimps and prawns are frequently important by-products, as are adventitious fish like the kakap (*Lates calcarifer*).

In a simple form of brackish-water culture, such as some of the Adriatic *valli,* the ponds are little more than natural salt marshes with channels to the sea closed off by a dike and gate. At appropriate seasons gates are opened and young fish are carried in by the tide. From this type of fishpond there are all gradations up to the extensive *tambaks* of Java, laboriously reclaimed from mangrove swamps and stocked with imported milkfish fingerlings. Tanrhaks are typically 1½ ft. deep; their salinity varies, with the site and season, down to almost completely fresh water. The principal food of milkfish in these ponds is algae, especially the blue-green *Oscillatoria,* giving a direct conversion from vegetable base to useful protein. Other species are used partly because the supply of milkfish is inadequate, partly for their own sake: tawes consumes large amounts of vegetation and may improve milkfish production, while Tilapia helps to control malarial mosquitoes by removing floating algae. About 33,000,000 lb. yearly of fish and shrimps are produced from 200,000 ac. of ponds in Java; the Philippines have 175,000 ac.

The only example of brackish-water culture on a large scale in cool-temperate regions is carried out in Jutland, Den. Each year young plaice (*Pleuronectes* platessa) are caught at sea and transported to the inner expanses of the Limfiord, where they grow rapidly and provide a good harvest.

II. STOCKING OPEN WATERS

1. Release of Fry.—In the natural reproduction of salmonid fishes (salmon and trout), the eggs are buried by the female up to a foot or more deep in gravel nests or redds. During the 1850s it became a popular practice, in Europe, America and the Antipodes, to remove eggs and milt (sex glands containing semen) from mature trout and salmon and hatch them artificially. In the usual dry or Russian method, eggs and milt are squeezed into a pan, stirred gently and allowed to stand for several minutes, then washed. Rate of development depends on temperature. It is measured in degree-days, that is, the sum of successive days' water temperatures on the centigrade scale. After about 200 degree-days the embryo is recognizable inside the shell, and the eggs are said to be eyed. Three hundred degree-days or so later the eggs hatch, the released fry, or alevins, being delicate creatures with the large yolk sac of the egg still attached. Finally, 800 to 1,000 degree-days after fertilization, the remaining yolk is absorbed into the abdomen and the young fish are called fingerlings. In nature, they then emerge from the gravel and begin feeding.

In the early days of salmonid culture, eggs were held in perforated boxes floating in a stream until the fry were ready for liberation. Later, special troughs supplied with running water were built to hold the eggs, and these were soon installed indoors. To increase their holding capacity the troughs were deepened and provided with removable screen baskets to hold the eggs; double baffles divided the trough into compartments and directed the water from below upward through the eggs in each basket. A newer method is to stack perforated trays containing eggs vertically in layers three or four deep in a special frame so that the water is fed by gravity down the stack but up through each tray. This arrangement permits a great saving of floor space in the hatchery building. Care of the eggs has been simplified by the regular application of malachite green, a fungicide which controls the once-dreaded *Saprolegnia.* Previously this fungus, spreading from a few dead eggs, would quickly blanket and kill a whole basket unless checked by laborious picking.

In traditional salmonid culture the fry were hatched and held in the troughs, to be liberated in natural waters after the yolk sac was absorbed. The reasoning was that fertilization of fish eggs in nature must be extremely haphazard, scarcely exceeding 5% efficiency, whereas with artificial fertilization it commonly exceeds 95%. If the eggs were further protected from flood, drought and enemies during the incubation period, it was assumed that the greater part of the mortality of the normal life history would be circumvented. A very few spawners should suffice to maintain a very large body of fish, and all fears of overfishing could be set aside. So plausible did this seem that the various assumptions involved were not tested individually for many decades.

From its beginnings with salmon and trout (Oncorhynchus and *Salmo* species), artificial spawning and hatching were quickly extended to other fresh-water and anadromous fishes (sea dwellers who ascend rivers to spawn). Even ripe sturgeon eggs (Acipenser species), usually slated for processing to caviar, were cultured. The small eggs of whitefish (Coregonus *clupeaformis*), shad (Alosa *sapidissima*) or walleye (*Stizostedion* vitreum) were incubated in special glass jars of about 1½ gal. capacity, the water rising gently through the egg mass. Many hundreds of millions of eggs of these species were reared annually in hatcheries throughout the United States and Canada. Similar procedures were applied to marine fishes like cod (*Gadus* morrhua) and plaice, particularly in the North sea region, Maine and Newfoundland, though there was greater difficulty in handling their buoyant eggs.

These intensive efforts to increase natural fish stocks were on the whole extremely disappointing. The expected large increases in production simply were not realized and direct tests were undertaken to determine the cause of the low yield. For production of marine fishes the most conclusive tests were those of Gunder Dannevig in Norway, who compared a series of four fiords alternately stocked and not stocked with cod fry. The number of young cod produced in them was independent of whether they received hatchery fry or not. Similar results were obtained in experiments with plaice in Loch Fyne by Thomas Fulton. with uhitefish in the Great Lakes by John Van Oosten, and elsewhere. In other experiments some advantage of liberating fry was demonstrated, but at a level far below original expectations. For example, in a 12-year Canadian test with sockeye salmon (*Oncorhynchus* nerka), the fry-liberation technique approximately doubled the smolt (two-year-old salmon) production of a small stock, as compared with nhat a similar number of females produced by natural propagation. Houever, this was not considered enough gain to justify the expense involved and a computation showed that the country's total hatchery effort was producing only a small fraction of the commercial supply of sockeye.

The failure of fry liberation in open waters led to a reluctant but rather general abandoning of the technique. Most hatcheries for cod, plaice, lobsters (*Homarus* species), whitefish, ciscoes (Leucichtkys species) and shad have been closed, as have the Alaskan and British Columbian salmon hatcheries. while in other places new techniques or new objectives have been introduced.

Later studies showed what was wrong with the original assumptions. Fertilization of fish eggs in nature is not haphazard, but highly efficient. Cod, for example, swim belly to belly, and the eggs are impregnated as they are extruded. Similarly, salmon eggs are laid in batches in the redd and are immediately smothered nith milt. D. F. Hobbs in New Zealand finally showed, as late as 1937, that naturally spanned trout eggs are practically all fertile and that total mortality to emergence may be as little as 20% on good sites. Even temporary drying up of a stream does not necessarily kill the eggs, nhich are buried deep and stay moist.

Mortality is greatest after hatching; a young fish at the end of the fry stage (yolk sac just absorbed) has just begun its perilous existence. R. E. Foerster's experiments at Cultus lake, British Columbia, indicate that even such large fry as those of sockeye salmon suffer 95% loss during the first year of life and an additional 90% of the survivors perish before they return from the sea to the river estuary. The mortality among the tiny fry of cod, shad or whitefish is far greater. In this way the hundreds of millions of fry released dwindle to hundreds of thousands, to tens of thousands or to merely a few thousands of adult fish—depending on the species.

Finally, it appears that cultured salmon and trout fry are inferior to naturally hatched fry. Richard Vibert in France demonstrated and measured the greater hardiness of fry reared in gravel in terms of their resistance to extremes of temperature, current and predation. A clue to other harmful effects of life in hatchery troughs is afforded by the work of F. Neave and W. S. Hoar in British Columbia. Pink salmon (*Oncorhynchus* gorbuscha) reared in gravel will, at migration time, snim downstream rapidly at night and re-enter the gravel of the stream bed by day until they reach salt water. Thus they remain inconspicuous during a very vulnerable period of their life. However, once the advanced fry are regularly exposed to even weak daylight, as they are in normal hatchery practice, they lose this behaviour pattern. Instead, they school up and let themselves be carried leisurely downstream by day as well as by night, so that they are exposed to attack by a host of voracious fishes, mergansers. etc.

In spite of all this, fry release may not be completely outmoded. Attempts are being made to adjust hatchery procedures so that fry will be normally hardy, with their natural behaviour intact. An alternative course being tried is to move the hatchery outdoors again. New gravel spawning areas are being constructed and existing ones improved in order to obviate damage from predators, silting, floods and drought. In a large installation involving hundreds of thousands of spawners it is necessary to let the fish deposit their eggs themselves, and fish hatching thus becomes linked up mith stream improvement. Such efforts are justified. however, only when there is no bottleneck to production at a later stage in the life history. This proviso is met by the pink salmon and the chum salmon (*Oncorhynchus* keta), which go directly to sea after emerging from the gravel.

2. Release **of** Fingerlings and Larger Fish.—Another reaction to the failure of fry liberation was the attempt to rear fry to a larger size before releasing them. This proved impractical with most of the small-egg species, but trout and salmon responded. Gradually the surviving hatcheries added rearing ponds and began to raise larger and larger fish. Beef liver was at first the standard diet, but the discovery of its effectiveness against human anemia sent its price skyrocketing and set off a protracted search for substitutes. Along with the search for suitable food, the quest for methods for combating diseases has been of major importance. Infections normally of low and unimportant incidence in the wild (endemic) often developed into epidemics in hatcheries, and many millions of young fish have succumbed to attacks by protozoa. fungi, bacteria and other parasites. Sulfa compounds, antibiotics and general sanitation work about as well with fish as with man. but there must be constant watchfulness for the signs of infection.

In Europe stocking streams with trout is for the most part a business. Typically, the owner of a stream purchases young trout (size and quantity based upon his previous experience) from a private hatchery and leases fishing rights by the day or by the season, expecting to make a profit. In North America fishing rights on most waters are still in the public domain, and responsibility for their stocking has been assumed by state or federal governments. It is impossible to make any over-all assessment of the success of their "maintenance" stocking with fingerling or larger trout. However, it is certainly true that many marginal trout streams, and many good trout streams in populous regions, would provide very little game fish without the "put-and-take" planting of large trout. Where hatchery trout are planted into waters containing a good population of native trout. R. B. Miller in Alberta found that the uild stock pre-empts favourable territories and the newcomers lose weight, and most die after a few weeks or months. Similarly, experiments in Michigan showed very little overwinter survival of planted trout when in competition with wild trout. The practical conclusion is that stocking is most successful, as well as most needed, where wild stock is sparse.

In stocking barren or reclaimed waters, of course, there can be good survival from liberations made at any stage from egg to adult. Often planting eyed eggs in gravel is most convenient, while for inaccessible lakes Gustave Prévost in Quebec showed that fingerlings can be dropped from an airplane without harm. A considerable portion of the production of trout hatcheries is now absorbed by lakes high in the mountains. lakes which lack spawning facilities, and lakes or streams cleared of fish by poisoning.

Anadromous fishes also have shared in the trend toward rearing fingerlings to larger sizes. In justification of this, it has been found that stocks of coho or silver salmon (*Oncorhynchus* kisutch) and Atlantic salmon (*Salmo* salar) are usually limited by the size of their river homes rather than by lack of fry. Hence rearing these fish to smolt size makes the hatchery product a clear net gain to the stock; in fact, that is the only way hatcheries can help in such a situation. The same is true for sockeye in some lakes.

Another powerful stimulus to salmon rearing has been the building of dams on salmon rivers. Some Swedish rivers are now dammed completely, from source to mouth, and their surviving runs of salmon and sea trout (Salmo trutta) are maintained entirely by rearing of smolts. Similarly, the progressive damming of western United States rivers has been accompanied by rapid expansion of rearing facilities for chinook (*Oncorhynchus tshawytscha*), coho and steelhead (Salmo *gairdneri*). Apart from their status as a (quite inadequate) compensation for lost nursery rivers. the average cost-to-benefit ratio for these installations seem to be close to marginal, if it is computed on the basis of the commercial value of the adult salmon produced and caught. However, most of the fish handled are also taken in large numbers by sport fishermen, and so are popularly assigned a value much greater than the fish buyer's price.

Fortunately, there is much scope for additional improvement in hatchery techniques. Evidence of this is found, for example, in experiments mith cohoes at Minter creek in Washington state, in which native stream-reared smolts produced 5 to 15 times as many adult fish as pond-reared smolts of the same stock. Improved diets or other changes should gradually eliminate this differential. Experiments with chinook salmon by Lauren Donaldson in Seattle indicate possibilities of selecting fast-growing and early-maturing stock for hatchery use. Transplanted fish commonly return to the stream where they were planted and very rarely return to their original stream unless it is close by. However, it has gradually become clear that in many instances transplanted fingerlings do not return to a stream nearly as successfully as fingerlings of the native stock, even when the two are similarly reared and similarly treated. The causes and full implications of this phenomenon have yet to be ascertained—in particular, have the missing fish gone somewhere else, or have they perished? Some of the evidence suggests the latter. Meantime, salmon hatcheries operated for maintenance should be wary of regular shipping of eggs or fingerlings from one watershed to another.

In the U.S.S.R., improved techniques of sturgeon culture are being used on the Volga, Don and Kura rivers, to compensate for the loss of spawning grounds cut off by dams and to increase their celebrated sturgeon fisheries.

3. Rearing Warm-Water Fishes for Distribution.—The general enthusiasm for fish culture in North America early spread from trout to warm-water species. It proved impractical to obtain live eggs by pressure from such "nesting" species as the black basses (*Micropterus* species), sunfishes (family Centrarchidae), crappies (Pomoxis species) and catfishes (family Ictaluridae), but these could readily be induced to spawn naturally in suitable ponds. In most species the eggs are guarded by the male parent. The basses require a sheltered gravel nest and the catfishes need a dark hole. Young bass are caught as they rise from the nest and are placed in rearing ponds previously fertilized with manure.

Other fish raised in the northern states and southern Canada include walleye, pike, chain pickerel (Esox niger) and occasionally the prized muskellunge (E. masquinongy). With any of these fish-eating species cannibalism is a major cultural problem which demands frequent sorting to even up the size classes, if major losses are to be avoided. For any considerable yield of fingerling walleye, pike or' muskellunge, feeding large numbers of live minnows (small cyprinids) is necessary. These are usually seined from natural waters.

The original object of the bass and bluegill culture was to stock lakes and rivers—most of which, however, were supplied naturally with far more fingerlings than the hatcheries could hope to add. After the early 1930s the young fish were more and more used for the initial stocking of small ponds. Many thousands of ponds an acre or so in extent have been developed, and both federal and state governments encourage their use for fishing by supplying planting stock. The most popular initial combination is a mixture of largemouth bass and bluegill (Lepomis *macrochirus*) fingerlings; the ratios recommended vary from 1:1 to 1:15. With luck such a mixture may produce a "balanced" pond population: the young bluegills provide food for the bass, while the bass keep bluegill reproduction under control, and both species grow rapidly. In practice the bluegills sometimes overpopulate a pond and fill it with slow-growing useless stock. An equally common trouble is invasion of the pond by unwanted prolific species like golden shiners (*Notemigonus crysoleucas*), green sunfish (Lepomis cyanellus) or black bullheads (*Ameiurus melas*). Remedies include the removal of surplus small fish by seining, drawdown (partial draining), poisoning or "correcrive" stocking with a voracious species like the pike. If a pond is sufficiently isolated so that the accidental appearance of wild fish is very unlikely, the initial stocking can be done using species which reproduce poorly under pond conditions, hence will not overstock the pond: rock bass (*Ambloplites rupestris*), smallmouth bass (*Mi*cropterus dolomieu), channel catfish (*Ictalurus lacustris*) and hybrid sunfish have been used.

Other measures of control have also been recommended. For example, the experiments of H. S. Swingle and his colleagues in Alabama show that controlled applications of certain kinds of inorganic fertilizers induce phytoplankton blooms which indirectly promote rapid growth of bluegills (the bluegills chiefly eat the aquatic insects which are dependent on the phytoplankton) and also, by sheer density, control unwanted submerged weeds. Indeed, when pursued rationally, the whole procedure can develop into an intensive pond-fish culture on the oriental pattern. However, in America the prime purpose is usually recreation, so harvesting of the crop is done by exciting but inefficient hook-and-line methods.

4. Introduction of New Species.—Much of the early fish cultural work in North America was devoted to introducing foreign species or to spreading native fishes more widely over the continent. Carp, tench, brown trout and other fish were brought from Europe. Eastern American species were sent west to Colorado, California and Oregon: the shad, striped bass (Roccus saxatilis), Atlantic salmon, brook trout. lake trout (Salvelinus [Cristivomer] *namaycush*), channel and white catfishes, largemouth and smallmouth black bass, perch, bluegills and various other sunfishes, crappies, and several small catfishes or bullheads. Success has been varied. The shad and white catfish (*Ictalurus catus*) have established moderately important commercial fisheries, and the striped bass is a very popular sport fish in waters near the Golden Gate. The black basses are locally important for angling. Sunfishes, crappies, perch and bullheads are also locally useful. but they often become overabundant and stunted and are blamed for the scarcity of more useful species in many waters. Brook trout thrived mainly in inaccessible waters not inhabited by native western trout, uhereas lake trout have "taken" in a few deep lakes only. The Atlantic salmon could not compete with the very similar steelhead trout. Carp are locally plentiful but do not tend to be overabundant as in eastern America, perhaps because they encounter in western waters an array of large cyprinids—the squawfish (Ptychocheilus oregonense) and its relatives—which eat similar foods and are warm-water predators capable of keeping carp fry at reasonable levels.

In exchange for this array of eastern species, the west had to offer principally its varied salmonids: five species of anadromous Pacific salmon (*Oncorhynchus* species), the lake-dwelling kokanee or fresh-water form of the sockeye salmon. the rainbow trout and its anadromous form the steelhead, two forms of the cutthroat trout (Salmo clarki), the Dolly Varden char (Salvelinus *malma*) and the beautiful golden trout of the southern Sierra Nevada (*Salmo* agua-bonita). Of these, only the rainbow trout has become extensively acclimatized in eastern North America, where it is still increasing in abundance and extending its range. As a stream fish it tends to displace the native brook trout except in the colder parts of trout streams. It has also produced some autumn-spawning runs of large fish in the Great Lakes, and true anadromous steelhead have appeared in Prince Edward Island. The European brown trout has also become widely distributed in the warmer trout streams, and has produced runs of sea trout in a few rivers of southeastern Newfoundland.

The most famous fish of western America is without question the chinook. king or quinnat salmon, which averages 20–25 lb. but often grons to 75 lb. and more. It has long been a principal sport and commercial fish from the Sacramento river to the Yukon. It was to obtain eggs of this salmon, specifically, that Livingston Stone established a fish-cultural station in 1874 on the McCloud river, at that time a remote tributary of the Sacramento. With makeshift equipment, and under the surveillance of the somewhat unfriendly Indians whose traditional fishing grounds had been pre-empted, eggs were eyed and shipped to eastern America and throughout the world. Coastal streams from the Mississippi river to the St. Lawrence received shipments, but unfortunately the great majority of the waters stocked were quite unsuitable, and in none was there any permanent success. The same was true in Europe. However, in the Waitaki river of New Zealand a run of chinooks became established, shortly after 1900, which maintained itself and spread naturally to most other major rivers of the east coast of the South Island. Although the McCloud river's salmon are now extinct and the very site of the early hatchery lies buried beneath the waters of Shasta reservoir, there is sentimental satisfaction in knowing that this historic stock still lives and is providing sport and food.

The success of introductions of new fish throughout the world is more or less inversely proportional to the variety and abundance of the native fish fauna. Australia and New Zealand, with a very limited assortment of native fresh-water fishes, have readily acclimatized such foreign species as carp, tench, bream, perch, brown trout and (in one river) Atlantic salmon from Europe; and, from America, rainbow trout, the chinook salmon and some brook trout and kokanee. South Africa also has provided a home for brown and rainbow trout, largemouth and smallmouth bass and bluegill sunfish. European rivers, with a much more varied fish fauna, have yet found room for American smallmouth bass and the brown bullhead (*Ameiurus nebulosus*), the latter not a particularly welcome immigrant. Asia, richest of all in fresh-water fishes, has apparently not as yet accepted a newcomer, and indeed has felt no need to attempt transplantations.

The acclimatization of desirable new species is difficult and full of pitfalls. Even in success there may be failure. The carp, most prized of warm-water food fishes in Europe, was introduced in North America with high hope but in most places it is now regarded as a nuisance. Indiscriminate stocking of sunfishes and minnows as "forage fish" has ruined many fine trout waters in western North America. The attempt to introduce a new sturgeon into the Aral sea (U.S.S.R.) in the early 1930s was followed by a massive (though not complete) mortality of the native sharp-nosed sturgeon (Acipenser *nudiventris*), which lacked resistance to a trematode (flatworm) parasite brought in with the transplants. In spite of such dangers, there is renewed interest in the introduction of new species almost everywhere in the world. Judicious selection of kinds which will not compete with useful native species, or which will substitute a more valuable for a less valuable species, offers a wide field for careful experimentation. For example, the very limited salmon stock and fishery of the North Atlantic suggests that a profitable industry could be built up around the Pacific pink, chum and sockeye salmon, species whose life history does not conflict with that of the native species (*Salmo salar*). Hence: renewed transplantation efforts are under way in Canada and the U.S.S.R. The tasty kokanee has been introduced in Oregon and California, and should be welcomed everywhere as a useful plankton-eating species, even if it were to supplant some of the less flavoursome and nonsporting ciscoes and small whitefishes. The Asiatic grass carp and fathead have been proposed for reservoirs of southern U.S.S.R. Greatest care should be taken with small omnivorous species like the American sunfishes or the African *Tilapia,* which can so easily take over waters without producing a desirable crop.

III. IMPROVEMENT OF THE HABITAT

1. Changes in Lakes and Streams. — In Britain and continental Europe much effort is sometimes expended by an owner in improving his trout stream or other river by creating pools. riffles or covers that harbour fish or make fishing easy. In North America such efforts are largely co-ordinated by governmental agencies. During the business depression of the 1930s when public works programs employed large bodies of labour for public projects, there mas extensive activity in stream improvement in most states. Provision of shade and shelter. control of bank erosion, formation of pools, etc., were all undertaken — methods being developed and codified in the first instance by C. L. Hubbs and his colleagues in Michigan. Attempts were also made to extend these activities to lakes by making brush shelters where fish would accumulate. providing gravel nesting sites for bass and so on. Some of this effort has doubtless had permanent value, though this was rarely actually demonstrated. Generally speaking. there was no time to develop and test a program suited to the individual stream or lake! nor was there much follow-up work.

A more rewarding activity, which has continued unabated, has been the construction of new lakes and ponds for public fishing and other recreation. There are also indirect subsidies for private fishpond construction. By these means fish-producing waters have been increased by hundreds of thousands of acres—or millions of acres if large multiple-purpose reservoirs are included.

2. Fish Passes and Screens. — Obstructions to the migration of fishes occur in many rivers, either as natural falls or as dams of various sorts. When a dam is constructed it has been found feasible to build fish passes which many kinds of migratory fish will use—for example, salmon, trout) shad, carp, suckers (Catostomidae) and eels. Depending on the size of the river and the height of the dam, these passes range from a simple succession of small pools, each about a foot higher than the last, to multimillion-dollar installations with a complex collection system built across the face of the dam.

The most elaborate and expensive series of fishways are those around the main-stream dams on the Columbia river in Washington and Oregon, where chinook and other salmon are the species principally affected. While these structures allow a large fraction of the adult salmon to pass upstream, there is some delay at each, which eventually may become very serious as more and more dams are built.

Not only must adult fish be permitted to go upstream, but the young must get down safely. For dams up to about 100 ft. high, the spillway or the more slowly moving types of turbines usually offer reasonably good routes. Higher dams present problems which are only beginning to be approached seriously. A young fish can fall any distance through the air into water without harm, so experimental overpasses have been constructed on this principle: the water. containing fish, is broken into spray at some point clear of the dam and the excessive turbulence below it, and the fish can fall safely. However, the trouble lies in guiding the young fish to the point where the safe descent begins; almost every installation presents a different problem. One difficulty is a lack of basic information concerning behaviour patterns, muscular capacity, sensory acuity and physiological tolerance of young fish of different species and at different ages. Active research on this problem is in progress.

Sometimes fishways are built to provide a passage over natural or accidental obstructions, rather than dams. 4 celebrated example is the obstruction of the Fraser river at Hell's Gate in British Columbia, which dates from a series of slides caused by railway construction in 1913–14. Although the most serious damage was corrected by immediate removal of much of the rock, the Gate remained a complete obstacle to the ascent of pink salmon and a partial obstacle to the more vigorous sockeye and chinook salmon up to the time fishways were constructed in 1945–46.

Diversion of water for irrigation has also been a major hazard to anadromous fishes. It has affected particularly the salmon of the Sacramento and San Joaquin rivers of California, and the herringlike hilsa (Hilsa ilisha) in certain Indian rivers. Apart from reduced flow in the streams affected, there is direct loss of downstream-migrating young into the irrigation canals. In the United States, government intervention resulted in the installation of elaborate rotary screens on many intakes to prevent fish from entering the irrigation canals. Later, a series of louvers set at an angle down a concrete channel was constructed on a large Sacramento river diversion; the water flows between the louvers, but most of the fish do not pass.

3. Reduction of Mortality From Predation. — There are numerous kinds of animals which, in consuming useful fish, are in competition with man for what he claims as his own food. However, until man can actually use the fish which might be saved from predators, the latter do not cause any real loss. Thus, generalized complaints concerning the tremendous number of fish destroyed by seals: sharks, cormorants, gars, piranhas or snapping turtles — to mention a few popular culprits — may be true or false, but are of no particular interest. Quite different is the situation where predators attack usable fish concentrated in limited areas; or where they interfere with fishing operations. For example, sea lions may follow a troller and take salmon off the line; gray seals can very skillfully rob pound nets; an abundance of dogfish makes trawling difficult; kingfishers and herons gorge on trout from unprotected ponds; and so on. Here either control or evasive action is indicated. whichever is most feasible. Sometimes no action seems possible: Japanese long-liners lose 20% to 30% of their tuna catch to sharks in tropical waters.

In only a few situations has it been shown that a predator is actually involved in limiting useful fish and that control of the predator is feasible. H. C. White in New Brunswick showed that mergansers (goosanders) set a limit to Atlantic salmon production at a level much below that which the streams could otherwise attain. Systematic control of these birds over a large area was begun and on some streams it increased smolt production fourfold. Similarly it was possible to increase sockeye salmon production threefold by control of squawfish in a British Columbia lake, at a cost amounting to approximately one-tenth of the commercial value of the increase in salmon caught. Local control of char, sculpins, etc., predators of salmon fry, has also been found effective, particularly in association with improvements in redds or water flow.

A spectacular attack on a predator, the sea lamprey, was begun in about 1945 in the Great Lakes. Lampreys are eel-shaped vertebrates that attach themselves to fish or mammals and suck their blood. The sea lamprey (Petromyzon *marinus*) probably became acclimatized in Lake Ontario during a late glacial stage when the lake was a brackish gulf of the Atlantic ocean, but Niagara falls prevented its ascent to the upper lakes. Lampreys frequently attach themselves to boats, so occasional individuals have probably entered Lake Erie since the construction of the first Welland canal. Eventually a pair was bound to breed successfully, but it was only after they had reached Lakes Huron and Michigan in the 1930s that they multiplied disastrously in the numerous suitable spawning tributaries of those lakes. Within a decade lake trout in those waters were commercially, and almost absolutely, extinct. To save the Lake Superior trout, and eventually to restock the other lakes, a system of electrical barriers was installed on all lamprey-spawning streams — some of them quite large rivers. In addition, their waters are being treated with a poison which in the correct concentration kills young lampreys without harming fish.

It is not yet known whether these heroic measures will successfully control or, as their more optimistic sponsors hope, actually eliminate sea lampreys in the Great Lakes. If not, there may be some hope in another direction. In Lake Ontario the lake trout has achieved an uneasy tolerance to lampreys. Many trout are attacked and survive, sometimes bearing more than a dozen healed scars; others seem to avoid attack. Whatever the reasons for this resistance, it may be something that their progeny will retain when transplanted to the upper lakes.

In practice it is difficult to make a clear distinction between predators and competitors; the term "coarse" fish embraces both. Coarse fish removal is sometimes undertaken to benefit the more valuable fish. Some states seine excess carp periodically from shallow lakes to keep in check their roiling (muddying) of the water and uprooting of vegetation. More spectacular is the poisoning of lakes to remove all fish in order to restock with more useful ones. The poison used is usually some form of rotenone, fatal to fish but in the strength used harmless to most other water animals and to all warm-blooded animals. As an example, Diamond lake in Oregon, just north of Crater lake, was poisoned in 1955 to remove an overabundant cyprinid (Sipkateles) population that had been introduced accidentally from the Klamath watershed, probably as a bait minnow. The trout, of course, perished along with the rest, and had to be reintroduced.

IV. REGULATION OF FISHING FOR BEST YIELD

Fishing regulations may be designed simply to divide the available catch among different groups of fishermen or methods of fishing, or they may have as their primary purpose the exploitation of fish in the most rational manner. In pursuing the latter aim, two lines of attack may be distinguished. An attempt may be made (1) to make best use of a stock of fish already in existence or (2) to provide a maximum supply of future recruits.

1. Best Exploitation of Existing Stock. — Any brood or year class of fish decreases in numbers continuously from the time it is hatched. In the first year mortality is severe, but in spite of this the young fish grow so rapidly that the year class as a whole increases in bulk, and may continue to increase for a year or more — depending on the average life span and on feeding conditions. Sooner or later, however, a turning point is reached; losses from natural deaths overtake the rate of growth, the year class begins to decline, and it eventually disappears. For a small minnow this cycle is completed in 2 or 3 years; for the halibut it may take 40 or more. At some time during the cycle the individual fish become large enough to be useful to man. However, if the year class is still increasing in bulk (growth exceeding natural losses) it may be desirable to wait and begin harvesting when a larger total weight is available. But harvesting should not be delayed too long, or the year class will have passed into the declining phase.

More exactly, obtaining maximum yield depends jointly on intensity of fishing and on size at first capture. If fishing is light, greatest yield is obtained by having a small minimum size limit, or none at all, so that thinning out may occur. If fishing is heavy, it becomes important to spare the smaller fast-growing fish so they can be caught when they are larger.

In commercial fisheries the intensity of fishing is determined largely by economic factors: numbers of fishermen and boats tend to increase until catch per trip falls to a level that discourages new investment. Unfortunately, this may happen only after fishing has become so intensive that the stock is no longer yielding at maximum capacity. For example, Michael Graham calculated during the 1930s that North sea fishing grounds for bottom-dwelling species would yield about 13% more if fished 16% less. But to reduce fishing in a manner that makes sense economically, some boats and fishermen must stop fishing entirely. To decide who should stop fishing has so far proved an insoluble problem. However, the biological benefits of decreased fishing were obtained for eastern Pacific halibut stocks (Hippoglossus steno*lepis*), following studies by W. F. Thompson and colleagues, by setting a yearly catch quota.

The other approach, popularized by R. J. H. Beverton and S. J. Holt, is to adjust minimum size limits; it is applicable particularly to trawl and gill-net fisheries. An increase in minimum size by stipulating nets of larger mesh can be instituted without special hardship to the fisherman and even with some saving to him, for nets of larger mesh are usually cheaper and there is less sorting of the catch. Thus, international agreement on larger mesh sizes has been achieved for cod and haddock trawlers of the western North Atlantic; sustained yield increases of 10% to 25% have been predicted as a result — particularly as many of the young fish spared were formerly discarded at sea.

Among the many factors which can complicate this simple theory of exploitation, two important ones are mentioned here. An increase in growth rate sometimes compensates for thinning of the stock; this makes production more stable and also less susceptible to improvement by management regulations. Also, F. I. Baranov long ago showed that an unfished stock of a long-lived species resembles a virgin forest: there is a big crop of mature fish, accumulated and ready to be harvested once. After the first few years of fishing, yield must depend on the (much smaller) annual biological production. Failure to make this distinction has caused and still causes much concern about "depletion" of stocks that actually are only lightly fished.

2. Obtaining Maximum Recruitment. — The above analysis tells how to get the most out of a fishery stock once it is in existence. But in order to have adequate recruits year after year, the spawning stock must not be allowed to become too small. The question is, how small is too small? And can a spawning stock be too large?

Direct study of these questions is made difficult by the tremendous variability of success of reproduction in most fishes. For example, Johan Hjort showed that the 1904 year class of herring (Clupea harengus) in Norwegian waters contributed more to the fisheries of 1908 to 1918 than did all other year classes combined. Usually fluctuations are somewhat less extreme than this, but large enough to be of great practical importance.

In addition to these year-to-year fluctuations, there are long-term trends in ocean conditions which may augment the supply of one species, while another becomes depressed until fishing is no longer possible. The marked increase in cod along the southwest coast of Greenland after 1935 is associated with a small increase in sea temperature in this marginal area. Increases in sprats (Clupea sprattus), herring and cod in the Baltic sea seem to reflect an increase in salinity there. Other times there is no obvious reason for an observed change. For example, in the southern North sea the supply of soles (*Solea* vulgaris) increased severalfold in spite of a regular and fairly intensive fishery.

In view of this large and little understood variability in survival of fish eggs, what should be done about maintaining a spawning stock? In the early years of this century there was widespread concern about a possible inadequate egg supply of both marine and fresh-water fishes, and a prevailing rule of thumb for size regulations was that each fish should be allowed to spawn at least once. Later, fish tended to be divided up into two classes. For oceanic species like cod, haddock (*Melanogrammus aeglefinus*), plaice and herring, the prevalent (but not unanimous) opinion is that recruitment is practically independent of the supply of spawn. Thus, fishing regulations should concentrate on the best utilization of whatever recruits are at hand, without worrying about the future supply.

For the various salmons, trouts, sturgeons and others the situation is quite different. Since these desirable fish are very easily caught as they crowd into estuaries and pass up narrow rivers, it is simple enough to deplete a spawning stock far below the most productive level. Indeed, if fish are caught only near the end of their lives, as is true of many American stocks of Pacific salmon, the only form that management can take is that of making provision for future supplies. Under these conditions what average fraction of a stock should be caught in order to give maximum sustained yield? Direct observation of certain stocks over a period of years indicates that from 50% to 90% should be caught. Thus, no single rate of exploitation can obtain best utilization of all stocks. Ideally each stock should be managed individually. Since this is difficult when species are mixed together in a common fishery, compromise is often necessary.

If numbers of fish caught can be accurately controlled, a better form of the management question is: what absolute number of spawners in each stock will give the best average yield? Already it is clear that too much spawning for best yield can occur, but too little is more common. Although success of reproduction varies, in fresh water as well as in the sea, this variability does not do away with the need for an adequate number of spawners. In poor seasons they may seem wasted, but unless eggs are available in quantity, a good reproductive season will not produce a big crop.

See also FISHES; FISHERIES; FISH AND WILDLIFE SERVICE; FISHING VESSELS.

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FISH CURING is the method by which fish is preserved in edible condition by drying, salting or smoking or by a combination of these. Fish decomposes rapidly, particularly in warm climates! as a result of the activities of the bacteria and molds that it harbours, and of enzymic self-digestion and atmospheric oxidation. From earliest times preservative processes have been developed and handed down, and these have permitted storage of day-to-day and seasonal surpluses until times of dearth.

Most methods of curing depend on dehydration, whether by evaporation, as in drying in the sun and wind or over smoky fires, or by extraction of fluid from the tissues by osmosis, in the case of treatment with salts. Common salt, which is chiefly used, and the chemicals absorbed from smoke also have specific bactericidal effects.

Drying alone is used in Norway and Iceland to produce stockfish (stock, a "stick") from nonfatty fish such as cod. Once a staple article of diet throughout Europe, it is now mostly eaten in Italy and Nigeria and by Scandinavian epicures in various countries. Hard drying is combined with heavy salting of split cod, etc., in making klipfish (*klipper*, rocks on which the fish was laid out to dry in Norway), an important export from North Atlantic countries to Iberia, the Caribbean and Latin America. French, Spanish, Portuguese and, occasionally, British vessels salt fish on the fishing grounds, usually for subsequent drying ashore. Certain bacteria, peculiarly resistant to salt, cause a form of spoilage known as "pink" from the colour produced.

Fatty fish, such as herring, pilchard and mackerel, are usually eviscerated and mixed with salt so that they become covered with a brine pickle. Packed tight with the pickle in barrels to minimize oxidation of the fat by atmospheric oxygen, this was formerly pre-eminent as an export. The Dutch fishery off the British coast salted and packed the fish on the fishing vessels (busses) at sea. In the 19th century the Scottish herring-curing industry was predominant and an extensive trade was built up, particularly with eastern Europe, but this declined after World War I.

"Red herrings" were ungutted herrings, hard salted and then hung in kilns for several weeks over smoldering sawdust fires, and were once popular in England, but are now mainly exported to the Mediterranean and the Levant. Salmon, also a fatty fish, was similarly cured for long-term preservation by salting in barrels or salting and smoking. For shorter storage these fish were "potted" by heating in a pickle of salt, vinegar and herbs.

The changes in the fish during hard curing produced a characteristic flavour which added variety to otherwise drab diets and is still appreciated by gourmets. However, when the railways in the mid-19th century permitted for the first time rapid inland distribution of fresh sea fish, later chilled in ice, the taste for these rather tough, salty and highly flavoured hard-cured products declined in industrialized countries. Trade in them is therefore generally confined to countries, mostly with warm climates, that are not yet sufficiently advanced economically to rely on the distribution of fresh and frozen fish. Many such countries are also developing their own fisheries and therefore hard-curing methods, suited to the preservation of expected increases in supplies, may continue to be used for some time.

In the more advanced countries, particularly in northwest Europe and North America, during the period 1850–1950, much more lightly cured, mildly smoked products were developed that can only just be distributed satisfactorily, but not stored, without refrigeration. Typical of these are the kipper, which is made from split, gutted herring; the bloater, a whole, ungutted herring; the finnan haddie or haddock, which is cut open in a special way; and various types of smoked fillets. In Germany and Sweden hot-smoked products are preferred, such as buckling (from unsplit herring) and smoked eels, which are cooked in the smoke. All such products contain only sufficient salt and smoke to impart an attractive flavour (colour usually being supplied by harmless dyes), while the slight degree of drying avoids undue toughness. Furthermore, cold storage can be used partially or almost wholly for preserving.

From 1935 onward research workers and engineers investigated the traditional processes with a view to improvement. As a result mechanical dryers and smoking kilns that provide a better degree of control are becoming widely adopted both for the hard export cures and the milder ones for home consumption.

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FISHER, ANDREW (1862–1928), Australian statesman, was born at Crosshouse, Kilmarnock. Aug. 29, 1862, and began life as a coal miner. He emigrated to Queensland at the age of 23, and was elected to the Queensland legislature in 1893 In 1901 he was elected to the commonwealth parliament. joined John Christian Watson's Labour cabinet of 1904 as minister of trade and customs, and became leader of the Labour party in 1907 on Watson's resignation. In 1908 he became prime minister, but his administration lasted only six months. At the general election in 1910, however, his party was returned with a sweeping majority, and he was prime minister. for three years, during which period he tackled the question of imperial defense,, adopted Lord Kitchener's report of 1909 and passed a measure establishing universal military training. His ministry fell in 1913, but at the election of Aug. 1914 he was again returned to power and gave Australia a vigorous lead in the early days of World War I. At the end of 191j he resigned and took up the high commissionership, retiring in 1921. He died in London on Oct. 22. 1928.

FISHER, HERBERT ALBERT LAURENS (1865–1940), British historian and statesman whose best-known book, *History of Europe* (3 vol., 193j), illustrates his broad sympathies, wide learning, keen critical faculty and the pictorial quality of his prose. was born in London, March 21, 186j. Educated at Winchester and at New college, Oxford, he became vice-chancellor of Sheffield university in 1912. He entered parliament in 1916, on becoming the president of the board of education. The Education act of 1918 *(see* EDUCATION, HISTORY OF: *Great Britain and the Commonwealth of Nations)* embodied his blend of humanism and humanitarianism. Later, his hope for a united Europe led him to support the League of Nations, and he was a delegate to the assembly, 1920–22. His experience with men and affairs made him an outstanding warden of New college from 1925 until his death in London on April 18, 1940. He resigned from politics in 1926. Fisher's works include: *Studies in Napoleonic Statesmanship: Germany* (1903); *Bonapartism* (1908); *The Whig Historians* (1928); *Lord Bryce* (1926); *The Common Weal* (1924); and his posthumous *Unfinished Autobiography* (1940).

See D. Ogg, Herbert Fisher, 1865–1940 (London, New York, 1947).

FISHER, IRVING (1867–1947), U.S. political economist, who combined the talents of a scientist with the interests of a crusader, was born at Saugerties, N.Y., on Feb. 27, 1867. After taking a bachelor's degree (1888) and a Ph.D. degree (1891) in mathematics from Yale university, he taught mathematics before shifting to economics, becoming a full professor at Yale in 1898. Fisher used mathematical methods to discover original solutions to some of the fundamental problems of economics. His crusading spirit led him into many fields of reform, including economic stabilization. health, eugenics, conservation, prohibition and the League of Nations.

In *The Purchasing Power of Money* (1911) Fisher developed the modern version of the relation between changes in the quantity of money and changes in the general level of prices. In numerous writings he expounded his plan for the "compensated dollar." a dollar of constant purchasing power, sometimes referred to as the "commodity dollar." In place of the conventional gold standard. which defined the unit of money in terms of a given *weight* of gold, Fisher proposed to define the dollar in terms of a given *value* of gold. The constant value of gold was determined by an index number of commodity prices of a given basket of goods.

Among more than two dozen books, his most important were: *Mathematical Investigations in the Theory of Value and Prices* (1892); *The Nature of Capital and Income* (1906); *The Purchasing Power of Money* (1911); *The Making of Index Numbers* (1922); *The Theory of Interest* (1930); *Booms and Depressions* (1932). (D. DD.)

FISHER, JOHN (*c.* 1469–1535), English cardinal and bishop of Rochester, born at Beverley, went in 1484 to Michael House, Cambridge, where he took his degrees in arts in 1487 and 1491, and, after filling several offices in the university, became master of his college in 1499. He took orders; and his reputation for learning and piety attracted the notice of Margaret Beaufort. mother of Henry VII, who made him her confessor and chaplain. In 1501 he became vice-chancellor; and later on. when chancellor. he was able to forward. if not to initiate, the schemes of his patroness in the foundations of St. John's and Christ's colleges, in addition to two lectureships in Greek and Hebrew. His love for Cambridge never waned. and his own benefactions took the form of scholarships, fellowships and lectures. In 1503 he was the first Margaret professor at Cambridge; and the following year was raised to the see of Rochester, to which he remained faithful. although the richer sees of Ely and Lincoln were offered to him. He was nominated as one of the English prelates for the Lateran council (1512), but did not attend. A man of strict and simple life, he did not hesitate at the legatine synod of 1517 to censure the clergy. in the presence of Thomas Wolsey himself, for their greed of gain and love of display; and in the convocation of 1523 he freely opposed the cardinal's demand for a subsidy for the war in Flanders.

A great friend of Erasmus, whom he invited to Cambridge. while earnestly working for a reformation of abuses. he had no sympathy with those who attacked doctrine; and he preached at Paul's Cross (May 12, 1521) at the burning of Luther's books. Although he was not the author of Henry's book against Luther, he joined with his friend, Sir Thomas More, in writing a reply to the scurrilous rejoinder made by the reformer. He retained the esteem of the king until the divorce proceedings began in 1527; and then he set himself sternly in favour of the validity of the marriage. He was Queen Catherine's confessor and her only champion and advocate. He appeared on her behalf before the legates at Blackfriars, and wrote a widely read treatise against the divorce.

Recognizing that the true aim of the scheme of church reform brought forward in parliament in 1529 was to put down the only moral force that could withstand the royal will. he energetically opposed the reformation of abuses. which doubtless under other circumstances he would have been the first to accept. In convocation. when the supremacy was discussed (Feb. 11, 1j31). he declared that acceptance would cause the clergy "to be hissed out of the society of God's holy Catholic Church"; and it was his influence that brought in the saving clause! *quantum per legem Dei licet.*

Through listening to the revelations of the "Holy Maid of Kent," the nun Elizabeth Barton (*q.v.*), he was charged with misprision of treason, and was condemned to the loss of his goods and to imprisonment at the king's will, penalties he was allowed to compound by a fine of £300 (March 25, 1534). Fisher was summoned (April 13) to take the oath prescribed by the Act of Succession, which he was ready to do, were it not that the Preamble stated that the offspring of Catherine were illegitimate, and prohibited all faith, trust and obedience to any foreign authority or potentate. Refusing to take the oath, he was committed (April 15) to the Tower, where he suffered greatly from the rigours of a long confinement. On the passing of the Act of Supremacy (Nov. 1534), in which the saving clause of convocation was omitted, he was attainted and deprived of his see. The council, with Thomas Cromwell at its head, visited him on May 7, 1535, and his refusal to acknowledge Henry as supreme head of the church was the ground of his trial. Paul III was unaware of the grave danger in which Fisher lay; and in the hope of reconciling the king with the bishop, created him (May 20, 1535) cardinal priest of St. Vitalis. When the news arrived in England it sealed his fate. Henry, in a rage. declared that if the pope sent Fisher a hat there should be no head for it.

The cardinal was brought to trial at Westminster (June 17, 153j) on the charge that he did "openly declare in English that the king, our sovereign lord, is not supreme head on earth of the Church of England." and was condemned to a traitor's death at Tyburn, a sentence afterward changed. He was beheaded on Tower Hill on June 22. 1535, after saying the *Te Deum* and the psalm *In te Domine speravi.* His body was buried first at All Hallows. Barking. and then removed to St. Peter's *ad vincula* in the Tower, where it lies beside that of Sir Thomas More. His head was exposed on London Bridge and then thrown into the river. He was beatified in 1886, and canonized by Pius XI in 1935.

Fisher's Latin works are to be found in the *Opera J. Fisheri quae hactenus inveniri potuerunt omnia* (Würzburg, 1595), and some of his published English works in the Early English Text Society, Extra series, no. 27, part i (1876). There are others in manuscript at the *P.R.O.* (27, Henry *VIII*, No. 887). Resides the state papers, the main sources for his biography are *The Life and Death of that renowned John Fisher, Bishop of Rochester* (London, 1655) by an anonymous writer, the best edition being that of Van Ortroy (Brussels, 1893); Bridgett's *Life of Blessed John Fisher, Bishop of Rochester* (London, 1880 and 1890); and Thureau, *Le bienheureux Jean Fisher* (Paris. 1907).

(E. TA.)

FISHER, JOHN ARBUTHNOT FISHER, 1ST BARON (1841–1920), British admiral, was born on Jan. 25, 1841, and entered the navy in June 1854. He served in the Baltic during the Crimean War, and was engaged as midshipman in the "Highflyer," "Chesapeake" and "Furious," in the Chinese War, in the operations required by the occupations of Canton and of the Peiho forts in 1859. He became sub-lieutenant on Jan. 25, 1860, and lieutenant on Nov. 4 of the same year.

The cessation of naval wars, at least of wars at sea in which the British navy had to take a part, after 1860, allowed few officers to gain distinction by actual services against the enemy. But they were provided with other ways of proving their ability by the sweeping revolution which transformed the construction, the armament. and the methods of propulsion of all the navies of the world, and with them the once-accepted methods of combat. Lieutenant Fisher began his career as a commissioned officer in the year after the launching of the French "Gloire" had set going the long duel in construction between guns and armour. He early made his mark as a student of gunnery, and was promoted commander on Aug. 2, 1869, and captain on Oct. 30, 1874. In this rank he mas chosen to serve as president of the committee appointed to revise *The Gunnery Manual of the Fleet.* It was his already established reputation which pointed Captain Fisher out for the command of H.M.S. "Inflexible," a vessel which, as the representative of a type, had supplied matter for much discussion. As captain of the "Inflexible" he took part in the bombardment of Alexandria (July 11, 1882). The engagement was not arduous in itself, having been carried out against forts of inferior construction, indifferently armed, and poorly garrisoned, but it supplied an opportunity for a display of gunnery, and it was conspicuous in the midst of a long naval peace. The "Inflexible" took a prominent part in the action, and its captain had the command of the naval brigade landed in Alexandria, where he adapted the ironclad train and commanded it in various skirmishes with the enemy.

After the Egyptian campaign, he was, in succession, director of Naval Ordnance and Torpedoes (Oct. 1886–May 1891); aide-decamp to Queen Victoria (June 18, 1887–Aug. 2, 1890, at which date he became rear-admiral); admiral superintendent of Portsmouth dockyard (1891–92); a lord commissioner of the navy and comptroller of the navy (1892–97) and vice-admiral (May 8, 1896); and commander-in-chief on the North American and West Indian station (1897).

In 1899 he acted as naval expert at The Hague Peace conference, and on July 1, 1899, was appointed commander-in-chief in the Mediterranean. From the Mediterranean command, Admiral Fisher went again to the admiralty as second sea lord in 1902, and became commander-in-chief at Portsmouth on Aug. 31, 1903, from which post he passed to that of first sea lord. Besides holding the foreign Khedivial and Osmanieh orders, he was created K.C.B. in 1894 and G.C.B. in 1902. As first sea lord, during the pears 1903–09, Sir John Fisher had a predominant influence in all the far-reaching measures of naval development and internal reform; and he was also one of the committee, known as Lord Esher's committee, appointed in 1904 to report on the measures necessary to be taken to put the administration and organization of the British war offices on a sound footing. The changes in naval administration made under him were hotly criticised by his critics, who charged him with autocratic methods, and in 1906–09 with undue subservience to the government's desire for economy; and whatever the efficiency of his own methods at the admiralty, the fact was undeniable that for the first time for very many years the navy suffered, as a service, from the party-spirit which was aroused. It was notorious that Admiral Lord Charles Beresford in particular was acutely hostile to Sir John Fisher's administration; and on his retirement in the spring of 1909 from the position of commander-in-chief of the Channel fleet, Lord Charles put his charges and complaints before the government, and an inquiry was held by a small committee under the prime minister.

Its report, published in August, was in favour of the admiralty, though it encouraged the belief that some important suggestions as to the organization of a naval "general staff" would take effect. On Nov. 9 Sir John Fisher was created a peer as Baron Fisher of Kilverstone, Norfolk. He retired from the admiraltv in Jan. 1910.

From 1910 until Oct. 1914 Lord Fisher remained in retirement, although Winston Churchill, then first lord of the admiralty, constantly consulted him and it was on Fisher's advice that Sir John Jellicoe was designated admiral of the Grand fleet in the event of war. (It is noteworthy that at the time of the Agadir crisis, Fisher expressed to Lord Esher and others strong disapproval of the war office plans involving Great Britain in extensive land operations in France.)

Fisher was recalled as first sea lord in place of Prince Louis of Battenberg in the critical days at the end of Oct. 1914. The "Audacious" had been sunk, Cradock heavily defeated off Coronel, German submarines were active, and the measures to stop the flow of supplies into Germany were not effective. Fisher took the responsibility of weakening the British fleet in home waters and detached the "Invincible" and "Inflexible" to engage von Spee, with the result that a complete victory was gained in the battle of the Falkland Islands. To Fisher's boldness and realism again were due the new blockade policy and the laying of extensive mine fields.

The association between Churchill and Fisher was most happy until it was broken by the Dardanelles enterprise. Fisher lever liked it; his preference was for a landing on the coast of Prussia in the Baltic and the employment of Russian troops against the heart of Germany. But he was overpersuaued by Churchill into reluctant acquiescence to the initial efforts against the Dardanelles.

When, however, the first attempt to force the straits had failed, and German submarines had made their appearance in Turkish waters, and it seemed doubtful whether the demands of the French campaign would allow the British to send the necessary reinforcements to the army in Gallipoli, Fisher felt that he could no longer continue to countenance the project of forcing the Dardanelles. At the War council of May 14, 1915, he had declared that "he was against the Dardanelles and had been all along." Churchill afterward told him that it was not fair to obstruct necessary measures at the Dardanelles and then when things went wrong to turn around and say "I told you so, I was always against it." Fisher replied "I think you are right—it isn't fair." That night Churchill in order to encourage the entry of Italy into the war on the side of the Allies gave instructions that four cruisers should go to the Mediterranean 48 hr. before the time arranged, and the minute was signed "First sea lord to see after action."

That was the first document seen by Fisher on beginning work as usual at four o'clock next morning. He refused to serve with Churchill any more and resigned. His resignation coinciding with the crisis about high-explosive shells, brought down the already shaken Liberal government, and led to the formation of the first Coalition. The manner of his leaving the admiralty became Fisher less than anything in his life, but his motives were neither personal nor unworthy. He felt that as things were he had lost his power of service; that he could only hamper the Dardanelles and be "unfair" to Churchill without influencing events in the direction which he felt was right.

Fisher did useful work later in the war as chairman of the Inventions board, and when he died on July 10, 1920, at the funeral in Westminster Abbey, the crowds felt that they were mourning the greatest British sailor since Nelson. Their reverence was the more remarkable because Fisher never commanded a fleet in action, nor, except the Falkland Islands, is any great victory at sea traceable to his direct inspiration. His enemies accused him of exaggerating the material side of naval pouer at the expense of the moral and intellectual. He was not good in the logical presentation of an argument; he thought pictorially and the sequence of his ideas expressed themselves in a series of verbal explosions. But his prescience amounted at times almost to second-sight, and he had a genius for the burning phrase that lights up the truth from within.

The most amazing quality of the man was that as he grew older he became more radical and revolutionary in his ideas. To the old man in 1919 his own Dreadnought of 13 years was a symbol of effete tradition; his slogan "Sack the lot" was not the prosecution of a personal vendetta against the admiralty chiefs, but expressed his conviction that though the spirit was eternal, its forms were only made to be broken. He wrote two volumes of memoirs: *Memories* (1919) and *Records* (1919); somewhat scrappy and disorderly in composition but full of his glowing vitality.

Fisher married, in 1866, Kate Broughton, by whom he had one son and three daughters. (D. H.; H. SM.)

FISHER *(Martes pennanti)*, a North American member of the weasel family (Mustelidae), black in colour, reaching a total length of about 42 in., and producing valuable fur. The fisher is also called Pekan, Pennant's marten, and, by trappers, black cat. *(See* **MARTEN;** FUR.)

FISHERIES. The term "fishery" as commonly employed embraces every method of pursuit and capture, whether for profit or for sport, of aquatic animals, from whales and seals, which are warm-blooded mammals: to the "tiddlers" prized by urchins. However, neither whaling nor sealing comes within the scope of this article, which is limited to the pursuit of fish properly so-called and is primarily concerned with commercial fisheries for fish for food. Fishing is probably the earliest form of hunting, and, as men were. surely hunters before they were cultivators, is actually the oldest industry in the world.

For the most part, the attitude of man toward fisheries has been that of the spendthrift: Nature gave the increase; he had but to use it if he could. The abundance of fishes in their different species varied from year to year, but there was always abundance and it is only in comparatively recent years that serious apprehensions have been entertained lest the operations of man might jeopardize the stability of the stock. The contrary view still finds vigorous expression in some quarters in spite of the rapid growth both of the volume of fishing and of the efficiency and destructiveness of fishing gears.

Most fishes are enormously prolific. A female turbot will produce in one spawning season more than 8,000,000 eggs, a cod 4,500,000, a plaice 300,000, a herring 31,000. The eggs produced by individuals of most of the species of chief importance are numbered at least in hundreds of thousands; but at all stages of their life the fishes are beset by a host of enemies, among whom it is probable that man has been, until recently, the least destructive.

With the growth of the population of the world and the increasing demand upon available resources of food, it has begun to be recognized that man has hitherto failed to take full advantage of the enormous resources of the sea. Approximately three-quarters of the earth's surface is covered by water; but the great fishing grounds of the world are determined primarily by the depth of water upon them, and are almost entirely within the limit of a depth of 250 fathoms, and chiefly within 100 fathoms. It is improbable that any great abundance of fish is to be found far beyond these limits, and in any case the difficulty and the cost of fishing operations by the methods hitherto in use increase in proportion to the depth of water on the fishing grounds. It is thus on what may be described as the shelves of the continents or the banks of the oceans that the deep-sea fisheries, the chief commercial fisheries of the world, are prosecuted.

Historically speaking, there has been no parallel to the development of the fisheries of the North Atlantic and North Pacific, and more particularly of European waters. Nor must it be forgotten when speaking of the great industrial developments of fisheries in Europe in the 20th century, and particularly of the ubiquitous trawlers of Great Britain, that in the days of the Tudors English fishermen were fishing not only in the North sea and other home waters, but at Iceland, as far east of the North Cape as Vardo, and even off Newfoundland. Throughout the middle ages salt fish played a recognized part in the economy of European nations; it was the Lenten fare of Roman Catholic Europe: a regular part of the rations of armies in the field, and the complement of salt meat in the winter food of northern Europe.

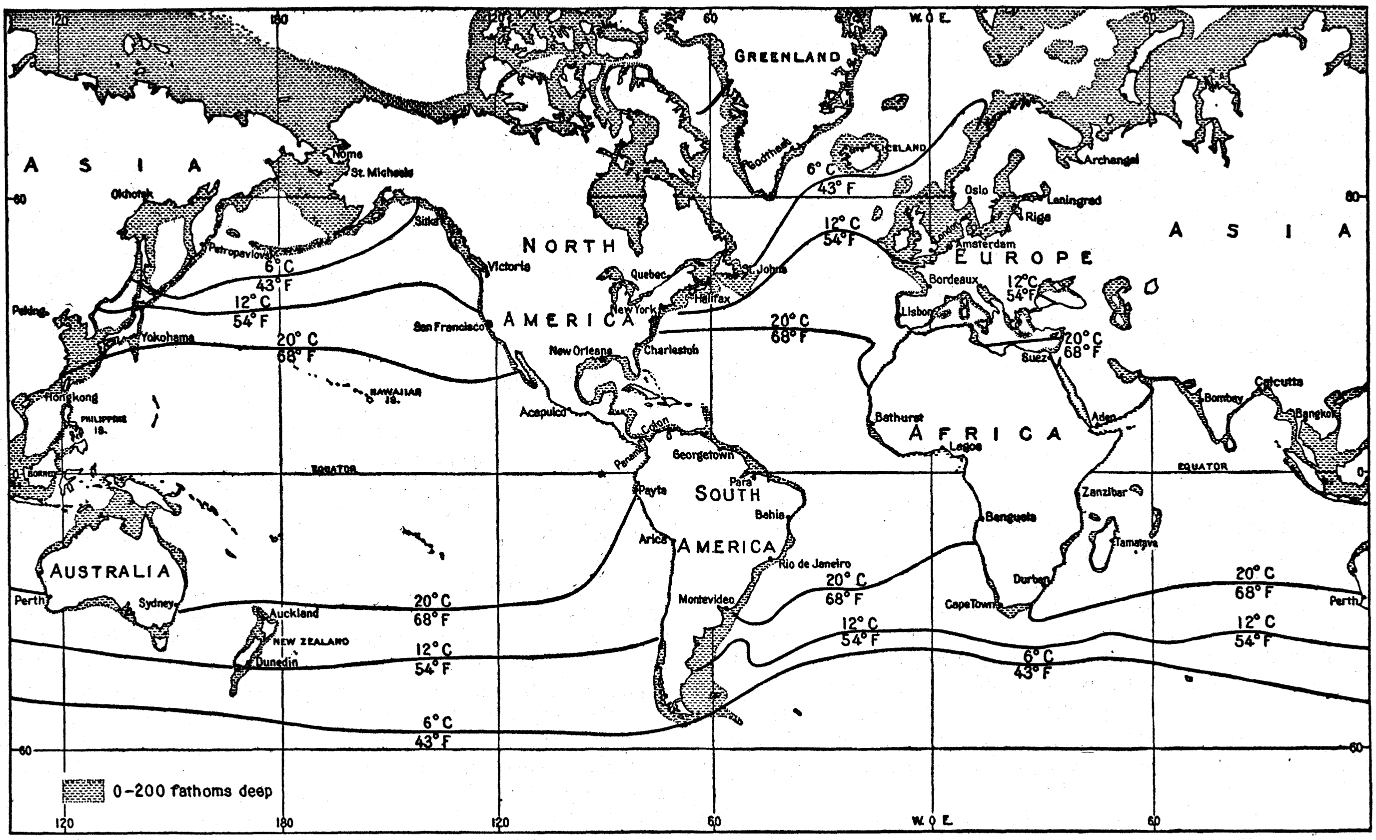
In Great Britain consumption of fish per person is about 32 lb. annually, and the total consumption of fish is normally about a quarter of the total consumption of meat. Fish is also the raw material of various industries: fish-canning; fish-salting; herring-pickling; the manufacture (from surplus fish and fish offal) of fish meal, which is a useful feeding stuff for poultry, pigs and cattle, and of fish-manure; and the production of oil of various grades from medicinal cod-liver oil to cruder oils used for such purposes as tanning, soap-making and tempering steel. Glue and isinglass are also among the by-products of fisheries, and fish skins are also converted into fine leather.

Again, fishing by modern methods provides employment on a large scale in connection with shipyards, ice factories, net factories, motor works, etc. The fishing ships of Great Britain use about 2,000,000 tons of coal and 171,000 tons of diesel and heavy fuel oil a year. The daily transport of fish is an important factor in the activities of the railways. The distribution of fish from the wholesale markets to the retail shops and to the fried fish shops —which handle about 40% of the total quantity of fish consumed — provides employment for many hands. If account be taken of the many trades and occupations which are in some sort ancillary to or activated, in whole or in part, by the fishing industry, it will be seen that, although the number of fishermen is comparatively small (about 43,000 in Great Britain at mid-20th century), the failure of the industry would cause widespread repercussions in the labour market. In every country with a fishing population this would be a calamity; in some, such as Norway and Iceland, where the leading industry is fishing, it would be a disaster.

But the influence of the fishing industry goes farther and deeper than this. It is not generally recognized how great a part fisheries have played in the destinies of nations. A full history of fisheries and even of the fisheries of any one country has yet to be written. When the first man ventured to sea in a dugout, it is probable that his purpose was the better to pursue fish, and not only the modern deep-sea trawlers, liners and drifters, but the merchant and fighting navies are the lineal descendants of the prehistoric fisherman in his dugout. Thus fishing may be presumed to have prepared the way for sea trade, without which modern civilization is inconceivable. The growth of the all-powerful Hanseatic league from the small beginnings of the herring fisheries of Scania, and the rise of the sea power of the Dutch in the 17th century, following upon their predominance in the fisheries of the North sea, are comparatively modern instances of the influence of fishing on shipping. "It is the fish taken upon his majesty's coasts," wrote Sir William Monson, admiral of the Narrow seas, in the reign of James I, "that is the only cause of the increase of shipping in Europe; and he that hath the trade of fishing becomes mightier than all the world besides in the number of ships."

The Tudors in England feared a loss of sea power from the decline of the fisheries which followed the Reformation, and by various measures, including the so-called "political Lent," sought to give a new impetus to the fisheries. The Stuarts, with the same object in view, sought to assert a British dominion over the North sea, and it was with the temporary decline of its fishing fleet that in the subsequent struggle with the Dutch, Great Britain encountered perhaps its greatest humiliation at sea. Moreover, throughout the history of Great Britain, the fisheries have not merely been a "nursery" for the mercantile marine and the royal navy but have directly contributed their quota to the fighting forces at sea, and when in World Wars I and II the fishermen with their ships played a prominent part in combating the menace of mine and submarine. history was repeating itself, as it had from age to age with variations, from the days when the fishermen of the Cinque ports acquired their privileges in return for naval service.

Fishing Methods and Gears. — The methods of catching swimming fish are almost innumerable, but all of them are variations of



FROM THE REPORT OF THE IMPERIAL ECONOMIC COMMITTEE, PART V—FISH

MAP OF THE WORLD WITH THE AREA WITHIN 200-FATHOM LINE STIPPLED SHOWING THE LOCATIONS OF THE PRINCIPAL FISHING GROUNDS, AND THE MEAN ANNUAL ISOTHERMS INDICATING THE DISTRIBUTION OF THE KINDS OF FISH

a few radical methods. One, perhaps the earliest, is that of direct attack by means of a spear and is still in use in some parts of the world. The next is a trap devised to intercept and capture roving fish. The various forms of fishweirs still found here and there, which work on the principle of admitting fish on the flood tide and trapping them on the ebb, are probably of primitive origin. From the fishweir or dam of stone or clay to a similar trap of wattle hedging and then to fixed nets is a natural logical evolution. Another form of trap is that into which fish are attracted by food, examples of which, probably of primitive origin, are the wicker-work traps for catching lobsters, prawns and crabs.

The baited line was probably first used without a hook, as it is even now in the method of catching eels known as "clotting" or "bobbing," that is tying a bunch of worms at the end of a line, and, when it has been taken by the eel, drawing it swiftly in before the eel has had time to disengage its teeth. This method was improved upon by the introduction of a hook, the earliest form of which may have been the thorn hooks still used in parts of Wales and the Thames estuary. From these methods the more elaborate devices employed in modern commercial fishing were evolved, the most important development being the device of bringing the trap, in the form of a net, to the fish, instead of trusting to the natural movements of the fish or the lure of bait to bring the fish to a stationary trap.

In the fisheries of the North Atlantic, which are the most highly developed and commercially organized in the world, the methods of fishing of chief importance are trawling, seining, drifting and lining. Trawling and seining, involve the use of a net which is brought to the fish. In the case of the trawl this is done by dragging a bag-shaped net the mouth of which is kept open either by a beam across the head or by its being towed by a pair of ships each with a warp to one side of the net, or by the pressure of the water upon wooden kites known as otter boards attached to the sides of the mouth, or wings, of the net, and, in the case of the seine, by gradually encircling the fish with a net in the centre of which is a bag not unlike that at the end (known as the "cod-end") of the trawl. The beam trawl is used only on some small fishing craft; the otter trawl is employed on almost all but the smallest trawlers. It is, having regard to all possible circumstances, the most effective instrument for taking demersal (*i.e.,* bottom-living) fish. The efficiency of the otter trawl was improved by several modifications, one of the most notable of which was the Vigneron-Dahl modification, a French invention of about 1924, which incorporated wires of up to 50 fathoms in length as the attachment between the otter boards and wings of the net. The Spanish method of pair trawling is very efficient for catching hake near to the sea bed, and pair trawling for herring off the bottom with large-mouthed trawls is very effective on certain grounds. Seines are used for catching both pelagic and demersal fish. The forms' most used in pelagic fisheries are the purse seine and the rather similar ring net.

Both involve first surrounding a shoal of fish with a curtain or wall of netting, the top of which is buoyed at the surface, and secondly, drawing together the bottom of the net by purse lines to trap the fish in a hemisphere of netting. The most efficient form of seine for catching demersal fish is the Danish seine, invented in Denmark, where it is the principal means of catching demersal fish. It is also used widely in other European countries, particularly Scotland and England. This method involves first encircling an area of the sea bed with two ropes of equal length of up to about one mile, which are attached one to each wing of a trawl-shaped net, and secondly drawing in the rope to an anchored ship so diminishing the area of sea bed surrounded. Fish are driven before the moving ropes to the centre of the encircled area and are then taken in the net which is eventually drawn up to the ship.

The principle of the drift net differs from that of the trawl and of the seine in that it is not actively approached to the fish. On the other hand, it differs from the stationary trap and the many forms of stationary net in that it is attached either to a floating buoy or to a drifting ship (hence the name) and moves with the buoy or ship under the influence of wind and tide. It is lightly and strongly made of cotton and is the instrument principally used in the great herring fisheries. Each herring net measures from 50 to 60 yd. long and about 14 yd. deep, but the nets are used in "fleets," as many as 85 or more of them being employed at one time from one vessel so as to form an extended wall of netting hanging perpendicularly in the water. The net is generally fished about 3 yd. below the surface of the water, being kept at the right level by a series of buoys or "pellets" connected with the headline by strops. This net is devised to intercept sizable fish which in the attempt to pass it are caught by the gills. Drift nets of various dimensions are used for catching "pelagic" fish, that is to say, fish that swim in the upper layers of the water, chiefly herring, mackerel, pilchards and sprats. Drift nets of larger mesh are also used for catching salmon.

Fishing by means of lines with baited hooks was formerly of much greater commercial importance than at present. There are three methods of lining, hand-lining, long-lining and trolling. In hand-lining the line is drawn by hand as soon as the fish is felt; in long-lining the line is shot and left unattended until it is time to haul; in trolling the lines are towed through the water and hauled when fish are caught. Hand lines are of greatest commercial importance in the Pacific tuna fisheries. A long line is fitted with a great number of hooks attached to the main line by thin strong lines of materials which vary according to the character of the fish and to local custom. Long lines may be set at low water on the sands, but more often they are worked from fishing vessels in deep water. Deep-water lines are anchored and buoyed at each end, and sometimes at intervals along their length, when used to catch demersal fish, bat are not anchored when used pelagically. On a large liner the number of hooks on one line may vary from 1,000 to 5,500. Deep-sea long lines are chiefly used demersally for cod and halibut and pelagically for tuna. The baits vary according to local conditions and include mussels, squid, herring and small pelagic fish.

FISHERIES PRODUCTION

World Fisheries. — The pursuit of fish is world-wide. No estimate of the output of the fisheries of the world can be wholly reliable because in many parts of the world where fishing is actively carried on no statistics are compiled. This applies particularly to inland fisheries, many of which are of great economic importance. However, most of the countries of Europe, the United States, the British dominions and Japan publish some form of annual statistics. A comprehensive statistical account of the greater part of the world fisheries is published in the *Yearbook of Fisheries Statistics* of the Food and Agriculture organization of the United Nations; of the fisheries of Europe in the *Bulletin Statistique* des *Pêches Maritimes* of the International Council for the Exploration of the Sea; and of the fisheries of the U.S. in the *Statistical Digest* of the fish and wildlife service of the U.S. department of the interior.

The fisheries in the cold and temperate waters of the northern hemisphere, with a yield equal to about 80% of the world total, produce an overwhelmingly great part of the world's fish supplies. Probably the best estimate of the annual world production of fish since World War II is that published by the Food and Agriculture organization of the United Nations, which put the figure at 27,100,000 metric tons in 1953. The published statistics of 1953 did not include the fisheries of the U.S.S.R. and China among the major fishing countries; with the exception of Japan they omitted most of the orient and the islands of the South Pacific and South Atlantic; also they omitted Turkey, parts of South and Central America, the West Indies and the greater part of Africa. The known quantity of world fisheries production in 1953 was 16,128,100 metric tons. Asia produced 43%, Europe 27%, North America 13% and the U.S.S.R. 9% of the estimated world total. By oceans the approximate share of estimated world production was Pacific 53%, Atlantic 46% and Indian Ocean 1%.

Japan is by far the foremost fishing country in the world, producing 4,576,500 metric tons in 1953, or 17% of the estimated world production. The production in 1953 of the other major fishing countries was, in metric tons, U.S. 2,385,200, Norway 1,505,500, United Kingdom 1,121,600, Canada 924,700, and, estimated, U.S.S.R. 2,500,000 and China 3,000,000. In Europe, next in order of greatest yield after Norway and the United Kingdom came the German Federal Republic with 730,400, Spain with 634,700, France with 520,300, Iceland with 424,700, Portugal with 392,400, the Netherlands with 343,300 and Denmark with 342.800 metric tons.

Shellfish. — The term shellfish embraces the edible species of both crustaceans (crabs, lobsters, crawfish, prawns and shrimps) and molluscs (oysters, mussels, cockles, scallops, clams, whelks, etc.). Their economic importance varies from country to country but is nowhere comparable with that of the fisheries for what are commonly known as wet fish. For instance. in Great Britain the total value of all shellfish (1953) was £1,229,000 as compared with £41,000,000 worth of wet fish, while in the U.S. the total landings of shellfish (1953) were worth $153,126,000 as compared with $199,149,000 worth of wet fish. The 1953 catch of shrimp in the U.S. was valued at $76,641,000 to the fishermen and that of oysters was worth $29,000,000 (*see* OYSTER). Lobsters are an important article of commerce in Canada and the U.S.; considerable quantities are exported. Japan has a considerable trade in canned crab meat and South Africa in canned and frozen crawfish.

The yearly values of the lobster and crab fisheries of Great Britain, producing 1,766,000 lobsters and 11,396,000 crabs, are £314,000 and £342,000 respectively. It is interesting to observe that the shrimp fisheries, yielding 37,000 cwt. annually, reach a value of about £143,000. The most prolific of the fisheries for molluscs are the cockle and mussel fisheries, in that order. The potential output of the mussel fisheries of Great Britain is very great, but the liability of mussels on beds polluted by sewage to transmit such intestinal diseases as typhoid makes cleansing essential and this, although economically practicable, restricts the fishery. The chief importance of the shellfish fisheries of Great Britain lies in the fact that they contribute to the livelihood of the declining population of inshore fishermen.

BRITISH FISHERIES

It is worthwhile in a study of fisheries to consider the British fisheries in some detail because they are, so far as sea fishing is concerned, the most highly organized in the world, with the possible exception of those of Japan. The inland fisheries of Great Britain are of little commercial significance. The salmon fisheries are exploited commercially, and thus have a certain importance, but reliable statistics of the catch of salmon in the British Isles are not available. The salmon fisheries of many of the rivers of Great Britain have suffered from reckless pollution. At their best they could not bear comparison in the commercial sense with those of the western rivers of North America which provide, in the various breeds of Pacific salmon, the raw material of a great canning industry and trade. The value of the trout and freshwater fisheries of Great Britain is almost wholly recreative.

It is as a deep-sea fishing nation that Great Britain is supreme, for no country has as great a fleet of powerful vessels equipped for distant voyages. In 1953 the fishing fleet of Great Britain included 1,015 steam and 593 motor vessels of more than 30 gross tons; nearly all of the steam vessels were trawlers, and most of the motor vessels drifters or seiners. In general steam power was preferred for the large distant water trawlers although some of these were motor driven, but late additions to the fleet of near-water trawlers, seiners and drifters were exclusively motor vessels. Comparative figures for the fleets of other European countries (vessels over 30 tons gross in 1953) were: German Federal Republic 200 steam and 356 motor, France 60 steam and 1,247 motor, the Netherlands 42 steam and 45j motor, and Norway 1,699 steam and motor vessels. The sea-fishing fleet of Denmark consisted of 1,336 vessels of more than 15 tons, most of them seiners and all motor driven.

Of the 1,147 vessels of more than 15 tons fishing from ports in England and Wales 616 were steam trawlers and 181 motor trawlers, 135 drifters or drifter-trawlers, mostly steam powered, 97 motor seiners and 56 motor liners. In Scotland the steam trawlers and motor drifters and seiners are the most numerous and important fishing vessels. British trawlers visit the fishing grounds

TABLE I.—*Quantity and Value of Demersal and Pelagic Fish of British Taking Landed in Great Britain in 1913, 1926 and 1953*

Year	Demersal		Pelagic (chiefly herring)	
	Quantity (cwt.)		Quantity (cwt.)	£ Value
1913	11,096,000	9,096,000	12,317,000	4,633,000
1926	10,961,000	13,541,000	8,000,000	3,503,000
1953	14,723,000	36,556,000	4,882,000	4,439,000

of the whole of the continental shelf from Iceland to West Africa and from the eastern Barents sea to the west of Scotland, Rockall and the southwest of Ireland, as well as the Newfoundland banks and Greenland.

The relative importance of the different methods of fishing in Great Britain may be gauged by reference to the following figures: quantity (in cwt.) of wet fish of British taking landed in Great Britain in 1953, by method of capture—trawl 12,405,100, seine 1,271,300, lines 282,800, drift net 3,843,400, ring net 588,700.

Trawlers, seiners and liners take chiefly demersal fish (known to the trade as white fish), but some mackerel are taken by these methods and at certain seasons herring trawlers land considerable quantities, particularly from the North sea Fladen ground and at the Smalls. Herring trawling has been most highly developed by Germany and adopted by France, the Netherlands and Belgium. The relative values of the demersal and pelagic fisheries may be gauged by reference to Table I.

In considering these figures, note that after World War I the herring fisheries, which depend for the most part upon the export trade in cured herrings, suffered seriously from the disorganization of the markets of Europe and particularly those of prewar Russia, which country formerly absorbed more than 50% of the export. The demersal fisheries, on the other hand, which depend mainly upon the home market for fresh fish, were not affected by postwar conditions to a great extent.

Trawling is known to have been practised in Great Britain as early as 1640. The industry was greatly enlarged when the Brixham and Barking smacks opened up the prolific North sea grounds in 1815 and again at the end of the 19th century with the advent of the steam trawler and with visits to Icelandic grounds. The greatest development of trawling in the first half of the 20th century was in arctic waters. The first voyage to the White sea was made in 1905; the most prolific Bear Island grounds, yielding an average of about 120 cwt. to each trawler per day's absence from port, were first successfully fished in 1929. Arctic and Icelandic waters in 1953 yielded respectively 3,006,000 cwt. and 4,036,000 cwt., together representing 34% of the total quantity of all wet fish landed in Great Britain in that year, or 48% of the total British demersal catch. Cod constitutes 75% of the arctic yield. Of other demersal fisheries in 1953, the North sea supplied 25% of the total British demersal catch.

The whole British fishing fleet includes many different designs of vessels, but certain major classes can be recognized. The specifications of typical vessels of these classes are given in Table II.

New methods of fishing are always being tried. The introduction of the Danish seine and its development in Scotland to fly-seining for catching fish just off the bottom, are comparatively recent, as is the practice of ring-netting for herring. There also have been developments of trawling in the direction of improved efficiency of the trawl itself, such as the introduction of Vigneron-Dahl gear around 1924 and the adoption of pair trawling. Later developments in fishing were associated with the use of supersonic

TABLE II.—*Specifications of Typical Vessels of the Main Classes of the British Fishing Fleet*

Type	Length in feet	Beam in feet	Depth in feet	Gross tonnage	Crew
Arctic steam trawler	173	30	14.3	560	28
Large North sea steam trawler	126	23	12.6	270	15
Small North sea motor trawler	75	21	7.6	80	7
Motor Danish seiner	56	16	7.4	36	4
Motor drifter	73	19	9.5	90	10

recording echo-sounders for locating shoals of fish and the construction of trawls to fish in midwater.

Trawlers did excellent work in World Wars I and II when they were employed principally as minesweepers and escort vessels, usually armed with guns and depth charges.

Especially after the introduction of steam power in the fishing industry, there was a growing tendency in Great Britain toward the centralization and industrialization of fisheries. Table III indicates the relative importance of the major fishing ports in which the commercial fisheries are chiefly concentrated (of the Scottish ports, Aberdeen and Granton alone are largely devoted to steam trawling; of the rest the herring fisheries supply the bulk of the catch, as is also the case of Yarmouth among the English ports).

From a general economic point of view this centralization has advantages, but it had a regrettable sequel in the depression of the smaller fishing ports, which have been unable to withstand the competition of their more powerful and better organized rivals. Their contribution to the fish supply of the country at mid-20th century was no more than 5% of the total—but they had played a great part as a "nursery" of seamen for the mercantile marine and the royal navy and had been the chief source of strength of the lifeboat service.

With the centralization of the fisheries and the development of the steam trawler, by means of which a smaller number of men

TABLE III.—*Average Daily Landings of Wet Fish at Ports at Which the Quantity Landed Daily Was 30 Tons or More in Any of the Years 1913, 1926 and 1954*

(In tons)

Port	1913	1926		1954	
	British	British	Foreign	British	Foreign
Hull	262	383	29	808	20
Grimsby	584	493	69	614	82
Aberdeen	263	243	153	306	19
Fleetwood	121	147	Q	184	...
Lowestoft	397	224	3	114	...
Fraserburgh	109	69	...	99	...
Yarmouth	512	246	...	83	...
Milford Haven	80	103	3	66	...
Shields, North	150	83	...	63	...
Ullapool	...	...	...	63	...
Peterhead	131	72	...	54	...
Granton	50	56	...	47	...
Stornoway	88	73	...	36	...
Mallaig	...	...	...	33	...
Lerwick	101	121	...	22	...
Newlyn	18		...	15	...
Wick	68	38	...	12	...
Swansea	25	83	...	11	...
Hartlepool	41	32	...	7	2
Plymouth	14	32	...	2	...
London	157	56	...	...	...
Stronsay	45	47	...	...	...
Blyth	36	...	...	...	...

can catch a greater quantity of fish, the number of fishermen regularly employed declined. This fact must be reckoned a misfortune to an island nation dependent for its existence on the freedom, of the seas and, therefore, on an adequate supply of seamen to sail and to defend the sea routes.

FISHERIES OF THE BRITISH COMMONWEALTH

If a chart of the world is studied with special reference to the sea areas within the depth of zoo fathoms—that being roughly the limit of the depth of the fishing grounds—it will be seen that most of the principal fishing grounds are fairly easily accessible from different parts of the British commonwealth.

Canadian fisheries together in 1953 yielded a total of 924,700 metric tons, comprised of 240,000 tons of cod and allied species, 237,200 of herring and 86,000 of salmon. The Canadian Great Lakes' fisheries yielded 47,300 metric tons in 1953. In that year about 11,300 metric tons of halibut from the Pacific were landed in the province of British Columbia, where salmon contributes half of the total value of what are the most valuable fisheries of any Canadian province; besides halibut, herring is another important species. Canada built up a large export trade which in 1953 distributed 27,000 metric tons of canned fish and 118,000 metric tons of fresh and frozen fish.

Comparatively little attention was bestowed upon the fisheries of Australia and in the latter 1950s the fishing grounds were only partially explored. The lack of interest in fisheries may be accounted for partly by difficulties of transport and partly by the relative cheapness of meat. Surveys show that there are large areas of trawlable water around the coasts, particularly off New South Wales and South Australia, and there is every reason to believe that they are prolific of fish. The Australian government, through the department of commerce and agriculture, promoted the development of the fisheries. The small trawling industry in New South Wales expanded steadily, and the development of pelagic fishing was begun. Total landings of all fish in Australia in 1952–53 were 51,600 metric tons, including 3,600 of oysters.

The fisheries of New Zealand yielded 35,300 metric tons in 1952. The trawling industry was modernized and expanded, the constitution of the trawler fleet changing from 20 steam and 28 motor trawlers in 1930 to 5 steam and 192 motor trawlers in 1952. The fishery for crawfish increased, but the Danish seine fishery declined. Oysters of a high quality are produced, particularly in the Foveaux strait (New Zealand).

South African fisheries were developed considerably after about 1933, partly as a consequence of continuing surveys which revealed rich and extensive fishing grounds, some quite close to Capetown and others not far from Durban. Trawling and lining increased. The catch of fish was increased more than threefold in the years after World War II to reach a level of 350,000 metric tons in 1953. The export trade, amounting to about £300,000 a year in 1938, rose to £7,820,000 in 1953, an important item of export being preserved crawfish tails, of which 3,300 metric tons were valued at £1,900,000. There is a considerable market for fresh fish in South Africa, particularly in the towns of the Rand.

The fisheries of the tropical regions of the commonwealth stand on a different footing from those hitherto mentioned. It is probable that in the warmer seas there is a greater number of species of fish, but that there are no such great concentrations of any one species as are found in the colder regions. Moreover, the areas within the 200-fathom line are on the whole less extensive in the tropics than in the northern seas, but fishing is practised on practically all the shores of the tropical colonies and of Ceylon, India and Pakistan. On the west coast of Madras about 54,000 metric tons of fish are landed annually and attempts have been made there to develop trawling. There are few statistics for other coasts of India, but it is probable that the economic importance of the inland fisheries is greater than that of the sea fisheries. The fisheries of Bengal supply about 16,000 metric tons of fish yearly to Calcutta alone. In Ceylon and Malaya the sea fisheries are actively exploited, and the governments undertook experimental work with a view to the development on more modern lines of age-old fishing industries.

In British West Africa, where climate and distribution difficulties necessitate fish being cured or processed, the British government, through the colonial office, tried to develop fisheries along the two main lines of fish farming and trawling. Trawling was started in Sierra Leone and in Nigeria. New canneries in the Gold Coast were prepared for increased catches of fish.

Generally speaking, it may be said that throughout the commonwealth there developed in the first half of the 20th century a disposition to pay greater attention than formerly to the food resources of the sea, and that this disposition had been translated into active measures.

JAPANESE FISHERIES

The fisheries of Japan are that nation's principal source of animal protein. Japanese fishermen make an annual catch of about 10,000,000,000 lb. of fish, shellfish and other aquatic products, about one-sixth of the total world catch. Approximately 1,500,000 persons are engaged either full or part-time in fishing and processing of marine products, and about 363,000 boats are used in the industry.

The development of Japan's fisheries, and its leading role in the production of fishery products, is associated with the geographical position of the country, its formation and its large and dense population. It has long stretches of coast, and much of its land area is unsuitable for agriculture and cattle rearing. The fisheries are, in general, not centralized; there are many small coastal fishing villages and few large fishing ports such as prevail in Europe and North America.

Japanese fishing is concentrated largely in the coastal waters of Japan proper, but operations also are conducted in the Yellow, East and South China, Okhotsk and Bering seas; in the North, Central and South Pacific ocean; and on Antarctic whaling grounds. Hokkaido leads in production, accounting for about one-third of the total catch. Honshu and Kanto are also regions of major production.

The principal species taken by Japanese fishermen are sardines, herring, mackerel, cod, tuna, bonito, sea bream, salmon and flatfishes. Shellfish (chiefly crustaceans and octopuses) and seaweed are important contributions to the Japanese food supply.

Aquiculture is important in Japan as in most oriental countries. The main products are carp, eel, mullet, trout, oysters, clams and seaweed.

The fisheries of Japan provide considerable foreign exchange, since large quantities of canned tuna, salmon and crab meat; fresh and frozen tuna and swordfish; fish liver oils and other fishery products are exported.

See Fish and Wildlife Service of U.S. Department of *the* Interior, ***Commercial Fisheries Review,*** published monthly.

UNITED STATES FISHERIES

United States fisheries, second largest in the world, are prosecuted on the seaboard of the Atlantic and Pacific oceans, in the Bering sea, in the Great Lakes and in many prolific rivers. In the Atlantic ocean, U.S. fisheries are conducted from the Grand Banks of Newfoundland to Campeche bank off Yucatan, Mex. On the west coast of North America, the range extends from the Bering sea to the coast of Peru. The variety of fish, shellfish and other aquatic products taken is so great that no summary account can do justice to it. For details, reference must be made to the reports of the United States fish and wildlife service of the department of the interior.

The importance of United States fisheries increased considerably during the first half of the 20th century, largely because of an increase in the output of manufactured products, particularly canned and frozen fishery items, and fish meal and oil.

The total landings of about 4,600,000,000 lb. in the latter 1950s were made by about 153,000 fishermen, and valued at about $325,000,000 to them. About 11,000 documented vessels of 5 net tons and over, and about 48,000 motorboats and 26,000 other boats, were used in making the catch. Processing and handling by primary wholesalers and manufacturers increased the value of the fishermen's catch to $548,000,000, and distribution to $775,000,000, while the ultimate consumer paid over $1,000,000,000 for a year's production.

Fishery products are taken commercially by U.S. fishermen in 40 U.S. states. However, well over 50% of the catch is normally made in only six states: California and Alaska on the Pacific coast; Massachusetts, New Jersey and Virginia on the Atlantic coast; and Louisiana on the Gulf of Mexico. Purse seines account for about 46% of the total weight of the catch; otter trawls for 23%, and lines for 10%.

A discussion of important U.S. fisheries which account for about 80% of the annual catch follows:

Atlantic Menhaden.—This fish, taken along the Atlantic and Gulf coasts, accounts for nearly 40% of the total volume of fish and shellfish taken by U.S. fishermen. The fish are not well known since nearly the entire catch is manufactured into meal and oil. The meal is used largely in poultry feeding, while the oil has many industrial uses and is widely used in Europe for manufacture into margarine. The catch of menhaden first exceeded 1,000,000,000 lb. in 1948, and in 1956 amounted to 2,067,000,000 lb. Nearly the entire catch is made with purse seines.

North Atlantic Trawl Fisheries.—This gear accounts for the major portion of the food fish taken in the North Atlantic states. The catch amounts to about 700,000,000 lb. annually and consists largely of cod, flounder, haddock, ocean perch, pollock and whiting. The major portion of the catch is made in international waters off the New England states, Nova Scotia and Newfoundland.

Pacific Salmon. — The salmon support the major fisheries of the states of Alaska, Washington and Oregon. The fishery reached its peak in 1936 when the catch amounted to 791,000,000 lb. Following that year, production declined and amounted to only 286,000,000 lb. in 1955, the smallest catch in nearly 50 years. Most of the catch is canned. The fish are caught principally in purse seines, pound nets and gill nets.

Pacific Tuna. — Tuna are the leading species taken in the Pacific Coast states, and they are the principal canned fish packed in the U.S. The major portion of the catch, which is landed in California, is taken off Mexico. Central and South America. In 1955 the U.S. catch of 265,000,000 lb., and imports of 145,000,000 lb., principally from Japan, were used to pack 193,000,000 lb. of canned tuna.

Shrimp. — Shrimp are the most important species taken in the South Atlantic and Gulf states, and they are the most valuable item taken by U.S. fishermen. These shellfish are captured principally by trawls operated by about 8,000 fishing craft. In 1955 the catch totalled about 250,000,000 lb., somewhat less than the record 265,000,000 lb. taken in 1954.

Herring. — The U.S. has two distinct herring fisheries, one on each coast. The Atlantic fishery is centred in Maine where the fish are packed as canned sardines. The Pacific fishery occurs principally in Alaska where the fish are used largely in the manufacture of fish meal and oil. In 1955 the herring catch in Maine amounted to 99,000,000 lb., while 63,000,000 lb. were taken in Alaska. Most of the Maine catch and all of the Alaska catch is taken with purse seines.

Pacific Sardines. — The Pacific sardine fishery, centred in California, is an outstanding example of the rapid growth and decline of a major fishery. First taken in large numbers in World War I, the fishery grew from 4,000,000 lb. in 1915 to 1,502,000,000 lb. in 1936 and then, because of disappearance of the fish, declined to less than 10,000,000 lb. in 1953. Following 1953, the fish became more abundant and a catch of 143,000,000 lb. was made in 1955. The entire catch is taken with purse seines, and the fish are canned or manufactured into meal and oil.

Crabs. — Various species of crabs are taken in all of the coastal states (including Alaska). The blue crab fishery centred in the Chesapeake bay, South Atlantic and Gulf states accounts for the major portion of the catch, followed by the larger Dungeness crab of the Pacific Coast states, and the giant king crab taken largely in the Bering sea. The total catch of crabs normally totals about 145,000,000 lb. Most of the catch is taken with pots and trot lines.

Oysters. — The U.S. oyster fishery is the largest in the world and produces about 80,000,000 lb. of oyster meats annually. The major portion of the catch is taken in Virginia, Maryland, Washington, Louisiana' and New Jersey. The Atlantic and Gulf fishery is based on the native eastern oyster, while on the Pacific Coast most of the oysters harvested consist of Pacific oysters grown from seed imported from Japan.

Disposition of the U.S. Catch. — The 1955 U.S. catch of 4,600,000,000 lb. was utilized as follows: fresh and frozen, 1,401,000,000 lb., or 30%; canned, 1,093,000,000 lb., or 24%; cured, 85,000,000 lb., or 2%; and for by-products and bait, 2,021,000,000 lb., or 44%.

Foreign Trade. — A large portion of the U.S. supply of fishery products is derived from imports. In 1954 imports were valued at $252,000,000 and accounted for nearly 39% of the total U.S. supply of fishery products. The principal items imported are: frozen and canned tuna; frozen groundfish and other fillets; fresh and frozen lobsters, shrimp, salmon and halibut; and canned sardines. Exports of fishery products from the U.S. in 1954 were valued at $31,500,000. They consisted largely of fish liver oils and canned salmon, sardines and anchovies.

Administration of the Fisheries. — The administration of the fisheries of the continental U.S. is in the hands of the various states except in certain fisheries where authority has been delegated to international agencies or other bodies as a result of a treaty. In the absence of a treaty, only the state governments have authority to regulate the fisheries. The fish and wildlife service of the department of the interior is the federal fishery agency.

Its activities include the conduct of a wide range of biological and technological research; assembling and publishing detailed statistics; issuing daily market news reports in important fishing or fish distributing centres; conducting economic surveys, exploratory fishing operations, and a wide variety of fishery educational and market development activities; and operation of fish hatcheries throughout the United States. In Alaska, the fish and wildlife service controls the Pribilof island seal herd numbering several million animals.

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PISCICULTURE

The prospect of considerably increasing by artificial means the stocks of those multitudinous fishes which are the foundation of the great modem commercial fisheries seems remote. There is no reason to discourage researches directed to the artificial propagation of fish of every kind, but for the present the more practical line of inquiry will be that which aims rather at the prevention of wasteful exploitation than at artificial contributions to the stock.

Certain fishes lend themselves to the art of pisciculture, more or less according to circumstances. Among freshwater fishes those of the carp family can be successfully bred and reared in captivity, and fish farming with this species is practised on a commercial scale in many eastern countries and in Czechoslovakia.

Trout can be profitably hatched in special receptacles and reared in suitable ponds to the yearling or two-year-old stage, or even further, to be disposed of either for stocking or restocking sporting waters or for consumption in hotels and restaurants. The process is comparatively simple. Usually the ripe female fish are "stripped," the eggs being allowed to fall into a vessel of water into which a little milt from the male is introduced, the eggs thus fertilized being then transferred to the hatching receptacles. The same process can be applied to sea fishes, and experiments have been carried out in the distribution of newly hatched larvae of plaice and cod in waters where it is desired to increase the stock; but there is no convincing evidence in the case of these fishes that the result sought has in any case been achieved. The great fecundity of sea fishes is nature's provision against an enormously high rate of mortality, and the number of larvae which it is practicable to hatch in a hatchery of reasonable size is so small by comparison with the natural distribution that it is inherently improbable that the output of a hatchery could make an appreciable difference in the abundance of the stock. The investigations undertaken by Capt. G. M. Dannevig in selected Norwegian fjords in 1904 and 1905 tended to confirm this conclusion. (See *Report for 1906 of the Lancashire Sea-fisheries Laboratory*, Liverpool, 1907.)

A possible exception may be found in the results of the work of the Commission on Inland Fisheries in the artificial rearing of young lobsters from the egg to the lobsterling stage in the quiet waters of Rhode Island, U.S. There appears to be some evidence of improvement of the lobster fisheries resulting from this work, but whether the improvement is to be attributed to this cause or to such methods of conservation as, *e.g.*, protection of the berried female, and whether in the former case the improvement has been proportionate to the cost involved, is open to some doubt. (See *Annual Reports of the Commissioners of Inland Fisheries, Rhode Island*, especially those for 1908 [special paper by A. O. Mead] and 1910 [appendix].)

Artificial methods of cultivation have chiefly proved useful where it has been desired to populate streams or parts of streams which are understocked, or to introduce into a river a new species of fish. The shad was successfully acclimatized in the rivers of California and in the Mississippi by the distribution of artificially propagated eggs from the eastern rivers of the United States. The quinnat and Atlantic salmon and the brown and rainbow trout were

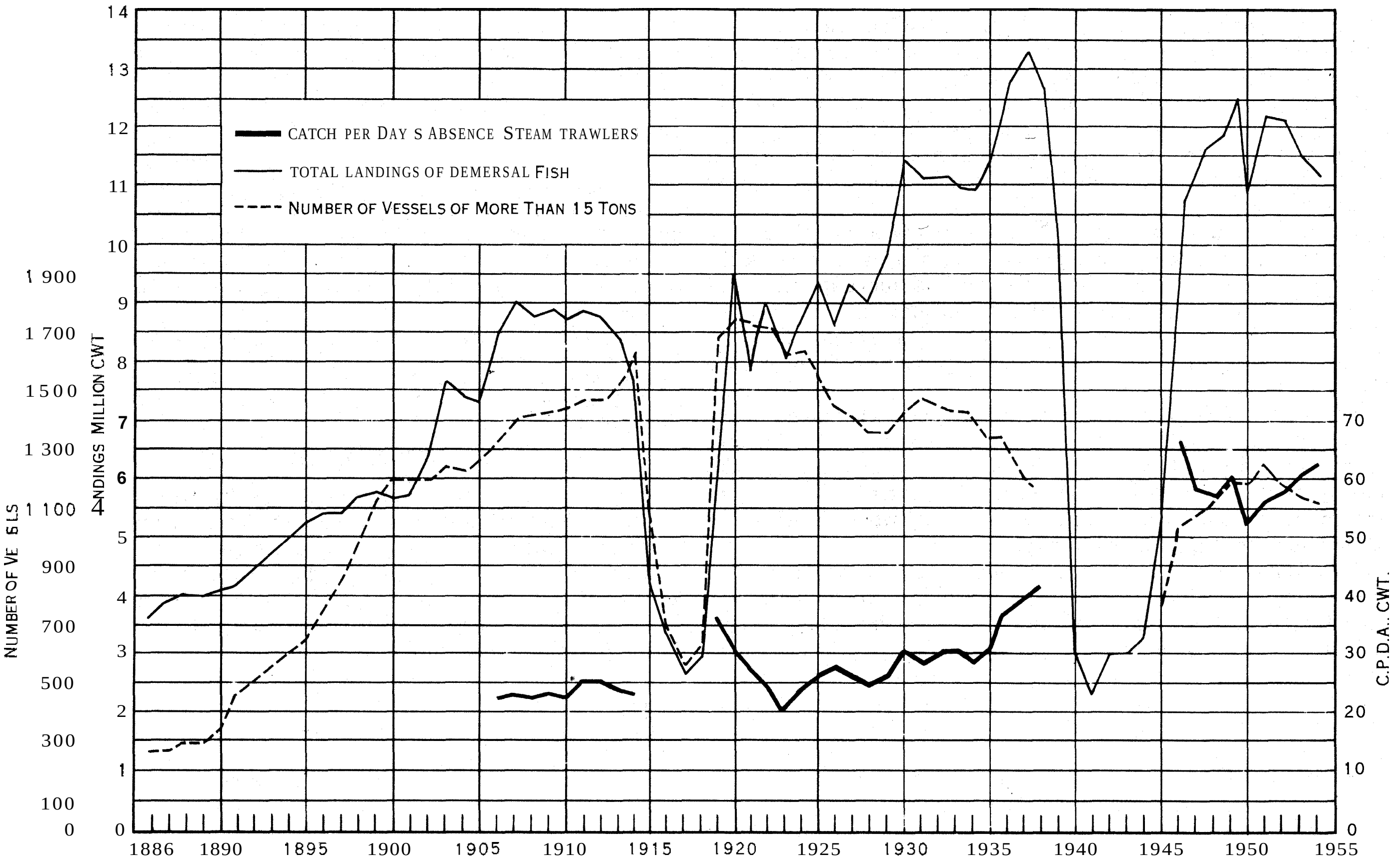

CHART SHOWING THE TOTAL LANDINGS OF DEMERSAL FISH AND THE NUMBER OF FISHING VESSELS OF OVER 15 TONS (EXCLUDING DRIFTERS. 1899–1950) IN ENGLAND AND WALES. YEARLY FROM 1886, AND THE AVERAGE CATCH PER DAY'S ABSENCE FROM PORT (C.P.D.A.) MADE BY BRITISH STEAM TRAWLERS FROM 1906 (EXCLUDING WAR YEARS)

by similar means successfully naturalized in the rivers of New Zealand. Experiments carried out in certain British rivers for the purpose of improving the native stock of salmon by the introduction of fresh blood by crossing with the stock of other rivers by means of artificial fertilization of the eggs were inconclusive.

There is another branch of pisciculture which may be broadly summed up as transplantation. This method is familiar to every oyster planter and is usefully employed in the cultivation of other molluscs, such as cockles, mussels, etc. The main purposes of transplantation of molluscs are to relieve overcrowding of young fish and to place the mature fish on beds where the conditions are suitable for fattening. Transplantation is an essential feature of successful oyster farming (see OYSTER).

Successful results have attended the transplantation of eels. Millions of elvers have been annually captured in the Severn river and exported to Germany for distribution in suitable waters in that country. Similarly elvers are trapped in the Danish fjords and transplanted to suitable lagoons to become the source of a profitable industry.

Reference is made below to the rapid growth of plaice transplanted from the eastern waters of the North sea to the Dogger bank, and Denmark undertook such transplantation on a pioneer commercial scale. Similar experiments in the transplantation of plaice from the outer lagoons of the Limfjord in Denmark to the inner, which are rich in food but are blocked against the immigration of flat fish by dense growths of sea grass (*Zostera*), laid the foundations of a profitable fishery in these waters.

Experiments in a Scottish loch showed that it is possible to increase substantially the growth rate of flounders in enclosed waters by fertilizing the water with inorganic salts to induce increased plankton growth and subsequently increased supplies of fish foods, but this method of fish culture seemed unlikely to prove an economic proposition outside fish farms.

So far as experience goes, then, it is clear that attempts to increase the supply of sea fish by artificial hatching had been unsuccessful, that the increase of the stock by transplantation succeeds in the case of molluscs and in the case of flat fish in special circumstances, such as those appertaining in the Danish fjords, and might prove successful with certain fishes in more open waters. Artificial propagation from the egg is useful for the introduction of a new stock of fish in suitable river waters either by the distribution of eyed ova or, where that is impracticable, by the distribution of young fish which have reached an age at which they can take care of themselves. It is extremely doubtful whether it is ever worth while to distribute the newly hatched larvae, which are very delicate, and on distribution in the open waters of a stream or of the sea are exposed to a thousand hazards.

Scientific Research and Fisheries Conservation.—At the International Fisheries exhibition of 1883, T. H. Huxley said. "I believe that the cod fishery, the herring fishery, the pilchard fishery, the mackerel fishery, and probably all the great sea-fisheries are inexhaustible; that is to say that nothing we do seriously affects the number of fish." In an earlier passage of his argument, which was, in effect, that the fish were so prodigiously numerous and the quantity caught by man so insignificant by comparison with the other destructive agencies at work that regulation of man's operations would be futile, he qualified his conclusion with the words, "in relation to our present method of fishing."

In 1883 the use of steam po er for fishing was hardly regarded seriously (the first experiment was made in 1877 with an old paddle tug out of North Shields), the otter trawl had not been invented, and the carefully designed steam trawler had not been dreamed of. Every innovation is an object of suspicion, especially among such conservative folk as fishermen, and Huxley was familiar with the complaints laid against the beam trawl before the royal commission of 1864 of which he was a member. Circumstances later became very different and, whatever view may be taken of the controversial topic of overfishing no one is now likely, with full knowledge of the evidence. to say that the operations of man are insignificant in their effects upon the composition of the stock of fish.

The exhibition of 1883 gave impetus to a demand for scientific investigation of the sea and its resources which had already made itself felt. Ten years had passed since the "Challenger" sailed on its famous voyage. The fishery board for Scotland had just begun systematic inquiries; abroad. notably in Germany, marine science was establishing itself and in Great Britain the next year was to witness the establishment of the Marine Biological Association of the United Kingdom. With the rapid development of fishing which followed the introduction of steam and later (about 1895) of the otter trawl, the old apprehensions were intensified and compelled the serious attention of the governments, so that, when in 1899 the king of Sweden invited representatives of the countries interested in the fisheries of the North sea and the Baltic to a conference at Stockholm to discuss the subject of co-operation in the study of marine problems the response was general. After a second conference in Christiania (Oslo) in 1901, the International Council for the Exploration of the Sea was constituted to co-ordinate the national researches of the participating countries. Later all the countries of northern Europe with important fishing interests together with Portugal and Spain became members of the council and the council's investigations covered the whole of the continental shelf of Europe and northern Africa outside the Mediterranean. In 1919 there was established the Commission Internationale pour l'Exploration de la Mer Méditerranée, fashioned in many respects on the model of the International council.

The aim of economic marine biology was well summed up in the object set before it by the International Council for the Exploration of the Sea: "the rational exploitation of the sea." To exploit the sea rationally means. presumably, to get as much out of it as is possible at the least possible cost and without waste.

The first necessity is to know, or at least to have a rational conception of what the stock of fish is and what are the factors governing these fluctuations of it which have puzzled and alarmed generations of fishermen. The first step in any such inquiry must take the form of statistics. The most complete and comprehensive statistics of sea fisheries are those of Great Britain. The International council and the United Nations' Food and Agriculture organization realize the importance of uniformity of method in the collection and presentation of statistics, but few other countries were as well equipped as Great Britain for their collection. The British statistics record annually the total landings of fish and of each of the most important food fishes separately. their values. the region in which they were taken, and the fishing power expended in their capture including the types, numbers and tonnage of fishing vessels. Note is taken of the proportions of the different trade categories in the landings—large, medium and small—and observers at the ports measure the lengths of fish in samples typical of the catches landed and also collect material to enable the age census of fish stocks to be made.

Increased landings from any region may be the result merely of increased fishing; therefore, note is taken of the number of voyages made and the length of time spent in fishing, from which is calculated the quantity of fish landed per day's absence from port or per 100 hr. of fishing. Allowance has to be made, as well as may be, for increased size and power of the ships fishing, and for increasingly efficient gear. Further observations on the populations of fish, particularly on the young fish that have not yet grown to a marketable size, are made by scientists working on specially equipped research vessels. The actual stock can never be other than estimated approximately; but the data collected by the methods just enumerated enable a reasoned opinion to be formed as to whether, making due allowance for all other factors, the stock is being overfished.

The accompanying chart, which illustrates generally the method of comparison of landings with fishing power, presents two interesting features. The first is the similarity between the ascending curves of landings and of steam power employed until t o new factors, the general adoption of the otter trawl and the development of fishing on the more distant grounds, appear to be reflected in a steep rise of the curve of landings. The second is the high point at which the interrupted curve of catch per day's absence from port starts immediately after each of the wars, during which little fishing had taken place, and its rapid decline apparently reflecting the influence of renewed fishing. In this curve the threefold increase in weight of the overfished North sea stock during the war years is somewhat masked by the increasing landings from the arctic.

Table IV of the landings of North sea plaice is an interesting illustration of what appears to be the effect of fishing operations on the composition of the stock of a single species of fish.

The graph and the table are to be regarded merely as samples of the statistical data by means of which the endeavour is made to record changes of the stock (which, in the nature of things can, at best, only be estimated) and to form a reasoned opinion as to the relation between these fluctuations and the operations of men.

Table IV.—*Quantities of Large, Medium and Small Plaice, Landed at English Ports from the North Sea by All Classes of British Vessels in Each Year from 1906 to 1927*

(In 000 tons)

	Large	Medium	Small	Total (excluding unsorted)
Pre-World War I 1906	10	7	9	26
1907	8	8	14	30
1908	8	8	13	29
1909	6	9	14	29
1910	5	8	11	24
1911	5	8	13	26
1912	5	9	11	25
1913	5	8	10	23
War 1914	4	6	10	20
1915	2	2	2	6
1916*	1	2	1	4
1917*	1	2	1	4
1918*	2	0	2	13
Postwar 1919	9	13	2	24
1920	13	12	5	30
1921	6	11	6	23
1922	5	10	11	26
1923	3	6	12	21
1924	2	5	14	21
1925	2	4	16	22
1926	1	3	14	18
1927	1	4	16	21

*Estimated figures.

Such statistical data are the starting point of biological investigations and may furnish the test of provisional biological conclusions. In order that all factors affecting the stock of fish may be taken into account, it is necessary to study the life histories of the food fishes severally and collectively. Since the life histories of fishes, as of other animals, must be governed mainly by the factors of their environment, that environment must also be studied. The most important factors of the environment are, to express it very generally, climate and food, the former naturally reacting to a great degree upon the latter. What corresponds to climate in the sea is—again speaking in general terms—the physicochemical composition and the movements of the water. It is an established fact that all animal organisms depend ultimately for their food supply in the sea, as on land, upon plant life.

The fixed seaweeds are found only in a narrow fringe in shallow water around the coasts, but in the upper water layers of the whole ocean to such depths as sunlight can penetrate are multitudes of microscopic plants, constituting the phytoplankton, upon which above all depends the great productivity of the sea. These plants are eaten by the small animals constituting the zooplankton which, in their turn, are eaten by larger animals, until at the other end of the food chain the fishes are exploited by man, who thus ultimately depends upon vegetable growth. The plant harvest of the sea depends on many physical and chemical factors, the most important being suitable temperatures, an adequate supply of sunlight, of carbonic acid and of certain chemical salts.

In 1924 the International Fisheries commission was established for the preservation of the North Pacific halibut fisheries, followed in 1937 by the International Pacific Salmon Fisheries commission and in 1940 by the International Commission for the Northwest Atlantic Fisheries. The convention of the International Overfishing conference, 1946, with a permanent commission for its administration which was drawn up as a result of the findings of the International Council for the Exploration of the Sea came fully into operation in 1954. These bodies all had the object of reviewing the results of scientific investigations of fisheries and framing regulations designed to achieve better international co-operation in and rational exploitation of the fisheries. An Indo-Pacific Fisheries council was set up in 1948 and a General Fisheries Council for the Mediterranean in 1952, both primarily for co-ordination of scientific investigations.

Branches of Research. — Thus, fishery research is divided broadly into five branches — statistics, to which reference has already been made; investigations of fishes; investigations of their food, including both the planktonic organisms and the invertebrates found at the bottom of the sea; hydrographical investigations; and investigations into improved methods of fishing and of fish preservation. The factors to be taken into account are so numerous and so complex and the area of inquiry so wide that the only hope of arriving at well-founded conclusions within a measurable space of time lies in organized team work. This fact was recognized by the representatives of the member countries of the International Council for the Exploration of the Sea who undertook shares of a program of work organized internationally through the council. Neither must it be forgotten that the deep-sea fisheries are for the most part prosecuted in waters in which all countries have equal rights of fishing. If, therefore, any practical results are to ensue from the knowledge acquired, in the form of regulation of fishing operations, or, as is not wholly inconceivable, actual cultivation of the stock, these measures must be applied with the good will and co-operation of all the interested countries.

A detail of the study of the life history of fishes of peculiar economic importance is the investigation of the rate of their growth and the variations of the rate of growth responding to different circumstances. For this purpose it is essential to have an index of age. The ages of some fishes — notably of flat fishes and cod — are fixed by counting the annual rings in the ear bones or otoliths, of others — notably the herring — by counting similar rings in the scales. The technique of age determination is by no means simple, and in the case of some samples, considerable difficulty is experienced in making accurate assessments of age.

Again, it is necessary to study the food of fishes by examination of the contents of the stomachs, and to correlate the information thus gained with information as to the distribution and abundance of food organisms. That an adequate supply of suitable food is essential to healthy growth is axiomatic, and it has been suggested that the present rate of destruction of small fish might advisedly be accelerated in order to promote the more rapid growth of the survivors. There is some evidence that overcrowding on unfished grounds during World Wars I and II slightly reduced the growth rate of plaice, but there seemed to be little cause to apprehend that food supplies were overtaxed.

It is also necessary to follow the migrations of fishes and to know the rate of depletion of the stocks caused by removal of fish by fishing, which can both be most directly done, where practicable, by marking large numbers of them and offering rewards for well authenticated information as to the time and locality of their recovery. Marking technique usually involves attaching some form of numbered and conspicuous tag or label to the fish.

Some or all of these various methods of investigation have been applied to the most important of the food fishes particularly the plaice, herring, cod, haddock and hake.

A classical example of the study of growth rate is that carried out in connection with the investigations of the plaice fisheries, where, by marking large numbers of young plaice, 7 to 8 in. long, taken in the shallow waters on the east side of the North sea, transplanting a proportion of them to the Dogger bank, where there is an abundance of suitable food, and leaving others where they were caught, it was proved that the transplahted fish developed at a remarkably greater rate than those left behind. The former, in 12 mo. grew about 5 in. in length and to nearly four times their original weight, while the latter grew little more than 2 in. in length and no more than doubled their weight.

An interesting illustration of deductions from scale reading was furnished by the investigations of Johan Hjort of the Norwegian herring fisheries, by means of which he showed that frequently and, indeed, usually, fish of a certain year group predominated over all other year groups over a series of years, from which it appeared reasonable to deduce that the stock of herrings from year to year depended mainly not upon regular annual accretions, but rather upon occasional floods from particularly prolific years. This phenomenon of the better survival of one year's brood of young fish than that of another is common to other species of fish and its occurrence is used as the basis of fishery forecasting.

The most important examples of the study of the migrations of fish by marking are the experiments conducted in connection with the plaice investigations mentioned above and those with marked cod carried out by Hjort and reported in his *Fluctuations in the Great Fisheries of Northern Europe*, and those with marked herring showing the large-scale movements between Icelandic and Norwegian waters. A notable example of the study of migration by other means than marking was furnished by Johannes Schmidt's investigations of the eel, in the course of which, by following the larval eels, he traced the European eels to their spawning place in the Sargasso sea.

The hydrographical investigations take the form not only of the study of the physicochemical composition (and temperature) of the sea, upon which depends the harvest of the plant growth which, as already observed, is the beginning of the chain of marine life, but also of the movements of the water at the surface, near the bottom and in the intermediate layers, which govern to a great degree the actual distribution of the stock of fish particularly in the larval stages. For these purposes various ingenious instruments have been contrived and are constantly being improved upon; water bottles for the collection of samples at known depths, self-recording thermometers and current meters, drift bottles adjusted to float at or near the surface, or to trail along the sea bottom. By means of such instruments and by many and various lines of investigation a few of which only it has been feasible to indicate above, the endeavour is being made to probe the mysteries of life in the sea.

Investigations of means of improving fishing methods are taking the line of developing means of locating concentrations of fish, such as using echo sounders, and of finding and developing the best gear for a particular fishery.

Provision for Researches. — The government of Great Britain, through the Scottish home department and the fisheries department of the ministry of agriculture and fisheries, with their laboratories at Aberdeen and Lowestoft and several research ships, takes direct responsibility for economic investigations and also supports by liberal grants unofficial institutions devoted to marine research, on no other condition than that their work shall be of such a standard of excellence as to make it worthy of support. The chief of such institutions are the Marine Biological Association of the United Kingdom, with its headquarters and laboratory at Plymouth; the Dove Marine laboratory at Cullercoats, the oceanographical department of the University of Liverpool and the Scottish Marine Biological laboratory at Millport (*see* also MARINE BIOLOGY).

The organization of fishery research varies from country to country, but it can be stated in general terms that in practically every country of Europe provision is made for such researches in a greater or less degree, and with a greater or less measure of government support; that in the U.S. the provision for fishery investigations partly under the direction of the states, partly under that of the central government, is elaborate and extensive; that in varying degree of development corresponding inquiries are in progress in most of the British commonwealth, and, indeed, in every country in which the economic importance of fisheries had gained recognition.

To pass under review the investigations of the first half of the 20th century and their results would be a gigantic task. No more has been possible here than to indicate briefly some of the lines of investigation and their aim.

The uses of science do not end with those studies which bear upon the capture of fish. The art and science of catching fish has developed far more rapidly than that of the disposal of fish when caught. The problem of keeping fish taken on distant voyages in a fresh state is not wholly solved by the use of ice. The fish which. in the course of a distant voyage go first into the hold. and, on return to port, come last out of it, are seldom fit for the fresh fish market; modern day methods of pickling herrings aye practically the same as those of the Dutchman William Beukels in the 17th century. In almost every phase of the handling and use of fish there is work ior the biochemist, and the problem of how to make the best use of the fish when caught became the subject of serious scientific study. Considerable progress was made in devising methods of preservation suitable for application to fish.

The most important advance in fishery technology was the development of quick-freezing; this allowed fish to be kept in cold storage for long periods without noticeable change in condition and thus increased the inland consumption of fish and gave impetus to the development of factory trawlers, several of which were operating by mid-20th century.

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(H. G. M.; A. R. Ms.)

FISHERIES, LAW OF. As fishing is carried on both within and beyond regions over which national laws are in operation, any consideration of the law of fisheries must consider both national and international aspects of the subject. The English lam applicable within territorial waters (as to the extent of which *see* WATERS, TERRITORIAL) is explained in the first place, and that of the United States next.

ENGLISH LAW

There is some.confusion in the nomenclature used by early writers on the English law of fisheries, but the classification may be reduced to fisheries which are exclusive, and those which are not. In exclusive fisheries the right of fishing belongs to the owner of the soil, or is derived from him. These fisheries are sometimes referred to as "several" or "free." They may be corporeal. where they comprise both the soil and the fishing, or incorporeal, where they have been granted without the soil. Fisheries which are not exclusive comprise (1) common fishery, which is the right of the public to fish in tidal waters not appropriated as exclusive fisheries, and (2) common of fishery, where one or more persons have a right to fish in common with the person who owned the exclusive right. A fishery does not necessarily include all fish. Thus one person may own the soil and oyster fishery: and another the fishery for floating fish. Royal fish, *i.e.,* whales and sturgeons, are under the statute *De Praerogativa Regis* (1324) the property of the crown and not of the finder.

"Ancient records from Domesday downwards show us that the most ancient and usual mode of enjoying the profit of fisheries, both in tidal and non-tidal waters, was by wiers, kiddels, fishgarths, stake nets, bucks, and other engines fixed into and permanently erected in the soil of the fishery" (Stuart Moore). Thus fisheries originally were profits of the soil over which the water flowed. This is still the general principle. The title to a fishery arises from the right to the soil. The rule is so well established that upon it has been based the converse proposition, namely, that ownership of a several fishery is evidence of the ownership of the soil *(Attorney-General* v. *Emerson,* 1891, A.C. 649). A fishery may be severed from the soil. or *solum,* and become a *profit à prendre in alieno solo* and an incorporeal hereditament, *i.e.,* a right exercisable over the property of another person. This broad principle is not restricted to inland or nontidal waters. It gives to the owners of lands on the foreshore or within an estuary or elsewhere where the tide flows and reflows a title to fish in the water over such lands, and this is equally the case whether the owner be the crown or a private individual. But in the case of tidal waters (whether on the foreshore or in estuaries or tidal rivers) the exclusive character of the title is qualified by another and paramount title which is *prima facie* in the public. "The common people of England" (wrote Lord Hale) "have regularly a liberty oi fishing in the sea or creeks or arms thereof, as a public common of piscary, and may not without injury to their right be restrained of it, unless in such places, creeks or navigable rivers where either the king or some particular subject hath gained a propriety exclusive of that common liberty." The subjects of the crown are entitled as of right not only to navigate but to fish in the high seas and tidal waters alike. This is probably a right enjoyed, so far as the high seas are concerned, by common practice from time immemorial, and it was probably in very early times extended by the subject without challenge to the foreshore (*i.e.,* to between high- and low-water mark) and to tidal waters which were continuous with the ocean, if indeed it did not in fact first take rise in them. The right into which this practice has crystallized resembles in some respects the right to navigate the seas or the right to use a navigable river as a highway. To the practice and the right there were and are exceptions. The king had the prerogative of excluding the right of public fishing in tidal waters. He could keep the fishery in hand. or grant it to a subject, but, since Magna Carta. no new exclusive fishery could be created by royal grant in tidal waters, and no public right of fishing in such waters, then existing: could be taken away without competent legislation. (This statement is summarized from the judgment of the privy council in *Attorney-General for British Columbia* v. *Attorney-General for Canada,* 1914, A.C. 153. Though the question at issue arose in relation to British Columbia, it was governed by the law of England, which, accordingly, was stated in the judgment.)

The public right above referred to depends upon the water being tidal and not comprised within the limits of any several fishery. There is no public right to fish in nontidal waters, although navigable. The public right (which is subject to statutory regulations referred to later) includes the right of fishing over the ioreshore (*i.e.,* between high- and low-water mark) when not within the limits of a several fishery, and of laying lines and drawing nets. It does not include the right of fixing stakes or fixed engines on the foreshore, or the right of drawing up boats above high-water mark and leaving them there for future use, though such rights may be gained by custom by fishermen in a particular locality. The public right does not include a right to appropriate part of the foreshore for the storage of oysters to the exclusion of the rest oi the public but they may take shell fish but not shells although placed there by fishermen *(Truro Corporation* v. *Rowe,* 1902. 2 K.B. 709). Oyster ponds or layings on a foreshore where there are no natural oysters are. it appears, the property of a private person, and may exist quite apart from the existence of a several oyster fishery *(Foster* v. *Warblington G.D.C.,* 1906, 1 *K.B.* 648). Disturbance of a several fishery is an infringement of a legal right, therefore the law presumes damage; other damage need not be proved (*Nicholls* v. *Ely Beet Sugar Factory Ltd., 1936,* Ch. 343 C.A.).

The public rights of navigation must be exercised with due regard ior the rights of owners of fisheries. If. by negligent navigation, injury is caused (*e.g.,* to an oyster bed), damages may be recovered. On the other hand, navigation must not be obstructed; *e.g.,* by the deposit of unreasonably large masses of oysters in the bed of a navigable river (*Mayor of Colchester* v. *Brooke,* 1845, 7 Q.B. 339). (S. D. C.; X.)

Statutory Provisions.—The following are some of the principal provisions as to British fisheries.

The Sea Fisheries act, 1883, confirmed the North Sea Fisheries convention of 1882 and made the principal provisions binding upon any person "within the exclusive fishery limits of the British Islands," or, if outside those limits, on "any person belonging to a British sea-fishing boat." The act therefore applies to British fishermen and fishing boats in all waters. Matters dealt with include questions of precedence on the fishing grounds and avoidance of damage in setting gear, and the prohibition of the carrying or use of cutting instruments.

The Sea Fisheries Regulation act, 1888, as amended by later acts provides for fishery jurisdiction in the territorial waters of England and Wales to be vested in local fisheries committees with Dower to make by-laws regulating methods and seasons of fishing. By-laws are subject to-confirmation and in certain circumstances to revocation by the minister of agriculture and fisheries. Members of committees are appointed by local authorities and the minister, and their expenses fall on the appointing local authorities.

The Sea-Fishing Industry act, 1933, as amended by the Sea Fish Industry act, 1938, provides for regulation by order of the landing of foreign-caught sea fish, prohibition of landings from specified fishing grounds, regulation of mesh of nets and prescription of minimum sizes for fish.

The Sea Fisheries act, 1868, as amended by later acts, provides for the making of orders conferring a right of several (*i.e.,* private) fishery in oysters, mussels or cockles, or for the improvement or regulation of such fisheries in public waters. The Sea Fish Industry act, 1951, set up a White Fish authority to re-organize, develop and regulate the white fish industry.

The Fishery Board (Scotland) act, 1882, established a fishery board for Scotland, whose functions were transferred to and vested in the secretary of state for Scotland by the Re-organization of Offices (Scotland) act, 1939, and are administered by the Scottish home department. Legislation affecting sea fisheries in Scotland only includes a series of sea and herring fishery acts dating from 1770.

The Herring Fishery (Scotland) act, 1889, legalized the cran and quarter-cran as measures for herrings, prohibited Sunday and daylight fishing for herrings in certain areas and trawling within the three-mile limit or in defined areas; and authorized the fishery board by by-law to close the whole of the Moray firth to trawling. (As to the Moray firth, *see* WATERS, TERRITORIAL.) The Sea Fisheries (Scotland) Amendment act, 1885, empowered the board to make by-laws prohibiting or regulating methods of fishing within the exclusive fishery limits. The Sea Fisheries Regulation (Scotland) act, 1895, extended the board's power of making by-laws. The Trawling in Prohibited Areas Prevention act, 1909, prohibited the landing and selling in Great Britain of fish caught by trawling in prohibited areas adjoining Scotland.

The Herring Industry act, 1935, amended in 1938, 1944 and 1948 and administered jointly by the departments responsible for fisheries in England, Scotland and Northern Ireland and by the ministry of food, established the herring industry board with power to make a scheme (the Herring Industry scheme, 1935, amended in 1946) to reorganize, regulate and develop the herring industry.

The Inshore Fishing Industry act, 1945, provided financial assistance which was increased in 1948 for the purchase or improvement of boats and gear. The White Fish and Herring Industries act, 1948, also empowered the fisheries ministers to license vessels fishing for white fish in the North sea.

The Salmon and Freshwater Fisheries act, 1923, consolidated and amended former acts relating to the constitution of fishery boards for districts in England and Wales, with power to make by-laws varying the statutory close seasons, to grant licences to fish, and to fix licence duties. The River Boards act, 1948, placed river systems under the control of single authorities exercising, *inter alia,* the functions of the fishery boards. Salmon fisheries legislation applicable to Scotland must still be sought in a series of acts dating back to before 1850.

The Diseases of Fish act, 1937, prohibited the importation of live fish of the salmon family and controlled (by licence) the importation of freshwater fish and fish eggs.

The Merchant Shipping acts, 1894 to 1950, and regulations made thereunder, contained numerous provisions applicable to fishing boats and fishing crews, skippers and mates in relation to registry of boats, safety at sea, terms of engagement and discharge and certificates of competency.

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UNITED STATES; INTERNATIONAL

From adoption of the United States constitution and through subsequent supreme court decisions, the several states were presumed to have governmental and possessory rights over the fish within their borders (*McCready* v. *Virginia,* 94 U.S. 391; *Geer* v. *Connecticut,* 161 U.S. 519). For Great Lakes states this extended to the mid-lake Canadian boundary, and for coastal states, a 3-mi.-wide strip of ocean called territorial waters. This strip is measured along the shore's sinuosities, except that a straight line is drawn across bays where not more than 10 mi. wide, and that "historic" bays (*e.g.,* Chesapeake) are wholly included. Superior federal power was considered possible for migratory fish (*Manchester* v. *Massachusetts,* 139 U.S. 240; see migratory birds, *Missouri* v. *Holland,* 252 U.S. 416). However, later decisions (*e.g., United States* v. *California,* 332 U.S. 19; *Takahashi* v. *Commission,* 334 U.S. 410) implied dominant federal control, possibly ownership, of all marine life and ocean bottom, perhaps even including tidal areas, though state use is permissible pending exercise of federal power. As a matter of actual practice, the several states continued to exercise full management of fisheries within their territorial waters excepting fisheries under international management. Federal attempt to take over control pursuant to court decisions appeared unlikely because of the opposition it would arouse.

Only vessels licensed by the United States may fish in U.S. territorial waters. By a 1950 amendment, no foreign-flag vessel might land in the United States fish caught on the high seas or received there from catching boats, except as provided by treaty (46 U.S. Code Sec. 251). The question arose but had not yet been determined by congress at mid-century as to the admissibility into the U.S. of fish from trust territories the same as domestically caught fish.

Except for ocean fisheries, each state has full right of taxation and, except for Alaska, regulation, even to prohibiting fishing, except as restricted by reservation Indian treaties (*Tulee* v. *Washington,* 315 U.S. 681). Federal control is absolute in territories, but is exercised exclusively only in the District of Columbia. In Alaska, Metlakatlans were granted special statutory fishing privileges (*Alaska Pacific Fisheries* v. *United States,* 248 U.S. 78), but Indian "aboriginal rights" to exclusive fishing were judicially rejected (*Miller* v. *United States,* 159 F 2d 997).

With required congressional approval, Washington and Oregon negotiate for regulating Columbia river fisheries. Similarly, groups of Atlantic, Gulf and Pacific states each, under congressional authorization, have research and recommendatory marine fishery commissions with no regulatory power.

Because of the general indifference of federal power-dam builders toward the damage done to other natural resources, particularly fisheries, legal questions were raised concerning the power of a federal agency to interfere with and even destroy state resources such as domestic fisheries (as distinguished from ocean fisheries). This became particularly important on the Pacific coast where fish which spawn in the lakes and rivers furnish a substantial food supply and the basis for a great industry.

Considerable agitation existed at mid-20th century, particularly on the Pacific coast, for clarification of international fishery laws. Ocean waters beyond three miles often are asserted free for anyone to fish, though England and Norway instituted litigation for a greater distance before the International Court of Justice. There is good support for a nation claiming special interest in its coastal fisheries beyond territorial waters, and a U.S. presidential proclamation of Sept. 28, 1945, did so. However, the United States protested certain Latin-American claims over broad areas which did not recognize existing U.S. fishing activities. When not violating rights of others, a state or nation may control its fishermen and vessels any distance seaward (*Skiriotes* v. Florida, 313 U.S. 69, concerning Florida sponge fisheries).

International fishery problems are wholly federal. The United States entered into a large number of fishery treaties of the usual character dealing with specific fishery rights (A. P. Daggett, "The Regulation of Maritime Fisheries by Treaty," *Am. J. of Int. Law*, vol. 28, no. 4, p. 693), but the International Fisheries commission, created first as a research body by a treaty negotiated in 1923, by a new treaty of 1930 became the first international body actually to give joint international (as distinguished from separate national) management to an ocean fishery (Pacific ocean halibut from Alaska to California). Its regulatory powers apply within as well as outside of each nation's territorial waters. Its success stimulated the similar creation by treaty (1937) of International Pacific Salmon Fisheries commission for the regulation of the sockeye salmon fishery common to British Columbia and the state of Washington, also the more complicated Northwest Atlantic Fisheries treaty between European as well as American nations historically fishing in that area, and still later tuna treaties with Mexico and Costa Rica. This increasingly popular method for the conservation of ocean fisheries by the nations directly involved must be distinguished from proposals for world-wide management through such organizations as the United Nations—proposals vigorously opposed by all elements of the U.S. fishing industry. The Food and Agriculture organization gave some indication of seeking increased authority, and the proposed International Trade organization charters also indicated a desire to invade this field.

Fishery disputes between the United States and Great Britain concerning U.S. fishing in Newfoundland and Nova Scotia waters, and related liberties, occurred frequently after the British claimed that the War of 1812 abrogated privileges granted in 1783, despite a treaty of 1818. The famous Atlantic Fisheries arbitration of 1910, though largely adverse to the United States, effected a peaceful settlement. Perhaps more bitter were contentions arising from U.S. seizure of Canadian vessels engaged in pelagic taking of Pribilof Island fur seals (seals, though mammals, being treated with fish). The U.S. claim of proprietorship of these seals while at sea was rejected by arbitration in 1893. The herd was saved by a 1911 treaty between Japan, Russia, Great Britain and the United States prohibiting pelagic sealing and giving the herd management to the U.S., which in turn shares the proceeds. Japan denounced the treaty in 1941. The herd at mid-20th century was handled under a temporary agreement between Canada and the United States.

The United States aggressively supported international protection of whales, regulated under a multilateral treaty of 1946.

(E. W. AL.)

FISHES, a name that was generally applied to all those vertebrate animals that live in water, swimming by fins and breathing by gills. Modern authorities are inclined to separate the lampreys and hagfishes, which have no gill arches and no jaws, as a distinct class. the Agnatha or Cyclostomata (*q.v.*) and relatives, opposed to all other vertebrates, wherein jaws are present and which are grouped together as Gnathostomata. The Chondrichthyes or cartilaginous fishes, that is the selachians (*q.v.*), or sharks and their allies! are also made a class distinct from the true bony fishes, Osteichthyes or Pisces, differing from them in having no ossified internal skeleton or segmented fin rays, and never comparable scales or bony plates, never ribs, an air bladder, or lung. These differences are not only considerable, but of much evolutionary significance according to the present interpretation of the fossil record.

The History of Fishes.—The most primitive vertebrates are fish-like, and the oldest known are the marsipobranchs, which appear to have had gills contained in a series of separate muscular pouches to expand and contract during respiration, and to have been quite without jaws or gill arches. Several types of marsipobranchs, one free-swimming (Anaspida), another a bottom form covered with a hard bony shield in front (Aspidocephali or Cephalaspida), are known from the Silurian and Devonian periods. The most primitive known marsipobranchs are already quite specialized creatures; their more primitive ancestors are not known. From what kind of invertebrates the vertebrate phylum arose, as it presumably did, is obscure. Various structural peculiarities of the lampreys and hagfishes lead to the conclusion that they, and they alone, are direct living descendants of these early forms.

The Palaeozoic marsipobranchs were of smallish size, seldom more than a few in. long, but there are remains of armoured fishes, the class Placodermi, in Devonian and lower Carboniferous strata, some of which grew to be 20 ft. or more. These are probably specialized derivatives from the ancestors of the sharks, which from varied, scattered fossil fragments in upper Silurian and lower Devonian rocks, are thought to have had an antiquity only less than that of the marsipobranchs. A rather complete fossil record of a primitive shark, *Cladoselache,* which might have been the ancestor of more recent forms, is known from the upper Devonian. No remains that can definitely be referred to modern sharks are known before the Mesozoic, but most types of these appear by the close of that critical era.

It is thought that the true fishes (Osteichthyes or Pisces) arose as an offshoot from the shark stem at a very early period, some time during the Silurian. The earliest known family of these, the palaeoniscids (ganoid family Palaeoniscidae), were present throughout the Devonian, attained their maximum development during the Carboniferous and lasted until toward the end of the Jurassic period. A few scattered representatives of families related to them are still living, but it was not until the middle of Mesozoic time that the orders comprising the great majority of living species began to appear. Their evolution was rapid, and most modern families were represented in the Eocene, the beginning of Caenozoic times. The three late periods of Palaeozoic history, Silurian, Devonian and Carboniferous, are known as the age of fishes, but it was not until the Carboniferous that true fishes became dominant, until the succeeding age of reptiles that any such comparable to species now living appeared, or the more recent age of mammals that the families now most abundant arose.

In the world today there are more living species of true fishes than of any other class of vertebrate animals; 30,000 would not be a high estimate of the number. They show a very great diversity of structure, as well as of size and colour, and inhabit every conceivable kind of water, from mountain torrents to the depths of the ocean.

General Features **of** a Fish.—The fish is a bilaterally symmetrical animal, adapted to an aquatic life. Its evolutionary position is near the base of the great vertebrate subphylum, characterized by an axial vertebral column or backbone, of a series of separate elements known as vertebrae, which affords protection for main longitudinal nerves and blood vessels, as well as support for other parts of the body. The body cavity of a fish, which contains its vital organs, is situated in the lower. anterior part of the body. The posterior part, behind the body cavity, consists mainly of bone and muscle, and usually has the primary function of propelling the animal through water. It is technically called the tail, and is indeed homologous with the shrunken and relatively useless tails of various land vertebrates, in which locomotion is a function of the limbs.

A perch or bass may be taken as the type of a standardized, modern fish. Here the head and body, together, are spindle-shaped, compressed from side to side, streamlined. The head is cuirassed with bony plates beneath the skin, the body covered with numerous thin, elastic, overlapping scales. Backward and downward from the eye, the bones of the sides of the head form a flat plate or gill cover, beneath which are several bony gill arches, the posterior edges of which bear the gills. New water is continually taken in at the mouth, passes backward over the gills, and escapes under the free hind edge of the gill cover. The gills themselves, which look like a broad, flat, dense red fringe, consist largely of numerous finely divided blood vessels.

Blood is pumped to the gills by the heart, passes through these fine blood vessels, where it absorbs oxygen from the water, and then is redistributed to different parts of the body, where oxygen is used up in the production of various kinds of energy. In other words, a fish breathes oxygen just as all animals do, taking it from the water by means of its gills, just as higher vertebrate animals do from the air by means of their lungs.

In the mid-line of the back of perch or bass there are one or two fins, more or less separate, connected or confluent (the dorsal fin). These consist of membrane stretched between supporting rays. The rays of the anterior fin or part of a single fin are stiff, sharp spines, of the posterior, flexible, jointed and more or less divided or branched. In the same median plane, at the hind tip of the body there is one cauda! or tail fin, with flexible rays, which is the chief organ that propels the fish through water. In the mid-line below, under and similar to the posterior dorsal fin, is the anal fin, with a smaller number of spines (only one to three) at its front end. In addition to these dorsal, caudal and anal fins, lying in the vertical plane which would divide the fish's body into symmetrical halves, there are two sets of paired fins. These are the pectoral or breast fins, of flexible (soft) rays only, one on each side of the body behind the head, and the ventral or pelvic fins, close together, one on either side of the mid-line of the body below the pectorals (farther back in more primitive fishes). In perch or bass the ventrals consist of an initial spine and five flexible, jointed, branched rays. In the light of modern investigation, there can be little doubt that the paired fins of fishes are homologous with the limbs of higher animals, that the latter complex structures were derived from the former relatively simple ones. They are, as it were, a marker pointing to the trend of evolution.

The primary purpose of the spines of a perch or bass's anterior dorsal fin is defense, the posterior dorsal and the anal fins steady its course like the feathering of an arrow, the paired fins are used to balance and steer, and the caudal fin to steer and propel the body forward. When analyzed, a fish's motion through water is found to have something of a weaving character, the body thrown into curves which press backward, sending it forward. Elongate, eel-like fishes wriggle through water, propelled by motion of the length of the body. A fish of standard shape, with flexibility mostly toward the tail, is more dependent on its caudal fin for propulsion.

To live a fish must eat, and though there are many types of fishes with a different, more specialized feeding habit, in general they are carnivorous and their jaws are set with numerous teeth to hold their prey, ranging from small crustacea (shrimp-like animals) to other fishes only smaller than themselves. Food, as well as water to aerate the gills, is taken into the one cavity of the mouth, which opens freely back to the outside under the gill cover behind these; and there is a row of short, stiff rods, known as gill rakers, on the inner, concave face of one or more of the gill arches, opposite the convex face which bears the gills. This helps retain the food until it is brought against the opening to the gullet and swallowed. The front of the gullet is otherwise kept closed by muscular control, to avoid taking in more than a small amount of water.

Digestive System.—A fish's food passes from the gullet, which is a simple tube, into the stomach, the front end of which is usually marked by a slight constriction, and which has a greater diameter than the gullet. or than the intestine behind it. It may be U-shaped, or it may be a blind sac with openings to the gullet and intestine close together. In any event, it is here that the processes of digestion commence. The character of the walls of the stomach differs from that of those of the gullet, and they contain gastric glands. The character of the stomach in different fishes varies greatly, correlated with their type of food. In some this organ is relatively straight and simple, in the gray mullet (*Mugil*) and gizzard shad (Dorosoma) it resembles the gizzard of a fowl. Many fishes have a varying number of blind, tubelike sacs of uncertain function, the pyloric caeca, attached near the exit from stomach to intestine.

The beginning of the intestine is generally marked by the presence of a ringlike thickening of the walls of the canal, and by entrance of the ducts leading from the liver, a large organ which varies in size and colour in different fishes and usually has a gall bladder, and from the pancreas, a smaller gland more or less partially embedded in the liver. Food enters the intestine in a liquid condition, and the function of that organ is its assimilation, that is, to pass it on to be absorbed by the blood. The length of the intestine, as is the character of the stomach, is correlated with the nature of the fish's food. In species which feed almost exclusively on other fishes, the intestine is thrown into a few loops, or may run almost straight from stomach to vent, which is normally situated near the lower hind corner of the body cavity. In species the food of which consists largely of vegetable matter, the products of the digestion of which are presumably not so easily digested and assimilated, the intestine is very long and variously coiled, to fit a great amount of absorptive surface into limited space. The stone roller (*Campostoma*), a North American carp, is unique in having it wound round and round the air bladder. At its termination the intestine runs straight to the vent, and has often a somewhat increased diameter. This part is the large intestine or rectum, its principal function in true fishes being to carry off waste products. In sharks and rays, on the other hand, much of the food absorption takes place in the large intestine, which in these has a complicated internal structure known as the spiral valve, so that the nutritive products travel round and round as down a winding stairway. The spiral valve of sharks has the same function of increasing absorptive surface as the variously lengthened small intestine of other fishes.

Circulatory System.—To understand the economy of a fish one may think of it advantageously as a living submarine. Food is the fuel which, burning throughout the living tissue, provides the power for life, growth and motion. The blood stream not only carries this food, but also oxygen to keep the "fires" burning, to every organ of the body. The pump which controls the flow of blood is, of course, the heart. A fish's heart is situated anteriorly, immediately behind and below the gills, in the pericardial cavity, which is separate from the main body cavity behind it. The heart of a fish has three or four chambers. Venous blood, collected from over the body flows into (1) a sinus venosus, then passes to (2) the auricle, and then into (3) the thick-walled, muscular ventricle, the rhythmical contraction of which drives it on; finally it enters a bulb at the base of the main artery carrying it to the gills. These may be compared with the intake of air at the bottom of a furnace, the faster or slower circulation of the blood, to the furnace draft. The bulb pulsates like the ventricle in sharks and some other of the lower forms. but is nonmuscular in the more specialized great majority of fishes. Having been aerated in the gills, the blood stream flows into a main lengthwise artery above the body cavity and below the vertebral column, whence finer and finer branches distribute it to all parts of the body.

The fundamental pattern of fish organization and anatomy is so much like that of higher warm-blooded animals, more complex, correlated with the greater complexity of their life on land, as to be excellent evidence that the latter evolved from fishes, even without the various more or less connecting links afforded by creatures which still exist or are known from fossils. As a specialized structure which has only undergone minor changes from fish to man, there is the vertebrate eye. The eye of a man is so much like that of a fish as to make it highly improbable that the two evolved independently. Per contrast, looking for a structure in fishes without homology or parallel elsewhere, one might choose the air bladder, in most fishes a sac filled with a mixture of gases, which lies along the upper part of the body cavity. It has various functions, the primary one in the generality of fishes being that of a hydrostatic organ, to accommodate the animal to varying pressure at different depths of water. A study of the embryological development of this organ shows that it arises from the gullet, much as the lungs of higher vertebrates do. Furthermore, many fishes can supplement oxygen obtained from water by gills, with air taken into the gullet. For example, goldfish are doing this when they gulp air at the surface of their bowl, when the oxygen in the water is exhausted. In a few fishes the inner walls of the air bladder are richly supplied with blood vessels, and it normally acts as a secondary organ of respiration. Whereas lungs might be said not to have evolved from an air bladder, yet both lungs and air bladder presumably actually arose from a pouch of the gullet which originally had a respiratory function.

Compared to the sea, fresh waters are more often low in oxygen content, and the probabilities are that such a structure arose in fishes inhabiting such fresh waters, for which it was advantageous to obtain supplementary oxygen. Sharks have no air bladder, but one is generally present in the diverse groups of marine as well as fresh-water bony fishes, thus an hypothesis that modern bony fishes evolved from fresh-water forms of the past. In one direction these would have given rise to the majority of fish species of today, both fresh-water and marine, in the other to lung-breathing amphibia, and through them to the higher vertebrates, reptiles, birds and mammals.

Archaic Fishes. — The fossil record shows us that true fishes (Pisces) mere present on the earth from the beginning of the Devonian period, estimated as a matter of 355,000,000 years, that sharks and other presumably ancestral fish-like creatures were living even further back in geologic time. It was in the Carboniferous period in the latter part of the Palaeozoic era that the first family of bony fishes, of which there is a living representative appears. This family (Coelacanthidae, in the superorder Crossopterygii) is known from fossils all through the ensuing Mesozoic era, for a span of an estimated 200,000,000 years, but was supposed to have become extinct at least 50,000,000 years ago, until a trawler off the South African coast caught one in 40 fathoms of water in 1938. It was a large-mouthed, ugly-looking fish, some five ft. long, weighing more than 100 lb., and was named Latimeria chalumnae. *Latimeria* has hard scales, most of its fins have elevated, fleshy bases and it has a peculiar tail fin, with a projection in the centre. Such a tail was characteristic of its probably numerous relatives which lived in the Jurassic period, differing from one another more widely than Latimeria does from those it resembles closely. This unique specimen was mounted and is preserved in a South African museum, a witness to what strange creatures may live unsuspected in ocean depths.

This discovery of an archaic, living fish, previously known only from fossils, is not without precedent. The Australian lungfish (Epiceratodus forsteri), a fresh-water species, found in Queensland in 1871, is very like members of its family which occurred in the Triassic and Jurassic periods of the Mesozoic era, which is estimated as existing more than 125,000,000 years ago. The fossil record shows lungfishes as a group to be among the most ancient true fishes, extending back into the Devonian period. There are also two others which survive today, the South American (*Lepidosiren*) and African (Protopterus) lungfishes, related to one another but only remotely so to those known from the past.

Epiceratodus is a large, sluggish fish, said to reach a length of more than five ft. It has a rather elongate body, pointed in front and behind, compressed from side to side, covered with large, overlapping scales. Its paired fins are placed low, the pectorals near the head, ventrals near the tail. They have the form of padNes, with fleshy bases. Otherwise there is only a pointed caudal or tail fin. Its air bladder, which opens into the gullet by a duct, extends back the whole length of the body cavity. This fish has a small mouth and feeds on crustaceans, worms and the like in the abundant water plants of the more or less stagnant pools which it frequents. From time to time it comes to the surface and renews the air in its air bladder or "lung," which thus supplements the gills as an organ of respiration. When, in the hot season, the oxygen content of the water of the shrunken pools is lowered by decomposing plants or animal matter, it gets along very nicely on atmospheric air.

South American and African lungfishes superficially resemble the Australian, except that they have fine. inconspicuous scales, their paired fins are very narrow, filamentous, and the South American is more elongate and eel-like. The African lungfish (Protopterus) was much studied and is very thoroughly known. It is a voracious, predatory fish, feeding indiscriminately on any aquatic animals small enough to be mastered. A favourite habitat for it is floodwater swamps and marshes. It is said to rise to the surface for air as the Australian lungfish does, and when the swamps dry up seasonally it burrows into the mud, curls up with its nose toward the surface and lies dormant breathing air into its lungs by a small aperture through the caked mud, and subsisting on its accumulated fat and other tissues until the water comes again. Fish thus encapsuled in the hardened mud are frequently dug up and shipped dry to distant parts of the world without injury.

The air bladder of Protopterus consists of an anterior unpaired part and two long, tapering lobes which extend backward for the length of the body cavity, having a more complicated structure and being more lung-like than that of Epiceratodus. This fish further parallels the Amphibia by passing through a larval tadpole stage, wherein it breathes with plume-like external gills as do various larval salamanders. The Amphibia are presumably no more descended directly from lungfishes than the lung of land vertebrates is a modified air bladder, but the parallelism gives an insight into the origin of both.

The three lungfishes still living, widely separate in different parts of the world, are relics of a distant past when their tribe was more numerous and more generally distributed, and are spoken of as relict forms.

In tropical African fresh waters there are fishes of an ancient type belonging to a family (Polypteridae) so far unknown in the fossil record. These were supposed to be related to the Coelacanthidae, and with them to be members of the large group or superorder Crossopterygii which flourished long ago, a view which is not held at present. They are elongated fishes which have the head covered with hard plates, the body with rhombic, thickly enamelled scales, broad rounded pectoral fins behind the head, and ventral fins placed far back, a series of finlets, each with an initial spine, along the back, and a rounded caudal or tail fin. *Polypterus* bichir is said to reach four ft., and to be mainly predaceous, feeding on smaller fishes. The air bladder of *Polypterus* is used in respiration, supplementing the gills, rather than as a hydrostatic organ, and its young have plume-like external gills. A second genus, *Calamichthys*, resembles *Polypterus* but is more elongate, eel-like. They form the suborder Polypterini in the order Chondrostei.

Other living representatives of ancient types of fishes are the sturgeons (Acipenseridae) and related paddlefishes (Polyodontidae), belonging to the suborder Acipenseroidea of the order Chondrostei; gar pikes (Lepisosteidae); and the bowfin (Amiidae), both in the order Holostei; all found in fresh water. Some of the sturgeons, however, descend to and get their growth in the sea.

Sturgeons are among the largest fresh-water fishes. Species which enter American Atlantic and Pacific rivers from the sea were recorded to lengths of 18 and more than 12 ft. respectively, and a Russian species is said to reach 30 ft. It is not unusual for exclusively fresh-water forms to run more than six ft. They have long snouts, with tactile barbels before the mouth, which is on the lower side of the head, longitudinal series of bony plates with nodules between them on the body, instead of scales, fins without spines, the pectoral fins behind the head, ventrals far back, a small dorsal, and anal fin below it near the tail, and the vertebral column bent upward into an upper lobe of the caudal fin, which is longer than the lower.

Thus, in several respects, notably in the shape of tail and caudal fin, they resemble modern sharks. In this connection it will be of interest to consider the evolutionary history of fishes' fins. We may suppose an original, simple fin fold extending along the midline of the back, around the end of, and forward along the lower mid-line of the tail to opposite the hind end of the body cavity, there dividing in two to follow along the two sides of the lower surface to back of the head. The paired fins would be an anterior and posterior relic of the double fold. The vertical fins, dorsals on the back, anal usually present on the lower mid-line of the tail, and caudal fin, would have been derived from the simple median fold. The original caudal fin, thus formed, was presumably weak for driving purposes, and its efficacy improved by bending its axis upward so that its lower base is directed more or less backward, and increasing the size of same. In a very primitive, elongate, living shark (Chlamydoselachus), which must mostly swim in an eel-like manner, the axis of the tail runs straight back, but may be bent upward somewhat in swimming. as the caudal fin on its mid-line below is definitely nider than on its mid-line above. Other sharks show variously intermediate conditions to that which pertains in the numerous species of the modern shark families Carcharinidae, etc., where the axis bends into an upper lobe (considerably longer than the lower, which is situated at the proximal end of the bent part) as it does in the sturgeons, In the mackerel sharks (Isuridae), particularly strong, swift swimmers, this lower lobe has become almost equal to the upper axial one, to form a firm, crescentic, driving caudal fin. In the great majority of modern bony fishes, the caudal fin is superficially symmetrical, but anatomically shows an ancestral upward flexure of its axis.

The family Acipenseridae is not of great antiquity or known to have occurred before the Tertiary period, where more modern fishes were also present, but extinct sturgeon-like fishes ancestral to them go back to middle Mesozoic, apparently a connecting link with the earlier palaeoniscids. Sturgeons are the most generally distributed archaic types of fishes still living. They are excellent food fishes, and their roe, made into caviar, is an item of much commercial importance.

The North American paddlefish (Polyodon spathula), belonging to a related family, is one of the strangest large fishes living. It has the general contours of a sturgeon, with a similar unsymmetrical (heterocercal) tail and caudal fin, but its skin is smooth and naked, lacking scales, plates or nodules. It has a large mouth. and a very small eye at the base of a very long, flat, paddle-shaped snout. about half as long as the whole rest of the head and body. The paddlefish inhabits sluggish waters of the lower Mississippi valley, grows to be more than four, but rarely more than six ft., weighing between 100 and 200 lb., and was reduced in numbers by commercial fishing, for its roe, from which caviar is made, as from that of sturgeons. It was thought to use its snout or paddle to stir up mud and feed on creatures therein contained, but perhaps this is only suggested by the shape of that peculiar organ. It feeds largely by sifting out clouds of minute animals (plankton) floating free in the water, which are taken into its large mouth and strained through its exceptionally long, fine gill rakers. The paddle, which is richly supplied with sense organs, doubtless helps locate these. But this is not its only method of feeding, for it will sometimes take a baited hook.

Besides American paddlefish, one similar species (*Psephurus* gladius) is found in the rivers of China, where it grows to a larger size, sometimes 20 ft. or more. These two are generally considered relict species from an age when their family had a more general distribution, though fossil evidence of it is scant and goes no further back than the Eocene.

There is no known fossil record of the family of the gar pikes (*Lepisosteus*), which still abound in North American fresh waters, back of the Eocene when they were more generally distributed, but they persisted little changed from that period some 45,000,000 years ago. A gar pike is an elongate, cylindrical, predaceous fish. Its jaws are elongate to a greater or less degree and set with formidable teeth. Its paired ventral fins are placed about in the centre of its lower surface, rounded dorsal and anal fin below it are far back near the tail. Its caudal fin, also rounded, is still slightly unsymmetrical externally. in evidence of a heterocercal past. Perhaps the most interesting feature of this fish is its scales, which are thick, hard, rhombic, nonoverlapping and articulate with one another by peg-and-socket joints. Scales more or less of this type evidently evolved before the thin, elastic, overlapping scales, which are the rule in modern fishes, and which allow more freedom of motion. They become more and more frequent as one follows back the series of fossil fishes into the geologic past. *Polypterus*, also, has such scales, but the gar pikes are the best example of them in living species. On large individuals of the alligator gar (*Lepisosteus* spatula) of the lower Mississippi valley, which reaches a length of nine ft. or more. it is said that these heavy, enamelled, plate-like scales may even turn an axe. Gar pikes are sluggish fishes, lying motionless at the surface in quiet waters, but are highly predaceous, rushing upon such prey as comes within range with lightning speed. They are very destructive to smaller species and have little food value.

The bowfin (Amia *calva*), an abundant fish in the Great Lakes region, Mississippi valley, and southeastern G.S., is the sole living representative of a family (characterized, among other things, by a single, large bony plate at the throat) known from fossils far back to the Jurassic period of Mesozoic time. It is, nevertheless, a very ordinary appearing fish, a foot or so in length. with normal. rather small scales, a large mouth. long dorsal fin of flexible rays. rounded pectoral and caudal fins. In fact, several unrelated, generalized modern fishes resemble it in superficial appearance, and. at first glance one would not suspect the bowfin of belonging to the archaic category, did one not notice that its caudal fin is slightly more heterocercal than that of the modern fish. The bowfin is a strong, tough, voracious fish, feeding on any animals that come its way, mostly smaller fishes. It is exceedingly tenacious of life, can breathe air with its air bladder to supplement its gills, and thus live in foul water, or for a long time out of water.

Herring, Trout, and More or Less Related Fishes.—The oldest and most primitive group of modern true bony fishes is presumably the Isospondyli, that to which the herring, salmon and trout belong. What seem to be true herrings occur as far back as the close of the Mesozoic era (Cretaceous), and there were species of the herring-like bonefish (*Albula*), not unlike that of today, in the Eocene. There is also more or less conclusive evidence that the Isospondyli are ancestral to various other groups of more specialized fishes of today.

A typical herring is a compressed, streamlined, silvery fish, a few in. to a ft. long, with large, thin. overlapping scales, modified to form a sharp, serrate keel, along its mid-line below, and with no evident lateral line. It has a single, rather short, soft-rayed dorsal fin near the middle of the back, paired ventral fins small, near the middle of the lower outline, and a well-forked caudal fin It has a large mouth but uses small food, its teeth are small or lacking, gill rakers long and numerous, and it swims in schools.

There are several allied, but more primitive, herring-like fishes. Such is the heavy-scaled tarpon (Tarpon atlanticus), which grows to a large size, feeds on smaller fishes and is much sought by big game anglers. The elongate, predaceous big-eyed herring (*Elops saurus*), related to the tarpon, is another. It has fine scales, a conspicuous lateral line, and is cosmopolitan, though varying slightly, probably only racially, in different warm seas. Two other fine-scaled species, the cylindrical bonefish or banana fish (*Albula vulpes*), with a small mouth and somewhat pig-like snout, which inhabits all tropical seas. and the milkfish (Chanos chanos), a valued food fish, inhabiting warm waters of the Indo-Pacific ocean, belong to this category. Then there are the mooneyes or toothed herrings (Hiodon) of North American fresh waters, which have strong, sharp teeth.

There are variations from type within the herring family proper (Clupeidae). Here different species are more or less elongate or deep-bodied, compressed or cylindrical, with larger or smaller scales, the keel along their lower mid-line stronger or weaker, lacking in the cylindrical round herrings (Etrumeus). Species of this family are most numerous in warm seas. All are good food fishes, but those of temperate and cool latitudes (which, in general, grow the largest) are of much the greatest commercial importance. The northern sea herrings (*Clupea* harengus in the Atlantic, and *Clupea pallasii* in the Pacific), because of their great abundance, are the basis for perhaps the most commercially important of all fisheries. Several species of the temperate North Atlantic are anadromous, that is, run up rivers into fresh water to deposit their spawn. Of these the North American shad (Alosa sapidissima) reaches an unusually large size for this family, weighing between two and six lb.. and is particularly prized for the table. Incidentally, the shad lends itself to fish-cultural methods. its eggs have long been hatched artificially and the fry liberated. and it was successfully introduced into rivers of the Pacific coast where it was not native. Here, however, it meets with less favour than in the east. There are comparable species (*Hilsa*) which enter the rivers of China. The Menhaden (Brevoortia *tyrannus*), a marine herring of warm and temperate waters of the western North Atlantic which reaches a length of more than a ft., carries the herring tendency to be plankton feeders to an extreme, subsisting largely on diatoms, minute drifting plants which are the basic food supply of the ocean. It gets very fat and plentiful on this lowly but abundant pasturage, swims in dense schools which are much preyed upon by predaceous fishes and is taken commercially for its oil and for fertilizer.

The anchovies are a family of smaller, more fragile fishes, particularly abundant along continental shores, and are closely related to the herrings. They are easily recognized from their rounded or conical snout projecting beyond a very large mouth, and commonly have a silvery band along the side. Although a warm-water family, the most important species occur in temperate seas, as Engraulis encrasicholus of the Mediterranean and *Engraulis ringens* of Peru. This last is excessively abundant in the cold, upwelling "Humboldt current" waters along that coast, and a principal food of the sea birds (which are the basis of the Peruvian guano industry) as well as of other aquatic animals. A genus (Coilia) of estuarine fishes belonging to the anchovy family, wherein the posterior portion of the body is lengthened and tapering, the anal fin very long, confluent with the small, pointed caudal fin, is abundant in fresh and coastal salt waters of the orient. This little fish is caught in vast numbers with special nets in Tungting lake, China, and dried in the sun.

The gizzard shads (*Dorosoma*), found in muddy, fresh, brackish and salt water, are of another family close to the herrings, their most obvious superficial difference from these consisting in a small mouth more or less below the snout. They have generally been considered mud-eaters, and whereas it was recently claimed that they are plankton strainers instead, their differences from herrings would certainly correlate with a mud-eating habit. Their young, which are more herring-like than the adult, doubtless, and the smaller species of which the same is true, very probably feed mainly on plankton.

Contrasted with herrings, trout and salmon are predaceous in habits, and, as a rule, have strong teeth to seize and hold their prey. There is little difference between a trout and a salmon. They are a northern, cold-water family, extending into the Arctic regions. Those species which are regularly anadromous, getting their growth in the sea and returning to fresh water to spawn, and which reach the largest size, are generally known as salmon. In temperate latitudes the great majority of trout spend their entire life in fresh water; but, wherever found in the lower courses of the streams, they enter salt water to some extent, and in the far north they run in and out of fresh and salt water rather indiscriminately.

A trout is a somewhat elongate, symmetrical fish with large mouth and strong teeth. Its body is covered with small, smooth scales, often so fine as to escape notice. Its fins are entirely of soft rays, without spines, the ventrals placed near the centre of the lower mid-line, a short dorsal fin near the middle of the back, the caudal or tail fin broad, and squarish to more or less forked. In the mid-line of the back, in the tail region well behind the dorsal fin, there is a small flap without rays, known as the adipose fin, of uncertain—if indeed it has any—function. Such an adipose fin is a peculiar, superficial characteristic of certain primitive groups of fishes, as of the trout and salmon family in this case.

Trout and salmon fall naturally into two main divisions, the black-spotted trout, and the charrs. These differ in the shape of, and arrangement of the teeth on the central bone in the roof of the mouth (vomer), which is straight with teeth for its entire length (deciduous in the Atlantic salmon) in the black-spotted trouts, boat-shaped with teeth only on the front, raised end in the charrs. The superficial character of colour will differentiate these groups more readily. The black-spotted trout have, sometimes scant, sometimes profuse, small black spots on the body and fins, the charrs may have red, blue or pale, but no black spots. Both Atlantic and Pacific salmon belong to the black-spotted group, which, except as represented by the sea-run Atlantic salmon or its landlocked races, or as planted artificially. is absent from eastern North America, but occurs native from the eastern slope of the Rocky mountains westward. The European black-spotted trout and the Atlantic salmon belong to the genus *Salmo*. The trout of western America are referred to that genus also, but the Pacific salmon, which have a slightly longer anal fin and a different life history—they spawn once and then die—are usually separated as a distinct genus *Oncorhynchus*. It is not certain, however, that western trout are not actually more closely related to the Pacific salmon (*Oncorhynchus*) than they are to those of Europe and to the Atlantic salmon (Snlmo).

The charrs (*Salvelinus*) are a circumpolar group abounding in the far north, occurring southward in cold, hill streams, or isolated in lakes, where they were apparently left by the retreat of the glacial period. They, as well as the black-spotted trouts. are represented by many local varieties, which merge into one another, and few distinct species, of which the eastern brook trout of North America is one, although silvery, sea-run individuals of this species are difficult to differentiate from those of the others. The black-spotted trout of Europe run freely into salt water; the sea-run fish is somewhat different from those in the streams, was formerly considered a distinct species, but is now thought to be identical and the differences entirely the result of environment. In the mountainous region of western North America there are many varieties of black-spotted trout which tend to merge into one another except where isolated by physiographic barriers. Those inhabiting fast water at high altitudes have finer scales and brighter colours, and there is a Rocky mountain series of forms differing from that of the Sierras and coast ranges. There is also a strain of coast range trout that runs to sea, reaches a large size and is known as steelhead salmon, though no more related than other trout to the true Pacific salmon (Oncorhynchus), of which there are five well-marked species.

The lake trout (Cristivomer) of northern North America, is somewhat different from either charrs or black-spotted trout, but more related to the former. Its vomer is boat-shaped with teeth in front, and also a ridge or crest of teeth extending back in the centre; and its dark upper parts are usually profusely spotted with pale. It has a large mouth. strong teeth, reaches a large size, is generally common northward and in temperate latitudes, at least, inhabits the cool depths of deep lakes.

The grayling (*Thymallus*) is a fish of this family found in Arctic and northern fresh waters, more or less southward in the mountains. It differs from trout and salmon in a smaller mouth and weaker teeth, less fine scales, and an expanded dorsal fin, which is high, broad, and brightly coloured.

The whitefishes (Coregonidae) form a subfamily of, or a family related to, that of salmon and trout. They differ from them in having smaller mouths, weaker dentition, slightly larger scales and being plain coloured, usually whitish on the sides. darker along the back. They are found exclusively in fresh water, except in the far north where they sometimes enter the Arctic ocean or its tributary bays, and are primarily lake fishes. All are good, some rank high as food fishes. particularly the lake whitefishes (*Coregonus*), with deep, compressed bodies, weighing up to 20 lb. or more. The round whitefishes (*Prosopium*) are more of a river fish. The smaller, schooling, lake herrings (*Leucichthys*) are very herring-like in superficial structure and in habits, but have the adipose fin characteristic of trout and whitefish families. A large, predaceous, salmon or pike-like whitefish, known as the inconnu or coney (Stenodus mackenzii), which reaches 15 lb. (occasionally 30 lb.) occurs in the larger rivers of far northwestern North America from the Mackenzie to the Yukon, with a similar fish in Siberia. It has weak, bristle-like teeth in bands, evidence that it is a specialized whitefish, not a transition form between the white fishes and the strong-toothed trout.

The smelts are a family of small, active, carnivorous marine fishes allied to the trouts, which they resemble in general contours and fin arrangement. They are commonly between six in. and a ft. in length, and are dark along the back, with silvery sides. They are an important item in the diet of larger species and are delicious food fishes. Smelts are abundant coastwise in northern and temperate seas. Some species. *e.g.* the common smelt of eastern North America (*Osmerus mordax*), run into fresh water, and even become landlocked in inland lakes. Others are confined to considerable depths in the ocean. A fine-scaled Arctic smelt, known as the capelin, swarms along the beaches where it deposits its eggs at spawning time.

In the orient there are small, elongate, fragile, translucent: trout-like fishes known as glassfishes (Salangidae), occurring in both fresh and salt water and represented by numerous species. Their body is scaleless or with fine deciduous scales, a small adipose fin is present, the dorsal fin placed well behind the ventrals which are near the middle of the body, anal fin rather long, still farther back and caudal fin forked. They have rather large mouths and very variable dentition. Many have elongate heads and large canine teeth, predaceous fishes in miniature, for they are slender and usually less than six in. They are considered a delicacy by the Chinese.

The common lizard fishes of the cosmopolitan genus *Synodus* and closely related genera, which are strictly marine and occur along the shores of all tropical seas, are quite trout-like superficially, though structural differences place them in a different, doubtless related order. They have an adiose fin like a trout, ventral fins more anterior in position though well behind the pectorals, somewhat coarser scales and a very large mouth with strong teeth, which opens to well back of the eye. They are elongate fishes which reach a length of a ft. or so and live in water of no great depth along sandy shores. They frequently lie on the bottom, where their gray or reddish mottled colours render them inconspicuous, but are swift, predaceous and very destructive to smaller fishes. A member of the lizard fish family, *Harpodon nehereus,* is found along the shore and in the mouths of the rivers of India. where it is a prized food fish. known as "Bombay duck" when salted and used as a relish. It has an enormous mouth, a small eye near the tip of the snout, large ventral fins and reaches a length of some 16 in.

Various peculiar fishes of the ocean depths, where daylight fades until it penetrates no farther, approaching perpetual abyssal darkness, lighted only by gleams of phosphorescence, have more or less certain relationship to, and have likely been derived from lizard fishes, or, if not, from the Isospondyli, to which lizard fishes are related. They are sometimes included in a heterogeneous order called the Iniomi. There are the fragile, little lantern fishes (Jlyctophidae), very abundant in individuals and species in the open sea. They have large eyes, large mouths, and a fin arrangement, including an adipose fin, much like that of a lizard fish, or of a trout for that matter, a series of small, luminous spots, suggesting portholes, along their lower sides, and give off flashes of phosphorescent light. hlany, which usually have large, silvery scales, easily detached, live deep down in the daytime and come to the surface at night; others are confined to the depths.

Lantern fishes are weak creatures with feeble teeth, but black, scaleless fishes of the depths belonging to the genus Astronestltes, which resemble them somewhat, are predaceous and have long fangs. They have an adipose fin, many fine luminous spots on the sides and below and a long, fleshy barbel at the throaf. This genus is sufficiently common to deserve mention as one of those closely related to lizard and lantern fishes. It has few species, no close relatives and is placed in a family by itself. The lancet fish (*q.v.*) is placed in the Iniomi, as also are a number of divergent kinds of deep-sea fishes of uncertain relationships, classified in as many distinct families. For instance, there is *Chauliodus,* an elongate fish with fang-like teeth exaggerated; Malacostercs, a peculiar form with an enormous mouth; *Ipnops* which is eyeless, but has the whole top of its flat head occupied by a pair of peculiar organs which possibly function as eyes, though more generally supposed to be luminous organs. Most of these fishes that live in the dark ocean depths are blackish in colour and many have variously placed organs to give off phosphorescent light. The hatchet fishes (*Argyropelecus*), one of the commonest types. which may come nearer the surface, are small, deep-bodied, flat from side to side, bright silvery in colour and are thought to swim in schools.

Two important families of fresh-water fishes, related to and sometimes included in the Isospondyli, though quite unlike herring or trout, are the Osteoglossidae and Mormyridae. The former has only five species, scattered around the world, two in South America, one in Africa, two in northern Australia and the East Indies. The latter has many divergent species and is confined to Africa. In the Osteoglossidae the ventral fins are placed well back, dorsal and anal fins, with soft rays only, variously long or of moderate length, not far removed from the caudal fin. The scales are large except in one of the South American fishes, in which they are rather small. This species! known as pirarucu (Arapaima *gigas*), is one of the largest fresh-water fishes, reaching a length of 1j ft. or more and weight of some hundreds of lbs. It has a large mouth, small eye, ventral fins behind the middle of the body, low dorsal and anal: and a small rounded caudal fin.

The hlormyridae are small-mouthed, slimy fishes, with small, often fine and inconspicuous scales. Their fin rays are all soft, the dorsal and anal fins placed well back and the caudal fin forked. The ventral fins, well behind the pectorals, are about in the centre of head and body, or farther forward. The dorsal fin may be long, occupying most of the back, the anal fin short (in *Mormyrus*), to the dorsal fin short and the anal fin long (in Hyperopisus), or the two of approximately the same moderate length, placed over one another. The body is usually rather elongate, but may be short and compressed (as in *Petrocephalus*). The peduncle (tail end of the body) is narrow and usually long. The eye is large (in some species of *Petrocephalus*) to small (in others of *Mormyrus*). The outline of the head and position of the mouth vary greatly, even in related species, but tend toward a few contrasting types. In *Mormyrops* the front of the head is narrowed (vertically), the mouth horizontal and terminal; in *Petrocephalus* the snout is short, bluntly rounded in profile, the mouth more or less beneath it. In *Gnathonemus* the lower jaw usually projects somewhat beyond the upper; in *G. petersii* it tapers into a thick, fleshy, forward directed barbel; in *G. rhyncophorus* and others the snout is narrowed, elongate, curved downward to suggest the trunk of an elephant, with the little mouth at its tip. Such a snout finds its extreme development in *G. curvirostris* and G. *numenius,* where it is some four times as long as the head behind the eye.

Eels.—Eels are fishes, with the body form of, but no relationship to, a serpent. They were almost certainly derived from more normal fishes, their differences, such as lack of ventral or posterior paired fins, correlated with their different manner of life and locomotion. There are eels everywhere, from inland fresh waters to the depths of the ocean. Superficially more or less alike, they differ fundamentally so greatly that they are classified in a number of families. It is more than likely that eels were derived from divergent groups of fishes. There are eel-like fishes the relationship of which to more normal forms is obvious. The others are commonly grouped together, and those which are not obviously unrelated, placed in the order Apodes. The lampreys and hagfishes (Cyclostomata, *q.v.*) are not eels, although commonly so-called.

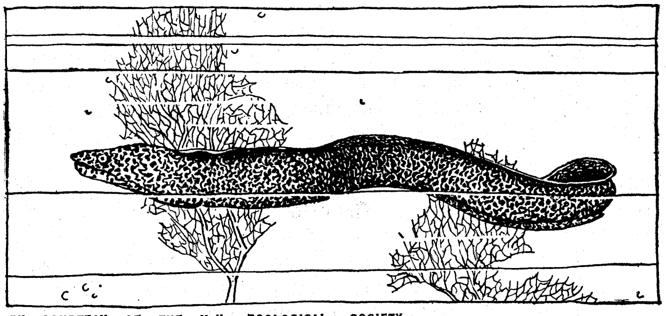
Of the several families in the order Apodes, the common eels (Anguillidae) ; conger eels (Congridae); snake eels (Ophichthyidae); and morays (Muraenidae) might form an evolutionary series, in which the common eels are closest to, the morays farthest removed from, normal fishes. So iar as known, all species of these, and of related families, spawn in the sea, and their young pass through a larval, transparent stage, quite unlike the adult.

The common eels (*Anguilla*) sometimes called fresh-water eels, were likely derived from the Isospondyli. They differ from all other families of Apodes in having the body covered with small, embedded, rudimentary scales. These scales may easily be seen with a hand lens. They are elongate and have a peculiar arrangement, placed obliquely, in groups, those in each group at right angles to those in an adjacent group. Similar scales occur in some of the Ophidiidae, eel-like fishes with no apparent relationship to true eels. *Anguilla* has a large mouth, lower jaw usually slightly projecting, strong teeth and is an active, predaceous, bottom fish, eating hungrily any animal food, living or dead. It has well-developed pectoral fins, a short slit before their bases, being the only posterior opening from the gill chamber. The dorsal fin, running along the back, and anal fin below, join broadly around the tip of the tail. It inhabits shallow coastal salt waters, and fresh waters as well, penetrating far inland, and not infrequently becoming landlocked and reaching a large size in lakes or ponds. Possibly little eels can reach such places by underground seepage, through which larger ones are unable to escape. Eels can live in foul water, for some time out of water, and there are reports of their moving overland in met weather, but these are not too well substantiated. They must return to the sea to spawn, and the spawning grounds of the European and American species were shown to be far out in the deep-blue water of the Atlantic. Common eels are extensively and generally used for food. The others are not so used as a rule, and the flesh of some, for instance the morays, locally at least is thought to be unwholesome.

The conger eel of the North Atlantic (Conger conger), which is abundant off the coast of Europe and there extensively marketed, is superficially so like a common eel that it might easily be mistaken for one. It is strictly marine, found in somewhat deeper water, reaches a larger size, its dorsal fin commences not far behind the head instead of toward the middle of the back and it is entirely without scales. There are several other genera also in the family Congridae.

The snake eels (Ophichthyidae) are a very varied group abundant in the shore waters of the tropics and comprising a number of genera. They are characterized by a finless tip of the tail, dorsal and anal fins not meeting around it. The pectoral fin may be well-developed, rudimentary, or absent, dorsal and anal fins very low, or the dorsal quite high. The mouth may be large or small, teeth strong or weak, and the snout usually projects more or less beyond the lower jaw, but does not always do so. Some are very slender and elongate, even for an eel. Some are feeble, others strong and aggressive, and when stranded at the edge of the water, as they sometimes are, become threatening, simulating a snake. Some are plain coloured, others brightly marked, and in the East Indies one or more have a colour pattern which resembles that of poisonous sea snakes found in the same waters, and which feed largely on eels.

The morays (Muraenidae) have a very small gill opening, never have a trace of a pectoral fin, and their dorsal and anal fins, which



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SPOTTED MORAY (GYMNOTHORAX MORINGA), AN EEL, ABUNDANT IN THE WEST INDIES. IT IS YELLOWISH IN COLOUR AND IS THICKLY MARKED WITH DARK SPOTS

may be rather high, especially the dorsal, or very low, are continuous around the tip of the tail. There are a number of genera and many species in this family, which is particularly abundant about coral reefs in the tropics. The typical morays (Gymnothorax, etc.) are heavy-bodied, somewhat compressed eels, with a rather high dorsal fin beginning well forward, before or behind the hind border of the head. Their snout is pointed, nape convex, jaws about even, mouth large, extending to well back of the eyes, teeth numerous, strong and sharp. They are strong and predaceous, hunting the crevices of the reef, where fishes on which they prey find security from other enemies; and the largest reach a length of five ft. or more. They may be plain coloured, mottled, or more boldly patterned. The genus Echidna comprises less aggressive, short-bodied, compressed species, with blunt teeth. There are several species in the East Indies, one small one in the West Indies, and so forth. They are commonly dark coloured with pale markings.

There are several peculiar deep-sea families of Apodes, of which the snipe eels (Nemichthyidae) constitute one of the strangest. These are very slender and elongate, the tail often ending in a finless filament and their finely-toothed jaws are narrowed and lengthened to suggest the bill of a snipe. In some species the jaws are twice as long as the remainder of the head and spread apart at the tips. It is difficult to see how such a mouth would be used in feeding, and it was suggested that its function is that of clinging to other larger fishes by which the snipe eel is carried about. Snipe eels have large eyes, and well-developed pectoral fins. They are recorded from water two or three mi. deep, and rarely within 50 fathoms of the surface.

The gulpers (*Saccopharynx* and Gasnostomus) are deep-sea eels, usually placed near the Apodes, but considered a separate order. They are black creatures of the depths, which rarely come to light, with enormous mouths and distensible stomachs, and thus are capable of swallowing fishes really larger than themselves. Their body tapers backward into a slender lash and their tiny eyes, which are probably functionless, are placed near the tip of the snout. *Saccopharynx* is known up to some six ft. The symbranch eels, also made a distinct order, inhabit sluggish fresh waters, water holes, and penetrate underground drainage. These differ from the Apodes in that their gill openings, instead of being separate, one on either side of the neck, join below across the throat. They have a small eye, tail tapering to a point, dorsal and anal fins rudimentary and no pectoral fins. Only two or three species are known. Fluta alba, represented by two or three poorly defined geographical races, is abundant in the orient and East Indies; *Synbranchus* marmoratus is common and generally distributed in tropical America.

The spiny eels (*Mastacembelus*), of which there are a number of species in the fresh waters of southern Asia, the Indies and Africa, have very uncertain if any relationship to other so-called eels. Their bodies are not greatly lengthened, more or less compressed, and covered with fine scales. They have well-developed pectoral fins, and soft dorsal and anal fins (of about equal length) join broadly around the tip of the tail. They have spines on the side of the head, two or three spines in the front of the anal fin, and many short, sharp spines along the mid-line of the back. They are further characterized by a pointed, more or less proboscis-like snout and are considered excellent food fish.

Pikes and Carps.—The orders of fishes to which the pikes (Haplomi) and the carps (Ostariophysi) belong were presumably derived from the Isospondyli, though their relationship to herring and trout is neither close nor clear. A pike (Esox) is a predaceous fresh-water fish. It has a long, streamlined body, covered with small, smooth scales, a long head and great mouth with projecting lower jaw and formidable teeth. Its paired pectoral fins are placed low, under the hind margin of the head, ventral fins about midway in the length of the body, rounded dorsal and anal fins, of about equal size and one above the other, far back near the caudal, which is moderately forked. The few species of pikes, found across the northern continents, are very much alike. They are strictly freshwater fishes of lakes and sluggish streams, where they lurk along the edges or near vegetation, to rush upon and seize any hapless fish (or other animal in the water) that comes within range, not excepting smaller individuals of their own species.

The larger species of pikes range well to the north. The American race of the northern pike (Esox *lucius*) occurs native from Alaska to New York and the Ohio valley. It reaches a length of four ft. and a weight of 40 lb. The European race grows to be 10 or more lb. heavier.

The tooth carps, of which many and varied species abound in coastal salt, in brackish and in fresh water, particularly-of the tropics and subtropics, although also placed in the Haplomi, are little fishes of an entirely different character, rarely more than a few in. long. Some are slender, not unlike the pikes in shape, though others have deep, compressed bodies. They have similar fine scales, fins of soft rays only, not dissimilarly placed, the dorsal fin more or less behind the middle of the back and towards or over the anal, not in the middle of the back as it usually is in the true carps. Unlike the pikes, and unlike true minnows, which belong to the carp family (tooth carps are sometimes erroneously called minnows), their caudal fin is usually not forked but rounded. Instead of being large, their mouths are even relatively small. Some are carnivorous, with small, firm, pointed teeth, but only tiny creatures need fear them, whereas they themselves are an important item in the food supply of larger fishes. The males of many species of tooth carps have bright colours, quite unlike those of the females, or assume them at breeding time.

There is a division of this group of fishes represented by many varied species in tropical American fresh waters, which, instead of laying eggs, give birth to living young, and have the anal fin, which is more anterior in position than in the others, developed into an intromittent organ in adult males. The males are frequently considerably smaller than the females, or with more decorative fin development, as well as bright colours. Various viviparous tooth carps are of very small size, multiply rapidly and become very abundant in quiet streams and pools, where they are a natural check on mosquitoes by consuming their aquatic larvae. One such North American species, Gambusia *affinis,* with a usual maximum length of about two in. and the males considerably smaller. was widely introduced as a mosquito control. On the other hand, one of the largest tooth carps which may grow to be a ft. long, the four-eyed fish (*Anableps*), is a member of this division. It is an elongate fish, with very peculiar eyes which project upward like those of a frog, and are divided into an upper part adapted for vision in air and a lower for vision in water.

Another division of tooth carps (the family Amblyopsidae) contains the blind fishes mhich inhabit the limestone caves of eastern North America in utter darkness. The most specialized of these is the Mammoth Cave blind fish (*Amblyopsis spelaeus*) an elongate, sluggish, colourless (whitish) fish, reaching a length of about five in. It has a large mouth and catholic appetite, but tiny, functionless eyes, and the body and head with many vertical ridges of tactile papillae. A peculiar feature of this family is that the vent is placed anteriorly, close behind the gill openings. Besides the blind species, it comprises eyed forms, one of which, the rice-ditch killifish (Chologaster cornutus] is abundant in streams and 101%-landswamps in the southeastern U S.

Two other small fishes of the order Haplomi, with no close relatives and superficially like the tooth carps, should be mentioned. The mud minnows (*Umbra*) of eastern North America and Austria-Hungary, growing to four or five in., resemble somewhat structurally a fossil pike known from the Miocene, more so than they do present-day pikes. They are active, very hardy little fish, found in streams and stagnant pools with a bottom of deep mud into which they dive when alarmed. The Alaska blackfish (*Dallia* pectoralis) is a large-mouthed, hungry little fish so abundant in some of the fresh-water summer pools in Siberia and northern Alaska, as to be an important food item with the natives, although it only grows to about eight in. It is said to freeze solid in winter, but be as lively as ever when spring thaws it out.

The order Ostariophysi comprises three superficially quite unlike series of fishes, catfishes, characins and carps, the relationship of which is proved by their having a same complicated structure of earbones, which would hardly have evolved independently in the three groups. They were presumably derived in fresh water from isospondylous ancestors, though direct evidence of this is lacking. They first appear in the fossil record of the lower Tertiary, then already separated into these three main types.

The standard catfish is scaleless, often with a broad head. It has fine teeth in bands, a more or less transverse mouth surrounded by several barbels, a strong spine in the front of the dorsal and of the pectoral fins, the ventral fins near the middle of the body and a small adipose fin over the anal, which is of moderate length. Numerous species of catfishes occur in the fresh waters of North America, Asia, Africa and South America, varying progressively more widely around this type in the respective continents in the order mentioned. In North America the most obvious difference between the different species is one of size. The Mississippi catfish (*Ictalurus furcatus*) may reach a length of five ft. and a weight of around 150 Ib.; the tadpole catfish (Schilbeodes *gyrinus*) is about five in. This last is one of several small, related, bottom species with poison glands at the base of their pectoral spines, a prick from which is like the sting of a bee but more severe.

In Asia, and particularly in Africa. there are catfishes without an adipose fin, with a long soft-rayed dorsal fin only on, and occupying most of the back, an only relatively shorter anal fin below it (*Clarias*). Others have a small dorsal fin, placed well forward, its spine weak and a long anal fin. *Parasilurus,* which is abundant in Asia, and *Schilbe,* which occurs in Africa, have no adipose fin; *Eutropius,* which is abundant in Africa, has a small adipose In Africa there are catfishes with broad sucker-like mouths on the lower side of the head, wherewith they cling to and presumably scrape the moss off rocks (Euchilichthys), and an electric catfish (*Malopterurus* electricus)—with a thick, soft skin, no spines, no rayed dorsal but an adipose fin—which is capable of giving a severe shock.

It is in South America, however, that the catfish tribe reaches its maximum expansion, and, in addition to standard forms. superficially similar to those occurring in the other continents, there are many others very unlike them. Catfishes were presumably among the few modern fresh-water fishes which reached South America prior to its long isolation from the other continents by sea during the Tertiary, and, lacking competitors, expanded there in many directions. They occur in every kind of water, even mountain torrents, where one small catfish (*Cyclopium*), by means of a sucking disk surrounding the mouth and its pectoral fins, can edge along the bottom against the current, and even climb up a vertical wall out of the water. There is a family (Pygidiidae) of tiny, slender, degenerate catfishes, which are parasitic, and attach themselves to other fish or animals like leeches. One of these, the candiru (*Vandellia*), which commonly lives inside the gill cavity of other fishes, on the blood of which it subsists, has the evil reputation of at times entering the urethra of unwary bathers. Catfishes are without true scales, but some of South America (*Callichthys*, Couydoras, etc.) have the body cuirassed by a double series of scale-like plates which meet along the middle of the sides, and the neotropical family Loricariidae of most aberrant. bottom catfishes, with sucking disk surrounding the mouth, have the body more or less completely armed with smaller scutes. There are a number of genera and many species of this family. Plecostomus and its relatives, some of which reach a large size, are not unlike catfish and have an adipose fin with an initial spine. Loricaria and its relatives are most peculiar, flattened, elongate, the cuirassed body, backward from the dorsal fin, tapering and slender.

Catfishes are, and presumably always were, a continental, freshwater group. but two types are also marine. Species of *Arius* and related genera, which are quite standard in appearance, inhabit warm coastal waters around the world. Many catfishes guard their eggs and newly hatched young, and some of this kind have very large eggs which they carry in their mouth until hatched. Relatives of *Plotosus* are another dissimilar, less generally distributed type, plentiful in the orient. Back to the level of their ventral fins they are normal appearing catfishes, but the posterior part of the body is lengthened, and a long anal fin extends evenly around the tip of the tail and forward, as the dorsal fin, a varying distance, sometimes equally far, on the back, instead of a rayless adipose fin being present. These two kinds of marine catfishes have reached, and established distinct species and even genera in the fresh-waters of Australia and New Guinea, although the group as a whole is continental and absent from land masses which have not been connected with the northern continents after the beginning of the Tertiary. Although they may not be utilized as food, so far as is known all catfishes are good to eat.

The characins are a varied group of fresh-water fishes confined to Africa and tropical America. Typical characins are active, streamlined, longer or shorter-bodied fishes. with fins without spines, a short dorsal more or less in the middle of the back and over the ventrals, pectorals behind the head placed low, a small adipose present over the longer or shorter anal and a forked caudal fin. Their mouths and feeding habits vary greatly; the mouth may be very small, the teeth insignificant or even absent, or the mouth large, with highly developed fangs. A common condition, especially in short-bodied, compressed forms, is a rather small mouth, with hinged lower jaw which drops down very freely, and strong, cusped incisor teeth. In a few genera the adipose fin is absent. There are many genera, some of the predaceous ones being moderately large fishes, but most are rather small, and a good many minnow-sized. In Africa species of the generalized genus *Alestes* are variously short-bodied and compressed, or more slender; the tiger fishes *(Hydrocyon)* are salmon-shaped fishes with notably large, strong, sharp teeth. The largest tiger fishes grow to three or four ft. They are usually silvery on the sides, with a tendency to narrow, parallel, lengthwise streaks. The large-mouthed, pike-like *Sarcodaces odoe* grows to one or two ft. *Distichodus* and *Citharinus* have small mouths with small or minute teeth. The latter, with a very deep, compressed body, grows large, two or three ft. in some species.

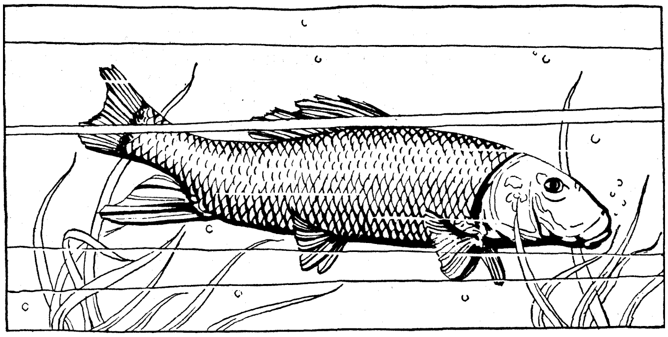
In South America, numerous small, more or less short-bodied and compressed species related to *Astyanax*, correspond to those related to *Alestes* in Africa. There are deep-bodied, fine-scaled fishes known as piranhas (*Serrasalmus*) with somewhat larger mouths and stronger teeth, a long anal fin with an oblique base and the lower edge of the body keeled and serrated, which reach a maximum length of about 18 in. At perhaps half that size they occur in some rivers in immense schools, and are reputed to attack and consume any warm-blooded animal that falls or ventures into the water: and to be dangerous to man. Fishes of the genus *Hydrolycus*, which may grow to two ft. or more, have large mouths and two very long fangs in the front of the lower jaw. *Curimatus* and related genera comprise small species with a very small mouth and no teeth. Species of *Pyrrhulina* are handsome, slender, small-mouthed little fishes, wherein the adipose fin is lacking. They are often kept in aquaria. *Hoplias*, a very ordinary looking, large-mouthed, strong-toothed fish, which grows to one or two ft., also lacks an adipose fin, and has little in its superficial appearance to suggest its belonging to this family.

Resemblances between certain South American and African characins was considered evidence of a fresh-water, that is, a land connection between the two continents. presumably in Tertiary times. However, recent taxonomic ichthyologists, most familiar with this family as a whole, are rather unanimous in the belief that it differentiated independently in the two areas, that these resemblances are parallelisms, subgroups comprising both African and South American species being matters of convenience, rather than truly phylogenic.

In the fresh-waters of South America there is an abundant and varied family of eel-like fishes, the Gymnotidae, thought to be a derivative or branch of the characins. These have the body behind the head relatively deep, but tapering to a long, slender tail. The anal fin, which is very long, occupying most of the lower edge of the body, is rippled to propel the fish slowly forward (or backward). There are \\ell-developed pectoral fins behind the short gill slits, no ventral fins, the dorsal fin insignificant or absent. There is sometimes a narrow caudal fin, or the anal may extend back around the tip of the tail, or this project in a finless filament. The profile, snout and mouth are very variable. In most species the snout is moderate or short, and blunt, the mouth rather small. In some the snout is long and narrow with a tiny mouth at its end, and even decurved *(Stevnavchorhynchzts)* as in some of the Mormyridae. In fact there are certain parallels, though presumably no relationship between the Gymnotidae and that African family.

The most notable gymnotid, and perhaps the largest, is the electric eel (*q.v.*) (*Electrophorus electricus*), which sometimes reaches a length of more than nine feet, and differs from most others in having a projecting lower jaw, the body cylindrical instead of compressed, and lacking even rudimentary scales. Large eels can give the most powerful electric shock of any animal, that from one five feet long being sufficient to knock a man down. This faculty is doubtless used in defense. It is also used to stun, without killing, the small fishes on which the electric eel feeds, and one of the remarkable things about it is the perfect control the eel has over its severity, appropriate to a given application. The electric eel is generally distributed through northern South America, frequenting pools, and well-shaded places in narrow, sluggish waters, and, though rather generally avoided on account of its electric potentialities, is occasionally used as food.

The carp like fishes make the third division of the Ostariophysi, presumably the most recent one in time, as they have not reached South America, which conlinent was isolated by sea from the others for a considerable period in the Tertiary. Their differentiation and distribution are sufficiently recent to be traceable with reasonable certainty. Carps (Cyprinidae) are ordinarily symmetrical fishes with larger or smaller scales, dorsal and anal fins rather short, the former near the middle of the back, with ventral fins about under it on the lower side of the body, pectoral fins behind the head placed rather low, caudal fin emarginate or forked. They lack teeth in the mouth but have them on the pharyngeal (throat) bones. There are ordinarily no spines in-the fins, but an initial spine is not infrequently present in the front of the dorsal, occasionally more than one such, and rarely a spine in the front of the anal fin also. One or two pairs of barbels may be present about the mouth. The family is a large one and there are other variations from type. The suckers (Catostomidae) are primitive carps, little different from, and sometimes considered merely a subfamily of, the Cyprinidae. They are bottom feeders with small sucking mouths, and so are various true carps for that



BY COURTESY OF THE N.Y. ZOOLOGICAL SOCIETY
COMMON SUCKER (CATOSTOMUS COMMERSONII), ABUNDANT IN THE GREAT LAKES AND NORTHWARD. A FISH WITH PROTRUSIBLE MOUTH AND FLESHY LIPS ADAPTED FOR SUCKING UP MUD AND ORGANIC DEBRIS FROM THE BOTTOM

matter, but differ in that their pharyngeal teeth are simple, and in a single comb-like row. Those of the true carps are fewer in number, variously specialized, and often in two or three rows. Suckers were presumably ancestral to the carps, evolved and lost their oral teeth at a period when mature, sluggish drainage, nhich they still favour, was widely distributed. The valleys of Asia, south of the line of deserts which must be of great antiquity, are the centre of differentiation.and have probably been the centre of distribution, for true carps. Here but a single. specialized Chinese species of sucker (*Myxocyprinus asiaticus*) remains. There are numerous species of suckers in North American fresh waters.

The carp family occurs in greatest abundance and variety in eastern 'and southern Asia. To mention a few of the numerous types there represented. the genus *Barbus*, of which numerous subgenera may be recognized, are,mostly symmetrical, free-swimming fishes with moderate or large eyes, moderate or small mouths. with or without an initial spine in the dorsal fin, usually two pairs of barbels, sometimes only one, or none. Southern species usually have compressed bodies and large scales. highland and northern species tend to be more elongate with finer scales. The common carp *(Cypvinus carpio)* and the related goldfish (*Carassius auvatus)* are not unlike this genus, but have a long dorsal fin for the family, likely a primitive character, a serrate spine not only in the front of the dorsal but of the anal fin, and the carp has well-developed molar teeth, a specialized character.

What seems to be an evolutionary line is traceable from *Barbus*, through bottom-feeding forms represented by *Garra*, which has a broad sucking disk on the chin, then through *Varicorhinus*, to numerous, closely related silvery fishes of the genus *Xenocy-*

pris, with a characteristic small cross mouth more or less below the snout, and which are probably secondarily freer swimming. There are several more or less related or unrelated genera of breams. with a longer or shorter sharp keel along the lower edge of the body. Most are well compressed, from side to side. some are deep-bodied, others slender and elongate like the abundant Chinese knifefishes (*Hemiculter*), small or moderate sized silvery fishes with a smooth spine in front of the dorsal fin. Another group of carps comprises genera related to Schizothorax, abundant in high central Asia with a few representatives farther east in hilly country. These have a characteristic row of enlarged scales bordering the vent and base of the anal fin, those over the body small. sometimes rudimentary. or even lacking.

Elopichthys bambusa, common in China: is a large, slender, fine scaled, swift predaceous carp: with long, firm jaws; and predaceous species of the genus *Opsariichthys* have a protuberance on the upper jaw fitting into a notch in the side of the lower, to compensate for lack of teeth in the mouth. There are also groups of mostly minnow-sized fishes. *Phoxinus* are fine-scaled minnows, perhaps most nearly related to those which are so abundant in genera and species in North America. *Pseudorasbora parva,* with a small, very oblique mouth, is abundant and widely distributed, represented by several poorly defined geographical forms. There are numerous bitterlings (Rhodeus, etc.), deep-bodied, compressed, large-eyed. active little fishes, usually three in. or less though some species grow to moderate size, which lay their eggs inside the shells of fresh-water mussels, where they are relatively safe until hatched and the fry leave this shelter. The oviduct of the female is protruded as a long tube to deposit the eggs.

The gudgeon series (Cobio and related genera) is abundant and varied in eastern Asia, very scantily represented in Europe and has not reached Africa or America. It varies from very carp- or minnow-like fishes of moderate or small size (Leucogobio, *Gnathopogon*), to bottom species with small mouths, fringed with papillae, placed under the snout. Such gudgeons occupy a comparable ecological niche to that which suckers do in America. They comprise numerous small species of Pseudogobio, and more elongate, generally larger species of Saurogobio.

The loaches make a third division of carp-like fishes. They are usually rather small. frequently somewhat eel-like, tend to have fine, inconspicuous scales; are sometimes altogether without scales and usually have more barbels than the two pair frequently present in the carps. In some superficial characters they seem intermediate between catfishes and carps, but are probably a more recent group even than the latter, and may have been derived from them. Loaches are more heterogeneous than carps or suckers and very likely have a multiple origin. They have a peculiar anatomical character, in that the air bladder is enclosed in a bony capsule. Some are very sensitive to weather changes, and this encapsuled bladder may be correlated with sensitivity to atmospheric pressure. The eel-like pond loaches (*Misgurnus*), which are sometimes kept in aquaria and called weatherfish, become restless at the approach of a storm. Some small species (allied to *Barbatula*), which are numerous in High Asia where barometric pressures run very low, have the capsule more or less incomplete, although they are closely related to others in which it is complete. Loaches have no spines in the fins, but in some there is a concealed. erectile, defensive spine on the side of the head, more or less beneath the eye. Of these the spined loach (*Cobitis* taenia) is abundant, with a certain amount of geographic variation, across Eurasia from England to Japan: There are a number of shorter-bodied, freer-swimming, more streamlined Asiatic species'of the genus Botia, also with a facial spine, which tend to be boldly patterned or brightly coloured, and usually have a forked caudal fin.

The subfamily Homalopterinae comprises a miscellaneous lot of loach-like fishes. the closeness of their relationship to other loaches. or for that matter to one another. being somewhat uncertain. *Gastromyzon* and related genera placed here. which cling to the bottom in swift water. have a short, much depressed body, wide from side to side and flat below. with a small cross mouth on the under side of the head. the paired fins expanded in a horizontal plane. Loaches are abundant in Asia, also occur in Europe and one small species is found in Abyssinia.

Houndfishes, Flying Fishes, Trumpet Fishes and **Pipefishes.**—Houndfishes (Belonidae), sometimes called needlefishes or silver gars, are slender, elongate marine species, abundant along the shores of all warm seas. They have large eyes, the jams, set with numerous sharp teeth, lengthened to form a beak which is longer than the remainder of the head. Their fins are entirely without spines, the ventrals placed well back. rather behind the middle of the body, nhich is covered with fine, inconspicuous scales. The dorsal and anal fins are placed opposite one another near the tail, and the caudal fin is forked or lunate. They are silvery in colour, darker, usually greenish along the back and swim near the surface, singly or in small groups, preying on lesser surface fishes. The smaller species gron to one or two ft , the largest to at least four or five ft. Many of them frequently leap above the surface of the sea. their long bodies propelled through the air like a thronn javelin or spear, and there are said to be instances of men in small boats being struck and seriously wounded by them. The large kinds, especially, have the lower lobe of the caudal fin somewhat larger and firmer than the upper, no doubt correlated with this leaping habit. In most the body is cylindrical, little if at all compressed (*Tylosurus,* etc), but one genus (*Ablennes*) with a flat, compressed body, turns on its side in the air. Though only locally so used. probably all this family are good food fishes, even large species with green bones.

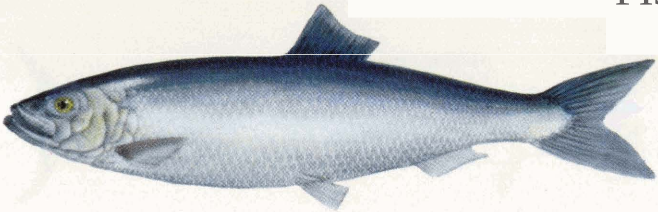
The halfbeaks (Hemiramphidae) are related to the houndfishes. but in these the lower jaw only is lengthened and forms a pointed, toothless spear. Exceptionally, both jaws are short (*Chriodorus*). Halfbeaks have small mouths and are mainly planktivorous. Just how their spear-like lower jaw functions is uncertain. It may attract bits of floating vegetation which slide back to the mouth as the fish swims along. They are small fishes, seldom more than a ft. long, abundant coastwise in warm seas. a few occurring in fresh water. Those found furthest offshore (*Hemiramphus*) have a forked caudal fin, with the lower lobe longer than the upper, as it is in the flying fishes and some of the houndfishes. This fin is usually at least emarginate, but there are more or less fresh-water or estuarine species wherein it is rounded, in the East Indies, etc., and these are viviparous (*Hemirhamphodon, Zenarchopterus*).

Some halfbeaks skitter along the surface of the water, sculling vigorously with their caudal fin, and with the body out of water at an angle, the short pectoral fins spread to balance and support it. It is logical to suppose that this habit gave rise to the related flying fishes, that in the course of evolution the halfbeak's pectorals lengthened and strengthened to make of the flying fish the efficient aerial glider that it is. Everywhere in nature we find an animal's structure closely correlated with its habits, usually aith no indication of which evolved first, and, as a matter of fact, they mere presumably very nearly synchronous. In this order of fishes (Synentognathi), if, as is supposed, the houndfishes are primitive and flying fishes, its terminal member. the habit of leaping came first, and gradually turned to flight, as it gave rise to structures which made flight possible.

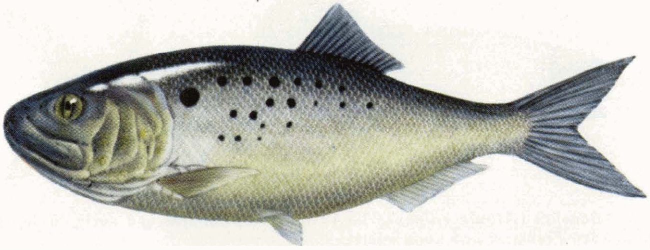
The flying fishes (Exocoetidae) are large-eyed, blunt-headed, silvery-sided fishes which swim at the surface of all warm seas. They have moderate-sized smooth scales; short, posteriorly placed dorsal and anal fins, of soft rays only; and are notable for their very long, firm pectoral Sns, which support them in the air. Their caudal (tail) fin is forked, its lower lobe firm and is longer than the upper. Two types of flying fish are common. The "four-winged" species have the ventral fins placed more or less behind the centre of the body, also large, and spread in flight to supplement the lift from the pectorals. The largest of these reach a length of around 18 in., and make the longest aerial excursions. The "two-winged" species, which are somewhat short-bodied and seldom more than six in., have the ventral fins small, less far back. not spread in flight.

An adult flying fish leaves the water with vigorous thrusts of the tail, spreading its wings rigidly as it does so. There was considerable argument as to whether it received any momentum or support from fin movement when in the air. It is now generally conceded that it does not, that. essentially at least, it is a glider. The

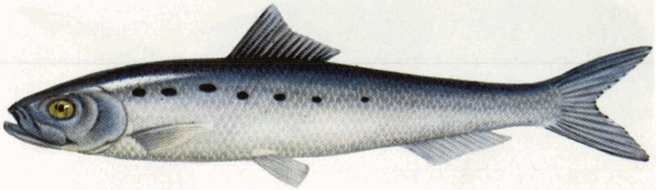
FISHES



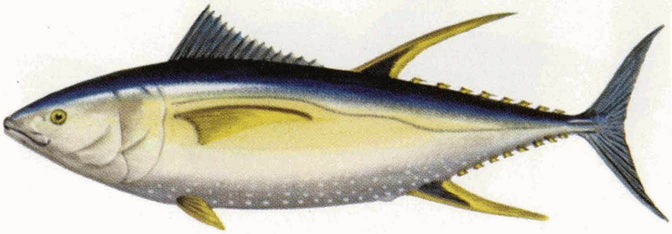
Herring *(Clupea harengus)*; 12-17 in. Both sides of the North Atlantic



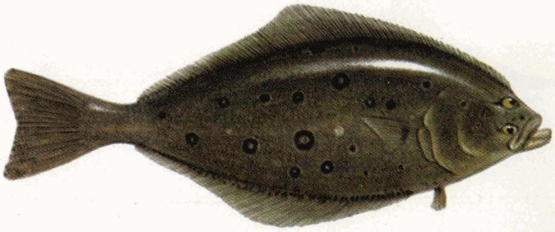
Atlantio menhaden *(Brevoortia tyrannus)*; *15* in. Nova Scotia to Florida



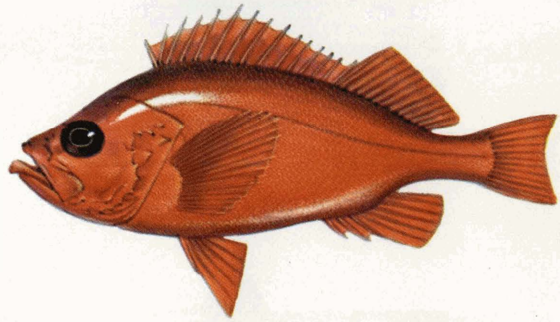
Pacific sardine *(Sardinops sagax)*; 8-14 in. Southeast Alaska to Lower California; Peru and Chile



Yellowfin tuna *(Thunnus albacares)*; *5-9* ft. Tropical and temperate Atlantic and Pacific

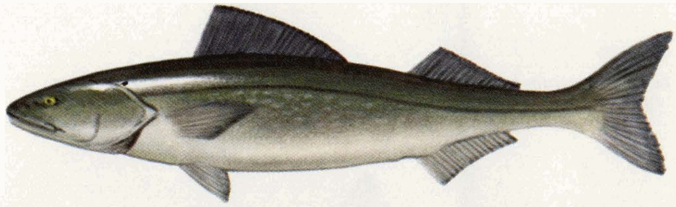


Atlantic halibut *(Hippoglossus hippoglossus)*; *7-8* ft. North Atlantic:, south to Bay of Biscay, south to New Jersey

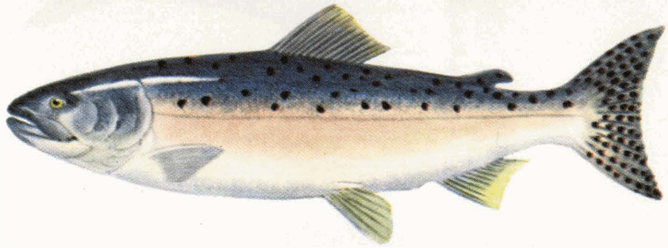


Redfish or ocean perch *(Sebastes marinus)*; 10-22 in. North Atlantic; North sea to Spitsbergen; Iceland; Greenland south to New Jersey

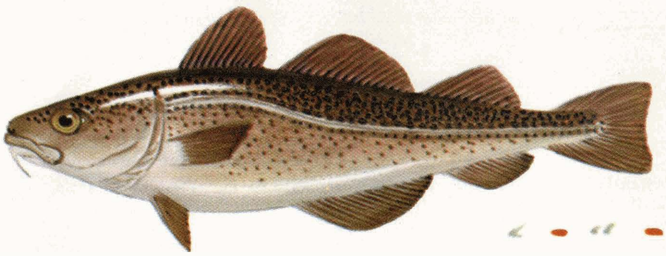
Mackerel *(Scomber scombrus)*; 12-24 in. North Atlantic: Noway to Spain and Gulf of St. Lawrence to North Carolina



Sablefish *(Anoplopoma fimbria)*; 20-36 in. Northwest Alaska to southern California



Pink salmon *(Oncorhynchus gorbuscha)*; 20-30 in. North Pacific: Asia, Alaska to Oregon



Atlantic cod *(Gadus morhua)*; *40-50* in. Greenland to the Carolinas

COMMERCIALLY IMPORTANT FISHES

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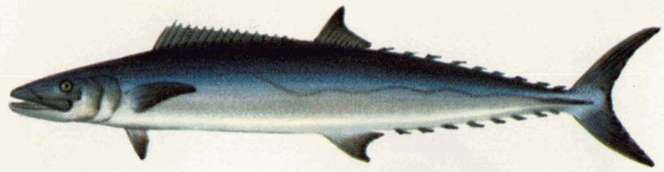
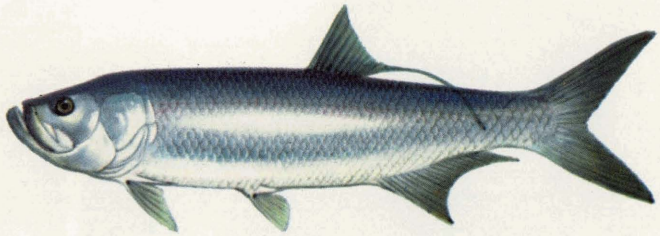
FISHES

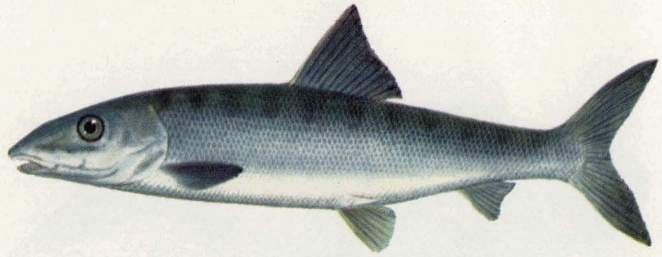


King mackerel or kingfish (*Scomberomorus cavalla*); 36-65 in. Tropical Atlantic

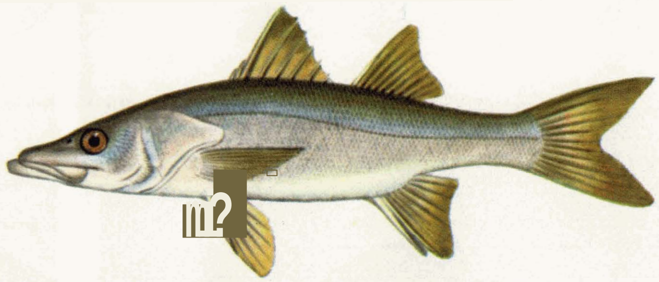
Wahoo (*Acanthocybium solanderi*); 30-78 in. All tropical oceans



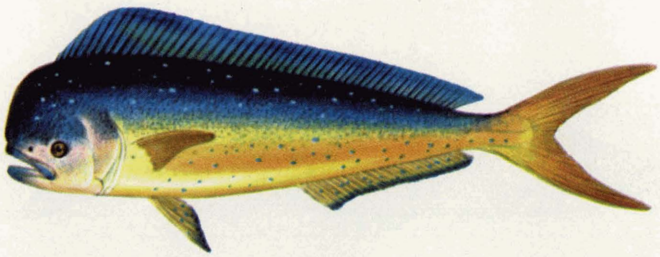
Tarpon (*Megalops atlantica*); 30-74 in. Tropical Atlantic



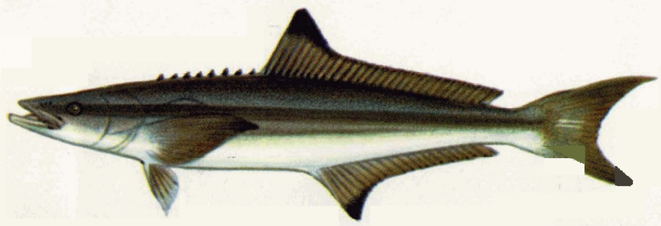
Bonefish (*Albula vulpes*); 15-42 in. Tropical teas and north to Japan, San Francisco and Long Island



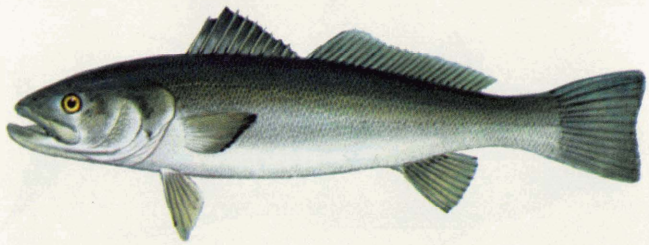
Snook (*Centropomus undecimalis*); 24-55 in. Gulf of Mexico, West Indies, south to Panama and the Guianas



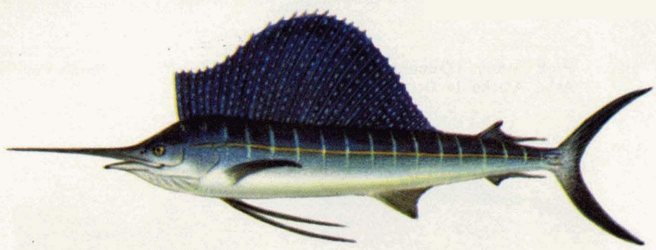
Dolphin (*Coryphaena hippurus*); 24-63 in. All warm oceans



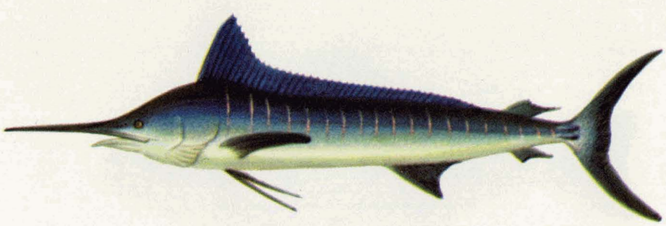
Cobia (*Rachycentron canadum*); 30-70 in. All warm seas



White seabass (*Cynoscion nobilis*); 25-65 in. California to southern Alaska



Atlantic sailfish (*Istiophorus albicans*); 60-124 in. Western Atlantic, Quif of Mexico, West Indies to Brazil



Striped marlin (*Makaira audax*); 161 in. Tropical Pacific

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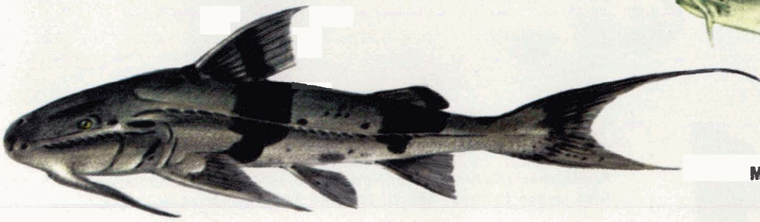
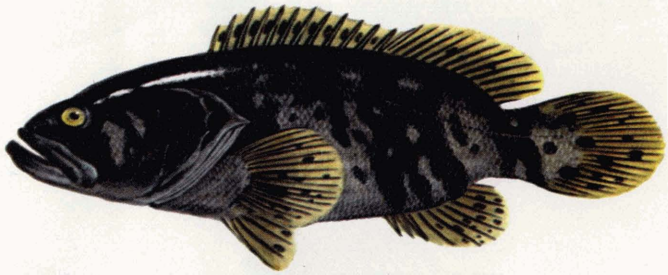
FISHES

Wels (***Silurus glanis***)**;** *6* ft., **occasionally** to **10 ft.** Central and eastern Europe, **Baltic** to Caspian teas

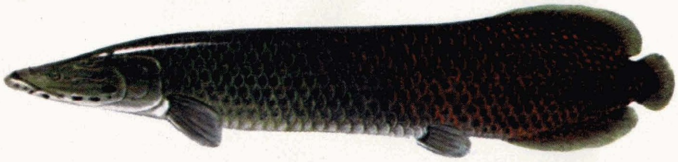
Sturgeon (***Acipenser sturio***); **6-10** ft., to **18** ft. Atlantic; Baltic, Mediterranean and Black seas; Danube river



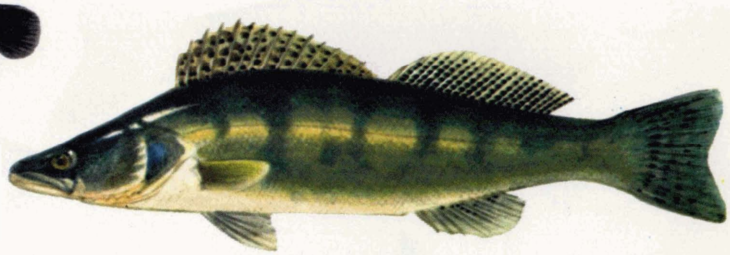
Goonch (***Bagarius bagarius***)**;** *6* ft. Rivers of India



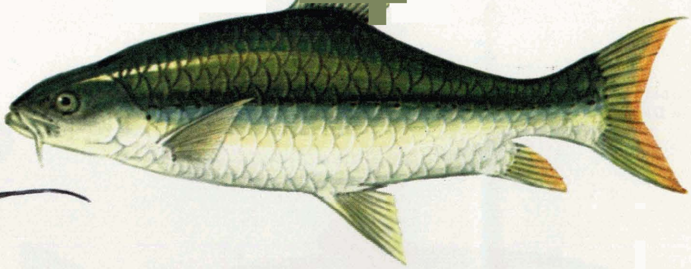
Giant sea perch (***Promicrops lanceolatus***)**;** *8* ft. Western Pacific and **Indian** oceans



Pirarucu (***Arapaima gigas***)**;** 8 ft. Rivers of South America from the Guianas to Argentina



Pike perch (***Lucioperca lucioperca***)**;** *6-20* in. Central Europe **and** USSR



Mahseer (***Barbus tor***)**;** *66* in. Rivers of India, **Assam** and Burma

Indian "trout" (***Barilius bola***)**;** 12 in. Rivers from northern India to Thailand

Tucunara (***Cichla ocellaris***)**;** 25 ft. Amazon river system and the Guianas

Dorado (***Salminus maxillosus***)**; 3 ft. Paraná and Orinoco rivers, South** America

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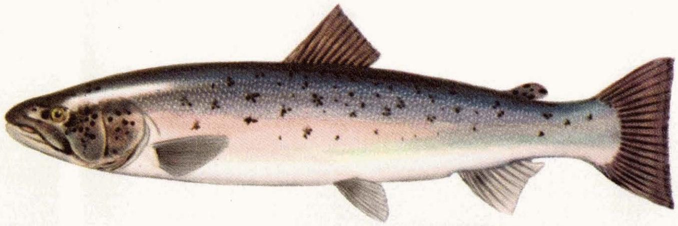
PLATE IV

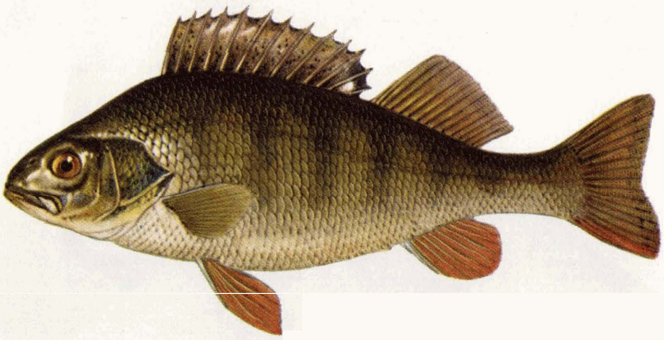
FISHES

Chub (*Squalius cephalus*); 12-24 in. England; Europe to Asia Minor

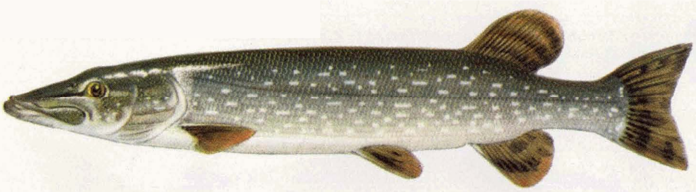
Barbel (*Barbus barbus*); 12-30 in. Engand, France and Germany to the Danube



Atlantic salmon (***Salmo salar***); **20-48 in.** North **Atlantic coastal regions** south to **New England** and **France**

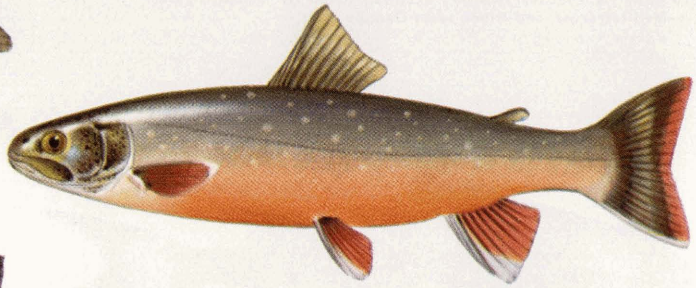


Perch (***Perca fluviatilis***); *6-12* In. England, Europe and northern Asia

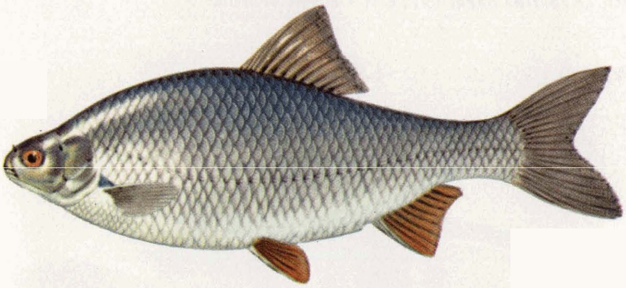


Northun **pike** (***Esox lucius***); 16-40 in. Cool md **cold** waters of **Europe, Asia** and **North America**

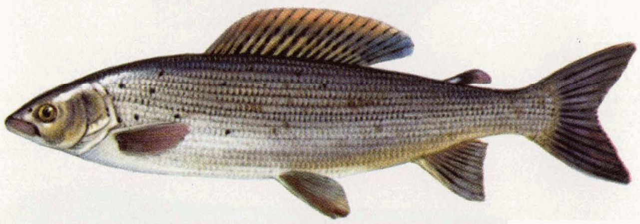
Brown trout (*Salmo trutta*); 6-12 in. Europe and Asia Minor; introduced into North and South America, Africa, India and New Zealand



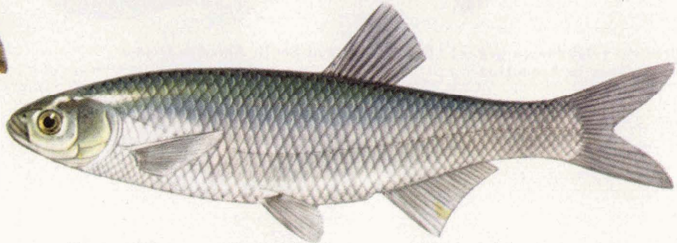
Arctic char (*Salvelinus alpinus*); 10-16 in. Circumpolar, south to the Alps, Japan to about 55° N. lat. and North America



Roach (***Rutilus rutilus***); 6-12 in. Europe, north of the **Alps** and **Pyrenees**



Grayling (***Thymallus thymallus***); **10-20** in. All **of** Europe **except** Spain, southern **France** and **Italy**



Bleak (***Alburnus alburnus***); *4-8* in. **England** and Europe, north of the Alps

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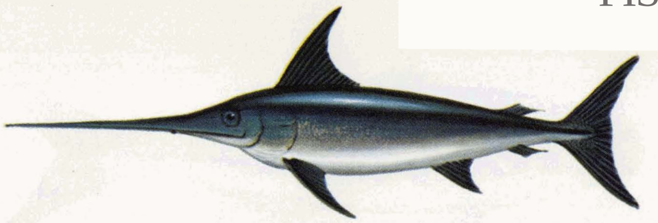
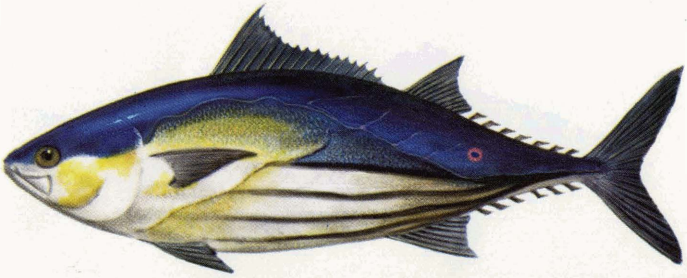
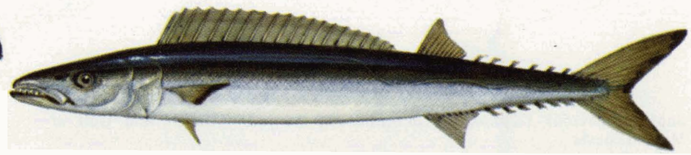


Swordfish (*Xiphias gladius*); 15 ft. All temperate and tropical oceans

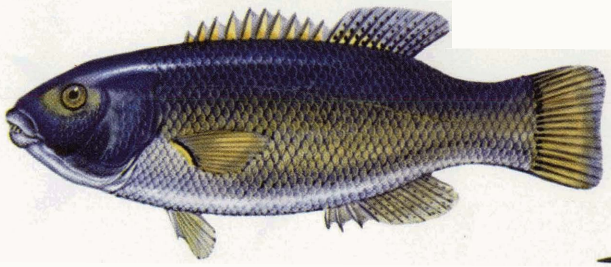
Murray cod (*Maccullochelia macquariensis*); *6* ft. Murray river system, southern Australia



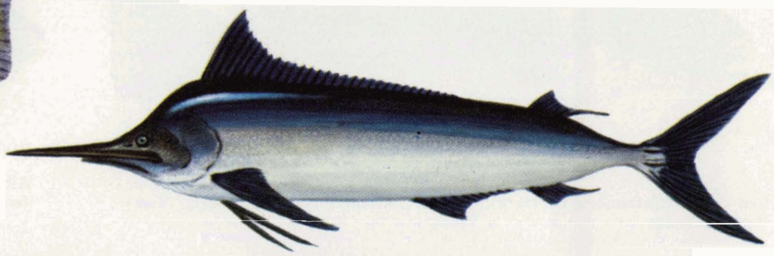
Skipjack tuna (*Euthynnus pelamis*); *3* ft. Pelagic temperate and tropical oceans



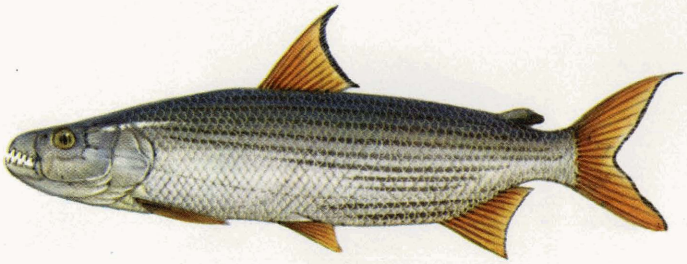
Barrácouta or snoek (*Thyrsites atun*); *4* ft. Coasts of South Africa, southern Australia and New Zealand



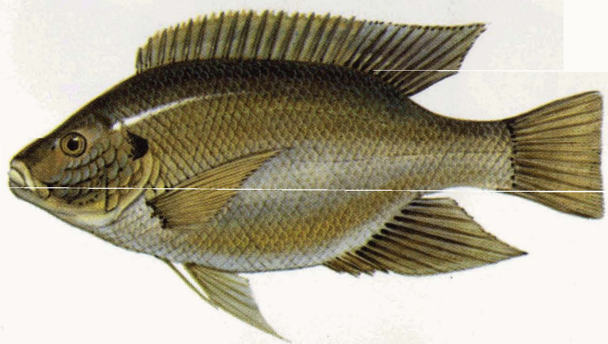
Groper (*Achaerodus gouldi*); *3.5* ft. Rocky coasts of Australia



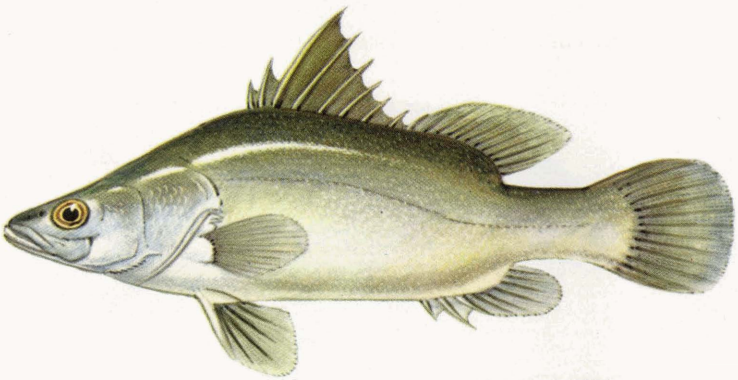
Black marlin (*Makaira indica*); 14.5 ft. New Zealand and Australia



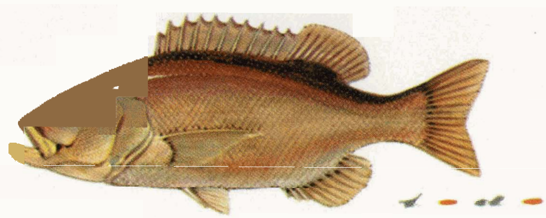
Tigerfish (*Hydroscion lineatus*); *2* ft. Large rivers and lakes of Africa



Tilapia (*Tilapia nigra*); *12* in. Athi river system, British East Africa



Nile perch (*Lates niloticus*); *6* ft. West Africa and Nile drainage



Red steenbras (*Dentex rupestris*); *4* ft. Cape seas, Africa

GAME FISHES OF THE WORLD

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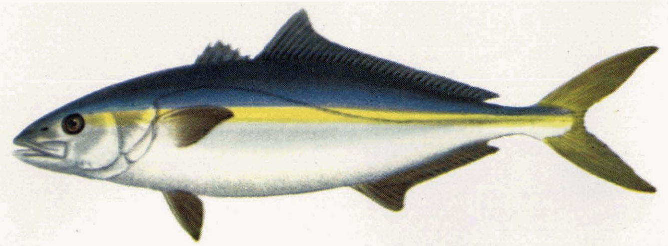
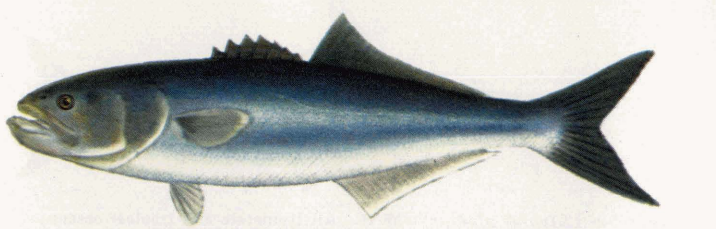
PLATE VI

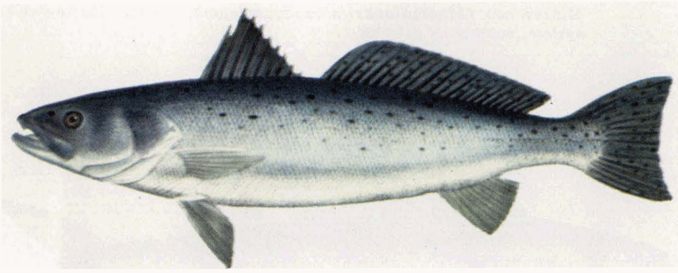
FISHES



Yellowtail (***Seriola dorsalis***); *65* in. Pacific coast, southern California and Lower California



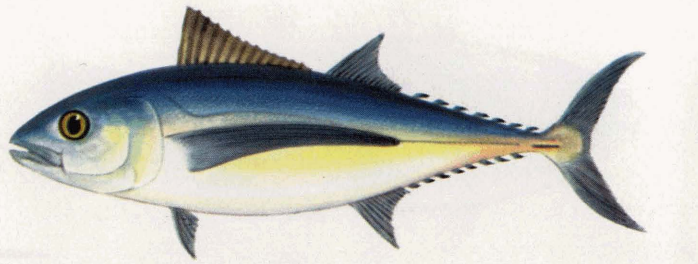
Bluefish (***Pomatomus saltatrix***); 40 in. Temperate and tropical oceans except waters of Oceania and eastern Pacific



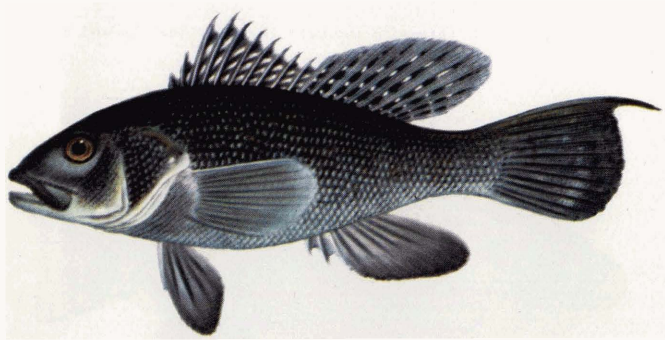
Spotted **seatrout** (***Cynoscion nebulosus***); **34** in. **Atlantic** and **Gulf of Mexico coasts**

Weakfish (***Cynoscion regalis***); 46 in. Atlantic, Nova Scotia to Florida

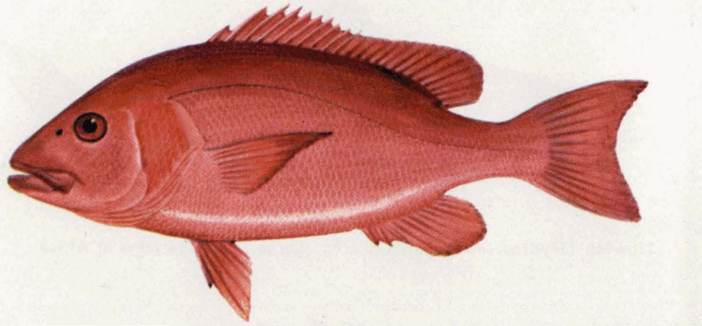
Red drum (***Sciaenops ocellata***); *52* in. Atlantic and **Gulf** coasts, New York to Texas



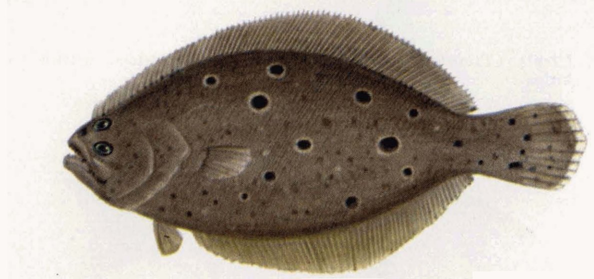
Albacore (*Thunnus alalunga*); 42 in. Alaska to Lower California through temperate Pacific to Hawaii and Japan



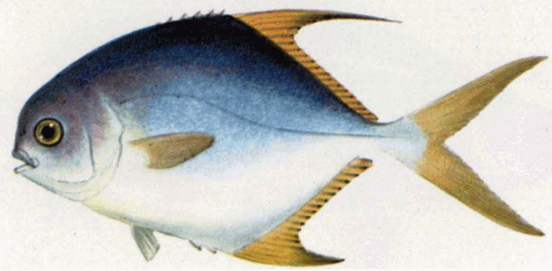
Black sea **bass** (***Centropristes striatus***); *24* in. Atlantic coast, Cape Cod to northern Florida



Red snapper (***Lutjanus blackfordi***); *30* in. Western tropical Atlantic



Summer flounder (***Paralichthys dentatus***); 36 in. Atlantic coast, Maine to Florida



Permit (*Trachinotus falcatus*); *43* **in. Tropical Atlantic**

NORTH AMERICAN MARINE FISHES

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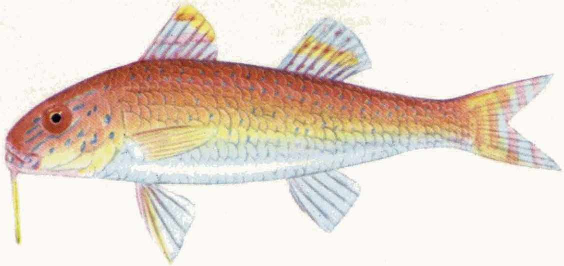
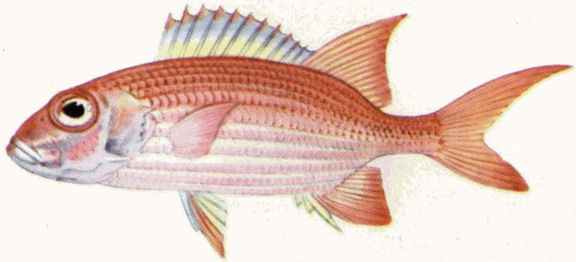
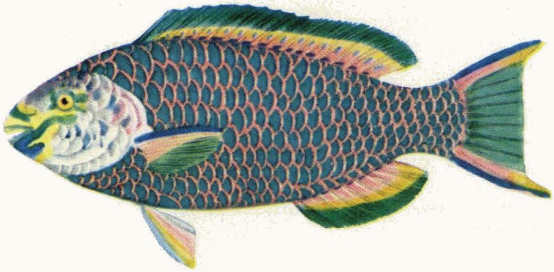


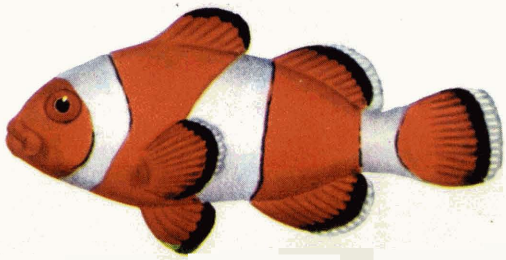
Spotted goatfish (*Pseudupeneus maculatus*); 10 in. Warm Atlantic



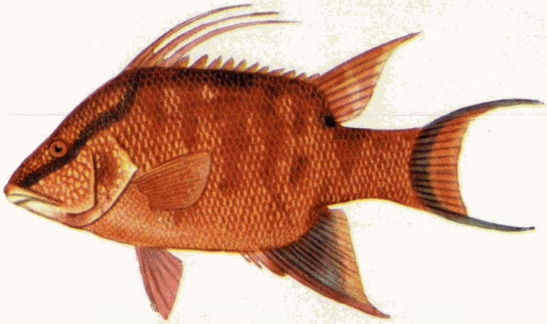
Longspine squirrelfish (*Holocentrus rufus*); 10 in. Bermudas, West Indies and Gulf of Mexico



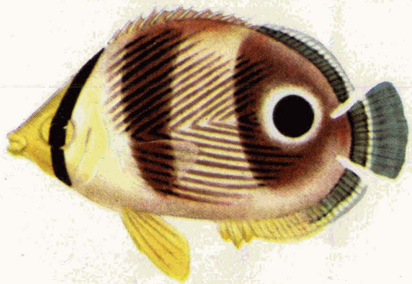
Queen parrot fish (*Scarus vetula*); 24 in. Warm Atlantic



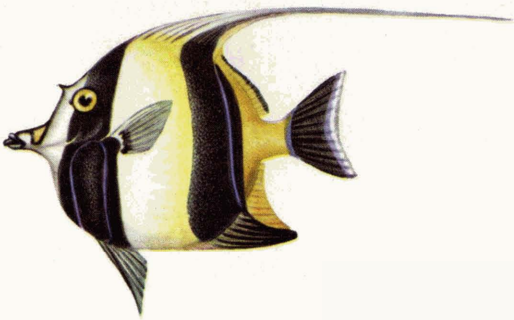
Anemone fish (*Amphiprion percula*); 3 in. Indo-Pacific



Hogfish (*Lachnolaimus maximus*); 26 in. Warm Atlantic

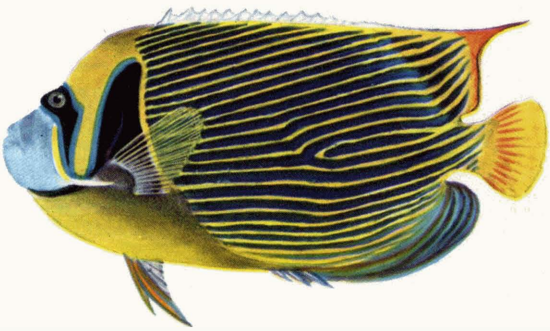


Foureye butterfly fish (*Chaetodon capistratus*); 6 in. Western tropical Atlantic



Moorish idol (*Zanclus cornutus*); 8 in. Indo-Pacific

Achilles tang (*Acantburw achilles*): 12 in. Indo-Pacific



Imperial angelfish (*Pomacanthus imperator*); 14 in. Indo-Pacific

Lionfish (*Pterois volitans*); 8 in. Indo-Pacific

CORAL REEF FISHES

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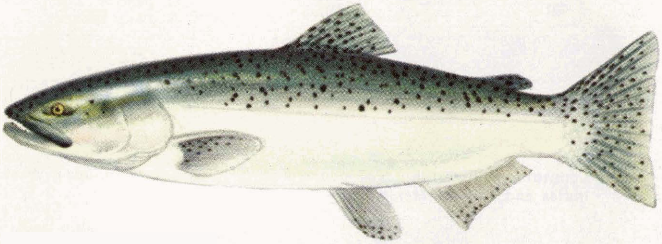
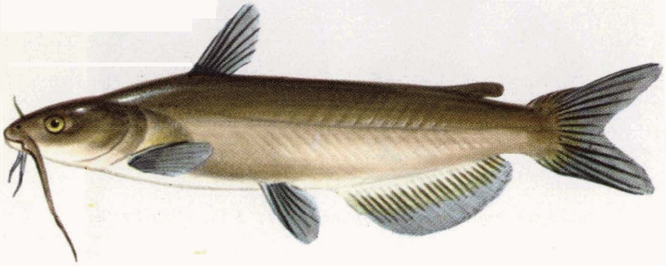
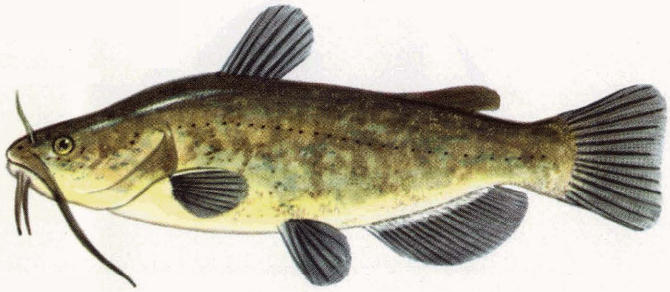
FISHES



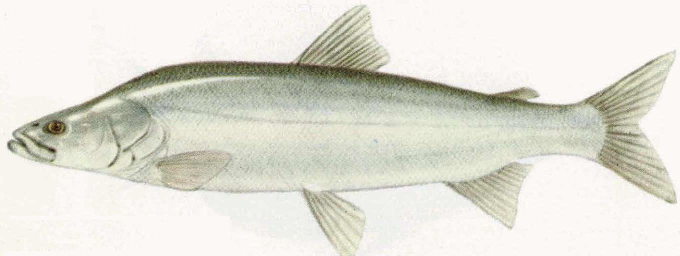
Chinook salmon (*Oncorhynchus tshawytscha*); 36-58 in. Pacific coast, California to Alaska and south to China. (Salmon migrate from the sea to fresh water to spawn)



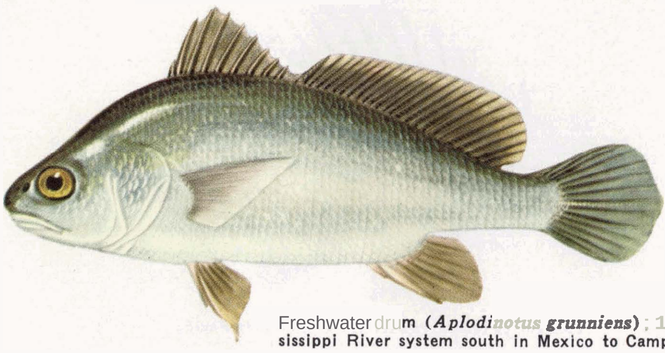
Channei catfish (*Ictalurus punctatus*); 11-30 in. Central U.S., Ap-palaohlans to Rookies



Brown bullhead (*Ictalurus nebulosus*); 6-16 in. Eastern U.S. and south-ern Canada



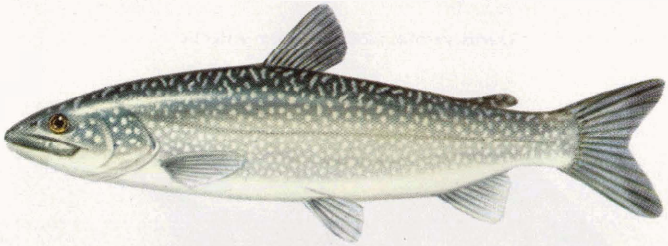
Inconnu (*Stenodus leucichthys*); 40-60 in. Yukon and Mackenzie rivers; also in northern Asia



Freshwater drum (*Aplodinotus grunniens*); 12-30 in. Great Lakes, Mis-sissippi River system south in Mexico to Campeche

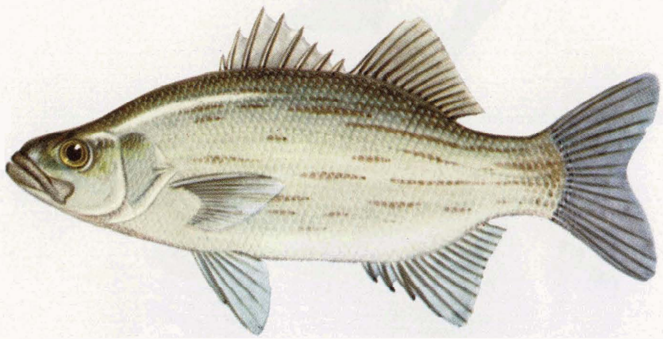
Cutthroat trout (*Salmo clarki*); 12-30 in. Western U.S. and Canada

Brook trout (*Salvelinus fontinalis*); 5-18 in. Northeastern U.S. and eastern Canada



Lake trout (*Salvelinus namaycush*); 15-36 in. Alaska; Canada south to the Great Lakes

Rainbow trout (*Salmo gairdneri*); 20-45 in. California to southeastern Alaska; introduced into Europe and New Zealand



White bass (*Roccus chrysops*); 7.5-16 in. Great Lakes, Mississippi river valley to northeastern Mexico

NORTH AMERICAN FRESH-WATER GAME FISHES

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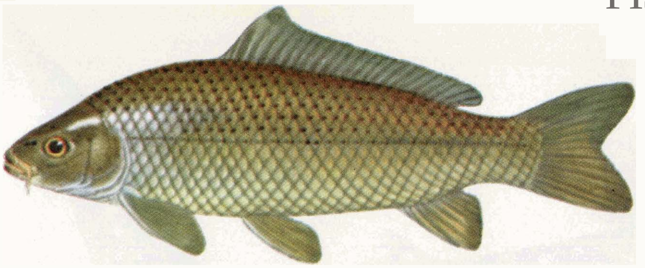
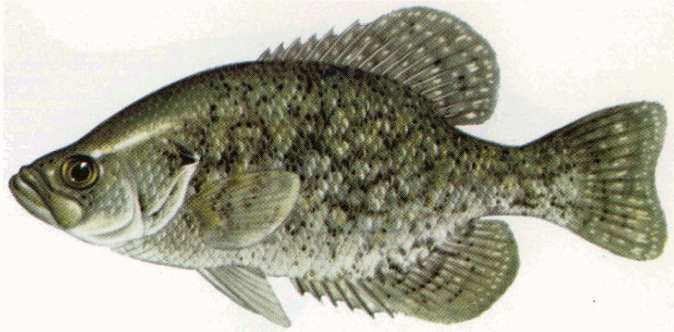
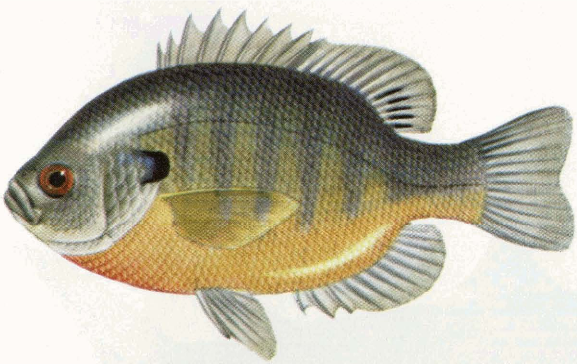


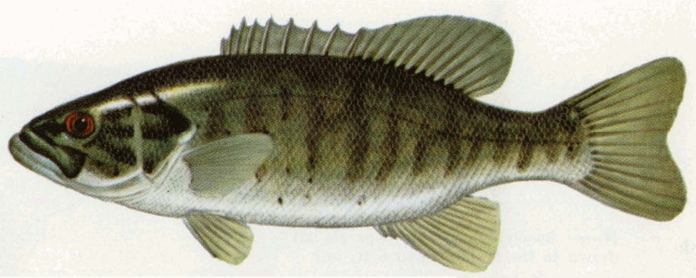
Carp (*Cyprinus carpio*); **10-40 in. Also** found in Europe and Asia



Black crappie (***Pomoxis nigromaculatus***); **5-12** In. **U.S.,** east of Great Plains, but not found In New England

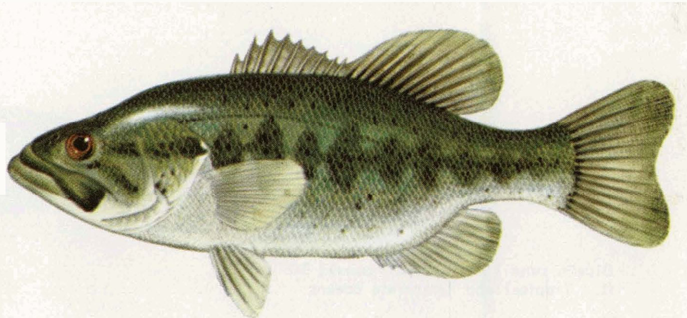


Bluegill (*Lepomis macrochirus*); **6-8 In.**, Throughout **most** of **conterminous** U.S., but **originally** from central states

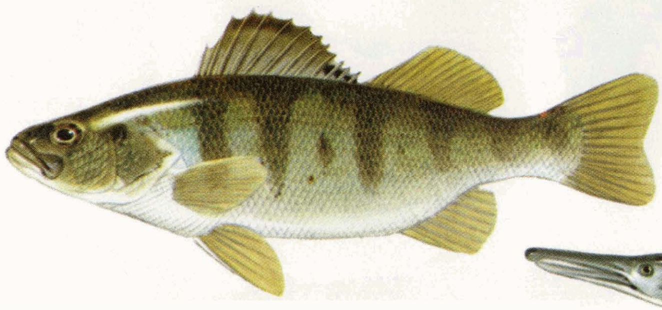


Smallmouth bass (*Micropterus dolomieui*); **10-22 in. North central** U.S. and **adjacent parts of Canada**

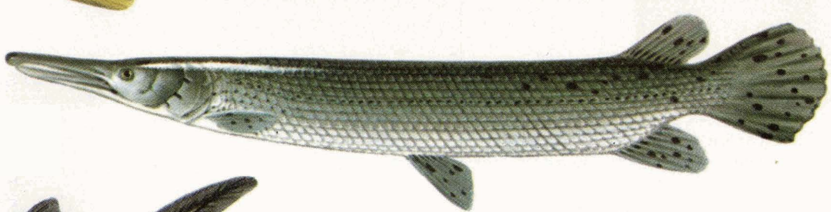
Walleye (*Stizostedion vitreum*); 12-30 in. **Northeastern US.** and **Canada**



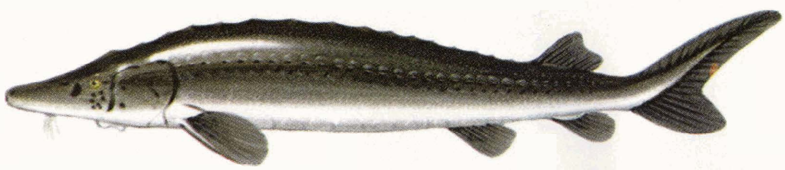
Largemouth bass (*Micropterus salmoides*); **10-20 in. U.S., east of Great** Plaint



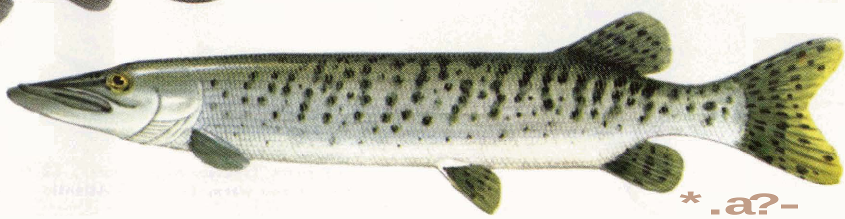
Yellow perch (*Perca flavescens*); **6-12** in. North-eastern **U.S.** and Canada



Alligator aar (*Lepisosteus spatula*); *5-9* ft. Lower **Mississippi** river and tributaries; **Gulf coast** of Florida to **Tampico**, Mexico



Lake sturgeon *(Acipenser fulvescens)*; **20-55** in., **oc**-casionally to **96** in. Great Lakes, upper **Mississippi**, lakes and streams of Canada to latitude **60°** N.



Muskellunge (*Esox masquinongy*); *24-45* in. Great Lakes basin, Ohio and upper **Mississippi rivers**

NORTH AMERICAN FRESH-WATER GAME FISHES

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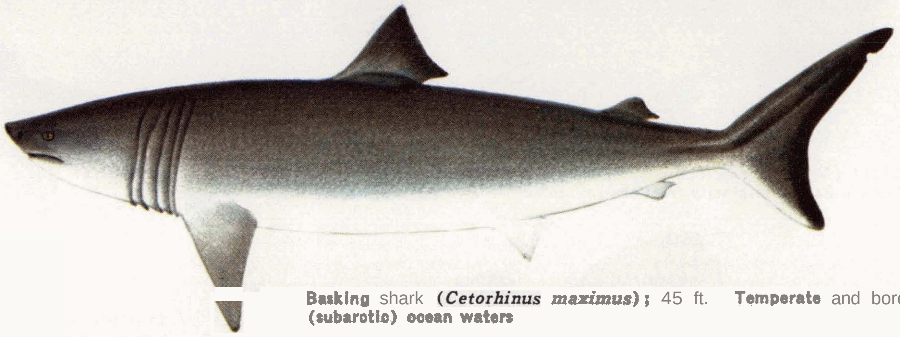
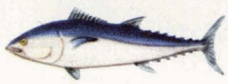
FISHES

Whale shark (***Rhincodon typus***); *60* ft. All tropical oceans

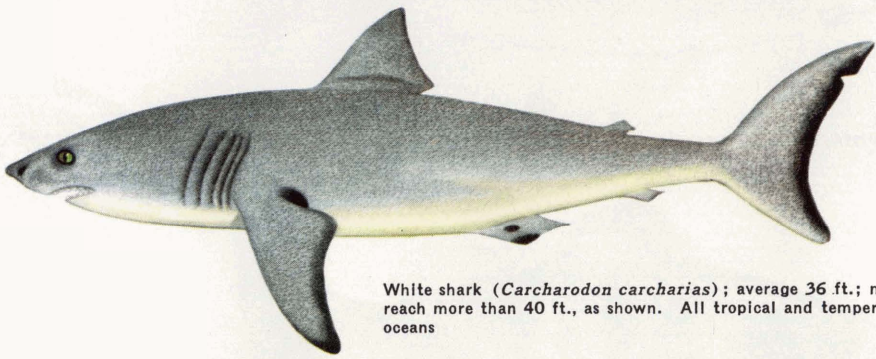
Note: Specimens on this page are all drawn to the scale of man 6 ft. tall



Basking shark (***Cetorhinus maximus***); 45 ft. **Temperate** and boreal **(subarctic) ocean waters**

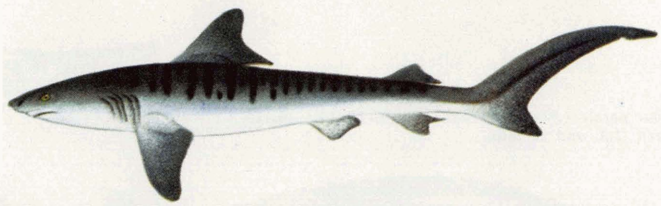


Bluefin tuna (***Thunnus thynnus***); **10** ft. Tropical and temperate oceans

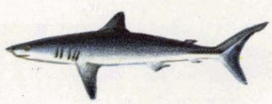


White shark (*Carcharodon carcharias*); average 36 ft.; may reach more than 40 ft., as shown. All tropical and temperate oceans

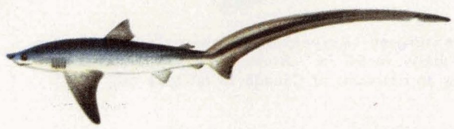
Atlantic manta ***(Manta birostris)*** ***(below)***: ***22*** ft. across the wings. Tropical and warm temperate Atlantlo



Tiger shark (***Galeocerdo cuvieri***); **average 18 ft.;** may reach 30 ft. as shown. **Tropical** and **subtropical oceans**



Mako shark (***Isurus oxyrinchus***); **12** ft. **Tropical** and warm **temperate** Atlantic



Thresher shark (*Alopias* ***vulpinus***); **20** ft. Tropical and warm temperate oceans **offshore**

GIANT FISHES

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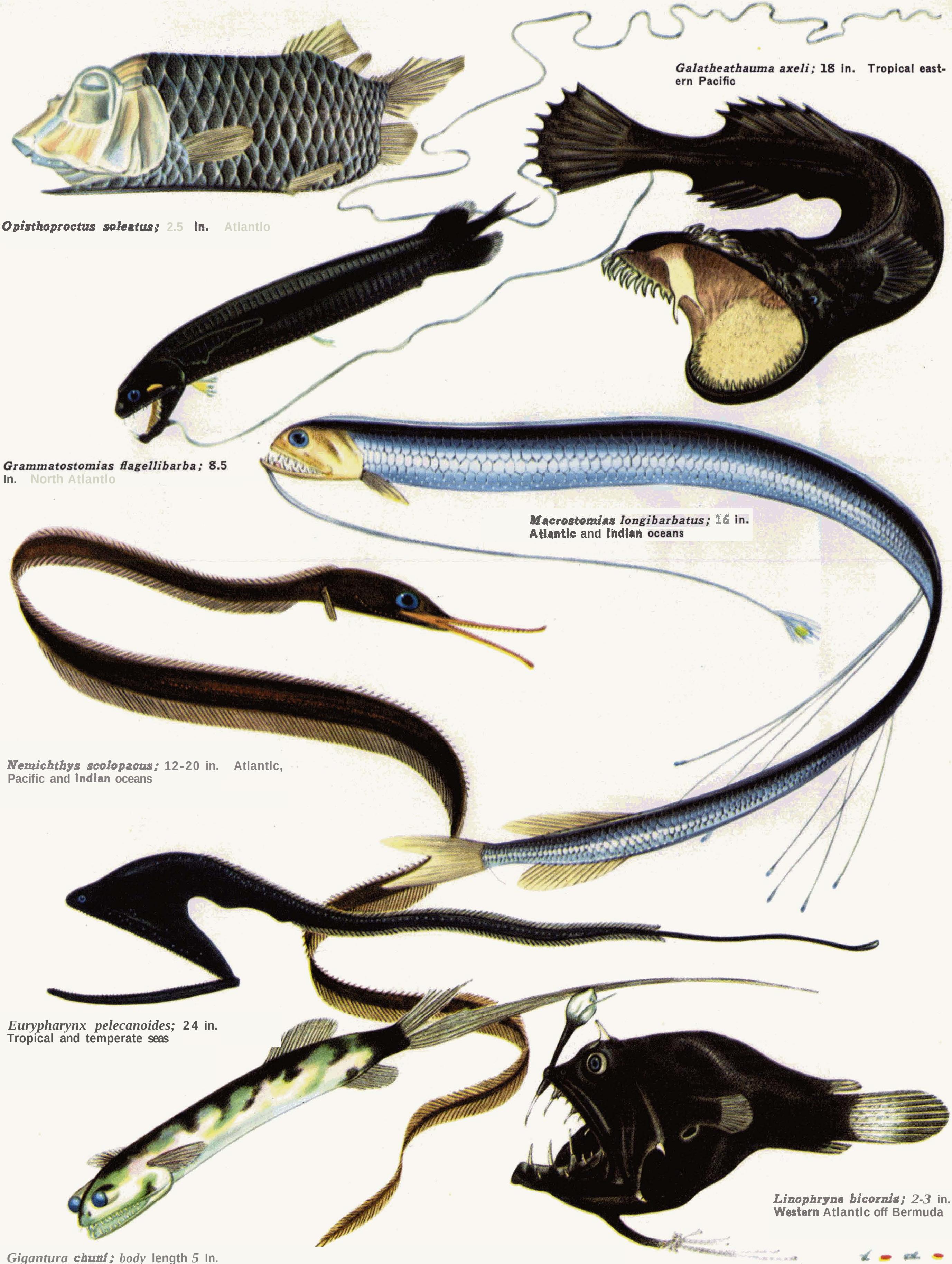

DEEP SEA FISHES

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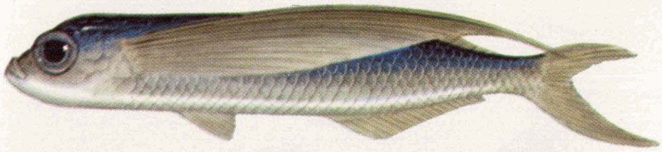
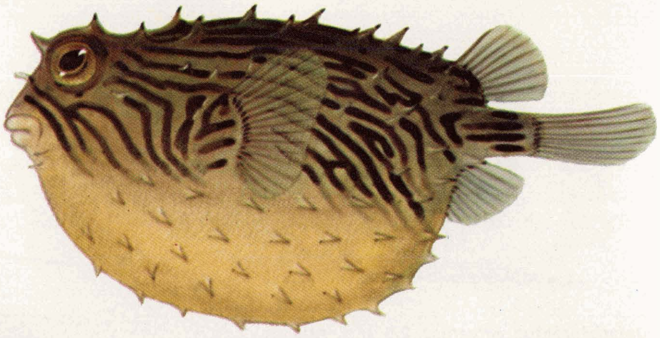
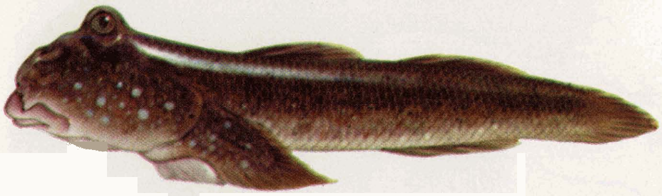
FISHES



Tropical two-wing flying fish (*Exocoetus volitans*); 6 in. All tropical oceans

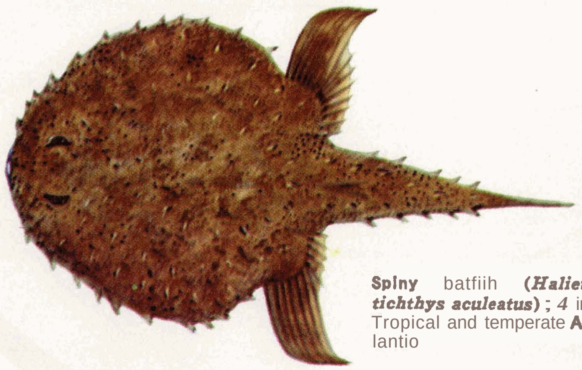


Striped **burrfish** (***Chilomycterus*** *schoepfi*); 10 in. Southern **coasts** of **U.S., West Indies**



Mud **skipper** (***Periophthalmus schlosseri***); *8* in. East **Indies**

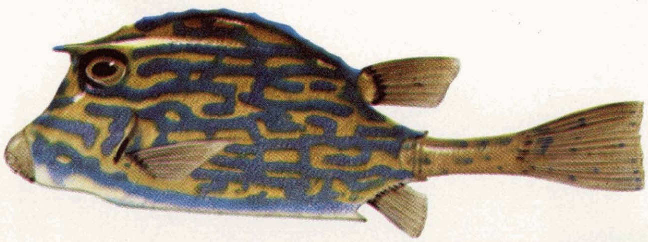
Four-eyed fish (***Anableps** anableps*); ***12*** in. Rivers of eastern South **America**



Spiny batfiih (***Halieu-tichthys aculeatus***); *4* in. Tropical and temperate **At-**lantio

Sea horse (***Hippocampus erectus***); *6* in. Attantlo **coasts, New** York to Brazil

Shrimp fish (***Centris-cus scutatus***); *6* in. **East Indies**



Cowfish (***Lactophrys quadricornis***); *15* **in. Western tropical** Atlantic, Carolinas to Brazil

Sea **dragon** (***Phycodurus eques***); 12 in. South Australia

Sargassum fish (***Histrio histrio***); *5* in. Tropical **Atlantic**

FISHES OF CURIOUS SHAPES AND HABITS

PAINTED ESPECIALLY FOR "ENCYCLOPÆDIA BRITANNICA" BY TOY DOLAN, UNDER THE SUPERVISION OF LOREN P. WOODS, CHICAGO NATURAL HISTORY MUSEUM

flying fish can see where it is going in the air and can alter its direction by banking to one side or the other. When its momentum is spent and it drops back to the water, it frequently dips the lower lobe of its caudal fin first, and sculling vigorously, shoots ahead for the new start of a shorter flight. It may do this two or three times before going under again. Flying fishes rise highest above the water, and make their swiftest and longest flights, by night or day, across the wind in a strong breeze. They usually fly to escape predaceous fishes which pursue them, or when alarmed, as by the bow of an approaching ship, but under these optimum flying conditions seem to do so also for sport, when one sometimes sees schools of the smaller ones in the air together, glistening in the sun. They cover considerable distances entirely clear of the water; an eighth of a mi. was estimated as the maximum for large ones. A few species of flying fishes are cosmopolitan. pelagic, found around the world, the commonest fish life one sees at great distances from land, especially in the trade-wind belts. A number of others have a more restricted distribution, are commonest coastwise or near islands. All are excellent eating, and there are local native fisheries for them, sometimes employing a light to attract them at night. On windy nights individuals frequently come aboard ship, striking the deck, or losing their balance by hitting the rigging, and falling aboard. By day they usually see where they are going and sheer off.

Sticklebacks (Gasterosteidae) are very small fishes of northern fresh, brackish and shore waters, usually three in. or less long. They have large eyes, an even relatively small mouth and a symmetrical, streamlined body, ending in a very narrow, firm peduncle. The caudal fin may be squarish, or slightly rounded or emarginate. They are well armed with a varying number of rather short. sharp, strong spines along the mid-line of the back before the soft-rayed dorsal fin, one at the front of the anal fin, and the ventral fins, placed under or a little behind the pectorals, consisting mainly of a pair of dagger-like spines.

Sticklebacks become very abundant in shallow water grown with aquatic vegetation, full of the tiny animals on which they feed; or drift into more open stretches in small schools. Their breeding habits are highly specialized. At spawning time the male assumes bright colours; selects a territory, where he builds a more or less barrel-shaped nest, mostly of bits of vegetation and attached to water plants; induces usually more than one female to enter it and deposit her eggs; and guards it against all comers, whether intruders or rivals. It is now seen that his formidable armature of spines is more for attack than defense. Though not ordinarily a rapid swimmer, when on the war path he shows great speed and dexterity in the water. Battles between males are frequent and sometimes to the death.

The two commonest sticklebacks, the three-spined *(Gasterosteus)* and nine-spined *(Pygosteus* or *Pungitius)* have a very wide. circumpolar distribution in both fresh and salt water, varying into confusing geographic and ecological forms, and are both plentiful along the Atlantic coast of America south about to, New York. The strictly marine 15-spined stickleback *(Spinachia spinachia)* of the coasts of northern Europe, which builds a nest by binding together fronds of seaweed with a sticky secretion from its kidneys, is a more elongate fish and reaches a larger size, growing to some seven in.

The trumpet fishes are elongate species which occur in tropical shore waters. They have a slight resemblance to the unrelated houndfishes, which is entirely superficial. Instead of long, toothed jaws, they have a small mouth at the end of a long tubular snout. There are two quite unlike trumpet fishes, *Aulostomus* and *Fistularia,* the former reaching a length of at least one or two ft., the latter, which is the more slender, sometimes four or five ft., though usually smaller. Both have short, soft-rayed dorsal and anal fins opposite one another near the tail. and *Aulostomus* has a row of short spines in the mid-line of the back, suggesting those of a stickleback. Its relationship to the sticklebacks. though not close, is probably real, for there is a singular small fish *(Aulorhynchus)*, in the cool coastal waters from California northward, in some respects intermediate toward it from *Spinachia.* This has paired ventral fins placed under the pectorals as in the sticklebacks, not well back as in trumpet fishes. The other trumpet fish, *Fistularia,* has no spines on the hack, and a very peculiar tail, with a long, thread-like lash extending backward from the centre of a small, forked caudal fin. There are few species of trumpet fishes, two of *Aulostomus,* which is uncommon generally recognized, one from the Atlantic and one from the Indo-Pacific; and those of *Fistularia,* which is common, are not well defined.

There are several strange, compressed little fishes, usually uncommon in warm seas, with long, tubular snouts and presumably related to the trumpet fishes. They are of three quite unlike types, represented by the genera *Solenostomus*, *Macrorhamphosus* (the snipefish), and *Centriscus.* Their small, soft-rayed dorsal and anal fins are far back near the tail, and they have an anterior, more or less spinous dorsal fin. In *Centriscus* the body is covered with thin scutes, the anterior dorsal fin has a heavy initial spine more or less coalesced with the armature of the back, and projecting backward beyord the tail which, with its soft dorsal, anal and caudal fins, is bent abruptly downward. This strange little fish is translucent, and is said to swim in a vertical position, at least at times.

If these stood alone, one might assume a line of descent from the sticklebacks, through the trumpet fishes, to the peculiar, specialized forms last mentioned. This would suggest that the variously functionless or specialized anterior spinous ddrsal fin usually present in such a series, foreshadowed, as it were experimentally, the simple, well-developed, functional, defensive spinous dorsal of the modern spiny-rayed fishes, which, abundant in species and individuals, now dominate many of the waters of the world. It would fit in with the thought sometimes held (not by the writer') that characters may arise in evolution as blueprints, so to speak. of something to be of value later. It is probably more reasonable to look on the series the other way round, as branching off from spiny-rayed fishes, parallel and ancestral to those of today, of which *Solenostomus,* etc., are exceedingly specialized remnants, and the sticklebacks a terminal member of the series.

The pipefishes, of which *Syngnathus* is the typical and most abundant genus. are very slender. elongate marine fishes. with a tiny mouth at the end of a tubular snout. the body angular in cross section, consisting of numerous bony rings, with a varying development of keels and ridges on head and body. They have good-sized eyes, a shortish dorsal fin of numerous slender, flexible simple rays placed more or less in the middle of the back. usually a tiny anal fin approximately below it and a small fan-shaped caudal fin at the end of the long, narrow. segmented tail. The pectoral fin is short and broad and ventral fins are lacking. Their eggs, and young, until these are large enough to fend for themselves, are carried by the male, usually in a pouch placed behind the vent, and his anal fin is inconspicuous or absent.

Pipefishes inhabit all warm and temperate seas, and are abundant in species and individuals, particularly about the shores of continents and continental islands. A few are commonly found in estuaries or inhabit fresh nater. They customarily live among seaweed, and one species *(Syngnathus pelagicus)* is plentiful across the eastern North Atlantic in drifting sargassum, where its mottled colours give it a low visibility. They normally glide through the water so slowly, propelled by their weak fins. that often they may be captured in the hand easily, but make better speed for short distances by an eel-like motion of the whole body, Pipefishes vary in size from one or two in. to one or two ft., and whereas a majority of the species are sufficiently alike to be placed in one comprehensive genus *(Syngnathus)*, a number of other genera are recognized for the more aberrant.

The sea horse *(Hippocampus)*, perhaps the most unfish-like true fish, is little more than a very peculiar pipefish, which has become short-bodied and compressed, its neck constricted and head bent downward at right angles to the rigid body. its slender tail devoid of a terminal fin, and prehensile. Sea horse? frequently assume an erect position with the head up, either clinging to senneed nith their tails or snimminq free in the water. Their head and arched neck are quite horse-like in outline, strongly suggesting the piece known as knight in the game of chess. The breeding and general habits of sea horses are quite like those of other pipefishes. When full grown they vary from about two in. to a ft. There are numerous species along the shores of warm seas, differing from one another in such minor characters as size, relative length of snout, development of keels and knobs and the number of their bony rings. The most aberrant (Phyllopteryx) lives in the rockweed in Australian waters, and is camouflaged by a very irregular form and membraneous flaps from head to tail simulating the weed.

The trumpetfish-like genus Solenostomus, already mentioned, has the body, although less completely cuirassed, with bony plates as pipefishes have, and resembles them in sufficient other structural characters to indicate a true though distant relationship, thus tying up the family Syngnathidae with the stickleback-trumpetfish series. A logical, evolutionary picture of this series would start with unknown, primitive spiny-finned fishes, superficially not unlike the modern ones, consider Solenostomus, etc., and the trumpetfishes divergent, specialized fragments remaining from transition forms, the family Gasterosteidae, little sticklebacks, abundant inhabitants of northern fresh, brackish and salt waters, a modern terminal member of the series in one direction, the Syngnathidae, pipefishes and sea horses, abundant in warm seas, the same in another direction.

The Squirrelfishes, the Perches and Basses, and their Relatives.—Squirrelfishes (Holocentrus) are rather small, blunt-headed, large-eyed, active, symmetrical fishes, one or more species plentiful in shallow water along the shores of all tropical seas. They have a moderate or rather small mouth with bands of small teeth, two dorsal fins, connected at their bases, the anterior with strong spines, longer than the posterior with soft rays, which is close to the narrow peduncle; and the caudal fin is firm and well forked. The anal fin, placed under the soft dorsal, has four initial spines, the first very small, the third very long, strong and sharp. The pectoral and ventral fins are of moderate size, the ventral, under or slightly behind the pectoral, consists of an initial spine and seven flexible, branched (soft) rays. There is a backwardly directed, dagger-like spine near the lower, posterior edge of the side of the head (on the corner of the preopercle). Their bodies are covered with rather large or moderate sized, firm scales, with toothed edges and their predominant colour is red, with white, sometimes yellow, and striped lengthwise, not infrequently with black markings on the fins. *Myripristis* is a not uncommon, somewhat shorter-bodied, close relative of the squirrelfishes, and found in the same waters, probably living somewhat deeper down, unless perhaps at night. It is more uniformly red in colour, and has an even larger eye. It lacks the dagger-like spine at the lower edge of the head, and those in its fins are not so large and strong. Fishes that swim deeper tend to be red in colour, as compared with their close relatives in shallow water, and it is not unlikely that the squirrelfishes are a shallow water invasion from greater depths. The several other families, related to them and grouped together as berycoid fishes, inhabit relatively deep water.

In superficial characters the berycoid fishes parallel the group of perches and basses (percoid fishes), which is the most modern, standardized group, abundant in world centres of fish concentration and competition, such as warm shore waters. They are of an older lineage, known to have been abundant in the upper Cretaceous, and are presumably ancestral to these. There are a number of percoid families very like the sea basses, etc., all of which have standardized ventral fins consisting of one unsegmented spine and five branched soft rays, whereas the berycoids more often have a larger number of branched rays in the ventrals. Then there are divergent groups of specialized fishes, wherein there is evidence of descent from standard spiny-rayed forms, whether from the percoids, berycoids or pre-berycoids is not always clear. Those supposed to have been derived from the percoids often have the number of ventral soft rays reduced below, seldom if ever increased to more than five. Two interesting little North American fresh-water fishes (Percopsis and Columbia) with two true spines in the front of the soft-rayed back fin, one or two in the front of the anal, small rough scales and an adipose fin like a trout or catfish, are probably to be considered specialized derivatives of some earlier group, possibly the Haploini, in the direction of the spiny-rayed fishes (Acanthopterygii), rather than as representatives of the ancestors of these, which, lacking further evidence, must remain uncertain.

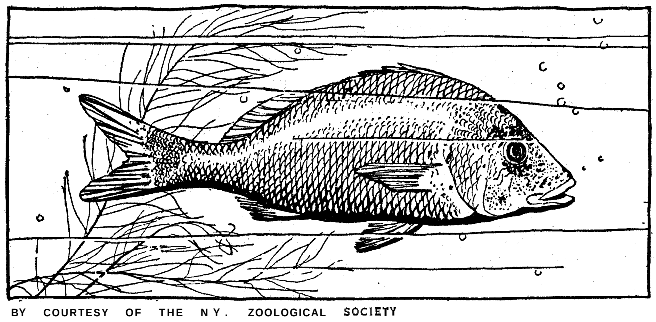
The three large central percoid (perch-bass) families are the perches (Percidae) of northern fresh waters, the sunfishes (Centrarchidae) confined to North American fresh waters and the sea basses (Serranidae) which are abundant in the shore waters of warm and temperate seas. All are symmetrical, standardized fishes, with a spinous anterior and soft-rayed posterior dorsal fin, the two more often confluent than separate. Their ventral fins, placed nearly under the pectorals, have consistently one spine and five branched rays, their scales are of moderate or small size, more often rough than smooth, their mouths, usually of moderate size, sometimes large, or smaller, their caudal fin rounded, truncate or emarginate, rarely well forked, spinous dorsal, soft dorsal and anal fins about equally long.

In the perches the spinous and soft rayed dorsal fins are more or less separate, though often contiguous. The perch (Perca) is abundant in quiet waters of Europe and America, those from the two continents very much alike, little more than geographic races of the same fish. It very exceptionally approaches five lb., and is usually much smaller, an excellent pan fish, familiar to all fresh-water anglers, with a pointed head, black cross bands extending from the back onto the sides and the lower fins variously yellow or red. The few species of pike-perches (Stizostedion) are more elongate fishes with large mouths and formidable teeth. Their fin arrangement and other structures show them to be nothing more than large, predaceous perches, which have assumed pike-like habits, superficial characters and appearance. One of these, the so-called walleyed pike, is a food fish of importance in America. In America there are also numerous genera and species of slender minnow-sized perches known as darters, inhabiting brooks and the edges of wider waters. They have mottled colours which render them inconspicuous on the bottom or among water weed, resting or moving slowly about, but show great agility when they have occasion to do so. Male darters, as a rule, become differently, often brightly coloured in the breeding season.

The sunfishes, of which there are a number of species, especially in the Mississippi valley drainage, are typically pond fishes, with deep, compressed bodies, their spinous dorsal fin continuous with that of soft rays behind it. They are of small size, only a few of the larger being of any importance as food fishes. Most sunfishes assume bright colours, often in an intricate pattern, red, orange, and iridescent blue or green, thus their name. The American black basses (Micropterus) belong to the sunfish family, but are more elongate, active, predaceous, reach a larger size, commonly reaching two or three and sometimes between five and 20 lb., and rank very high as fresh-water game fishes, as well as being excellent for the table. They lack bright colours, approach the true basses in form and have a notch between the spinous and soft dorsal fins, which are only confluent at the base. All members of this family scoop out a hollow in the bottom of pond or stream where they deposit and guard their eggs.

The sea bass family (Serranidae) is one of the largest and most varied, comprising very many genera and species of standardized carnivorous marine fishes, which range close to the bottom in shallow or moderately deep water. They vary greatly in size, and are usually excellent food fishes. Their bodies, are, as a rule, symmetrical, streamlined, with at most a shallow notch between the spinous and soft portions of the dorsal fin. A few species found in north temperate waters, however, have two separate dorsal fins, at most in contact at the base, and other characters which make of them a well-defined subfamily (Moroninae), sometimes given full family rank. These are the true basses in the narrow sense and are not strictly marine. Belonging to this group are the European bass (*Morone* labrax), two large, comparable species found in both fresh and salt water; the American striped bass (Roccus saxatilis) and oriental spotted bass (Lateolabrax japonicus); the American fresh-water white and yellow basses; and brackish water white perch. In the vernacular the smaller species of this family are in general known as perches, the larger as basses. As a matter of fact, these two names are frequently and less appropriately used for similar but more or less unrelated fishes—belonging to other families.

In tropical seas fine-scaled sea basses related to the groupers (*Epinephelus*) are abundant, represented by a number of genera and many species. Some attain a very large size, the largest up to



BY COURTESY OF THE N.Y. ZOOLOGICAL SOCIETY
MARGARET GRUNT (HAEMULON ALBUM), A MARINE PERCH OF THE FAMILY HAEMULIDAE, PEARLY WHITE IN COLOUR. IT RANGES FROM FLORIDA TO BRAZIL

five or seven ft., weighing 600 to 800 lb. The number of spines in the dorsal fin in this group is unusually standardized, a difference of one or two (or about 10%) sometimes a criterion to separate not only the species but the genera.

Besides these three central ones, there are several other important families of related marine percoid fishes, mostly inhabitants of warm shore waters, which differ from perches and basses, in that their gill covers are spineless, the maxillary slips under the edge of the preorbital when the mouth is closed and there is a specialized axillary scale at the upper corner of the base of the ventral fins. The snappers (Lutianidae) are of moderate size, characterized by large mouths and strong teeth. They usually have deeper, more compressed bodies, emarginate caudal fins, are more active swimmers, and range about in small schools preying on smaller fishes. The somewhat similar grunts (Haemulidae), so-called from the grunting sounds they make, mostly small species and particularly abundant in West Indian waters, have a weaker dentition. The porgies (Sparidae), varying in size, have molar teeth on the sides of the jaws, and the front teeth frequently incisor-like. In the Leiognathidae, more active, weak-toothed fishes with well-forked caudal fins, the mouth parts are excessively protractile, can be thrust out or drawn back.

The croakers (Sciaenidae) are a large family of carnivorous fishes, generally abundant on the sandy shores of all warm seas, somewhat less closely related to the central percoid families. They have a long soft-rayed dorsal, and short anal fin, the anal spines reduced in size and number to two or even one. Most of them feed on or close to the bottom, but a few, like the weakfish and so called sea trout (Cynoscion *regalis* and C. *nebulosus*) of the eastern U.S., swim more actively higher up in the water. The shape of the body, size and shape of the mouth varies greatly in this family. The weakfish has a symmetrical, streamlined body, a large mouth with projecting lower jaw and slightly emarginate caudal fin. Bottom feeding species such as the croaker (*Micropogon*) and kingfish (*Menticirrhus*) have a rather small mouth, the lower jaw somewhat the shorter, and sometimes barbels on the chin. In the croakers the caudal fin tends to be rounded, sometimes is pointed, never deeply forked. They are notable for croaking or grunting sounds which they make, and for unusually large, more or less ivory-like otoliths or free ear bones. One of the largest species is the sea-drum (Pogonias) reaching a length of four ft. and weight of nearly 150 lb.; the smallest are seldom more than a few in. long. The most notable, and one of the very few found in fresh water, is the fresh-water drum (*Aplodinotus grunniens*) of the Great Lakes and Mississippi valley, which grows to three or four ft. and weighs 50 or 60 lb.

Some of the most excellent or important food fishes and most sought after game fishes are members of these percoid families. There is the walleyed pike in the Percidae. black basses in the Centrarchidae. The striped bass is unexcelled for the table, often weighing 50 and recorded more than 100 lb., and is much sought by devotees of rod and line. The weakfish of the Sciaenidae furnishes excellent sport as well as being an important market fish. In the West Indies and adjacent regions, snappers (Lutianidae) are of the choicest food fishes; grunts (Haemulidae) a very popular pan fish; porgies (Sparidae) in all markets; and the larger groupers (Serranidae) probably of greater market importance.

Flatfishes or Flounders.—The flatfishes (Heterosomata) are in one respect the most remarkable of any in the sea. Fishes in general, be they shark, sea horse, perch, or something in between, are bilaterally symmetrical, but a flatfish lies on one side on the bottom, and has both eyes on the other (upper) side. Furthermore, their upper side is dark, usually mottled gray or brown, their underside, with rare exceptions, is white, colourless. They can change the tint and even pattern of the upper side to make it correspond more completely with their surroundings and reduce their visibility. At rest they lie motionless on the bottom, their flat, compressed bodies at times more or less covered with sand or mud, with the eyes, which protrude slightly and can be moved freely, exposed. They glide short distances and settle to rest again, but many of them swim up freely into the water at times, in pursuit of small fishes or other creatures on which they feed.

Their bilateral asymmetry is made no less remarkable by the fact that when a tiny flatfish hatches from the egg it swims or drifts free in water for a time and has an eye on either side of the head like a typical fish. The great halibut (Hippoglossus *hippoglossus*), largest of the flatfishes, which reaches a maximum length of about nine ft. and weight of 700 lb., goes to the bottom when an in. or two, smaller species when a fraction of an in. long. Most species lie consistently with one or the other side up, according to their kind, a few with sometimes one, sometimes the other up in different individuals. As the time approaches for giving up its free-swimming habits, one eye of the larval flatfish travels around the top of the head from that which will be the lower to the upper side.

The soles are well distinguished from other Heterosomata by their very small eyes, small crooked mouths, and frequent absence of pectoral fins. For the rest, species with a large symmetrical mouth and symmetrical ventral fins were placed in a "halibut tribe"; those with smaller crooked mouth and ventral fins nearly or quite symmetrical, in a "flounder tribe," species of northerly distribution which are dextral (lie with the right side up); those with the mouth symmetrical, large or small, the ventral fins unsymmetrical, in a "turbot tribe," which extends into warmer waters and comprises sinistral species (that lie with the left side up). This is still a convenient way to classify these fishes, although it does not express all the phylogenetic relationships recently worked out within the group. There are many genera and species of flatfishes, especially along the shores of northern seas. They are common enough in the tropics also, but usually smaller species and a less important factor of the fish fauna there. So far as is known, all flatfishes are good to eat and some are very highly prized for the table. They are important food fishes in the cool and temperate shore waters of all seas.

The origin and relationships of flatfishes were a puzzle until it was pointed out that *Amphistium paradoxum*, a fossil fish from the upper Eocene, with an eye on either side of the head as in normal fishes, was in many respects intermediate between them and the Zeidae, of which the John Dory (*Zeus* faber) is the best known of a few living representatives. The Zeidae are deep-bodied, compressed fishes, with a narrow peduncle, a spinous and a soft-rayed dorsal fin, and six to eight soft ventral rays. They are very likely a specialized offshoot of the berycoids. Their classification with the Heterosomata, although not now universally accepted, is probably correct.

The Silverside-Barracuda, and Labyrinth Fish, Groups.—The silversides (Atherinidae) are slender fishes a few in. long, very abundant in salt water on mainland shores of warm and temperate seas, and with comparatively few fresh or brackish water species. They swim near the surface, and most of them are pale-greenish above, white below and with a bright silvery band along the side. In the economy of the sea they are an important food item with larger fishes and with sea birds. This colouring presumably decreases their visibility, especially to enemies below, and prevents their ranks being depleted. They are carnivorous, and in turn prey on smaller aquatic creatures.

Silversides have two dorsal fins, the anterior, near the middle of the body, very small, of a few flexible spines and connecting membrane, well separated from the posterior of soft rays, which is placed well back more or less over the hind part of the usually somewhat longer anal fin. Their spinous dorsal fin would seem to be a nonfunctional rudiment, inherited from more perch-like species, and their paired ventral fins, placed somewhat farther back than the pectorals, have five soft rays as in percoid fishes, but they are generally considered more primitive than, rather than derivative from, these. They have large eyes, streamlined bodies and are active swimmers, usually with a rather well-forked caudal fin.

The mullets (Mugilidae) and barracudas (Sphyraenidae) are two other families of fishes, with a similar small, well separated, anterior spinous dorsal fin. Although superficially quite unlike each other and the silversides, the differences are obviously closely correlated with habits of life. The three families are related and belong in the same natural order or suborder (Percesoces).

Mullets are schooling fishes of small or moderate size, with short soft-rayed dorsal and anal fins, placed one above the other, well back. Their bodies are streamlined, more or less cylindrical; and they have a small, transverse, toothless mouth, slightly on the under side of the head and are bottom feeders. They are strong swimmers and proficient at leaping out of water. The marine species are abundant in shallow water on muddy or sandy shores, often running into brackish water, and are gray, and white or silvery in colour. One of the largest (*Mugil cephalus*), one or two ft. in length, with dark streaks along the rows of scales above, occurs cosmopolitanly in all warm seas. There are a few fresh-water mullets, one of which (Agonostomus or *Dajaus* monticola) inhabits most of the streams in the West Indies and Middle America. Contrasted with mullets, the barracudas are moderate or large-sized, highly predaceous, pike-like marine fishes, with large mouth, projecting chin and formidable teeth. The smaller species grow to a ft. or two in length, the largest, the great barracuda of the West Indies (*Sphyraena* barracuda), questionably distinct from an East Indian form, to five or six, possibly even ten ft.

Silversides are good to eat. A large one (Basilichthys or *Odontesthes* bonariensis), resembling a smelt, is abundant in Argentina, where it is called "pejerrey" (that is, kingfish) and particularly highly prized. A small brackish water species (*Menidia* beryllina) is fried en masse and called "white bait" near New York. Although relatively little marketed in the U.S., mullets are a favourite table dish in some countries and are raised by Chinese in coastwise ponds. The smaller species of barracuda are usually considered exceiient, the large ones thought to be unwholesome in some localities. Whether it is that their meat may have intrinsic toxic properties, or that it spoils very quickly, is uncertain. The danger to swimmers from barracudas is doubtless exaggerated, but large, predaceous fishes may strike at anything moving in water, and accidents, where a barracuda is the culprit, certainly occur.

The Melanotaeniidae, small, compressed, usually deep-bodied fishes, numerous species of which inhabit the fresh waters of Australia and New Guinea, are closely related to the silversides, although they do not look much like them. They have a longer soft-rayed dorsal, and especially anal fin, the anterior spinous dorsal somewhat stronger and higher, close to although separate from the soft-rayed fin behind it. The threadfins (Polynemidae), with comparatively few marine bottom species, which are sometimes placed in the same order, have the spinous not greatly smaller than the soft dorsal, soft dorsal and anal fins short, caudal fin well-forked, the pectoral fins low down, consisting of two parts, the lower part of free thread-like filaments, which can be moved independently and serve as organs of touch.

The goatfishes (Mullidae) are an easily recognized family of moderate sized marine fishes, closer to the percoids. There are numerous species in warm seas, usually valued for food. A goatfish has two dorsal fins, spinous and soft-rayed, of approximately equal size, the ventral fins placed about under the pectorals, and a well-forked caudal fin. It has a long, curved snout, which may project slightly beyond the tip of the lower jaw, and a pair of long, fleshy tactile barbels at the chin. The prized "red mullet" of Europe is a goatfish. The cardinal fishes (Apogonidae or Cheilodipteridae) are another easily recognized family, this one classified as of the percoid series. They are short-bodied little fishes from two or three to ten in. long, with two separate dorsal fins not greatly different in size, a large oblique mouth and unusually large eyes. There are numerous species, a majority referred to the genus Apogon common in the shallow shore waters of all tropical seas, and in fresh water in New Guinea. They have a tendency to be nocturnal, and some, at least, carry their eggs in their mouths. Small West Indian species (Apogonichthys) are known to inhabit the shells of living conchs. There are a few longer-bodied, stronger-toothed genera of this family in deeper water,

The labyrinth fishes, of somewhat the same evolutionary level as the Percesoces, are fresh-water species with a breathing organ accessory to the gills, which enables them to live out of water for protracted periods. Two or three snakeheads and a number of small fishes allied to the climbing perch, which belong to this group, are plentiful in Africa but it is primarily south Asiatic. At the base of the labyrinth fish series there are the snakeheads (*Ophicephalus*), in which a pair of pouches from the top of the pharynx, lined with thickened and puckered membrane richly supplied with blood vessels, function as might rudimentary lungs. These are vigorous, elongate, large-mouthed fishes, more or less cylindrical in front and compressed behind, with a single, long, even-bordered dorsal fin of soft rays only occupying most of the length of the back, an only shorter anal below it, the small ventrals about under the rounded pectorals and the caudal fin also rounded. Their bodies are covered with rather small, smooth scales. This is a generalized type of fish suggesting the bowfin in appearance, but, of course, with no relationship to it, beyond that of having a not dissimilar manner of living. Snakeheads are very tenacious of life, can push themselves along the ground out of water with the pectoral fins and can survive being buried in the mud of marshes and pools when these have temporarily gone dry. The largest species reach a length of three or four ft.

Other fishes of this group have a more complicated labyrinth-like accessory breathing organ in a chamber above the gills. One of these, the climbing perch (Anabas *testudineus* or scandens), found in fresh or brackish water of southern Asia and adjacent continental islands, is not unlike a snakehead in shape and general appearance, with a smaller mouth, blunter head, larger eye and its long dorsal and anal fins are spinous except for a short posterior part of soft rays. It reaches a length of nine or ten in. Climbing perches migrate from pond to pond at night, and use their spread gill covers as well as their fins in hitching along overland. When in water they frequently come to the surface to gulp air; and it is said that they will suffocate if unable to do so; also that after rain they come out of water and invade gardens in search of earthworms, and that the natives of some parts of India dig them up with a shovel for food where they lie dormant in the mud of temporarily dried up waters.

The goramy or gouramy (*Osphronemus*) is a deep-bodied, compressed fish, with a dorsal fin—which has about an equal number of spines and soft rays—along the posterior half of the back, a longer anal fin with more rays than spines and the first soft ray of the ventral fins produced in a very long filament. about as long as its head and body. Gouramies reach a length of 20 in. and are an excellent food fish, introduced in various tropical countries where they are not native. Smaller, similar fishes of the genus Trichogaster, frequently kept in aquaria, have the ventral fins reduced to the single, long filament and a rudimentary spine. Several small labyrinth fishes are favourites for household aquaria because of their bright colours and interesting breeding habits. The paradise fish (Macropodus) has large, decorative fins, the dorsal and anal pointed behind, and the caudal fin forked in the common species. It makes a floating nest of foam by blowing bubbles of air and a sticky mucus, which adhere together, and beneath which the eggs are placed. Unlike the paradise fish, the fighting fish (Betta) has a short dorsal fin with not more than one initial spine, spines in the front of the long anal fin few or absent. The dorsal fin, although short, may be high, caudal fin is large and somewhat pointed. Fighting fishes are only three in. or so long. They build a bubble nest like the paradise fish and the males not only guard nest and eggs assiduously, but are so combative that they are sometimes pitted against one another for sport, as are gamecocks. Another small aquarium fish, seldom over two in. long (*Ctenops* vittatus), is called purring gouramy on account of the sound which it makes, especially during the mating period. In making this sound, the fish, with gill covers and fins extended, shakes itself violently, and it can sometimes be heard more than 25 ft. away.

Mackerel-Like Fishes.—The mackerel-like fishes (Scombriformes) are an adaptation to strong, continuous swimming in open water. They are carnivorous and marine, have pre-eminently streamlined bodies and a firm, well-forked caudal fin, their propelling organ, set on a firm, narrow peduncle, which is frequently keeled in a horizontal plane, that of the fin's motion. Whatever the mechanics involved may be, this kind of tail is obviously advantageous to wide-ranging aquatic animals. Its form in the whales and porpoises, which are mammals, simulates that in the big mackerels, though differing by an angle of 90°, for they move their flukes in a vertical instead of a horizontal plane.

The Scombriformes as now recognized, are characterized by expansion of the tail (hippural) bones which support the rays of the symmetrical caudal fin, so as to mask almost completely its hereditary asymmetry. The principal families in this order are the pompanos and crevallys (Carangidae); mackerels (Scombridae); spearfishes and swordfish (Istiophoridae and Xiphiidae). In the Carangidae, the most primitive or perch-like of these, the spinous dorsal fin is much shorter than the soft-rayed fin behind it, its spines weak, the premaxillaries are more or less protractile and snout and upper jaw not fused. In the Scombridae the snout and upper jaw are fused, more or less pointed and beak-like. The spinous dorsal fin may he short, well-separated from the posterior dorsal fin of soft rays, or long although weak, depressible in a slot in the back and very low posteriorly, but extending approximately to the front of the soft dorsal. The soft dorsal, as well as the anal fin, below or slightly behind it, is short, but both are followed by a series of independent small finlets, each of a single branched ray, which extend back to the peduncle. The Istiophoridae and Xiphiidae are strange, large fishes in which the fused snout and upper jaw project far forward as a hard spear or sword, round in cross section in the former, and horizontally flattened in the latter.

There are at least three natural divisions of the Carangidae. The large. predaceous, wide-ranging amberjacks (Seriola), abundant in all warm seas, and perhaps the most primitive. In these the spinous dorsal fin is very small and low, the anal fin is considerably shorter than the soft dorsal and the pectoral fins are short. A slight arch in the front of the lateral line blends into its posterior straight part which runs in the centre of the tail and a gristly keel in the mid-line of the narrow caudal peduncle is more or less developed. The largest amberjacks reach a length of five or six ft. Their young have dark crossbands and hover about driftwood, small boats, or follow coastwise sharks. Of two or three related genera, the pelagic pilotfish (Naucrates *ductor*), which follows offshore sharks, is most interesting. It is quite like an amberjack, but somewhat more slender and cigar-shaped, with a smaller mouth; and with age, first the membranes connecting the spines of its dorsal fin, and then the spines themselves, become obsolete. It only grows to be a ft. or two in length, is blue above instead of greenish in colour, and its crossbands, which are persistent through life, are somewhat broader than those of young amberjacks. In short, it is essentially a somewhat specialized young amberjack which retains its youthful habits and colours to maturity.

In the crevallys (Caranx) the anal fin is preceded by two short, stout spines, separate from the rest of the fin, and is little shorter than the soft-rayed dorsal above it. As the fish grows large, the pectoral fin becomes long and falcate. The lateral line consists of a more or less arched anterior, rather clearly defined from the posterior straight part. The scales, fine over the rest of the body, are enlarged on the peduncle into keeled scutes. The peduncular keel, thus formed, may be strong or weak, the keeled scutes confined to the peduncle, or extending forward to occupy the entire straight part of the lateral line. A number of genera allied to Caranx differ widely from one another, and yet are so connected by intermediates, that the number recognized becomes a matter of judgment, and there is little doubt they evolved from a common ancestor. In the scads (*Trachurus*), cooler water fishes than the others, more abundant in temperate than in tropical seas, enlarged scutes extend the whole length of the lateral line, though usually less firm and without keels on its anterior arch. The mackerel scads (Decapterus) are more elongate and cigar-shaped. Contrasted with them there are several deep, short-bodied, compressed genera (Selene, Vomer or Argyreiosus, *Alectis*). Young moonfishes (Vomer) look a good deal like a silver dollar. Young threadfishes (Alectis *ciliaris*) are also almost circular in outline, with dark crossbands and with a number of anterior rays of soft dorsal and anal fins prolonged as thread-like filaments, which extend back well beyond the tail. They drift widely in ocean currents, and are indistinguishable in all warm seas. Most young fishes are more slender than adults of the same species, but there is a tendency for young Carangidae to be considerably deeper and more compressed than their elders, probably correlated with a drifting habit.

The pompanos (*Trachinotus*) have a small, horizontal mouth, beneath a blunt, rounded snout, short pectoral fins and the curve of the lateral line low and even as in the amberjacks, but their anal fin is little shorter than the soft dorsal above it, as in Caranx. They have a very small spinous dorsal fin, reduced to isolated rudimentary spines in the adult. The leather jacks (Scornberoides and *Oligoplites*) are quite different from, although probably related to. the pompanos. They are usually elongate, more compressed, with large mouth and projecting lower jaw, linear, more or less fused scales which give the skin a leathery texture, and are bright silvery in colour.

In the true mackerels (Scomber), the spinous dorsal fin is short and distant from the soft dorsal; there are a pair of small keels at the bases of the upper and lower lobes of the forked caudal fin, but none in the centre of the peduncle. Members of this genus are less than two ft. and weigh less than four lb. They swim at the surface in close-ranked schools. These schools are sometimes of immense size in the common mackerel (Scomber *scombrus*) of the North Atlantic, a familiar and important food fish. This species invades and spawns in cooler waters in summer than are frequented by most of this family, and is remarkable for a surface fish in that it also swims at considerable depths. It lacks an air bladder, and on this basis was considered generically distinct from its close allies, but lacking one is probably correlated with the great difference of pressure at varying depths, and to be considered here as no more than a species character. The mackerel schools disappear in winter and where they go is not well understood.

Other members of the mackerel family have a central, gristly keel on the peduncle, the spinous dorsal fin usually extending along the back to approximately the front of the soft dorsal, although low behind and depressible in a slot. Those of the genus Scomberomorus or *Cybium* are slender and of moderate or large size. The American Spanish mackerel (Scomberomorus *maculatus*), a very choice food fish, has a maximum weight of about ten lb., and the Florida kingfish (Scomberomorus cavalla), a well-known game fish, may reach a length of five ft. and weigh 100 lb. There are several genera of mackerels of moderate or large size, those reaching a weight of 20 lb. or less are commonly known as bonitos, and the larger species as tunas. The largest is the tunny or blue-fin tuna (*Thunnus* thynnus) which not infrequently exceeds 1000 lb. It has the body covered with fine, inconspicuous scales, and silvery marks on the Sides. It is a very active, full-blooded fish, with body temperature appreciably above that of the water in which it swims. This species and two or three of its close relatives have a somewhat different structure of the vascular system from other mackerels, which led to their unjustifiable classification in a different family by some authors. The oceanic bonito (Katsuwonus pelamis), which reaches a maximum weight of about 20 lb., has enlarged, more or less fused scales forming a corselet in the shoulder region, most of the body scaleless. It is a heavy, barrel-shaped fish, pointed at both ends, with lengthwise dark stripes on the lower parts, and is truly pelagic, roaming the open ocean far from land in small schools which prey on flying fishes.

The sailfishes (*Istiophorus*) and marlins (*Makaira*) have a long dorsal fin extending on the front of the back to over the first anal fin, small, low second dorsal and anal fins farther back, the ventral fins slender, reduced to one or two rays, body covered with irregular, linear scales and a small keel at the base of each lobe of the deeply forked caudal fin, but no central keel on the peduncle. In the sailfishes the ventral fins are long, the dorsal fin is very high throughout, although depressible in a slot in the back; in the marlins it is moderately high in front and becomes low behind. Sailfishes are slender and compressed, and although they reach a length of more than eight ft., seldom weigh more than roo lb., whereas the largest marlins approximate 1,000 lb.

The broadbill swordfish (Xiphias) has a short, high dorsal fin on the front of the back, pectoral fins placed very low and ventral fins absent, a keel in the centre of the peduncle and smooth, scaleless skin. The largest swordfish exceed 800 lb. They prey on smaller schooling fishes such as mackerel and herring, apparently killing or disabling them with their sword so they can be picked up easily. Swordfish are taken commercially with the harpoon, a dangerous pursuit, as they not infrequently drive their sword through the bottoms of small boats engaged therein. There are also many instances of the swords of swordfish and spears of marlins being driven into the timbers of wooden ships at sea, and broken off. Hatching from a tiny egg, the swordfish passes through two or three unlike phases before it approaches the form and appearance of the adult. At one time it has a long, high dorsal fin. at one time it has scales, showing its relationship to sailfish and marlins. The several scombriform families just passed in review contain highly valued food fishes, and nhereas a few of the many species of crevallys and mackerels are locally considered unwholesome, it is questionable whether it is that their flesh has intrinsic toxic properties, or that it spoils quickly.

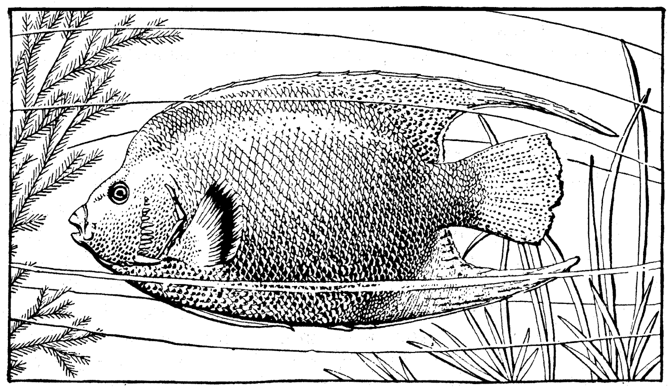
The family Bramidae, containing short-bodied, compressed, deep-nater fishes, wherein there is no distinct spinous division in the long dorsal and anal fins, and the scales are somewhat larger than is the rule with this order, are also placed in the scombriformes. So is the dolphin (*Coryphaena*) without close relatives. The common dolphin (C. *hippurus*) is a slender, streamlined, very swift swimming fish which reaches a length of about six ft., and is one of the most truly pelagic. Small groups of dolphins swim at the surface of all warm, blue seas, when far from land preying on flying fishes for the most part. They sometimes come head and shoulders out of water to seize one when it takes to the air, or speeding under the shadow of another are ready for it nhen it drops back into the water. The dolphin is very beautifully coloured, marked with blues, and bright yellow behind. When taken from the water, pink and green flushes run over its sides It has an even-bordered, undifferentiated dorsal fin extending the whole length of the back, old males a high, narrow crest which gives their forehead a vertical profile.

This fish is the dolphin of sailors. The name dolphin is also used for porpoises, which are mammals, not fish at all, particularly for the offshore, blue water porpoise (*Delphinus delphis*). This sometimes caused confusion which extended far back in language, for the dolphin of heraldry, as figured, usually combined characters pertaining, or supposed to pertain, to these two unlike marine animals.

The bluefish (*Pomatomus saltatrix*), a highly predaceous schooling species found in the Atlantic and Indian oceans, and particularly valued as a food fish on the Atlantic coast of the U S . has much the contours, fin arrangement and appearance of an amberjack, the most obvious differences being an appreciably broader peduncle without a trace of a keel, and that the scales, although small are slightly rough (ctenoid). It was sometimes classified with the Scombriformes, but is actually a percoid, a freer-swimming, wide-ranging representative of the sea bass family (Serranidae). One might arrange the mackerel-like fishes in a rational series of increasing specialization, from the bluefish to the crevallys, to the mackerels, to the swordfish. but this would not be a true evolutionary line. Each more highly specialized group probably branched off from some spiny-rayed fishes at an earlier phase of the history of these, and has been changing in its present environment for a longer period. It is even questionable if the family Carangidae is an entirely natural one, if its different divisions had a common origin, or rather have followed a somewhat parallel evolutionary course. Through close relatives of the mackerels, a series leads to increasingly slender, deep-water forms, in which a typically mackerel-like though tiny caudal fin is evidently vestigial, and the elongate, band-shaped, bright silvery cutlass fish (Trichiurus) of shore waters, with large mouth and canine teeth, dorsal fin extending the length of the back, no ventral fins and the finless tail tapering to a slender filament, seems to be a terminal member of this series.

The pomfrets (Stromateidae) are small, deep-bodied, compressed shore species, usually valued for food, which bear a strong, superficial resemblance to some of the Carangidae, though their relationship to the Scombriformes is uncertain. They are characterized by having small ventral fins present in the young, but reduced or altogether absent in the adult, and the oesophagus armed with numerous horny teeth. Several peculiar pelagic species are usually placed near this family, *e.g.* the little banded man-of-war-fish (*Nomeus gronovii*) which accompanies the Portuguese man-of-war (Physalia), and when alarmed swims up close under the iridescent bubble-like float of this dangerous jellyfish for protection, familiarity enabling it to avoid its long, stinging tentacles.

Coral-reef Families, Triggerfishes and Others. — There are several series of fish families supposed to have been derived from the modern percoids. The surf fishes (Embiotocidae), cichlids (Cichlidae), and demoiselles (Pomacentridae), are mostly small, active centrarchid (sunfish)-like fishes. with the anterior part of the dorsal fin, of strong spines, confluent with the posterior part, of soft rays. The surf fishes, of which a number of species are abundant in shore waters from British Columbia to California, and others are recorded from Japan, are notable for giving birth to a relatively small number of large young, instead of laying eggs. The cichlids and demoiselles have a single nostril on each side, instead of the usual two. The former are fresh-



BY COURTESY OF THE N.Y. ZOOLOGICAL SOCIETY
ANGELFISH (ANGELICHTHYS CILIARIS) A CHAETODONT FROM THE WEST INDIES

water fishes of Africa and South America, the latter very abundant about coral reefs, many of them brightly coloured. The distribution of these two families suggests that they had a common origin in tropical seas and diverged on the basis of this habitat difference. The cichlids all care for their eggs and young; a number of African species carry the eggs until hatched and harbour the young in their mouths.

The butterfly and angelfishes (Chaetodontidae) are another abundant coral-reef family. They have deep, compressed bodies, covered with rather small, rough scales, small mouths with bands of fine bristle-like teeth, the anterior spinous and posterior soft-rayed parts of the dorsal fin continuous, with the base of the latter, and of the similar anal fin below it, masked with fine scales. The butterfly fishes are of small size, and a profusion of different species are mostly boldly marked with black bands, frequently with ocelli, especially in the young. Many have similar patterns, but those of so two are quite identical. Their markings, combined with bright colours, mostly yellows, make them very conspicuous. A coral reef itself is often monotone, or with its colour in masses. It is its great variety of gay, active fishes, preeminently conspicuous as one looks down through clear water, which makes of it one of the most colourful phenomena in nature. The fishes in most environments are coloured so as to give them a low visibility, a protection from their enemies, or not to attract the attention of their prey. The colours of active reef fishes were called immunity colours, the hypothesis being that the reef is a labyrinth, providing so many avenues of escape that the danger from predators is minimized. It is also to be noted that these highly coloured fishes are not themselves predatory. The angel differ frvm the butterfly fishes in having a strong, backwardly directed spine at the corner of the preopercle (on the lower side of the head). The angelfishes as a whole grow larger than the butterfly fishes. Some have bright, massed colours, and are among the most gaudy denizens of the reef, others are rather uniformly dark in hue.

The limits of the Chaetodontidae are not well-defined, there being several different fishes, more or less obviously allied to, but not properly belonging in, this family. Another, perhaps the most numerous, coral reef group, the wrasses and parrot fishes, is more clearly set apart. The wrasses (Labridae) are characterized by a small mouth, rather thick lips, strong, well-spaced, usually pointed teeth in the jaws, the throat bones heavy and bearing teeth which are often blunt grinders. Most have moderately elongate, compressed bodies, covered with large, smooth scales, the anterior spinous and posterior soft-rayed parts of the dorsal fin are continuous, usually even, and the spinous as long or longer than the soft part, which is opposite and approximately equal to the anal fin. With a little experience one can recognize a member of this family at sight, although its many genera differ considerably from one another. Some have small, fine scales, some are short-bodied, some little, others excessively compressed. They have a characteristic manner of swimming, gliding about propelled by a rowing motion of the pectoral fins, only using the tail when extra speed is requisite. Their tail is usually deep and compressed. The caudal fin, although large and deeply forked in the adults of some species, is an adornment rather than a propeller. The reef species are, as a rule, brightly coloured; any colour in the rainbow may be present, according to species, in a fine intricate pattern or in masses. Comparatively very few wrasses are found outside the tropics in cooler northern waters. One such, the tautog or blackfish (*Tautoga onitis*) of the Atlantic coast of the U.S., is an excellent food fish; and another, the bergall or cunner (*Tautogolabrus adspersus*), is found in really cold water, as far north as Labrador. The parrot fishes (Scaridae) are little more than heavy-bodied, large-scaled wrasses, in which the jaw teeth, instead of being well-spaced, are fused above and below, to form a hard, parrot-like beak, no doubt capable of biting off bits of coral. Most of these are highly coloured also, although some found over muddy or in weed bottoms are dull, or mottled so as to be inconspicuous. Their colours are usually massed; a few are red or blue, but in most green predominates, with red, orange, yellow or blue markings. A great many wrasses are small, some of moderate or large size; the parrot fishes on an average are larger.

The Acanthuridae, another tropical marine family, have well-compressed, usually deep bodies, fine, inconspicuous scales, a narrow peduncle and emarginate to forked caudal fin, a good-sized eye placed high, a small mouth placed low and are largely herbivorous. An evenly-margined, sometimes high dorsal fin of weak spines and soft rays extends along most of the back, and a similar anal fin, shorter because it has only two or three initial spinous rays, is placed under its posterior part. The surgeonfishes (Hepatus, sometimes called *Acanthurus* or *Teuthis*) are the commonest genus in this family. There are a number of species. characterized by a strong sharp-edged spine on the caudal peduncle, depressible in a groove, and when erect pointing forward and outward. Most are dull coloured, some yellow or blue. or with bright markings. Another genus has the dorsal and anal fins excessively high, another has immovable nodules on the peduncle in place of the depressible spine. Just how the Acanthuridae are related to the Chaetodontidae is uncertain. The peculiar Moorish idol (*Zanclus*), widely distributed across the Indo-Pacific Ocean, seems to occupy a somewhat intermediate position between the two families. In some respects the Acanthuridae approach the plectognath fishes, next to be considered.

The Plectognathi are supposed to be the terminal member of the central line of specialization evolved from percoid fishes. They comprise several unlike families which are clearly more closely related to one another than to anything else. All have small. nipper-like mouths, soft-rayed dorsal and anal fins alike, placed well back and over one another, the scales abnormal or absent and are weak swimmers. The triggerfishes (Balistidae) have a leathery skin reinforced with small, nonoverlapping scales, a spinous dorsal fin placed well forward, consisting of one strong. and one or two weak, depressible spines behind it, the first weak spine locking the strong spine when that is erect. The mechanism involved suggests the trigger of a gun, thus the name triggerfish. The filefishes (Monacanthidae) are more strongly compressed, thinner bodied, the leathery hide with fine inconspicuous asperites only, and have a single high but more slender spine on the front of the back, with the small one behind it inconspicuous or obsolete. The boxfishes (Ostraciontidae) have the head and body completely encased in fused bony plates, leaving only the tail and bases of other fins free to act as propellers. Their cuirass is either four angled, squarish, or with a raised ridge in the centre of the back, making it triangular in cross section; and some species, called cowfish, have horn-like spines projecting forward above the eyes. The porcupine fish (Diodon), on the other hand, is covered with long, strong spines, and can inflate the body so that they project in every direction. The swellfishes (Tetraodontidae) have a loose skin, variously smooth or with fine prickles, and can inflate themselves with water or air until they become approximately spherical. All the above fishes are of small or moderate size, but the great ocean sunfish (Mola) grows to some eight or ten ft. and weighs more than a ton. This singular fish has a short, deep, compressed body, with rounded outlines, a thick, tough, wrinkled skin, a tiny mouth, small eye, small, rounded pectoral fins behind short gill slits and high, pointed dorsal and anal fins, the distance between their tips somewhat greater than its total length. Behind these the body ends abruptly without tapering backward, and is fringed from top to bottom by a narrow caudal fin.

None of the plectognaths have paired ventral fins, their place being taken by a spiniferous projection at the end of the long pelvic bone in the triggerfishes and some of the filefishes, and no trace of them remaining in other of the filefishes, boxfishes, porcupine fishes, swellfishes or sunfishes. The triggerfishes and filefishes have crowded incisiform teeth on the jaws, the boxfishes a single series of narrow teeth. In the porcupine fishes the jaws are covered with a bony plate and resemble the beak of a parrot fish; in the swellfishes such a beak is divided into four parts by a median suture in each jaw, and in the sunfishes it is relatively weak.

The filefishes are the most: sluggish family. They swim to some extent by rippling their even-bordered dorsal and anal fins, and are great drifters, motionless among weed where they are concealingly coloured, as often as not head down, and can frequently be caught in the hand. Filefishes abound coastwise and are occasionally carried offshore by currents. The triggerfishes are more active, use their caudal fin more for propulsion, but the young are great drifters in floating weed, found far out to sea, and some of the species are truly pelagic, occurring in small schools in mid-ocean. The offshore species tend to have the dorsal and anal fins high and pointed, and to swim by moving them from side to side. Those with low, even fins doubtless ripple them much as the filefishes do, but in some of the larger coastal forms, where these fins become higher and more pointed as the fish increases in size, it is correlated with this somewhat different mechanics in their use. The swellfishes, with short dorsal and anal fins, scull with them in normal swimming, and the offshore species have the higher and more pointed fins. The ocean sunfish, wherein these fins are particularly high, firm, pointed, and placed far back, must propel itself entirely by moving them from side to side, as it lacks any caudal locomotor apparatus. This fish is usually seen lying more or less on its side at the surface of the sea, often far from land. How it manages to nourish its great bulk with so tiny a mouth, where it lives and what its habits may be at other times, are something of a mystery.

In some localities the meat of the back of smellfishes was considered a delicacy, but known to be dangerous. The ripe spawn of these fishes is poisonous, and it is likely that the poison may permeate the rest of the fish when it is dead. Perhaps its virulence varies according to species and according to locality. Some are considered sure death by Pacific islanders and strictly avoided. Most fishes are good to eat, and information on the toxic properties of those few which are not is vague, only less vague as regards swellfishes than others. Various plectognaths have the reputation of being poisonous, *e.g.* the filefishes and porcupine fishes, which have no meat worth bothering with anyway; also the boxfishes, although these are sometimes cooked in the shell and eaten without ill results. In some localities the larger plain-coloured triggerfishes are regularly marketed; in others the bright-coloured reef species have an evil reputation.

Sculpin-Like Fishes and **Gobies.**—Typical marine sculpins (*Myoxocephalus*) are abundant, smallish fishes inhabiting shallow, coastal waters of northern seas. They have good-sized eyes placed near the top of large, spiny heads, large mouths with bands of small teeth and are greedy and omnivorous. Their anterior spinous, contiguous although separate posterior dorsal fin of soft rays, and similar anal fin below it, do not differ greatly in size; pectoral fins are large and rounded, ventral fins narrow, with a more or less concealed spine and only three soft rays. Their tails are slender, the small caudal fin usually squarish. Their skin is mostly smooth, or with a few wart-like tubercles, lacking true scales, Sculpins spend much time resting on the bottom, move forward a few inches and come to rest again, and their mottled colours match giving them a low visibility in their environment. An abundant Atlantic species (M. *octodecimspinosus*), which has an unusually long spine on the side of the head, when taken from the water commonly assumes a defensive attitude by drawing the upper jaw down and forward, slanting these long spines up and back at an angle of forty-five degrees, meanwhile emitting a low, drumming sound.

The sculpin (Cottidae) is a northern cold water family, containing many genera. The fresh water genus *Cottus* comprises' similar smaller fishes with big, broad heads, which are spineless except for one or more small, concealed spines on the edge of the preopercle. Other marine forms, especially those in deep water, differ more widely from this type.

A skeletal peculiarity of sculpins, namely, a bony stay across the cheek, is shared by various related marine families. Scorpion fishes (Scorpaenidae) replace them in the tropics, with deeper-bodied, more compressed, less strictly bottom species, commonly found among seaweed. These have equally spiny, although smaller and less broad heads, and usually stronger spines in the dorsal and front of the anal fins, which are capable of inflicting painful, sometimes serious wounds. The poison fish (Synanceja) of the western Pacific has definite poison glands associated with the dorsal spines. It is a sluggish fish, lying on the bottom, sometimes partly buried in the sand, where it could be stepped on easily, and is greatly feared. The freer-swimming, brightly mottled. more conspicuous lionfish (Pterois), with very wide, expanded fins. which is found in the same seas, also has a bad reputation. Fishes of this family allied to the genus *Sebastodes,* misnamed rock cod, and more appropriately known as rockfishes, are plentiful in cooler water along the shores of the North Pacific. They are more active, have weaker spines, reach a larger size and are of considerable market value, as is their single Atlantic representative, the bright red rosefish (*Sebastes* marinus). They are ovoviviparous. The eggs hatch within the body of the mother and hundreds of tiny young are born. Other scorpion fishes and sculpins, what is left of them when their big heads have been removed, are good to eat, although little used as food. The flatheads (Platycephalidae), with much depressed, flattened spiniferous heads, are an allied warm-water family, represented by numerous species along the shores of the Indian and western Pacific oceans.

The sea poachers (Agonidae) are more or less slender and elongate relatives of the sculpins, with an angular body covered with longitudinal rows of scutes. The peculiar lumpfish (*Cyclopterus lumpus*) of the North Atlantic, has a short, thick, lumpy body, the ventral fins rudimentary, forming the bony centre of a sucking disk on the breast. It is a bottom species, but its young are found in detached, drifting rockweed. They are usually green or purplish, sometimes mottled gray in colour, and with whitish markings, a pattern obviously designed to give them a low visibility in the rockweed, as that of the mousefish (Histrio) does in the yellow gulf weed of the open ocean. The sea snails (Liparidae), which also have a pectoral sucking disk, are small, sluggish, tadpole-like, bottom fishes, wherein the body and even the fins are veiled in smooth thin skin. They mostly inhabit Arctic seas. The greenlings (Hexagrammidae) are food fishes living about rocks and kelp in the North Pacific. Their bodies are covered with small scales and they are notable for the presence of several well-developed lateral lines. They are usually elongate and compressed, dorsal fins are confluent, occupying the length of the back and the spines of the anterior are weak. Their heads are essentially spineless. The related cultus cod (Ophiodon elongatus) has a single lateral line, less compressed body and very large mouth with strong teeth. It reaches a length of more than three ft., a weight of 30 or 40 lb., and is one of the most important cold-water food fishes of the Pacific coast of America, although its flesh is bluish or greenish in colour. The sablefish or so-called "black cod" (*Anoplopoma fimbria*) of these same waters, is highly valued for the table about Seattle, Wash. It is a streamlined fish mostly blackish in colour, with two well-separated dorsal fins and a forked caudal fin.

Fishes of the above and related families which comprise the sculpin series are present in greatest variety in the cool waters of the North Pacific. Many types of 'them are not found elsewhere, and comparatively few found elsewhere are not there represented. The scorpion fishes are the most perch-like, the sculpins have standardized characters of the group best developed and obviously adapted to their manner of life and there are other peculiar, more highly specialized families. It is reasonable to suppose the tropical, cosmopolitan scorpion fishes were ancestral to the series, which expanded in North Pacific waters, and the sculpins, one of its few divisions represented in the Atlantic, to have reached that ocean via the Arctic.

The gurnards (Triglidae) are well-defined, warm-water, marine fishes of rather small size, presumably related to the sculpin series. Their rather large, pointed heads, encased in a complete armature of more or less spiny plates, with eyes placed high, mouth low and horizontal, are very characteristic. Their body is covered with small scales, pectoral fins large and broad, with the three lower rays detached, thickened, and used to finger the bottom. American species (*Prionotus*), known as sea robins, are little used for food, although perfectly good to eat, after the large head is removed. Mediterranean species (*Trigla*) with smaller and less spinous heads, are of market importance.' The deep-water gurnards (Peristedion) are peculiar fishes from deep water of the continental slopes, obviously close to the Triglidae. Their snout is produced in two long, flat processes which extend forward beyond the mouth, body covered with longitudinal rows of large, keeled scales. They have two free tactile rays at the base of the pectoral fins, branched barbels at their chins and are characteristically bright red in colour. Also related are the flying gurnards (*Cephalacanthus*), which, though not common, are generally distributed in tropical seas. They have a blunter head, with a long, backwardly directed spine at its lower hind corner, and exceptionally large, broad pectoral fins. Sea robins have the habit of swimming upward, then spreading their pectoral fins and gliding slowly back through the water to the bottom; and the flying gurnard sometimes launches into the air in a like manner and is supported by its spread pectorals for a short flight, not comparable with that of the true flying fishes, however.

The gobies (Gobiidae) are mostly small, bottom fishes, comparable with although not directly related to those of the sculpin series. They are very abundant in individuals and in species in the shallow shore waters of all warm seas. A relatively small number occur in fresh water, but they are an important factor in the meagre fresh-water fish fauna of tropical oceanic islands. Gobies are variously elongate or shorter bodied, usually with smooth scales of moderate size, and no evident lateral line, sometimes with fine scales, or scaleless. The size of their mouth varies; and they usually have good-sized eyes, placed rather high, but there is a blind species (Typhlogobius *californiensis*) in Lower California, living in holes and crannies of the bottom, in which the eyes are rudimentary. They have two separate dorsal fins, the anterior supported by weak spines, the posterior, of soft rays, similar to the anal fin below it, usually a rounded or more or less pointed caudal fin, and broad, rounded pectoral fins, with ventral fins below or slightly in advance of them. There are two principal subfamilies, of which the more primitive Eleotrinae have ventral fins separate from one another, as is usual. In this subfamily there is sometimes a small, hooked spine at the angle of the preopercle, and the species tend to be larger, some growing to one or two ft., although most gobies do not exceed a few inches. In the Gobiinae the ventral fins are joined to form a shallow cup, presumable of service in clinging to the bottom. They are fairly active little fishes, but concealingly coloured when at rest on the bottom or in seaweed. Among the many other forms in this subfamily which have a more or less limited distribution, one of the most abundant (Bathygobius), characterized by having the upper pectoral rays free from one another, slender and silk-like, is found at the edge of tropical shores, represented by no more than poorly defined races in different seas around the world.

The mudskipper (*Periophthalmus*) is a specialized goby that spends much of its life out of water, skipping about actively on moist mud or among rocks at low tide, chasing insects or other small fry on which it feeds. It has bulging eyes at the top of a frog-like head, and supports the front of its body with the pectoral fins, which have fleshy, muscular bases, and are bent downward, while its tail rests on the ground behind, or is used to propel it in its longest leaps. When out of water its large gill chambers are kept filled with air. It probably breathes as well, to some extent, through its skin, as when it clambers out and rests on some mangrove root with only the tail in water. It is said that the mudskipper is unable to live submerged for any length of time.

Relatives of Weevers and Blennies.—Having concluded those obviously related to, and presumably derived from, the percoid stem, we come to a variety of modern, specialized fish families, about the derivation of which, and their relationship to one another, ichthyologists are in less agreement. The weevers (*Trachinus*) are fishes growing from six to 18 in., found in the Mediterranean and on other European shores. They are notable for having a spine on the gill cover, and those of the dorsal fin, grooved, and associated with poison glands, thus capable of inflicting an extremely painful sting. They are elongate, compressed fishes with eyes near the top of the head, over the large mouth, which slants upward, body covered with small scales. There is a short, anterior, spinous dorsal fin, long, even, soft-rayed dorsal and anal fins extend along the upper and lower outlines of the body. The caudal fin is squarish, ventral placed appreciably in advance of the pectoral fins. The shallow-water lesser weever (Trachinus *vipera*) often buries itself in the sand with only the eyes, mouth and tip of the dorsal spines exposed. The sand stargazers (Dactyloscopidae) of similar body form and presumably similar habits, are exceedingly fragile sand-coloured little fishes less than five in. long, with no pungent spines, not uncommon on sandy tropical shores; the stargazers (Uranoscopidae) are sluggish bottom fishes which may grow to be one ft. or so in length, which have a large, cuboid head more or less covered with bony plates and small eyes which look upward placed near the front of the head, over an almost vertical mouth. The toadfish (*Opsanus* tau) is a representative of another family (Batrachoididae). It is a sluggish bottom fish of shallow shore waters, reaching a length of one ft. or more, tadpole-shaped, with a big, flat head, bulldog-like mouth with strong, blunt teeth, rounded fins, no scales and a fringe of skinny tabs along the lower jaw. Toadfishes place their eggs in some crevice, empty shell or other receptacle, and one or both parents guard them until hatched. The young hide in seaweed before taking up life on the bottom.

The above families are known as trachinoid fishes, and various others with more uncertain relationships are often included in that group. There is a small, heterogeneous lot of fishes with long, even dorsal fins, which includes two well-known American food fishes, the whitefish (Caulolatzlus) of the Pacific coast and the tilefish (Lopholatilus) of the deep water of the North Atlantic continental slopes. There are the uncommon jawfishes (Opisthognathidae), small species with large eyes, very short snouts, large mouths and very long upper jaws. The Nototheniidae are a family of superficially more or less sculpinlike fishes which replace the cottoids, to which they are not related, in the higher latitudes of the southern hemisphere.

In reviewing the principal of the many types of fishes among perhaps 30,000 living species, those of peculiar structure correlated with some unusual and standardized manner of life are most difficult to place. They were presumably successful and persisted, while any relatives which might give a clue to their position were swept away long ago in the tide of evolution. Such are the tadpole-shaped little clingfishes (Gobiesocidae), with a large sucking disk between and behind the ventral fins, which form a part of it, more efficient and different in structure from any similarly placed sucker in other groups. They have smooth, scaleless skin, eyes near the top of their round, flattened heads, dorsal and anal fins of soft rays, placed well back. Those found in deeper water are most often reddish or pinkish in colour, and some species exceed a length of six inches. One common in the West Indies (Abraciosa fasciatus or *rupestris*) is only one or two inches and matches the colour of the rocks to which it clings in the wash of the surf.

Where the remoras (Echeneididae) belong in the evolutionary system is even more uncertain. These singular fishes have a large, oval sucking disk occupying the top of their flattened heads and extending more or less onto the front of the back, with a central lengthwise ridge and series of slightly movable transverse plates like the slats of a blind, wherewith they attach themselves to sharks and other large fishes. They are almost invariably associated with such hosts, which, at least, furnish them free transportation to distant waters. They are more or less slender and elongate, stream-lined fishes, with minute scales which are easily overlooked, fair-sized eyes, projecting lower jaws, ventral fins about under the pectorals, dorsal and anal fins of soft rays, placed well back, and an emarginate caudal fin. They are usually grayish in colour and they lack countershading. Inasmuch as they rarely swim free in the water, countershading would have no significance for them. The one (Echeneis) most commonly attached to coastwise sharks is elongate and has a dark, lengthwise band. One (Remilegia) which attaches to small whales is especially stout-bodied with the sucking disk relatively large. *Remora remora* is the species usually attached to offshore sharks, *Remora* brachyptera often found within the gill cavity of large fishes and Rhombochirus particularly associated with marlins. The sucking disk of the remoras represents and is presumably derived from a spinous dorsal fin, and they have superficial characters which suggest relationship to the cobia (Rachycentron), one of the mackerellike series, which has that fin reduced to isolated, short spines. But they are widely separated from mackerellike fishes in current classifications.

Other forms which may be mentioned here are the little, slender, silvery sand lance (Ammodytes) which swarms along northern beaches, darting in and out of the loose sand, an important item in the food of various fishes and sea birds, also the iridescent pearlfish (Fierasfer) which spends most of its life inside molluscs or echinoderms. This is a slender little fish with a long tail tapering to a thread, and no caudal fin. It has been observed to enter sea cucumbers through their small posterior opening, with remarkable facility either headfirst or tailfirst, and to rest inside with its head projecting from the apertures on the lookout for food.

The blennies and related families are a very large and varied series of marine fishes which have the ventral fins placed well forward, often at the throat, with a reduced number of rays, or these fins lacking altogether. There are three principal families of blennies. The Blenniidae are tropical or subtropical. They lack scales and for the most part are little fishes with more or less frog-like heads, rather small, transverse mouths with a row of comb-like teeth in each jaw, a rather high, continuous dorsal fin, the front part with rather weak spines, of about equal extent, with the soft-rayed part behind, and a rounded caudal fin. Numerous species are found associated with gobies in shallow shore waters, resting on or moving deliberately over the bottom, ready to dart away with agility and hide in some hole or cranny. The Clinidae are also small, tropical fishes, with more symmetrical, compressed bodies covered with scales, a more normally shaped head, larger, more normal mouth, rather large eyes and the long dorsal fin supported by more pungent spines for most of its length, usually with few, frequently only one soft ray at its hind end. They hide among seaweed, rather than living actually at the bottom. The Pholidae, on the other hand, are primarily fishes of cold northern seas. They have elongate, compressed, more or less eel-like bodies, usually fine, inconspicuous scales, a long, low, even dorsal fin with spines only, no soft rays, the ventral fins often reduced to a tiny spine and single soft ray, sometimes lacking. Blennies have variously patterned colours to render them inconspicuous in their particular habitat.

There are a number of mostly cold-water families, closely or more distantly related to the blennies. The wolf fishes (Anarhichadidae) comprise a few large species of the north, with deep, compressed heads and foreparts of the body, large mouths and heavy formidable teeth, a long, high, even dorsal fin supported by flexible spines, broad pectoral, and no ventral fins. Those of the not especially elongate genus Anarhichas, reach a length of three or four ft.; the eel-shaped *Anarrhichthys* is said to grow to eight ft.

Most of the species of the rather stocky eel-like eelpouts (Zoarcidae), with short, rudimentary ventral fins under the gill cleft, and the cusk eels (Ophidiidae), with ventral fins near the chin, each developed as a long, forked barbel, are found in moderately deep water. The genus Brotula, which inhabits shore waters of tropical seas, comprises fishes one or two ft. long, with moderately elongated, compressed bodies, covered with fine scales, good-sized eyes and mouth, with small teeth in bands, several barbels on the jaws, long, even, soft-rayed dorsal and anal fins meeting in a point around the tail and ventral fins reduced to a pair of filaments placed under the gill cleft. The family to which it belongs (Brotulidae) is large and varied comprising 40 or 50 genera, most of which occur at varying distances down in the cool depths of the ocean. Strangely enough, two inhabit subterranean fresh-water streams of Cuban caves. These are almost colourless little blind fishes, with tiny rudimentary eyes.

Cods and Anglers. — The cod (*Gadus morrhua*) is probably the best known fish to seafaring peoples of the North Atlantic, which is the cradle of our modern commerce and civilization. It is a cold-water species that abounds on offshore banks, and from early days fishermen have made long voyages in its pursuit. It frequently reaches a weight of 50 lb., and may attain four times that weight and a length of six ft. It is a symmetrical fish, with good-sized eyes, a large mouth, the upper jaw projecting slightly beyond the lower, and a barbel at the chin. Its body is covered with small, smooth scales, its fins are without spines, and, like its close relatives, it has the distinction of three separate dorsal, and two separate anal fins. Cod come close in shore, and also range far down the continental slopes into deep water. They usually swim near the bottom, but occasionally rise into upper waters in pursuit of surface swimming fishes. They range about in hungry schools, devouring any animal food that comes their way, from crabs and molluscs on the bottom, to fish and squid higher up in the water.

Of the several close relatives of the cod found in the same waters, all excellent food fishes, the haddock (Melanogrammus *aeglefinus*), has a smaller mouth and is more exclusively a bottom feeder; the pollack (Pollachius *virens*) is more streamlined, with a slightly projecting lower jaw (its barbel minute), a larger, more forked caudal fin, and usually swims at or close to the surface; the little tomcod (Microgadus *tomcod*), which runs into shallow water and enters estuaries in late fall and winter, rarely exceeds one ft., and is usually smaller.

The cod family (Gadidae) also comprises somewhat different fishes. The European lings (Molva), which have large eyes and a well-developed chin barbel, are more slender and elongate, with but two dorsal fins, the anterior short, the posterior long, over the single, almost equally long anal fin. The common species which is around five ft., is extensively dried for food in Iceland. Fishes known as hake or ling in America, as fork-beards in England (Phycis), have a similar fin arrangement, except that their ventral fins are each reduced to a long, bifid filament, and are placed at the throat. There is one fresh-water member of the cod family, the burbot (Lota), found in northern lakes. The European hake and American silver hake (*Merluccius*) are close to the cods but usually placed in a separate family. These are predaceous fishes with large mouths and numerous sharp, slender teeth, a projecting lower jaw and no barbel. They have two dorsal fins and one anal fin, but approach the condition in the cod, etc., in that the long, posterior dorsal and anal fins are marginate, imperfectly divided in two.

The grenadiers or rattails (Macrouridae) are strange, bottom fishes of the cod order (Anacanthini), which inhabit the deep sea, rarely straying up the continental slopes to inside the 25-fathom line. They have rather large, sometimes angular heads, mouths and eyes of varying size, the latter often large, usually a small barbel at the chin, a short, anterior dorsal, placed about over the pectorals, which are about over the ventral fins, a long body covered with small scales, tapering backward into a slender rat-like tail, and no caudal fin, a long posterior dorsal and anal fin, the former commonly, and the latter sometimes very low or vestigial. Among deep-sea fishes the rattails are numerous in individuals, and in species which inhabit varying depths. More than 15 genera are recognizable.

The Anacanthini are very distinct from any other order of fishes. Earlier classifications placed them near the blenny-like series, which they suggest in various mays. More recent classifications derive them from much further back in the evolutionary line, perhaps directly from the Isospondili, but their position is by no means certain. Their tails and caudal fins are strictly isocercal, lacking the structural asymmetry characteristic of those of most fishes, doubtless a secondary character, and probably inherited from ancestors with eel-like tails. Their fins are without spines, but might easily be so secondarily. The number of rays in their ventral fins is very variable, one to nine in the Gadidae, and may be as high as 12 in the Macrouridae. In any event, they are highly specialized rather than primitive fishes, as evidenced by the complexity of the cod skull.

There is general agreement that the Pediculati (anglers, etc.) are the most specialized side branch of the spiny-rayed fishes. They are usually short-bodied, more or less shapeless forms, and have a short, fleshy arm to support the broad pectoral fins, small gill openings, somewhat behind. in or near the axil of these fins, and the anterior dorsal fin reduced to more or less isolated, slender spines. The North Atlantic angler (*Lophius piscatorius*) which reaches a length of three or four ft. and may weigh as much as 50 lb., is common in cold, shore waters, and ranges well south at considerable depths. It has a very large, broad head, about as long as its tapering, scaleless body, an enormous transverse mouth with projecting lower jaw and bands of formidable pointed teeth Its eyes are on the top of its head. its first, slender dorsal spine situated near the tip of the snout, has a skinny tab or "bait" at its apex, which was observed to lure smaller fishes to their doom over the great mouth of the angler, lying inconspicuously on the bottom. The frogfishes (Antennariidae) are small, sluggish fishes of irregular outline which hide in seaweed, where their colours and markings render them inconspicuous. These too have good-sized mouths opening obliquely upaard, a very slender, movable spine with a bait at its apex over the tip of the snout, and probably either angle in the same way for little shrimps and the like, or clamber through the weed stalking their prey. The mousefish (Histrio) is wonderfully camouflaged in the drifting weed where it lives. But the Ceratioid fishes or deep-sea anglers, sometimes called sea devils, are the most remarkable in this group. There are numerous, mostly small species of these, of different strange shapes, commonly black in colour, often with large mouths and many fang-like teeth, which live in the darkness of the oceanic abyss, and frequently have a phosphorescent, luminous bait. A unique feature in the life history of ceratioid fishes is that the male, nhich is tiny compared to the female, attaches himself to some part of her exterior with his mouth, and becomes a parasite for the rest of his life. His organs, except those connected with reproduction. degenerate and he becomes fused with her; even their vascular systems connect.

Distribution and Migration.— Almost every known type of water has its fish life, from mountain torrents to the depths of the ocean. There are three main habitats, each with fishes peculiar to itself and that enter the others to a very limited degree, namely fresh water, shore water and deep sea; thus there are three main fish faunas, fresh-water fishes, shore fishes and deep-sea fishes.

Sharks were presumably always marine, but there is some evidence that the ancestors of modern "true" fishes (Osteichthyes or Pisces) inhabited fresh water, where various archaic relict forms still live. Be that as it may, almost every modern order of fresh-water fishes has marine species or relatives, and presumably came out of the sea. which its ancestors may have entered at an earlier epoch. An exception is the continental order Ostariophysi (catfishes. characins, carps), nith no knonn marine relatives, and no marine species except a few catfishes which are doubtless secondarily so.

Some fishes are most abundant in the transition zone of brackish water between salt and fresh. as about the mouths of streams. Most of these can also live in quite fresh or quite salt water, some better in the one, some better in the other. Some fishes, notably species of the trout and herring families. make regular migrations between salt and fresh. In the Arctic regions fishes cross the line between fresh and salt water more freely than in warmer climes. However, it was found that tropical salt-water fishes enter rather freely local fresh water that is heavily impregnated aith lime. The line between fresh water and marine shore fish faunas is then a somewhat intangible one. Nevertheless, and in spite of the fact that living conditions are so similar in the two habitats that many of their fishes are much alike, it was one of the most effective barriers in general to fish distribution. Fresh water will not support the abundance of fishes to be found in salt, competition was less keen and specialization less active there, and its fishes are, in general, more primitive.

The deep-sea habitat is the most peculiar, its fish life most specialized, and unlike that found anywhere else. At the same time competition was less keen in the deep sea than in shore waters, enabling primitive types and groups to persist there. The three obvious physical characters of the depths of the ocean to which fishes living there must be adjusted, are pressure, cold and darkness. The fishes' bodies are so permeable to water that pressure evidently is balanced and makes surprisingly little difference to them, provided they do not change their level too quickly. Cold must act as a deterrent, preventing warm-water shore fishes especially, from entering the domain of. and competing nith deep-sea forms. Most of their peculiarities are directly or indirectly traceable to darkness.

Various shore fishes go to considerable depths at times. The shore fauna is dominant on offshore banks and on the continental shelves in general. Certain cold-water species, found in shallow water along coasts to the north, range farther south in deep water. The deep-sea fauna becomes dominant below the 100-fathom line. A few of its members very occasionally cross the 25-fathom line shoreward; and, at intermediate depths. representatives of both faunas are found. However, although deep-sea fishes were presumably derived from those of shore waters, their specializations are so pronounced that there is seldom difficulty in assigning a species from where the two mingle to one or the other category. There furthermore seems to be a narrow transition zone on the continental slopes between shore and deep-sea faunas, which has character of its own, some fishes peculiar to it, with shore affinities, but not related to those in nearby shore waters. On the Atlantic slope of North America we have two dogfishes (*Scylliorhinus retifer* and *Pristiurus* arae) representing the European dogfishes; *Zenopsis ocellatus* representing the European John Dory; and the tilefish (Lopholatilus chantaeleonticeps) representing the blanquillos of Middle and South America. Pelagic fishes, found at the surface of the open ocean far from land, for the most part belong to a division of the shore fauna, not to the deep-sea fauna. On the other hand, many little lantern fishes mhich follow the zone of darkness to the surface at night, obviously belong to the deep-sea fauna. Not only are they specialized for life in dim light. but their relatives live deeper down.

It would be possible to subdivide the deep-sea fauna according to zones of depth which its members occupy. A large number of its species—so far as known—have a more or less limited range in this or that sea. But they live in a remarkably uniform environment with few natural barriers, and, as our scant knowledge of them increases, closely related if not identical forms turn up in the most nidely separated parts of the continuous ocean.

By contrast, there are and were various natural barriers to the dispersal of fresh-water fishes. To begin with, they cannot cross salt water. Those of one part of the world differ from those in another, correlated not only with differences in the aquatic environment, but with the geologic history of the lands. The fresh-water fish fauna is separable into a number of natural divisions and subdivisions which make an interesting contribution to the science of zoogeography (see ZOOGEOGRAPHY; DISTRIBUTION OF ANIMALS). The order Ostariophysi (catfishes, characins, carps), which dominates continental fresh waters today. appears to have been distributed from the larger land masses to the north The dispersal of catfishes reached South America prior to the long isolation of that continent by sea in the Tertiary, and, with few competitors the catfishes expanded there into a great variety of normal and aberrant branches and forms. The dispersal of carps came later and, not being able to cross salt water, they have not reached South America. Ostariophysi are dominant in the larger East Indies but entirely absent, except for marine groups of catfishes, from Australia. New Guinea and Madagascar. which were isolated by sea for a longer period. The eastern limit of their range is approximately at "Wallace's Line." In such ways the subdivisions of the fresh-nater fish fauna correlate nith what is known of geologic history from other sources.

The various elements of which this fauna as a whole is composed, each has a different derivation. Its subdivisions should be based, not only on the presence or absence of one or another element, but also on the balance between those which are present. A (I) Continental dixision has the Ostariophysi dominant, as opposed to a (II) Peripheral division where a large proportion of the fishes have marine affinities. The former occupies the continents (with the exception of Australia) and most continental islands. It has an Arctic Peripheral fringe where relatives of the pikes (Haplomi) and of the trouts are abundant. and this fringe fades into it southward. The genus *Galaxias* mhich occurs in the southernmost margin of South America and tip of Africa gives these small areas a Peripheral complexion.

The Continental fauna may be divided again into (1) Northern, which occupies Eurasia and North America, with carps and their relatives very abundant; and (2) Austral. in Middle and South America, and Africa. The (A) Holarctic division of the northern fauna is found in Europe, North America, and crosses Asia, where it is separated geographically from the (B) Oriental division in China, India, etc., by mountains and deserts. Finally, the (a) Palaearctic fauna in Eurasia is characterized by the presence of loaches, the (b) Nearctic in North America by an abundance of suckers. The (A) African and (B) Neotropical divisions of the Austral fauna are very comparable, characterized by great variety and abundance of catfishes, characins and cichlids, which led to recurrent but probably erroneous belief that there was a fresh-water (land) connection between Africa and South America in the Tertiary. There is an abundance of mormyrids in Africa, of gymnotids in South America, families parallel in some ways, but presumably unrelated.

Such are the main components of the continental fauna, although these may be subdivided further to advantage. For instance, the carp family makes up a greater proportion of fresh-water fish life in East and South Africa than in West Africa. They are a relatively recent invasion from Asia which found more room in the periphery than in the centre of abundance of the already established Nile-Congo fishes. In temperate North America, fishes in the elevated or broken terrain from the Rocky mountains westward are different from those of the eastern part of the continent. In Asia and North America particularly, the fish life varies according to temperature zones, dependent on differences in latitude or altitude.

The Peripheral fauna is characterized by groups of fishes found in the fringes of, penetrating more or less deeply into, and becoming dominant only where the continental fauna is weak. It is less tangible, has less unity and is less correlated with the history of the lands. Its (1) High Latitude part consists of an (A) Arctic and subarctic fringe where the trout family is abundant, and (B) a barely recognizable touch at the edge of southern land masses, which do not extend into such high latitudes. Its (2) Tropical part is dependent on long isolation of fresh waters by the sea, and may be divided into the (A) Australian; (B) West Indian; and (C) Insular-Oceanic faunas. The Australian, in Australia, New Guinea and the Soenda Islands, is characterized by the Melanotaeniidae, fresh-water cardinal fishes, halfbeaks and representatives of marine catfishes, and so forth; the West Indian by fresh-water mullets and an abundance of lire-bearing tooth carps; the Insular-Oceanic is still more reduced, and gobies are its principal factor, augmented in the western Pacific by fresh-water species of Kuhlia, a primitive percoid.

The marine shore fish fauna varies in different parts of the ocean, primarily on the basis of water temperatures, which are much affected by ocean currents. Its (I) Tropical division extends around the globe, and is little varied, with representatives of the same fishes in most of them, even distant seas. A branch of this tropical fauna, the (1) Pelagic, is characterized by a few cosmopolitan species found across the surface of the open oceans far from land, the blue shark, pilot fish, dolphin, oceanic bonito, two or three flying fishes, mousefish in drifting sargassum. The majority of its species, with more limited ranges, occur (2) Coastwise or about islands. For them there are two main centres of abundance, the East Indian and the West Indian. The (A) Coastwise Tropical Indo-Pacific fauna is remarkably uniform from the East Indies west to the Red sea, and east to the Hawaiian Islands. Although it becomes progressively less rich eastward, and many species occur only limited distances beyond the Indies into the Pacific ocean, others are found all the way from the Red sea to Hawaii, and a few, such as the Moorish idol (*Zanclus cornutus*) and a swellfish (Tetmodon *hispidus*), even to tropical American waters. The Tropical fauna of the west coast of America is somewhat intermediate between the Indo-Pacific and (B) West Indian, but perhaps more referable to the latter. The distance between the American coast and the Hawaiian Islands seems to have been, in general, an equally or more effective barrier to the distribution of shore fishes than the geologically recent land barrier of Central America.

The (II) Boreal fauna is characterized by cod, Sculpin, smelt, northern blenny families, and their relatives, flatfishes in abundance and northern herrings. It is best developed in the northern North Atlantic, changes its character little as it fades into the Arctic. Temperate faunas between the Boreal and Tropical are less strong and well-marked, largely dependent on ocean currents and configuration of the lands, isolated from one another and difficult to classify. The Tropical fauna centres about coral reefs, and usually has a fringe north of where such occur and lacking reef elements, but otherwise little changed; where Sciaenidae are abundant on sandy shores. On the east coast of North America this fringe extends north to the Carolinas, the Boreal extends south to Massachusetts, the intervening area is dominated by the former in summer, by the latter in winter, and the two faunas are well contrasted. There is the merest suggestion of a warm Temperate fauna between in the presence of the tautog (*Tautoga onitis*), abundance of the sea bass (Centropristes striatus), etc.

On the west coast of North America an opposite condition prevails. The Boreal merges into a strong, widely distributed (III) Cold Temperate North Pacific fauna in southern Bering sea, which is characterized by rockfishes (Sebastodes, etc.), greenlings, and other aberrant cottoids; farther south, as it merges into the (IV) Warm Temperate California fauna, by surf fishes. The California, which corresponds with the Warm Temperate Mediterranean fauna of the eastern Atlantic, amalgamates southward with the northern fringe of the Tropical, and the Tropical becomes pure only at about Cape San Lucas.

In the southern hemisphere an (V) Antarctic fauna, characterized by the Nototheniidae, extends northward to New Zealand, the southern end of South America and Kerguelen Island. The warm temperate Peruvian fauna is of especial interest, although it occupies only a narrow strip of relatively cool northward flowing or upwelling sea along the west coast of South America. It is characterized by a very great abundance of a species of anchovy (*Engraulis* ringens), an abundance of croakers (Sciaenidae) and several fishes which have their closest relatives in widely separated and distant parts of the ocean. But its closest affinity is with the California fauna to the north. The configuration of ocean currents is such that warm water spreads poleward along the east coast, and cool water extends equatorward along the west coast of the continents (see OCEAN AND OCEANOGRAPHY). It follows that the Tropical faunal area is particularly narrow along the west coast of America, and is or was crossed by various warm temperate fishes.

The distribution of fish life in the past was influenced by the same agencies and barriers which affect it at present. Few barriers are insurmountable. Environmental differences, as between fresh and salt waters, coastal waters and the dark depths of the ocean, warm water and cold, were the most effective barriers in the long run. It is also probable that each strong fauna is to some extent a closed corporation, which can only be penetrated to a limited degree by that adjacent to it. This very likely keeps the line between fresh-water and shore fishes, or, in the western Atlantic, between cold-water and warm-water fishes as distinct as it is.

Wide stretches of relatively currentless ocean, free from islands, are a barrier to the dispersal of shore fishes. On the other hand many of these have pelagic young which drift great distances in ocean currents, hence a very wide distribution. Currents are often a factor in the migration of the individual to and from its nursery grounds, which may differ ecologically and geographically from those it occupies when grown. As regards fresh-water fishes, the isolation afforded by different drainage systems is apparently too temporary to have more than a slight effect. Fresh-water fishes of western are quite different from those of eastern North America, but the continental divide has nothing to do with it. The mountain-loving black-spotted trouts of the west have crossed this easily enough and are native on the eastern slopes of the Rockies, to be stopped by the Mississippi valley lowlands. It is the broad mountain area of the Rocky mountain system that prevented an invasion of the west by eastern fishes.

Birds are the only animals that have migrations as regular as, or more extensive than, fishes; and fish migration is much more complicated than that of birds. It is usually similarly correlated with the change of seasons, but less predominantly with reproduction. Search for food and optimum temperatures are larger factors in it. Furthermore, a fish has three directions to migrate into a different environment, north and south (latitudinal), on shore and offshore (horizontal) and up and down (vertical). The migration of shore fishes commonly combines the three.

As regards spawning migrations, there is a strong tendency for fresh-water fishes, in some species more than in others, to run upstream to spawning grounds. The value of this habit is obvious. It places the baby fishes in an appropriate nursery ground, in narrower waters, and where they have fewer enemies to contend with. A similar migration is better developed in anadromous fishes, those which get their growth in the sea and ascend fresh waters to spawn. These have appreciably fewer eggs than comparable species which spawn in salt water, correlated with less wastage of eggs and fry. The chinook and blueback salmon have wandered an unknown distance in the Pacific from the mouths of the rivers in which they spawn, and ascend these rivers for hundreds of miles to their spawning grounds. Like other Pacific salmon they spawn but once and die, and the return downstream and out to sea is made by the succeeding generation, which spent its early life in fresh water. There is thus a single complete round-trip migration in the life of an individual Pacific salmon.

Fishes are peculiar among vertebrate animals in that the majority hatch from tiny eggs, and there is so great a discrepancy in size between young and old that they occupy different ecological niches more often than not. It follows not infrequently that young and old belong in different faunas. In this case the small salmon is a part of the fresh-water, the larger salmon a part of the marine shore fauna. Any spawning migration implies a return migration of the young which is usually more protracted in time and often follows a different pattern.

The best known anadromous fishes belong to the relatively primitive order Isospondyli, and like other anadromous fishes can become landlocked and go through their entire life cycle in fresh water. As previously mentioned, there is some evidence that the ancestors of bony fishes were inhabitants of fresh water, and the question of theoretical interest suggests itself, whether the Isospondyli are not to be considered a fresh-water group becoming adapted to life in the sea. Probably not, except in so far as being a generalized group it is also adaptable. Most primitive Isospondyli are marine. The big-eyed herring (*Elops*) and bonefish (*Albula*) have larval, pelagic young, and those of the tarpon are unknown.

The anadromous shad runs up rivers to spawn, from Florida to New Brunswick, progressively later in the spring northward, but this does not imply northward migration along the coast, for it is different fish that come into each river from the sea. It is not improbable that some northward movement is associated with the shad's vernal migration, however. Northern coastal waters become too cold for it in winter, and whereas it may reach sufficiently warm water by moving offshore, direct evidence of its doing so is lacking thus far. There is an anadromous Chinese herring (*Hilsa*), corresponding to the American shad and an equally prized food fish, which runs up the Yangtze river a 1,000 mi. or farther from the sea.

A few (catadromous) fishes live in fresh water but spawn in the sea. Among these the fresh-water eels (Anguilla) are preeminent. European and American species, which are very much alike, are known to spawn in adjacent areas of the open Atlantic southeast of Bermuda, at a probable depth of 200 fathoms or somewhat more. Their young are larval, elongate but flattened, transparent, uneel-like and pelagic, living near the surface of the Gulf stream drift, on the first leg of the long two-way migration in the life of an individual. The larval stage of the European species until, shrinking somewhat in size, it metamorphoses into a tiny cylindrical, although still transparent replica of its parents, lasts nearly three years, that of the American about one-third as long, by which time they have respectively drifted to the shores of Europe and America and enter coastal waters. Such tiny eels are sometimes very abundant in New York harbour in spring. They work into shallow water, quickly lose their transparency, become dark in colour, and begin to grow again. Some remain in salt water along the coast. Others travel up stream as far inland as the rivers are quiet or muddy—it may be hundreds of miles—or get into ponds, and live their years in fresh water. When fully adult and ready to spawn, however, those in fresh water return to the coast. In fall such mature eels become more or less silvery in colour, and, instead of going down into the mud for the winter, head out to sea on the long migration back to the spawning grounds, from which only the next generation will return. As they do so their eyes grow larger, and there are other changes in their appearance. Marine or pelagic larval young, unsuited to fresh-water existence, are a characteristic of eels in general, and this stage obviously makes it necessary for Anguilla to spawn in the sea. Occasional individuals which become hopelessly landlocked in fresh water can not reproduce their kind. It is also significant that there are primitive Isospondyli, for instance *Albula*, with elongate, larval young not unlike those of the eels, suggesting the possibility that these played a part in the evolution of eels from that group.

The migrations of marine shore fishes are largely determined by water temperatures and search for food, and in the case of their young by nursery grounds. Their breeding migrations are, for the most part, of lesser extent or complicated with these other factors. The common mackerel of the east coast of America is an example. Nobody knows exactly where its schools spend the winter, perhaps at a considerable depth in the ocean, but they appear off the Carolinas in spring and work northward. They spawn in summer abundantly from Massachusetts bay to the Gulf of St Lawrence and over offshore banks, but it would seem that they move into these favourable feeding grounds when water temperatures permit, and their spawning there is more or less incidental. The blue-fin tuna and swordfish of the western Atlantic invade the same grounds in summer, but have certainly spawned elsewhere. The mackerel's migration presumably combines a movement to and from a greater depth farther offshore with northeast-southwest movement along the coast. and there is even some evidence that those north and south of Cape Cod in spring are different fish. Its young follow along the coast for some distance in fall, those which are abundant in Long Island sound at that season presumably having come from New England.

As has been said, the shore waters between Cape Cod and the Carolinas are occupied by warm-water fishes in summer and by cold-water fishes in winter. Of the former the tautog and striped bass may be little migratory, merely becoming less active in the colder months. Other bottom fishes such as the summer flounder and sea robins move offshore into deeper water with falling temperatures. To what extent they edge southward while doing so is uncertain. The arrival in spring and departure in fall of the menhaden is closely correlated with water temperatures, and its migration along the coast is probably combined with an inshore-offshore movement, but it is very improbable that it goes to any considerable depth. It is abundant southward at any season, but temperatures at the edge of the Gulf stream would be sufficiently warm for it. It spawns to the south in winter, progressively later northward, and in the area under consideration in summer, so different lots of fishes must be involved. The pattern of bluefish migration seems to be somewhat intermediate between that of mackerel and menhaden. Like these, it spawns in its summer range. Its young grow rapidly, and have a well-marked southwesterly migration along the coast in fall.

To cite examples of fishes of northern distribution which are abundant in shore waters south of Cape Cod in winter, schools of cod, which normally wander considerable distances in search of food, invade the area from the northeast when its temperatures fall to a suitable level and the warm-water fishes withdraw from it. As a rule only an occasional individual of the little tomcod is to be met with here in summer, but in late fall a wave of this species invades inshore waters, presumably coming up along the bottom from a greater depth, to spawn in winter in shallow bays and estuaries. The long-horned sculpin, which is abundant in the colder months, and spawns in late fall and winter, doubtless also comes up aiong the bottom, probably with little or no southward movement from northern shore waters where it is plentiful the year round. Much remains to be learned about the migration of any fish, even in this narrow and comparatively accessible area, where a large part of the species are migratory. Enough was said to show that whatever north-south migration there may be is complicated by retreat to offshore or deeper waters which have less seasonal temperature change. More favourable spawning grounds for most, be they warm-water or cold-water species, are inshore, and so they spawn inshore in summer or winter as the case may be, and the temperature migration is also a spanning migration. A series of fishes could be selected showing every intergrade in migration pattern between that of those which are strictly marine and spawn when they approach the coast, and those which are anadromous and run far up the rivers for that purpose.

Some warm-water marine fishes, especially, are pelagic, many shore fishes have pelagic young. When their nursery grounds lie in a well-marked ocean current, they may be drifted great distances. How they get back to where they came from is usually obscure. The young of many tropical species are drifted northward along the American coast by waters of the Gulf stream, occurring in temperate latitudes in summer and fall. In the majority of cases they occur merely as stragglers, and the presumption is they are lost and do not get hack. But young of the common pompano, for instance, are frequent in small schools on sandy ocean shores in autumn, far north of where adults occur. They have by then reached a sufficient size to migrate southward along the coast, and presumably do so. The several tropical crevallys (*Caranx*) common on the Atlantic coast of America have somewhat different nursery grounds from one another. A known nursery ground of *Caranx crysos* is in the Gulf stream, where these little fishes were found in numbers so far to the eastward as to raise the question whether they might seek African rather than American shores when large enough to navigate independently of currents. This particular species does occur along African as well as American coasts. Grown fish, though not ordinarily pelagic, would be quite capable of crossing back from Africa to South America, or young of another generation might drift back in equatorial currents. Too little is definitely known of the migrations of marine fishes, and these remain a fertile field for hypothesis and investigation.

The Place of Fishes, Their Size, Speed, Age, etc.—Though not the only, fishes are the principal free-swimming, aquatic animals. Most of the vast number of aquatic invertebrates are either more dependent on the bottom, or, because of lowly organization or small size, drift about in the currents. The molluscan squids, just as the mammalian whales and porpoises, are very exceptional in having invaded the fishes' proper sphere. Thus removed from serious competition by other groups, fishes are abundant everywhere, have expanded into every conceivable ecological niche and evolved a much greater diversity of forms than any other class of vertebrates. Fish competition was primarily with fishes, one species balanced against another, making for evolutionary divergence in every direction, and fishes present a particularly fertile field for the student of evolution.

The basic food supply of animals is plant life, and the mass of vegetation, such as is found in terrestrial, is relatively small in aquatic environments, taking them as a whole. This is compensated by the very great abundance of diatoms, microscopic, drifting plants, in water that is within the reach of sunlight. Although their mass is quite adequate, diatoms are too tiny to be utilized directly as food by more than a very few fishes, but by serving as pasturage for creatures somewhat larger than themselves, by one or more stages their stored up food substances are presently brought within fishes' reach. Most important of these intermediate creatures are small, also planktonic (drifting) crustacea (shrimp-like animals), frequently so abundant as to form clouds in water. They are a principal food of many, if not most newly hatched fishes.

Some fishes are omnivorous, some are herbivorous, subsisting mainly on such water plants as there are in fresh water, along the shore, or adrift, but the majority are carnivorous. An increasing proportion of the larger ones eat other fishes smaller than themselves, simply because these are the most available food. The saying "fish eat fish" is by no means an invariable rule, but is rather generally applicable. And the largest factor of basic food supply on nhich the pyramid of fish life rests is made available to it by diatoms. It must be almost entirely from diatoms of sunlit waters that the food chain, which is their subsistence, extends to the carnivorous fishes, living in the dark miles, down in the ocean.

One principal, underlying and easily traceable reason for the great divergence in character of different fishes, depends, directly or indirectly, on how far back each reaches for subsistence toward the base of the food pyramid. The menhaden goes all the way and feeds on diatoms. The minority of fishes which are herbivorous are specialized in diverse ways correlated with that habit. The predaceous bluefish feeds on menhaden and other fishes of comparable size. There is also a basic cause for the diversity of fish life in the vastness of aquatic environment. Fishes of one heritage may have been superseded by those of another in centres of abundance and competition, yet persist somewhere, perhaps in fresh, perhaps in deep, perhaps in isolated waters.

Fish utilize every available resource. Many fresh-water species eat insects which drop upon the surface by chance, or the aquatic larvae of terrestrial insects. The former are a main food supply of trout in summer, and these go on comparatively short rations through the minter. Rivers wash waste products of the land to the sea, which nourish fishes, or marine animals on which fishes feed. It follows that off the mouths of great rivers is one situation where fish life is usually abundant. Fishes are abundant and in great variety about coral reefs, but coral-reef fishes do not lend themselves to becoming the basis of a fishery more extensive than that for local consumption. There are three reasons for this. The irregular bottom makes it easy for fishes to escape. and difficult to operate fishing equipment. No one species is dominant, or sufficiently abundant to be captured and handled in quantity conveniently. As a rule, the coral-reef habitat is narrow and isolated, easily fished out, and slow to recover by influx from similar areas. The extensive offshore, cold-water banks of the North Atlantic show an opposite condition in these respects to that which pertains on coral reefs, and have been one of the chief sources of commercial fish. Here the supply of bank cod which range widely in schools, seeking favourable pasturage, is still adequate in spite of all the cod that have gone to market; that of the more sedentary halibut has given out at spots which used to be the most favoured by that species. Fish life is abundant where two environments meet, relatively scarce over monotonous stretches. Fishes abound along shores, and are plentiful on offshore banks where the life of the bottom meets that of the upper waters, scarce across the open ocean. Their great abundance in cool water of the Peruvian coast is probably correlated with the abrupt change to warm ocean water a relatively short distance out.

From the time that a tiny fish leaves the egg until it becomes full grown, and lives out its life span, it is part of the intricate balance of aquatic life, although its position therein alters as greatly as its size increases. The increase or decrease in abundance of various fishes is of importance to man, but, especially as regards salt-water species, we have too little knowledge of their enemies, food and other requirements throughout their life cycle, of the balance of aquatic life, which may vary in different waters, and of which they are a changing part, to take appropriate measures for the control of their numbers, which may be indirectly dependent on the microscopic diatom, or the only larger crustacean. Further research is requisite for an intelligent approach to such problems.

The size to which each species of fish grows is less standardized than that of most other animals. A fish probably continues to grow through life, although at a diminishing rate, much as a tree does. However, its life span is so much shorter, that its size is less an index of age than in a tree. Most of its growth is made in its youth, and how much that shall be depends on various factors, of which available food supply must be one, but is not the only one. Unusually large individuals of any species are not necessarily unusually old ones. As regards the normal and maximum age fishes attain, there is little exact information for most species. From a study of the gro th marks on their scales it is known that the different Pacific salmons (*Oncorhynchus*), which spawn and die at maturity, reach an age of two to six years. The life span of one or more small fishes is no more than a year. Some pike in fresh water, and halibut in the sea, probably live 50 years, it may be considerably more. But reported instances of any fish passing the century mark are unsubstantiated and more or less mythical. The smallest fish is reputed to be a tiny goby (*Mistichthys luzonensis*), in a Philippine Island lake, only one-half in. long when mature. The largest is probably the whale shark *(Rhineodon)*, more than 50 ft. and weighing several tons. Among Pisces, Osteichthyes or true fishes the largest sturgeons and the ocean sunfish probably exceed 2,000 lb., the largest blue-fin tuna, and marlins, weigh more than 1,000 lb.

Greatest swimming speed is very likely attained by some member of the group of mackerel-like fishes to which tuna and marlin belong. Here again exact knowledge is scant, but it is safe to say that, unless in short spurts, very few attain 20 mi. per hour. It is not improbable that the fastest swimmer can make 30, and 40 or 50 are in the fringe of possibility, but one may well be skeptical of records, however circumstantial, of more than 50 mi. per hour claimed for any fish.

Sound does not pass readily between air and water, and fishes have the reputation of being mute. This is not the case, however. Many are quite vocal, and some particularly so in the breeding season. The range of noises that they make is not very great—grunting, tooting, chirping, clicking, rattling, humming or drumming sounds—the voice of one species different from that of another and usually recognizable. A school of sea drum (*Pogonias*) in spring make quite a racket which can be heard through the bottom of a boat lying at anchor in some bay. They are recognized immediately, and it may be assumed that their voices can be heard and recognized by others of their kind. In spite of attempts to do so, very little direct evidence was obtained so far that fishes hear underwater sounds, but there is considerable indirect evidence that they do.

A fish's vision is doubtless somewhat more restricted than our onn in various ways, but less restricted than, for this or that reason, it was supposed to be. Some fishes certainly have colour vision, and there is no good reason to suppose that fishes in general do not. The deflection of light at its surface doubtless prevents fishes from seeing objects out of water, in varying degrees with light conditions. However, the archerfish *(Toxotes)* sees insects on overhanging vegetation sufficiently clearly to knock them off with jets of water; a speeding dolphin sometimes follows the course of a flying fish in the air, to seize it when it drops back into the sea; and the behaviour of trout in a stream leads one to suppose that they can see a man on the bank when he sees them, if less clearly. Fishes utilize chemical sense, which we may call smell, to a varying degree according to their kind, in obtaining their food. From the behaviour of sharks it is certain that most of them rely on their noses to a considerable extent. On the other hand, free-swimming, predaceous fishes, like the mackerels and bluefish which strike at a glittering metal lure, the trout rising to an artificial fly, are presumably largely dependent on sight. Many fishes have highly developed tactile organs, and fishes are thought to have special organs for sensing conditions peculiar to their aquatic life and environment.

We assume, probably correctly, that fish behaviour is more mechanical than that of the higher animals, in no wise to be compared psychologically with our own. Nevertheless, it has plenty of features to suggest an anthropomorphic interpretation, or that the difference in mentality is as much one of degree as of kind. An underlying factor in fish behaviour seems to be that the individual fish seeks to swim at a given distance from others of its kind, no more and no less. This distance varies according to the fish's condition, and still more according to its species. It is very short in herrings and mackerels that swim in dense schools, and varies all the way to fishes that are essentially solitary. Many sedentary fishes living in a circumscribed area at or near the bottom, defend their property rights to the area, being domineering within its confines or driving intruders from it; and these property rights, when asserted, tend to be respected by their neighbours or strangers. This is most marked in, but by no means confined to fishes protecting their mates, eggs or young.

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Colours of Fishes.—If a beauty contest among animals were staged, representatives of fishes would rank among contestants for highest honours. The most colourful insects, the most resplendent birds of the tropics are rivalled in gorgeous colour by some fishes. It would be difficult to find, or paint, or imagine a more brilliant blue than that of the "neon tetra" of the home aquarists, a more intense red than that of the redbelly dace of American streams, a brighter silver than that of the ocean bream. These, of course, are extreme (although not isolated) examples. Most fishes, like a large proportion of insects and birds, are coloured no more brilliantly than are their usual surroundings.

The colours of fishes are most commonly greenish, olive or brown, but range through most of the visible spectrum from red and orange through yellows and greens to blue, with such mixtures as orange-brown and purple common. The colours are usually mixed with black to produce dark shades and are often combined with white to yield such colours as pink and lavender. A single colour may cover the entire fish but more commonly two or more colours are combined to form definite markings, particularly on the back. The lower surfaces are very often light gray, white or silvery. Black spots, bars or streaks are very frequent elements in colour patterns, As in most groups of animals the different species, and often the two sexes, are distinctively coloured.

The almost limitless range of colours and patterns that fishes exhibit is attributable to variations in the number, distribution and mode of combination of only a few kinds of minute pigment cells (chromatophores). Black pigment cells (melanophores), each containing myriad microscopic granules of melanin, are of almost universal occurrence. They produce black markings as well as general shading and are involved in the elaboration of the iridescent greens and blues that appear on most fishes. These latter "physical colours" result from the play of light on tiny, needle-like crystals of guanine that overlie a background of melanin. The underlying black absorbs the red and yellow components of light. When the iridocytes or leucophores (the guanine-containing cells) occur alone, a silvery or white appearance results. When yellow pigment is added to an appropriate mixture of melanophores and iridocytes, green is produced. Although certain fishes, particularly in the families Belonidae and Cottidae, have a green chemical pigment in the bones, the greens and blues that appear in the skin are almost invariably the result of such combinations of colour cells as are mentioned above, rather than to special pigments or to special chromatophores. Yellow, orange and red areas when viewed under high magnification are stippled with yellow xanthophores or red erythrophores, or with both of these carotinoid pigment cells. Pink, purple and lavender colours in fishes are the result of different combinations and arrangements of erythrophores and iridocytes, or to a mixture in fine pattern of spots and streaks of red and white, or of red and blue, or of red. blue and white. When small areas of yellow are interspersed the result is a brown or some other secondary colour.

These colour cells "expand" or "contract" in response to visual stimuli, to the physiological state of the fish and to various internal secretions and drugs. By this mechanism fishes are able to change their appearance rapidly as they move from one environment to another. What actually happens is that the pigment granules within the colour cells either become dispersed throughout the whole star-shaped cell, to intensify the colour concerned; or become aggregated into a dot at the centre of the cell, to accomplish a fading of this colour.

The melanophores react particularly fast and those in different parts of the body may respond in the opposite way. As a result, changes in shade and in dark and light patterns may be accomplished almost instantaneously. Changes in other colours, as from green to brown, are less rapid and less universal, and often require time for the decrease or elimination of certain pigments and for the increased manufacture or deposit of other biochromes. Actual changes in the amount of melanin and of guanine also take place when fishes are shifted from a light background to a dark one or *vice versa.*

Because of their capacity to change colour, fishes are past masters at camouflage. In this self-protective scheme the flat-fishes (flounders and soles) are famously adept. As these fishes move about over the sea bottom, the upper side (bearing both eyes) quickly takes on the colour of the surrounding mud, sand or rock. The pattern is also matched. Thus white fragments of shells are imitated by white spots on the body. Even the size and the abundance of dark and light objects are reproduced. These changes take place within a few minutes and are effected through the sense of sight. Similar transformations, even more rapid although not quite so perfect, are exhibited by other fishes, such as the groupers of tropical shore maters. Some reef fishes show vertical bars when at rest, but horizontal stripes when swimming.

Even more astonishing colour adaptations are attained by some fishes that live in marine plants of different colours, although the change may require days or weeks since some pigments in the skin must be lost and others gained. Thus the kelp blenny (*Heterostichus rostratus*) of California is wonderfully well concealed, whether it lives among the large brown "leaves" of the giant kelp (*Macrocystis*) or in the beds of eelgrass (*Zosfera*). In the kelp it is uniformly brown, just like the alga. In the eelgrass it is striped with the intense green of this plant and with brilliant silver that matches the streaks of light between the slender blades of the plant. The two colour phases could hardly be more unlike and certainly appear to represent different species. They may, however, be changed back and forth experimentally.

In its imitation of the backgrounds the kelp blenny does not rely solely on perfect colour matching. It seldom swims horizontally. Ordinarily it heads up or down in line with the plants and may even waft its tail back and forth to simulate the movements of the leaves. A South American leaf-mimicking fish (*Monocirrhus*) drifts along just like a leaf. Baby gars (*Lepisosteus*) look like tiny twigs and float stiffly at the surface. Other fishes increase the efficacy of camouflage by imitating in posture or movement the environmental objects which they match in colour. In the light of such facts it is difficult to understand why some scientists doubt the reality of protective coloration and of adaptation in general.

Species that live on sand or other drab-coloured backgrounds do not possess a capacity to change colour that is at all comparable to the abilities of the kelp blenny. Those that live in a single kind of plant may imitate that plant only. The sargassum fish (*Histrio histrio*) does not show great range in colour variation but does simulate closely the floating sargassum weed in which it invariably occurs. The resemblance is so perfect that the fish is almost invisible even at close range as it slowly crawls about in the plant. Like other animals of the floating sargassum it shows white marks that look like the white growths of bryozoans on the alga.

Some biologists suggested that fishes and other animals take on the colour of the particular plant in which they live merely because they imbibe the plant pigment either directly by feeding on the plant or indirectly by eating smaller herbivorous animals. For fishes this is not true. Their colours are usually otherwise constituted and the changes can be effected when the experimental fish that are being kept in aquaria with differently coloured plants are fed the same type of food and are denied access to the plants by being kept in glass jars submerged in the aquaria. The last-mentioned test shows that the colour matching, like bottom mimicry by flatfishes, is effected somehow through the sense of sight.

That protective coloration involving only darkness and lightness in fishes really has survival value was experimentally proved (see ANIMAL COLORATION). Even before such proof was obtained field naturalists firmly believed that background mimicry arose through the evolutionary process of natural selection. The simulation of the background colour by fishes is too universal to admit of any other explanation. Nearly all species that swim near the surface—such as herrings, flying fishes and mackerels—are bright green or blue above, and are more commonly green inshore and blue offshore. just as is the ocean. The blue fishes of the coral reefs are the ones that swim into open water. Seen from beneath, all surface swimmers (*e.g.* halfbeaks and silversides) are silvery below and thus match the surface film nhich shines from below like a mirror. Most gobies, flatfishes and other species that live on the bare bottom are uniformly coloured or speckled or mottled with neutral colours. Tide-pool sculpins and blennies that habitually live among varicoloured aquatic plants, in contrast. are brightly and variously coloured. commonly grading from bright green through browns to red and often matching the peculiar pinkish-lavender of the coralline algae. Most fishes of the "twilight zone" of moderate depths are red, but in their own environment they are probably plainly coloured and concealed. Since red rays penetrate less deeply than the green, only green is reflected and it is absorbed. On a similar basis, coral-reef fishes that are red are almost invariably nocturnal. As is well known, red becomes invisible in dim light.

Cryptic (concealing) coloration is effected in almost all fishes, as in most other animals that live in light, by "obliterative countershading" (first stressed by the artists A. H. and G. H. Thayer). The back is enough darker than the lower parts to offset the shadows below, so that the whole image appears flat and indistinct. The exceptions among fishes interestingly prove the rule. Many deep-sea fishes, living below the zone of light, are as dark or darker below than above. The remoras (Echeneidae) are lighter above, but they adhere to sharks by their backs which are thus in the shadow. The "batensoda" (Synodontis), a catfish of the Nile, also reverses the usual scheme of countershading, but this fish habitually swims upside down. Some critics suggested that the darkening of the most exposed parts is the direct effect of light, but it was demonstrated that countershading is inherited and, therefore, that it is almost certainly the result of natural selection.

Although they render a fish in hand or in an ordinary picture very conspicuous, black bands and stripes are also regarded as concealing and protective, for at a moderate distance they disrupt the telltale fish outline. To be most effective such ruptive markings must extend to the very edge of the body and fins—and this they usually do. The eye is a particularly revealing organ, but in many fishes it is more or less completely obliterated by a black streak or bar or by radial markings. These markings pass across the whole eye or through the otherwise conspicuous pupil. That they are of definite significance is suggested not only by their frequent occurrence but also by the fact that they extend across several entirely different tissues. Streaks that pass through the pupil can commonly be resolved into seven parts: two outside the orbit; a pair on the sclerotic coat and conjunctiva; two on the iris; and one on the pupil. The sclerotic sectors extend under the orbital margins, so that the streaks remain continuous when the eye rolls. As Hugh B. Cott and William H. Longley pointed out, such "coincident disruptive" markings can hardly be the result of chance, or have any other basis than natural selection.

Usually the sexes in fishes are coloured alike, or the male in the spawning season is merely more intensely or more deeply pigmented, but in many species having a complicated breeding behaviour the male is much more colourful than the female The puppy (*Lebistes reticulatus*) of aquarium fame is a familiar example The "darters"—dwarfed perches that inhabit the riffles of streams in the eastern U.S.—exhibit nuptial male colours that are among the brightest in the whole animal series. Among marine fishes the dragonets show a similar sexual dichromatism. Darwin's theory of sexual selection (see SELECTION: Sexual Selection), although discredited of late. does seem to explain in part the development of such sexual differences in colour. Sex recognition and intimidation of rivals, however, are probably more significant.

Some pigmentation appears to have a simpler significance. in that it serves a physiological function primarily. Thus the melanin that is usually concentrated over the brain presumably shields this vital organ from harmful effects of light rays. The black pigment in the peritoneal lining of the body cavity may similarly protect the viscera. The particularly black peritoneum of herbivorous fishes may furnish necessary protection for enzymes that aid in digestion of plant tissues. Melanin and guanine are excretory products of metabolism. Their discharge through the skin may serve the animal in this physiological way. But the pigments also provide protective coloration. Evolution often "kills two birds with one stone."

Some critical biologists thought that the skin pigments of fishes merely represent excretions, or serve no function at all. On this basis Jacob Reighard attempted to explain the extraordinarily varied and brilliant colours of coral-reef fishes. He argued that the fishes are adequately protected by their proximity to safe retreats among the coral growths and are, therefore, immune to attack. The riot of colour (with hundreds of distinctive and constant patterns) then "just happened." This "immunity theory" of tropical fish coloration is not generally accepted, although other explanations are not wholly convincing. Alternative theories are (1) that the reefs are so brightly coloured as to render the fish inconspicuous; (2) that the bright markings are mostly of the ruptive category that destroy the fish's outline; (3) the colours may not appear as bright to some predators as they do to us; and (4) that the colours are recognition marks that keep the schools intact and bring mates together and, since the species about the reefs are so numerous, the distinctive markings must be greatly varied. There is probably some truth in each theory.

There is little el-idence that fishes with poisonous flesh or foul taste are conspicuously coloured for their own protection, as many insects are supposed to be. Even the dangerous sting rays and the poison-spined madtoms (small catfishes of eastern North America) are as concealingly coloured as their innocuous relatives. "Warning coloration," however, may be exhibited by some of the surgeon fishes (Hepatidae), which have a needle-like spine on the tail. The flashy orange of the garibaldi or ocean goldfish (*Hypsypops rubicundus*) of southern California appears to advertise the presence of this fish, which boldly fights to defend its home territory. Since revealing coloration seems seldom to have been evolved by fishes, it is not surprising that in this group (unlike the Insectai there are few examples of the mimicry of a poisonous or unsavoury species by an innocuous one living with it. One probable case is that of an eel that simulates a poisonous sea snake.

Vivid colours were developed in some fishes by selective breeding. From time before history the Chinese and Japanese produced goldfish breeds as bright and varied in colour as they are bizarre in form. In recent years aquarists bred a jet-black "mollie" (*Mollienisia latipinna*), a red "swordtail" (*Xiphophorus hellerii*) and many beautiful colour phases of the "platy" (*Platypoecilus maculatus*). See also ANIMAL COLORATION; PIGMENT, ANIMAL.

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FISH FLY, the name given, especially in North America, to small insects of the genus *Chauliodes* and allied genera, related to the alder flies (*q.v.*). Fish flies belong to the order Neuroptera (*q.v.*), suborder Megaloptera. The larvae are aquatic.

FISHGUARD AND GOODWICK, a market town, seaport and urban district on the northern coast of Pembrokeshire, Wales, near the mouth of the Gwaen. Combined pop. (1951) 4,839. Area 2.9 sq.mi. The town is perched high above a smaller harbour village also called Fishguard, or Abergwaen, on an inlet on the south side of Fishguard bay. On the west side of the bay are Goodwick and Harbour Village. From Fishguard harbour a service is maintained with the Irish ports of Rosslare, Waterford and Cork. When the harbour, which is protected by a breakwater more than ½ mi. long (see BREAKWATER), was built by the former Great Western railway, it was hoped to make it a port of call for ocean liners. In 1908 transatlantic liners did call to disembark mails and passengers, but this part of the scheme had to be abandoned because of the difficulties of approach in rough and misty weather. The neighbourhood is interesting for the landing by Gen. William Tate. an Irish-American adventurer, with French soldiers and convicts, at Careg Gwastad point in 1797. His force soon capitulated to the local militia (who were preceded, according to legend, by the women of the town whose tall hats and red cloaks caused them to be mistaken for soldiery). The surrender was signed at the Royal Oak inn at Fishguard.

FISH HAWK, a common name in America for the osprey (*q.v.*).

FISHING. Primitive man fished to obtain food. Yet even when his very existence depended on success in catching fish and. of course, in hunting animals. he must have found pleasure and excitement in both pursuits. The desire to hunt and fish has remained a powerful force in man's nature; the excitement of the chase and the fascination of water are still strong.

This article deals with fishing as a sport: for commercial fishing see FISHERIES. For the various craft used in fresh-water and salt-water sport fishing see BOATING. See also HUNTING AND FISHING. PRIMITIVE.

The main divisions of the article are as follows:

I. HISTORY

As fishing ceased to be a means of supporting life and became a sport, man gradually chose the more pleasurable means of catching fish. In the 20th century sport fishing, or angling, came to mean fishing with a rod, reel, line and hook. It is still a growing sport, above all in the more industrialized countries. and practised with pleasure by many nations and for many different sorts of fish. The basic methods of fishing are few in number and although anglers, fish and types of lake and river differ, the styles of fishing are all remarkably similar. These few basic methods, the equipment for them, the angling lore, and the ethics and customs they assume have all evolved by a slow process.

Fishing has been referred to in the literature and portrayed in the art of every civilization. Two thousand years B.C. an Egyptian angling scene mas depicted with figures shown fishing with rod and line. with a hand line and with a net. There are references to fishing in ancient Greek, Roman, Assyrian, Jewish and Chinese writings.

Paleolithic man drew on the walls of his cave pictures of the fish he caught as well as of the animals he hunted. The Chinese were by far the most advanced, for somewhere between 1500 and 900 B.C. it was written "fishermen used the silk of cocoons for their lines: a piece of sharpened iron for their hooks, thorn sticks for their rods and split grain for their bait."

The hook must be one of the earliest tools on which man depended for his existence: the argument as to which came first, spear, net or hook. has not been resolved. Man first used sharp bones, thorns and pieces of wood as rudimentary hooks or "gorges" (pieces of flint, stone or bone the fish could swallow with bait but could not eject afterward). When he attained skill in working with wood, stone, shells and, much more important, with metal, fishhooks were among his first products.

The history of fishing as a sport had its starting point in modern Europe in 1496 when Wynkyn de Worde printed at Westminster the Treatyse of Fysshynge *With* an Angle, part of the second edition of The Boke of *St.* Albans. This, the first angling manua! in any language, is generally thought to have been written by Dame Juliana Berners. This work lists 12 artificial flies and the method of making each. So little have the basic principles of fishing altered that six of these flies are still in use.

1. Basic Methods.——Angling gradually developed in technique. literature and equipment according to four basic methods — fishing with bait, trolling, bait casting and fly-fishing.

Bait Fishing. — Bait fishing is the oldest form of fishing. A bait, that is, something that a fish will eat. is impaled on or pressed round a hook. Common baits were and still are worms. larvae, insects (including flies), small fish or minnows, pieces of meat, shellfish and pastes made of flour. The hook is attached to a line. These two items composed the original equipment for bait fishing and are still used in the form of a hand line for sea fishing. Such tackle, however, is very limited in its use. for unless the bait is heavy. or unless some weight is used, it is difficult to cast far, it is impossible to fish over reeds and similar vegetation and it is troublesome to recover the bait or bring a fish to land unless the bank is very clear. The answer to these problems was a rod, a length of stick or cane to which the line was tied.

It is strange that in all the ancient illustrations a very short rod of only a few feet is shown, and man seems to have been very slow in seeing the advantages of a longer one. It is not known when or where a long rod, one as long as ten feet: was first used but there is strong evidence to suggest that the Romans saw the advantage of joining two or more pieces of cane together. This not only gave additional reach. but allowed the rod. when unjointed, to be carried about more easily. The reference is made by Martial (40–*c.* 104 A.D.), a poet who loved fishing and other country pursuits. Scholars have differed over the correct interpretation of the reference, but it seems reasonable to suppose that a nation as advanced as Rome, with different sorts of cane procurable in its colonies, hit upon the simple expedient of jointing two pieces together.

The bait fisherman, then, equipped with a rod, could reach out from the bank and over vegetation. He could thus let his bait lie on the bottom of river or lake if he wished, holding it there against the current if necessary by adding a weight or weights to his line; alternatively he could let his bait drift down with the current. By using a float or bobber, that is, a buoyant article like a piece of cork, he could suspend the bait at a desired depth. The float also acted as an indicator, its sudden movement or submersion warning him that a fish was nibbling his bait or taking it into its mouth.

Trolling.—By this method the bait is trailed behind a slowly moving boat. The bait is either a small fish or some lure which, when drawn through the water, spins, wobbles or vibrates. It is a very old method of catching fish, particularly large fish, and has been used, for example in the South seas, since earliest times. In the 19th century the term "trolling" was used in Great Britain to describe early forms of bait casting and the term "trailing" was used to describe trolling.

In South Africa still, what in the United States is called casting or bait casting and in Great Britain spinning is often referred to as trolling. This is, however, an exception and the term has come to be generally used to describe the trailing of a lure behind a boat.

Bait Casting and Spinning.—This is the casting of a lure or minnow, or a dead fish, which when drawn in by recovering line or when influenced by current imitates a small or wounded fish, frog or other bait. Of much later development than the other three methods, bait casting is linked in its growth with the invention and improvement of the fishing reel. In Great Britain all bait casting is called spinning; in North America the term "spinning" refers only to the casting of a lure using the fixed-spool or spinning reel, and spin casting designates the use of the enclosed fixed-spool reel.

Fly-Fishing.—Generally thought to be a modern development, fly-fishing is in fact a very old form. In the 3rd century A.D., the Roman poet Aelian described the way the Macedonians caught trout with an artificial fly and gave the "dressing," that is, the materials and method of making the fly they used. Dame Juliana also gave this dressing as did Izaak Walton in 1653, and this same fly is still used with only minor alterations.

In fly-fishing the angler seeks to imitate with silk, feathers, hair, wool and other materials the flies and insects that live in or near water and on which many fish feed. Artificial flies can also be lures which imitate small fish or other bait, or confections, which, for reasons only to be guessed at, arouse curiosity and rapacity in fish.

2. Development of Equipment.— The four basic methods of fishing outlined above have remained fundamentally unchanged, but gradual improvements in fishing tackle have allowed man to cast farther, to cast more accurately, to present his bait, fly or lure in a more natural and lifelike fashion and to handle hooked fish with greater certainty. The history of fishing as a sport is therefore largely the history of its equipment.

At the end of the 15th century, man fished, as he hunted, for pleasure and to obtain food. His tackle had progressed little in 3,000 years. His rod was a massive pole, about 15 ft. in length, made from local woods and hooped at both ends with iron. His line, probably of plaited horsehair, was tied to the end of his rod and his hook, bound to a strong single strand of horsehair, was attached to the end of the line. His effective casting range was the length of his rod plus the length of the line, so the greatest caution had to be exercised in approaching the water and every advantage of cover taken.

Even more difficult was the handling of a big fish after it had been hooked. The angler, having no running line, had to tire the fish within the limits of his rod and his short line. If a fish insisted in swimming away beyond these limits the fisherman had either to hold him with the risk of breaking his tackle or to throw his rod into the water, let the fish tow it round until it tired, and then recover his rod and renew the struggle.

This primitive and limited equipment was to endure for another 150 years, through a century and a half of constant and rapid progress in almost every other field. During this period of restless invention, no one offered the simplest idea to extend the range of the fisherman; it was not until 1651 that Thomas Barker, in his Art of Angling, mentioned a ring of wire on the top of a rod and a simple form of winch which held, retrieved and released line to run through this ring. Four years later, in the second edition of The Compleat Angler, Izaak Walton mentioned the use of a reel to hold the line. He wrote, "Note also, that many use to fish for a salmon with a ring of wyre on the top of the rod, through which the line may run to as great a length as is needful when he is hooked. And to this end, some use a wheele about the middle of their rod, or nearer their hand, which are to be observed either by seeing them or a larger demonstration of words." Walton was obviously writing about a piece of equipment of which he had little knowledge and no practical experience. That so passionate an angler should not have used so fundamental an improvement shows that the use of reel and end ring was still exceptional.

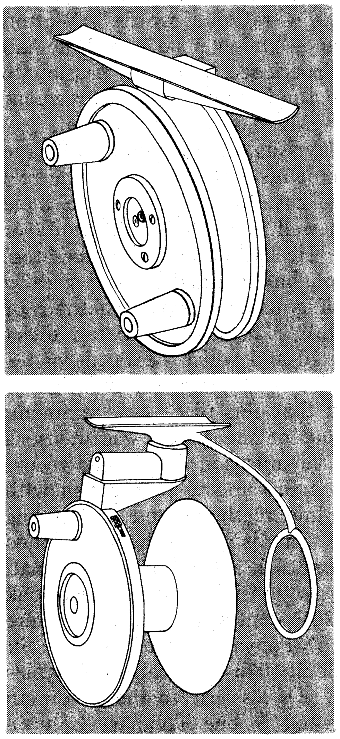
The angler, then, in Walton's day was just beginning to have an opportunity to extend the scope of his activities. A crude reel and running line permitted him to cast his bait or lure a little farther and to allow a fish to run well beyond the old limits of a line fixed to the end of the rod. He had other advantages too, for by 1655 Charles Kirby, a London hookmaker, had greatly improved the quality of the fishhook by using improved methods of tempering and hardening the metal. The hook, with an offset bend of the point, which he invented and which bears his name, is still in use all over the world. In 1613 there was mention of a landing net. although it is likely that this piece of equipment, which is used to lift a large fish out of the water, was in use a century or so before. In 1657 Barker mentioned the need to use a line 26 yd in length (five times more line to play a fish with than was given by the old tight-line method) and a "landing hook," which is now called a gaff. This is a large hook attached to a shaft which is used to lift large fish ashore or into a boat. While the use of horsehair as a scarcely visible link between hook and line was to continue into the 20th century, experiments were made with other materials. In 1667 Pepys wrote of using a gut string with a minnow as a bait, while in 1676 Col. Robert Venables mentioned the use of a lute string. Of less use to the fisherman of those times was a patent made out to one Thomas Grant in 1632 for a "fish call or looking glass to lure fishes to net, spears, or hooks." one of the first 60 patents ever granted in Britain.

Despite much progress in the development of fishing tackle, however, the improvement of having wire rings, or guides, throughout the length of the rod and not only at the end is not mentioned until 1726. The nature of the reference in the Gentleman Angler makes it clear that such rings and the use of a "winch or wheel" were far from common.

About this time a transfer of the manufacture of fishhooks from London to the small Worcestershire town of Redditch was to have a far-reaching effect on the angler's equipment and thus indirectly on his methods and his sport. Until this period the fishhook trade had been centralized in London and to a much lesser degree in Yorkshire and Ireland. About 1730 the needle industry was establishing itself in Redditch and was quick to see, and seize, a kindred product. In the space of about 70 years the whole of the world trade in fishhooks had become centralized in this town. Not only was the making of hooks greatly improved, but the Redditch manufacturers progressed from these articles to other items of tackle, and gradually from what had been a cottage industry grew the first organized factories concentrating on all types of angling equipment.

Although it seems that relatively few fishermen took advantage of the increased scope given by a fishing reel, progress continued to be made. In 1770 a London tackle dealer was advertising "brass multiplying reels"—reels which were geared to give increased winding speed. Such reels never became popular in Great Britain, and although it seems certain they were first made in that country, they were developed in the United States, where George Snider of Kentucky pioneered this type of reel in 1810. Indeed from the beginning of the 19th century progress in equipment. and especially in fly-fishing equipment, ran on very parallel lines in both Great Britain and the United States. In North America, however, most of the fish are predaceous and the Americans therefore concentrated on bait-casting tackle; in Great Britain, where few fish are wholly predaceous, the emphasis was on bait fishing.

Another great step forward was taken between 1840 and 1850 with the development in the area of the river Trent of what became known as the "Nottingham" reel (fig. 1). This reel, made first in wood and later in metal, spun very freely on a spindle or "centre pin." It had an enormous effect on many sorts of bait fishing, for it allowed float and bait to proceed unchecked with the current and greatly increased the area that a river bait fisherman could cover efficiently. It also permitted a heavy lure or heavy tackle to be cast a long way and was therefore to lead to great progress in casting and in sea fishing, besides having considerable effect on the design of reels for fly-fishing.



T B THOMAS

FIG 1 — (TOP) NOTTINGHAM CENTRE-PIN REEL. 1840–50; (BOTTOM) MALLOCH TURNTABLE REEL, 1884

Rods, too, were being improved, although the process was a slow one. Early in the 19th century the tips of rods were being made from several strips of cane glued together, and by 1847 tips made of six strips were known in Britain. There is divergency of opinion as to who made the first complete rod in the hexagonal form but it seems likely it was made in the United States between 1865 and 1870. About this same period, too, there were improvements in turning rods, particularly those in greenheart, a South American wood, and rods gradually started to become lighter and shorter.

Progress on lines was likewise slow and although silk, cotton and flax lines began to be used from about 1850. horsehair. sometimes mixed with silk, remained popular until almost the beginning of the 20th century. The period from 1870 until the beginning of the next century was the second great era of development in fishing methods and equipment.

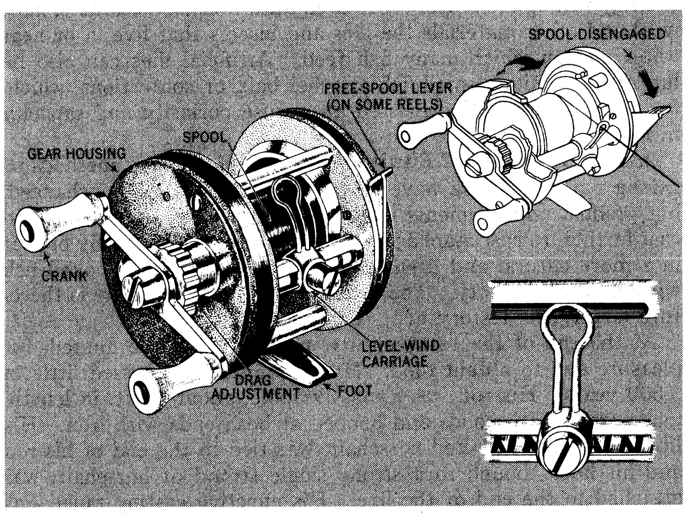
Rods became still shorter and lighter, and anglers began to give up the heavy rods made from native woods like ash, and even the lighter woods like greenheart, in favour of the much lighter and more efficient rods built from strips of cane in hexagonal form and known as split, or built, cane. The wire rings through which the line ran, the fittings to hold reels in position and the ferrules used for joining the parts of the rod together were all lightened and improved. Silk lines came into general use and fly lines began to be "dressed"; that is, covered with coats of linseed oil which was then allowed to oxidize. These dressed lines were far heavier than the old horsehair lines, could be cast much farther, and most important, could be cast against a wind. The use of these lines altered the whole concept of fly-fishing and resulted in the use of the floating fly. Silkworm gut, first mentioned in 1722, at last began to supersede horsehair as the link between line and hook.

It was in the field of fishing reels, however, that the greatest progress was made, both in improved materials and improved design. The distance a lure could be cast was greatly increased, first by a method of coiling loose line in a basket and casting out these coils, and then, as the Nottingham reel was improved and became more and more free running, by actually casting from the reel.

In the United States, progress was made in the same may and in similar fields. The fly rod became even lighter and shorter than those in Great Britain and fly lines likewise were greatly improved. The multiplying reel (fig. 2) became a precision tool and, having much less spool inertia than the British Nottingham reel, became a much better casting instrument. This lack of inertia, coupled with the fact that bait casting was often practised from a boat, led to the short bait-casting rod of between four and six feet.

In 1896, William Shakepeare of Kalamazoo, Mich.. invented the level-wind. a mechanism which traversed back and forth across the spool as the reel revolved and laid the line level upon it. About the same time wooden lures, called plugs, were also developed.

The difficulty of casting direct from a Nottingham reel and the skill required to control such a reel when casting led to the invention that was to have the greatest effect on angling. A long rod and a casting weight of at least one-quarter of an ounce were required to set the reel in motion and unless it was skilfully controlled throughout the cast the speed of the reel overtook the speed of the line and a tangle resulted. Between 1878 and 1884 reels were developed which operated on a turntable system. To cast, the reel was turned so that the axis of the reel lay along the rod instead of across it. This allowed the line to slip in coils over the edge of the spool instead of running out with its rotation, thus eliminating spool inertia. The line was recovered by turning the axis back to the normal position and winding in. These reels made casting easier, but they had certain disadvantages, in particular in the way they twisted lines. In 1905, however, Holden Illingworth, a Bradford, Eng., textile manufacturer, patented the first fixed-spool, or spinning, reel, on which the spool remained stationary with its axis along the length of the rod and on which the line was recovered by a bail, or flyer. Two years later he greatly improved this reel. The main purpose of the Illingworth reels was to cast very light baits, and the seven-foot rod he designed for use with them remained basically unaltered. This type of reel was gradually improved as the years went by and began also to be used on the continent of Europe. In Great Britain, however, the lack of game fish and limitations set on spinning for trout restricted development except in the field of float fishing.

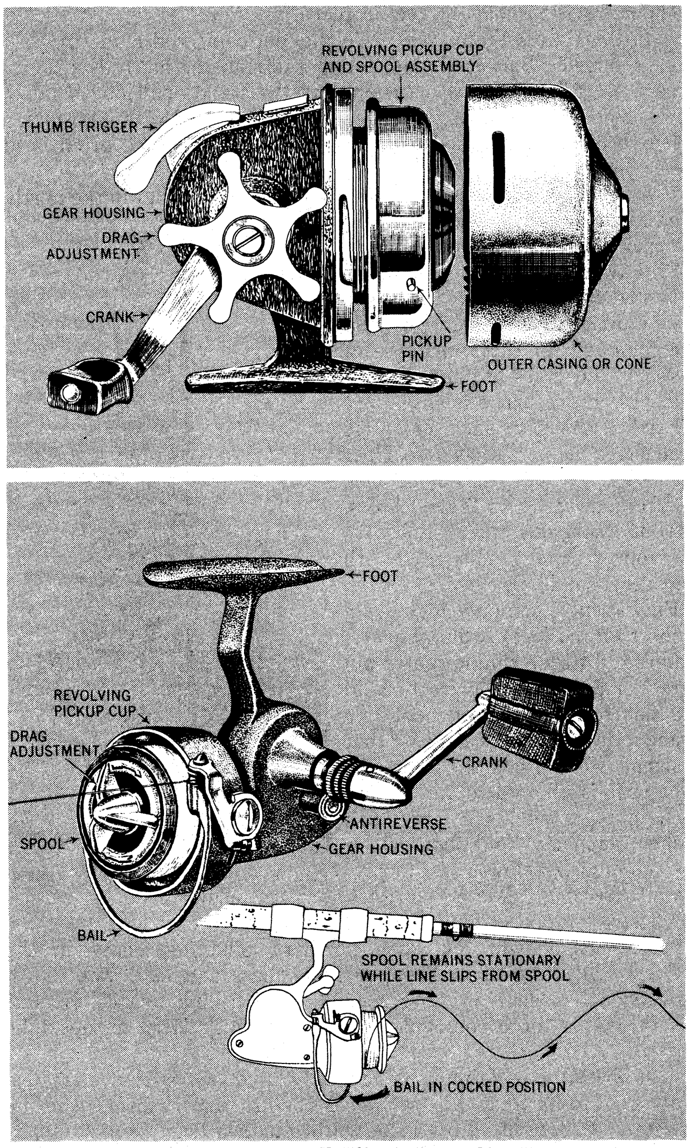


BY COURTESY OF JAMES HEDDON'S SONS

FIG. 2. — MULTIPLYING OR BAIT-CASTING REEL SHOWING: (TOP RIGHT) TOTAL FREE SPOOL; (BOTTOM RIGHT) LEVEL-WIND CARRIAGE

3. Developments After World War II.—Great improvements in fishing tackle were made after World War II. Fixed-spool reels (fig. 3) enjoyed wide popularity in Great Britain and on the European continent, where their manufacture was taken over and improved by specialist firms such as, for instance, French clockmakers. After the war they were also introduced with enormous success into the United States and other countries.

In the United States rods made of glass fibre are favoured over those of all other materials. In Great Britain and Europe, however, the split-cane rod still holds pride of place and the glass-fibre rod has not found great popularity. The fixed-spool reel has been



(TOP) BY COURTESY OF THE GARCIA CORPORATION; (BOTTOM) FROM "THE WISE FISHERMEN'S ENCYCLOPEDIA," ED. BY A. J MCCLANE. BY PERMISSION OF WM. H. WISE & CO., INC., PUBLISHERS

FIG. 3.— FIXED-SPOOL REELS: (TOP) CLOSED-FACE: (BOTTOM) OPEN-FACE

further improved and the use of nylon monofilament lines with it has greatly increased its efficiency. In the United States a different type of fixed-spool reel, one with an enclosed spool, the closed-face or spin-casting reel. has been perfected and has won wide popularity (fig. 3). Paired with the flexible and highly active glass-fibre rod and using 6 to 10 Ib. test lines and $\frac{1}{8}$ to 1 oz. lures; the spin-casting outfit is preferred in some areas. Lines are made from various man-made fibres and fly lines have been greatly improved by plastic dressings. The wide use of plastics has lightened and improved many other articles of fishing equipment.

Equipment in the second half of the 20th century was further improved: tackle was made lighter and simpler to use; the effective casting and fishing range became almost unlimited. Yet with all these advantages, the angler still has to locate the fish and ofier them the right sort of bait or lure in such a way that it appears natural and does not alarm them. He must still be able to read the weather and understand water. Angling, like other field sports, remains basically a matter of applied natural history.

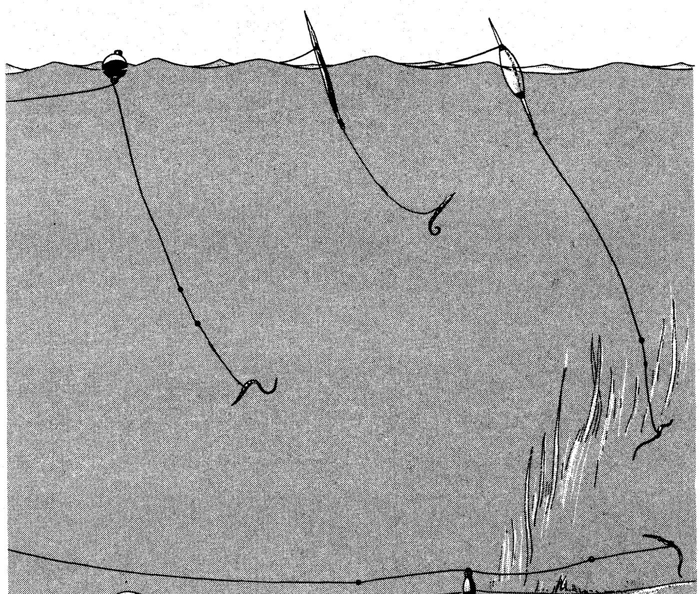
4. Angling Literature.—–Most of the best writing on fishing has been in English, for up until World War II nearly all the advances in all forms of fishing as a sport were made either in Great Britain or in North America. Izaak Walton set the standard with *The Compleat Angler*, the greatest of fishing books. and the works of Thomas Barker, Col. Robert Venables, W. C. Stewart, F. M. Halford, George La Branche, E. M. Hewitt, G. E. M. Skues, Robert Hartman and, more recently, A. J. McClane, Ted Trueblood. B. Venables and R. Walker, to mention very few, will long be read with both profit and enjoyment by fishermen everywhere. In France too, the writings of L. De Boisset and of Charles Ritz are more than uorthy of what Walton called "the contemplative man's recreation."

II. FRESH-WATER FISHING

1. Bait or Still Fishing. — This term has been used in the most general sense to describe one of the four basic methods of fishing. There are, however, a large number of ways of still fishing with bait. All involve the use of hook and line and, for most sport fishing, a rod or pole Fishing from the banks of a stream, a pond or a lake. from a pier or breakwater, or from an anchored or drifting boat are the most common methods. A large number of different baits are used, according to the species of fish sought and the type of nater being fished. A float or bobber or some other signaling device. as a trip (see Ice Fishing, below), may be used but frequently is dispensed with in deep lakes or choppy nater The discussion of float fishing below indicates the basic techniques and tackle involved. (In the United States, especially in the Ozarks and the middle west, the term "float fishing" also refers specifically to a float trip in which the fishermen drift in a boat down a selected stretch of river, fishing as they go.) Float fishing and ledgering (using a sliding sinker to fish a bait on the bottom) are both known as coarse or bottom fishing in Great Britain *(see* under *Great Brztain* and Ireland, below).

Float *Fishing* —*A* float, or bobber, is a small buoyant object used to suspend the bait at a given depth, and to act as an indicator that a fish is taking or has taken the bait. It is also used as a means of conveying the bait to where the fish are known or suspected to be Float fishing has been brought to a high degree of efficiency in England, where it is mostly employed to catch the species classed together as "coarse fish." The methods used in England will therefore be described. and other types of float fishing used elsenhere will be discussed as variations of these methods.

Tackle — Float tackle consists of the line, the float and the equipment below it in the water (fig. 4). At the very bottom is the hook. which usually is attached to a length of nylon monofilament called a leader. The distance between float and hook depends on the type and depth of water being fished and the species of fish sought. A number of small lead weights, or sinkers, may be used. These are usually small lead shot, partially split so they



(TOP LEFT AND BOTTOM) T B THOMAS

FIG. 4 —FLOAT TACKLE (TOP. LEFT TO RIGHT) BOBBER. PORCUPINE QUILL. ANTENNA; (BOTTOM) LEDGER

can be clamped on the line between float and hook. Their purpose is to give added casting weight; they "cock" the float, that is, cause it to ride upright in the water so that any indication of the bait being taken (a "bite") is seen. Sinkers also are used to suspend the bait at the right depth or, if there is any current, at the right depth and in the right position in the current, or to keep it on the bottom of the river or lake.

The question of depth is important for the float fisherman, for much of his art consists of presenting the right bait in a lifelike manner at the depth at mhich his quarry is feeding. Fish, according both to species and to prevailing conditions such as the water temperature, the strength of the current or the time of year, may be feeding just under the surface or at various depths right down to the bottom. The angler must first decide at what level he is going to fish. This he generally does by attaching a lead weight to his hook and taking soundings to determine the depth of the water. Then he adjusts his float, usually by means of metallic. rubber or plastic rings which hold it to the line, so that his bait "fishes" at the depth at which he reckons the fish to be.

The angler's line is attached to a leader and is usually between 25–100 yd. long. of nylon monofilament, braided nylon, Platyl or Terylene. This line is held on a reel which will either be of the Nottingham type or more likely a fixed-spool reel.

The float-fishing rod used in England is a long one, usually 10–15 ft. Such length is essential, for the waters fished often require 10–15 ft. of terminal tackle and without this length of rod it would be difficult to cast such tackle or land a fish. Because such rods are held for long periods, they must also be as light as possible. They are usually made in three pieces and at least two-thirds of such rods are made of light, "whole" bamboo cane. The best canes for this purpose are tonkin, from China, and Spanish reed from Spain and the south of France. Rods of this type have a number of wire rings (guides) along their length through which the line runs. uith a big ring at the butt and a smaller one at the tip usually made of agate or some similar hard substance. The handles are made of cork and they have a simple system of two

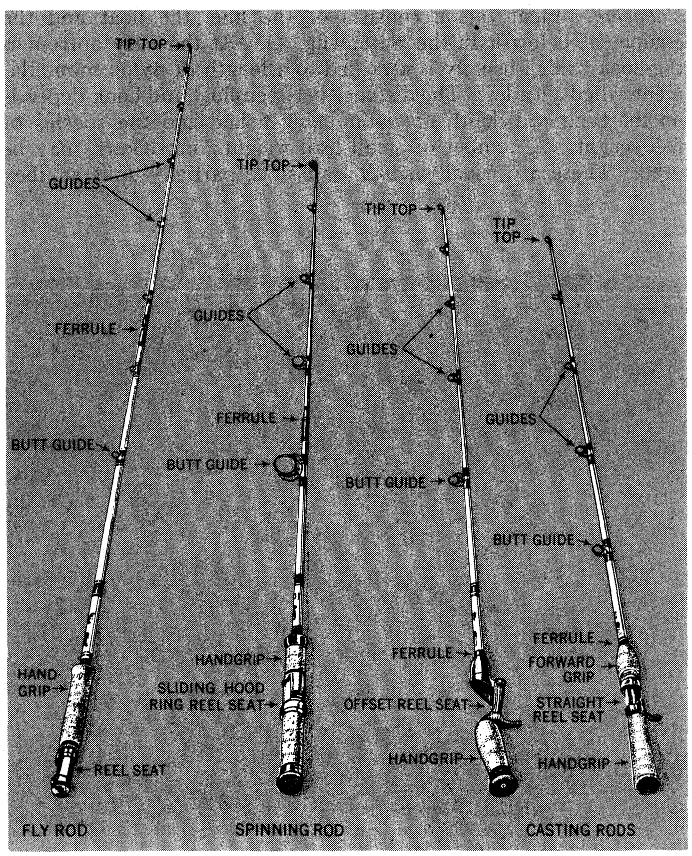


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FIG. 5.— BASICTYPES OF RODS USED WITH DIFFERENT REELS

sliding rings to hold the reel in place.

In the United States a lightueight telescopic rod made of glass is preferred Bait-casting, spinning and spin-casting rods also are used for still fishing on occasion, and the traditional long bamboo "cane pole" prevails in many locations It is used without a reel, a length of line being tied to the tip of the pole, which often is of one piece

Ice *Fishing* —This winter sport is especially popular in the northeastern United States and the upper Mississippi-Great Lakes-St Lawrence valley region of the United States and Canada The ice must be thick enough—usually a minimum of three inches—for safety and holes are cut through it with an ice bar, a heavy, long-handled chisel, or spud, or an ice auger; a dipper is used to clear the chips from the hole One fisherman can tend several holes. Minnous. grubs and nymphs are favoured baits, usually used with a very small jig or ice spoon. Equipment commonly includes a short (three feet), uhippy, glass-fibre rod with a simple centre-pin reel or a cleatlike device to hold a nonfreezing monofilament line and a tipup or tilt (see fig 6) that signals when a fish has taken the bait; it is allowed to run before the hook is set For larger fish the tipup may hold the reel in some models below water to prevent freezing Many pan fish (mostly crappies bluegills and perch) are caught, but also northern pike especially in the Great Lakes region, walleye. pickerel; bass and lake trout, with occasional catches of other species. Ice fishing usually is done with one or more companions and frequently large groups take part.

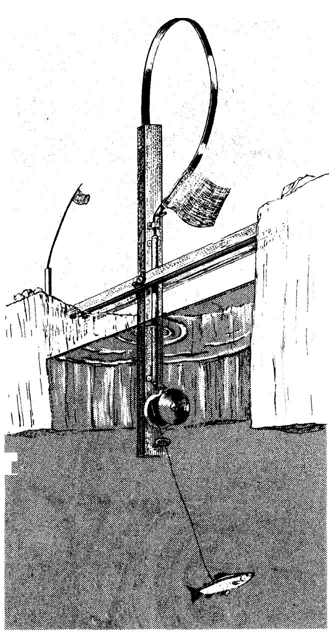

FIG 6 — ONE TYPE OF TIPUP ASSEMBLY ICE FISHING

2. Trolling.—Trolling is generally used on waters where fish are hard to locate and in particular for fish that swim deep in the water. It is used all over the world but has been brought to its highest peak of efficiency in North America. There is considerable skill involved in trolling the right bait at the right speed and depth in the right places. Local knowledge is of particular importance in this type of angling.

Lures for trolling are numerous. Any of the lures described below (see *Bait Casting* or *Spinning),* or a live or dead fish or other bait mounted so that it spins or wobbles. may be used. These are trailed slowly behind a rowboat or one driven by a motor. The amount of line out controls the depth at which the lure is worked. In deep waters and for deep-swimming fish, metal lines are sometimes used.

The rod used is usually short, between five and seven feet, although longer rods are used in Great Britain and Europe. The rod is held or placed roughly at right angles to the direction in which the boat is moving so that the recovery (resiliance) of the rod tip helps to hook the fish.

A slightly different type of trolling is used in Britain and Norway for Atlantic salmon. This is known as harling and it is practised in rivers. The lure is fished from the stern of the boat in the usual manner, but instead of towing the bait, the boat is held by the oarsman in the current and the flow of the stream causes the bait to behave like a small fish. In this way the lure can be held over the parts of the river where fish are thought to be resting.

3. Bait Casting or Spinning.—Bait casting is the North American term for casting out a bait, plug or lure and recovering it with a multiplying reel. Spinning and spin casting refer to the use of fixed-spool spinning and spin-casting reels. In Great Britain, on the other hand, spinning refers to all of these methods.

Casting tackle consists of a rod, from 5 ft. up to about 10½ ft. in length. a reel containing about 100 yd. of line. a leader, or trace. and the lure. The line is usually of either nylon monofilament, braided nylon. Dacron or Terylene. The leader, or trace, which is the scarcely visible link between line and lure is usually of nylon monofilament or, if used for fish with sharp teeth, wire. It may be fitted with one or more swivels to prevent the line from becoming twisted. Leaders may be from nine inches to four feet Iong.

There are very many different sorts of lures. A small fish, mounted to spin or wobble through the water, is now little used.

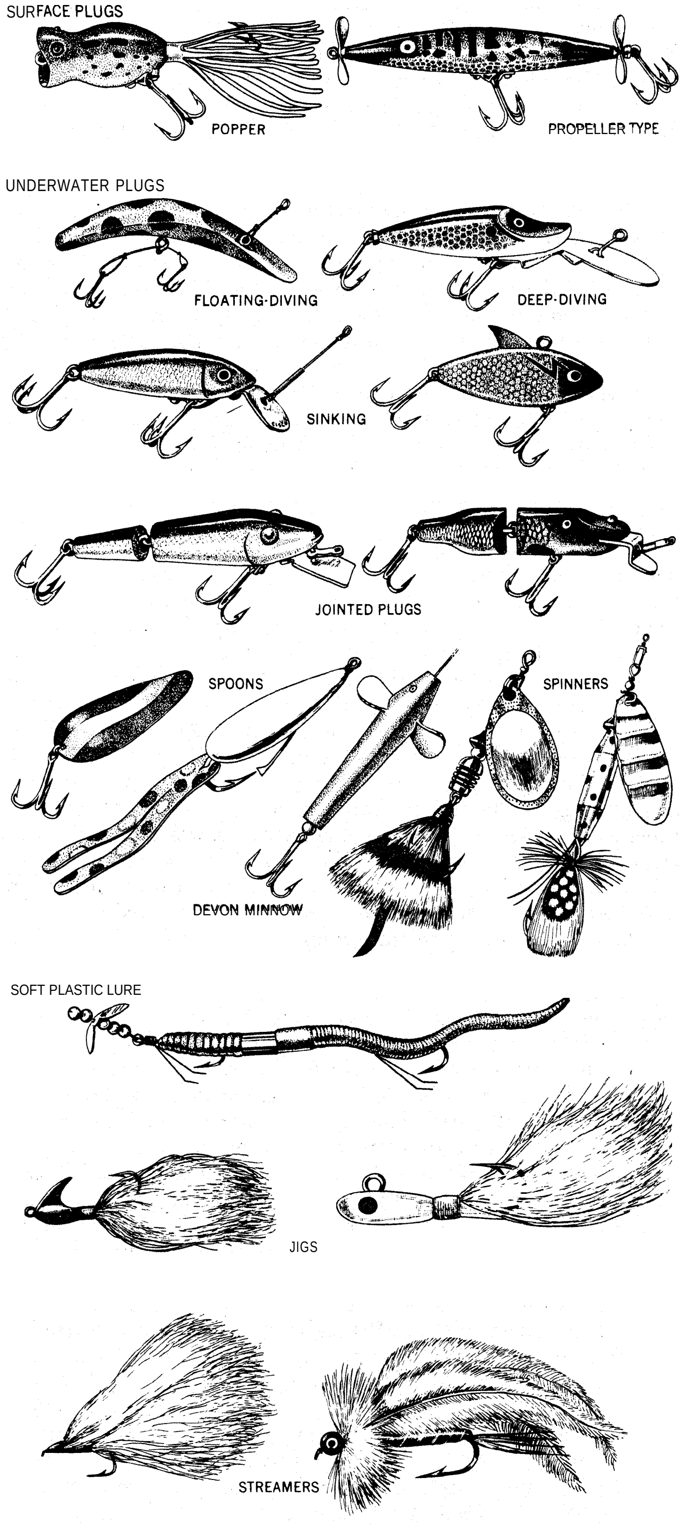

FIG. 7.— REPRESENTATIVE SELECTION OF FISHING LURES

In Xorth America plugs, lures first made of wood but now mostly of pliable plastic in a vast variety of shapes. colours, sizes and weights and behaving in a most lifelike way when drawn through the water, are used (fig. 7).

In Great Britain the most popular lure for many years has been the Devon minnow, a cylinder of wood, metal or plastic fitted with two fins which cause it to spin. Spoons, that is spoon-shaped metal lures which spin, wobble or vibrate, are used all over the world.

Although the methods of fishing are similar, the methods of casting with the three different types of reel—the centre-pin, the multiplying and the fixed-spool—are very different.

The centre-pin reel is now little used. It is difficult to cast with becduse of the considerable inertia which must be overcome before the drum of the reel will start to spin. Once the drum does start to spin, however, it spins too fast for the bait, which decreases its speed as it travels through the air, and unless it is controlled the speed of the line being drawn off the reel becomes much slower than the speed at which the drum is revolving and a tangle of the line results.

The centre-pin reel is used with a rod 8½–10½ ft. long. The rod must be limber so that the build-up of casting power which causes the reel to start to revolve is gradual. The lure is swung back behind the angler and then forward and upward. The reel is prevented from spinning during the swing but this pressure is released early in the forward cast. As the lure flies out over the water the speed of the drum is controlled either by finger pressure or by some form of governor so that it does not exceed the speed at which the line is being drawn off. While these reels are difficult to cast with. and their rate of recovery, being ungeared, is slow, they are excellent reels with which to play fish.

The multiplying reel is less difficult to use, as its drum is much lighter than that of a centre-pin reel. A shorter rod and a shorter swing can be used. These reels are mounted on top of the rod, and the drum is controlled by pressure from the thumb so that its speed does not exceed that of the line. Sumerous forms of governors are in use to control the drum speed automatically.

In North America and in parts of Scandinavia multiplying reels are mostly used with a short. single-handed rod of between 4½ and 6 ft. The lure is propelled with a short, snappy, overhead cast which gives great accuracy. In Great Britain these short rods are little used and, as the multiplying reel is there used for large fish like pike and salmon, a longer double-handed rod of eight to ten feet is generally employed; longer rods, usually about nine feet, are used likewise on the uestern coast of North America for steelhead (trout) and Pacific salmon. The gear ratio of multiplying reels normally is four to one; the rate of line recovery is therefore very fast.

The methods of fishing are the same the world over and irrespective of the species of fish sought. On rivers the cast is usually made across or slightly donnstream. If the current is strong enough to impart fishlike motion to the lure by causing it to spin or wobble. the angler does not wind in. In slower water he assists the current by winding slowly. The depth at which his lure is "fishing" is again very important, and leads may be used to sink the lure down in the current.

Another effective way is to cast the lure upstream and to recover it donnstream by winding very fast. In Great Britain this is a particularly effective way of catching salmon in the summer.

Probably the most interesting iorm of casting is that practised in North America particularly for black bass These fine sporting fish like to lie in weedy water in the vicinity of snags like old logs. The angler, approaching carefully in a boat, casts a floating lure from either a bait-casting or a spinning reel. Considerable accuracy is essential, for the lure must be dropped precisely in the right place Having cast the lure to where he thinks a bass lies, the angler moves it gently so that it causes a slight commotion bn the surface, as would a frog or a swimming mouse. The accuracy needed the savage way in which a bass takes the lure and the excitement of being able to watch the lure working makes this as exciting a method of casting as the dry-fly is of fly-fishing.

When a fish is hooked. it is played by allowing it to pull against the spring of the rod and is allowed to swim away from the angler by being given line from the reel. With the revolving drum reels. that is, the multiplier and the centre-pin, line is given by allowing the reel drum to rotate backward, but with the fixed-spool reel this obviously cannot happen. These reels are therefore fitted with a slipping clutch, the tension of which is controllable. This tension is set so that when a fish exerts a certain amount of pull the spool is allowed to rotate and line given in this way. The rotation is also controllable by finger pressure.

With the centre-pin or "single action" reel, line can be recovered against the pull of the fish by winding, for the wind on these reels is direct and not through gears. With the other two types, however, the angler cannot exert enough pulling power through the gears and has therefore to use his rod as well, in a method known as pumping The point of the rod is dropped and as it is lowered the angler winds in line. He then clamps his thumb on the multiplier or his finger on the fixed spool so that neither will rotate and raises his rod, thus recovering line, repeating the process until the fish is brought close to him.

The spinning. or fixed-spool, reel is initially much easier to use tha'n the other two. although maximum efficiency requires considerable skill. practice and dexterity. 4 s the line slips off the end of the spool, there is no inertia to overcome and as the drum does not revolve there is no problem of control to prevent line tangles

There are two types of rod ,used with these reels—a single: handed one of from 4 to 8 ft and a double-handed one of $8\frac{1}{2}$–$9\frac{1}{2}$ ft. With both types the method of casting is similar. More importantly, there are two types of reel, the bail and the closed-face (spin-casting). With the bail type the right forefinger gathers and holds the line. The pickup mechanism or bail, that is, the mechanism which recovers the line on winding in, is lifted so that it no longer retains the line. The cast is then made, the forefinger releasing the line very late on the forward swing. To reel in the line, the pickup mechanism springs forward and as the handle is turned collects the line and distributes it onto the spool.

In the latter half of the 1950s spin-casting reels which uere a combination of fixed-spool and multiplying reels were perfected in the United States: the line peels off the drum in the same way as nith a stationary drum reel but the drum is enclosed in a bell-shaped cover. They are used on top of the rod like a multiplier and controlled in the same way by the thumb. These spin-casting reels are extensively used in North America and in Scandinavia.

The lack of inertia of these reels enables them to cast much lighter lures than the other two types. They are, however. intended for use with fine lines, and with lines of more than ten pounds breaking strain they progressively lose efficiency. This is because with thicker lines the gap between the top of the line on the spool and the lip of the spool widens rapidly, with consequent increase in friction.

Rods used with spinning reels require a large butt ring (the first ring up the rod). The line peels off these reels with a considerable cone and the large ring cuts down friction and prevents the cone from flapping against the rod. This is not the case with spin-casting reels so spin-casting rods do not have a large butt ring.

4. Fly-Fishing.— In this sport the angler uses a natural fly or. very much more commonly, an artificial fly made from silk, furs, feathers and other materials, so that it imitates one of a large number of flies which live in or near water. Flies are also made which imitate small fish, worms or other bait, while the flies used to catch salmon imitate nothing in nature. Sometimes flies that imitate frogs or mice are "tied" or "dressed" for black bass fishing. The original purpose of the artificial fly was to imitate some insect, however, and most 20th-century fly-fishing is with insect-imitating flies rather than with lures.

While fish feed on an enormous number of different flies, both aquatic and terrestrial, the basis of fly-fishing is the imitation of two insect groups found all over the world. Ephemeroptera and Trichoptera (caddis flies). in their various stages of development.

The first-named are known to fishermen as May flies, ephemerids or upwinged flies. Broadly speaking. their life cycle is in three stages—as nymph. subimago or dun, and imago or spinner—and each stage is imitated by fly-fishermen (*see* MAY FLY). Not dissimilar to the life of the May flies is that of the very many species which make up the insect group Trichoptera—the flies the angler knon s as caddis flies or sedges (*see* CADDIS FLY). Imitation of the different stages in the lives of these two groups of flies has developed the different methods of fly-fishing

Excluding salmon fishing, a totally different problem which will be dealt with separately, the various methods of catching trout with a fly can be applied, with perhaps slight Iocal differences. to the catching of other fish For this reason fly-fishing in general will be described on the basis of fly-fishing for trout.

The use of the natural fly is a style of angling little used but one no doubt of great antiquity. This method of fishing is known as dapping. One style of dapping is used with a very short line, using some insect such as a bluebottle, crane fly or grasshopper as bait. It is practised on bushed streams and the angler, concealing himself behind or in a tree lowers the impaled insect to struggle on the water and thus attract trout. Another form of dapping developed on the Irish and Scottish lochs. The bait is generally either the May fly, the largest of the upwinged flies, or the crane fly or. daddy longlegs. The rod is long, 14–15 ft. in length. and the line very light, with floss silk (embroidery floss) attached near its end. One or two flies are impaled on the hook and fly, and floss silk and line are allowed to blow out over the water with the wind, which is essential to this form of fishing. The fly is lowered onto the water well away from the boat and thus behaves in a very natural manner. Another form of fishing with a natural fly is practised in the maritime provinces of Canada in the spring. One or two of the ephemerids which hatch there in May are hooked onto a small hook called a midge hook and cast out onto the water. Such types of fishing obviously have many limitations, not least the difficulty of keeping the fly on the hook, and no doubt this prompted anglers to make imitation flies.

There are two main methods of fishing with the artificial fly—wet-fly fishing and dry-fly fishing. In the former the fly is used under the water, where it imitates a nymph, a drowned dun, some other water insect or a small fish. In the latter the fly floats on top of the water and represents a dun, spinner (spent spinner) or caddis fly (sedge), or some terrestrial insect blown onto the nater.

Wet-fly fishing is by far the older of the two methods, for fishing with a floating fly was only developed toward the end of the 19th century. Originally men fished with a 12- to 14-ft. limber rod, a tapered line of horsehair, a leader or cast of horsehair and the fly Fishing consisted almost entirely of casting across a stream and allowing the fly or flies (for with the wet fly several flies are often used) to swing round in the current. It was not until Stewart wrote The *Practical Angler* in *1857* that the advantages of fishing upstream were demonstrated. Trout and other fish swim nith their heads facing upstream and Stewart showed that they could be approached much more simply and effectively from below and that the fly cast in this manner behaved in a more lifelike way. The method was easier to describe than to perform. The sport was dependent to a great extent on the wind, for it was impossible to cast against it, and, because long casting was not possible with so limited an outfit, a wind-ruffled surface allowed the angler to approach within range of the trout. It was not until the 1880s that rods and, above all, lines were improved enough to enable the angler to cast in any direction under most conditions of wind.

The development of the split-cane rod and the heavy, oil-dressed line brought about great changes in fly-fishing. The wet-fly fisherman was enabled to cast a much longer line, upstream or downstream. In Great Britain the concentration was first on the floating fly and then on improved ways of representing insect life just below the water's surface. In the United States progress was initially a little behind Great Britain in these two types of fishing, but similar styles were soon developed to suit the local conditions; the American angler also saw an advantage in the heavy line that his British counterpart overlooked. By its weight, and with a long cast. the heavy line enabled a fly, either one imitating some water creature or one representing a small fish. to be fished deep down in the water. Methods using the sunk line have been used for many years in North America and, as a result, in many other countries. Such methods are still, however, little known or used in Great Britain.

Before examining in greater detail the individual methods of catching fish nith an imitation fly. it is necessary to explain how the fly is cast and thus presented in different ways.

The only aeight that assists the angler to cast a fly is the neight of his line Until the 1880s lines were undressed—that is, they were not covered with the coats of oxidized oil and. later, plastic that now render the line relatively heavy. The modern line may be level (a line of between 20–30 yd of the same diameter throughout), double tapered (tapering from a fine end up to a thick middle and back to a fine end), or forward tapered (tapering quickly to a thick portion and then quickly back to a long, fine back end).

This line is used aith a limber, springlike rod With some yards of line lying on the aater in front of him, the fisherman lifts his rod sharply from a position roughly horizontal to a position just past the vertical. As the rod is moved to the rear. the neight of the line and the pull of the water cause it to bend When a position of just past the vertical is reached the rod is stopped. As it recovers and straightens itself it throws the line upward and backward in a loop. The caster allows this loop to straighten until the line is nearly straight out behind him He then brings the rod forward through the same arc and the line follows. behaving in the same way as when it was thrown to the rear. To lengthen the line the caster holds a few yards in his left hand which he releases late in the forward stroke. The weight and impetus of the line going forward carries out this slack line. This lengthening of line is called shooting.

A leader or cast is tied to the end of the line This is a two- to three-yard length of nylon monofilament or transparent silkworm gut The fly is tied on the end; if more than one is used these are tied to short lengths of nylon or gut, called droppers, which are attached at intervals to the leader.

There are many styles of wet-fly fishing The angler. wading in the nater, may cast a short line upstream, pulling the flies toward him at a rate slightly quicker than that of the current by lifting his rod so that they represent the nymph just before emergence He may imitate the same stage in the fly's life by casting a longer, floating line upstream, and letting his flies drift down with the current He may cast a short line across the stream and allow his flies to swing with the current or, holding his rod high, allow the droppers to play on the surface of the water (dapping) like a dun struggling to leave the surface or a caddis fly dipping as it lays its eggs He may cast a long, heavy line across and downstream and allow his fly to sink well down, imitating a small fish or a nymph swimming on the bottom. The skilled angler uses each method according to the prevailing conditions. If his fly is close to the surface the strike or "take" of a trout is revealed by a movement in the water which he calls a rise. If he is fishing deeper he feels a pull on his line. In either case he raises his rod and sets the hook.

In dry-fly fishing the lure is manipulated to imitate a fly floating on top of the water. While a wet fly is slim and sparsely dressed so that it sinks easily, the dry fly is fuzzy. When the fly becomes wet and sodden the dry-fly fisherman whisks it through the air a number of times to dry it.

There are tao sorts of dry-fly fishing—fishing to the rise and "fishing the water." In the former the angler is casting his imitation to trout that are feeding during a hatch of fly. The correct choice of fly under these circumstances is crucial, as feeding trout become conditioned to eating just the one type of insect and will ignore every other sort which is brought down by the current. Fishing to the rise is a particularly interesting and exciting sport, for often the trout can be plainly seen in the water and the fisherman is trying to catch one individual fish.

In the other type of dry-fly fishing the trout are not activelv feeding. Here the angler casts his fly, searching the water for a fish which can be tempted and paying particular attention to parts of the stream where his experience tells him a trout may be lying.

Both wet and dry flies are used on lakes as well as on rivers and streams, though the most common form of lake fishing is mith wet flies from a boat. The boat is allowed to drift with the wind and the angler casts in front and to the side. A dry fly is sometimes used, particularly when there is a hatch of fly. Lakes are also fished by wading, as in streams. in shallow waters along the shores, and from the bank; a particularly popular sport in Great Britain is fishing from the shores of reservoirs which have been stocked with trout. This type of fishing often requires very long casts. and specialized, powerful rods are needed.

The tackle used for these different types of fishing varies greatly. Rods run in length from about 7 ft.. used on small streams, to $10\frac{1}{2}$ ft., still used for boat fishing in Scotland; most rods run between 7 and 9 ft., being generally about 6 in. shorter in North America than in Europe. Rod actions, that is, the degree of stiffness depend on the type of fishing and the weight of line it is necessary for them to cast. A rod for big migratory trout, such as the American steelhead or the European sea trout, obviously needs to be more powerful than a rod for trout of, say, a pound in weight.

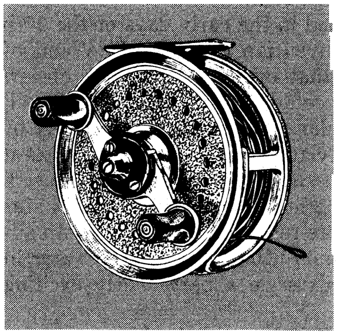

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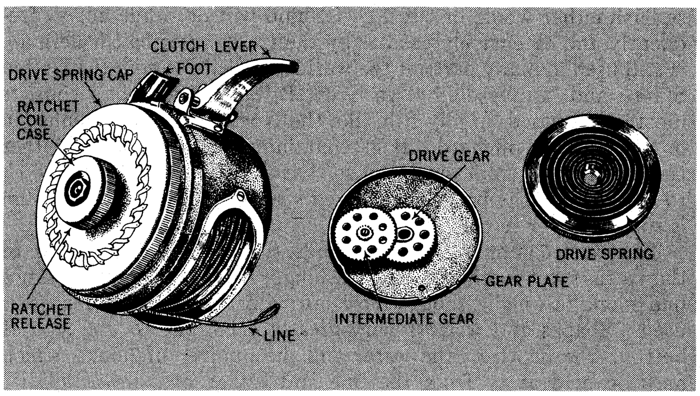
FIG. 8.— SINGLE-ACTION FLY REEL

The line is the most important part of the fly-fisherman's equipment, and must be of the right weight to bring out the power of the rod. At the same time, for dry-fly fishing, it must not be too heavy, for it has to float. The reel is a simple, single-action type, often in North America with an automatic, spring-powered pickup that rewinds any free line, of the right weight to be in harmony with the rod and big enough to contain sufficient line for the type of fishing for which it is used.

There are many different types and patterns of artificial flies, usually named after the fly they imitate (*e.g.*, March brown), the materials from which they are made (*e.g.*, snipe and purple quill) or the inventor (*e.g.*, Greenwell's glory). Local conditions dictate the shape and nature of local flies. for a rough river will need a different type of fly from that used for a smooth stream or a lake. Thus there are the well-hackled dry flies of New York state, designed with a big tail to ride on rough water, and the spider flies of Yorkshire, sparsely dressed wet flies made of soft hackle, ideal when fished just under the water on a fast river. All over the world there are fly dressers who. working either in factories or individually, create flies of silk, fur and feather. Many anglers tie their own flies. finding both pleasure in making them and added interest in their use.

Salmon Fly-Fishing.—Salmon fly-fishing differs from other types



BY COURTESY OF THE ENTERPRISE MANUFACTURING COMPANY

FIG. 9.— AUTOMATICFLY REEL SHOWING DRIVE MECHANISMS

because these fish, which enter the rivers from the sea to spawn, do not eat during their stay in fresh water. The angler, therefore, is not seeking to imitate some part of their immediate diet. although it is reasonable to suppose the lures which interest them remind them in some way of food they have eaten. Flies tied in a wide variety of sizes, colours and patterns, but not representing any particular insect, are used.

One of the methods of fly-fishing for salmon is known as sunk-line fishing. The sunken fly is principally used early in the year. that is. in North America in April, May and early June and in Great Britain in February and March. Salmon entering a cold river are interested in fairly large lures, fished well-sunken in the water and moved as slowly as possible. The size of fly varies from river to river, from very large flies three inches long down to smaller ones half an inch in length. For this style of fishing the angler uses a heavy line which takes his fly well down in the water, and casts rather more downstream than across, letting his fly swing slowly across the stream with the current.

Greased-line fishing was developed in the early days of the 20th century and was principally the invention of A. H. E. Wood of Glassel, Scot. Wood discovered that even in conditions of low water and warm weather salmon could be caught with a small, sparsely dressed fly fished just under the surface. The object of this style of fishing is to bring the fly across the current in a natural manner. and to keep the fly up in the water the line is greased. With this method salmon can be caught in the summer in low water under conditions which hitherto were regarded as hopeless. In addition, when taking the fly the salmon usually breaks the water in a "head and tail" rise, making this style a particularly exciting one.

It is most unusual for salmon in Britain and indeed in most parts of Europe to take a floating fly. In Canada and on some rivers in Iceland. however, the dry fly is most successful. A big, fuzzy fly is used and the technique is broadly the same as already described for trout.

In the United States and Canada short (8–11 ft.). single-handed rods are used except on one or two very rough rivers in the Gaspé area. In Europe, for the most part, long, double-handed rods of 11–15 ft. are best suited to the prevailing conditions.

III. SALT-WATER FISHING

The four basic methods of fishing are likewise used in salt water. Bait fishing and trolling are widely used; casting and spinning are used much less but are rapidly growing in popularity, especially in U.S. waters; and fly-fishing, although also growing in popularity. is practised only in a few areas and for a few species of fish. While the methods are basically the same as those used in fresh water, the tackle used is often very different due to the conditions of greater depths, wider areas, rocks, tides and currents.

1. Fishing With Bait.—The various methods of bait fishing are commonly used for sea fish, irrespective of whether the angler is fishing from a beach. off rocks, from a pier or from a boat. The baits used are those which form a normal part of the diet of sea fish—worms which live in sand or mud, marine shellfish and small sea fish either whole or cut up. Ground baiting, while not so frequently and extensively used as by the fresh-water bait fisherman, is still used in many parts of the world. Called chum in the United States, and "rubby-dubby" in Great Britain, ground bait consists mostly of pulped-up oily fish, like the North American menhaden or the Cornish pilchard. Bags containing crushed fish are eithet trailed behind a boat or placed so that the tide carries out a slick to draw fish to the bait on the angler's hook. Sometimes the chum is spooned over to drift down tide.

The most commonly used methods are those greatly similar to the fresh-water methods of bait fishing. A lead sinker, sometimes one pound in weight, though more normally four to eight ounces. is used. Shapes and weights vary greatly according to the type of bottom, the depth of the water and the number of hooks, which may be held away from the line and leader by wire or plastic booms.

Such tackle can be cast out from beach or rocks, cast or lowered into the water from a pier or jetty or lowered from a boat to where the fish are known or suspected to be.

Surf fishing, casting from the shore, has long been a popular form of sea fishing in. for example, South Africa and the United States, and this style of angling is probably the one growing most rapidly all over the world. It is a highly skilled form of fishing, for great knowledge is often necessary to locate the fish and very considerable skill is needed to make long casts with heavy weights and to handle big fish in heavy surf.

A long rod, 9–11 ft , is ordinarily used in surf fishing. All three types of reel are used and at one time the centre-pin reel was used a great deal, particularly and with exceptional skill in South Africa. Because such reels are so difficult to control, the multiplying reel, designed for surf casting. is being used by more and more fishermen. The fixed-spool (spinning) reel, used with light tackle, gained greatly in popularity after World War II, especially in North America.

Surf fishing has probably reached its highest degree of skill and the highest degree of organization along the Massachusetts coast. Some surf fishermen camp out on the beach in "beach buggies," vehicles equipped with oversized balloon tires to enable them to give high performance on sand, as well as with bunks and cooking equipment. Small aircraft are used as spotters on occasion to locate a shoal of fish and radio the information to the buggies, which race to the reported area. Surf fishing is sometimes very effective at night.

The British sea angler, less fortunate in the fish around the coast and fishing often in very heavy currents, which demand heavy leads and shorter, stouter rods, nevertheless fishes in a very similar way. Because conditions vary so greatly even within a small area, tackle likewise varies and rods run from 7 ft. up to 12 ft. In many other parts of the world, where conditions are rather more similar to those in North America, surf casting in the American style is becoming increasingly popular, even in countries like New Zealand and parts of South America, so well blessed with fine trout fishing.

Many forms of bait fishing can be practised from a boat. The most common is again a form of bait fishing using a sinker. As always the fish must first be located. and a knowledge of the "marks." that is, the exact location of their feeding grounds and thus of navigation, is essential. The boat angler must also find out at what depth the fish are feeding. The usual method is to lower the sinker until it touches bottom and then to wind in line until a bite is received. The angler notes how many turns of his reel he has made from the bottom to the depth at which the fish are feeding and is thus able to ensure that his bait is fishing at the right depth. Usually the sinker is left on the bottom and the hooks are adjusted to the right depths.

The one disadvantage of such fishing is that heavy leads have to be used. Other methods using lighter and more sporting tackle can also be used from a boat. For fish which sometimes swim high in the water, fish like the sea basses and the mackerels, an unleaded line and tackle can be allowed to run out with the tide or current or can be trailed behind a slowly moving boat. Another form of bait fishing is used on the west coast of Canada and the United States for coho and spring or Tyee salmon. The bait is a strip of herring. cut so that when drawn through the water or when influenced by current it moves in a lifelike manner. A small lead of about an ounce is fixed a yard or so above the bait, and bait and lead are either cast and retrieved, trolled. or allowed to hang in the current. These methods are called "strip casting" or "mooching." Caught on light tackle, the Pacific salmon is a very sporting fish indeed.

Not dissimilar is the method developed in the 1940s and 1950s for catching blue and mako sharks off the Cornish coast of England. The ideal conditions occur when the wind is blowing against the tide. The boat is allowed to drift, putting out a trail of "rubby-dubby" which runs off with the tide and attracts the sharks to the angler's bait. This bait, usually a whole herring or pilchard, is allowed to trail behind the drifting boat, suspended at the required depth by a cork float. Sharks caught in this way give a very good fight, and although these British fish are not as large as those in many other parts of the world, they do run to more than 300 lb. and provide a sporting method of fishing.

2. Float Fishing.—This is practised all over the world for fish that can be caught close to the surface, and because very light tackle can be employed it is a particularly sporting way of catching salt-\later fish. Fresh-water tackle is often used and a very popular outfit is a seven-foot, light spinning rod and a fixed-spool reel. Very many species of fish are caught by such means and members of the bass, mullet and mackerel families are taken on float tackle all over the world.

A particularly interesting and unusual form of float fishing is practised in the southern states of the United States, generally for speckled weakfish (Cynoscion *nebulosus*). The bait is a shrimp fished a yard or so below an egg-shaped float with a concave top. These are cast out either from a bait-casting or spinning outfit and then retrieved in a series of jerks. These jerks cause the float to be pulled under the water, and the air escapes from the concave top causing a very audible pop which attracts the weakfish to the bait. In this way the float acts both as a bite indicator and as a means of attraction.

3. Trolling. — This style of fishing is greatly practised for sea fish, for it is the best way of locating fish in great expanses of water, often of considerable depth. With the exception of trolling for what are known as big game fish, a specialized technique which will be dealt with separately. the methods of fishing are very similar to those used for fresh-water fish.

Typical of salt-water trolling is the method used on the west coast of North America to catch the large Pacific salmon (*Oncorhynchus tshawytscha*). All types of craft are used, from rowboats to special power-driven ships designed for this sport. Behind such crafts are trailed spoons, plugs and dead fish, either whole or cut up. A very popular method is to use a dead herring preceded by a large spoon called a "herring dodger." The dodger acts both as an attractor and to cause the herring to move in a lifelike manner. Basing itself on this sport of trolling for Pacific salmon is the famed Tyee club of Campbell River, British Columbia. This club lays down rules as to tackle that may be used. and presents buttons to anglers who catch large specimens of these salmon—bronze for 30-lb. fish; silver for 40-lb. fish, gold for 50-lb. fish and diamond for those of 60 lb. and above.

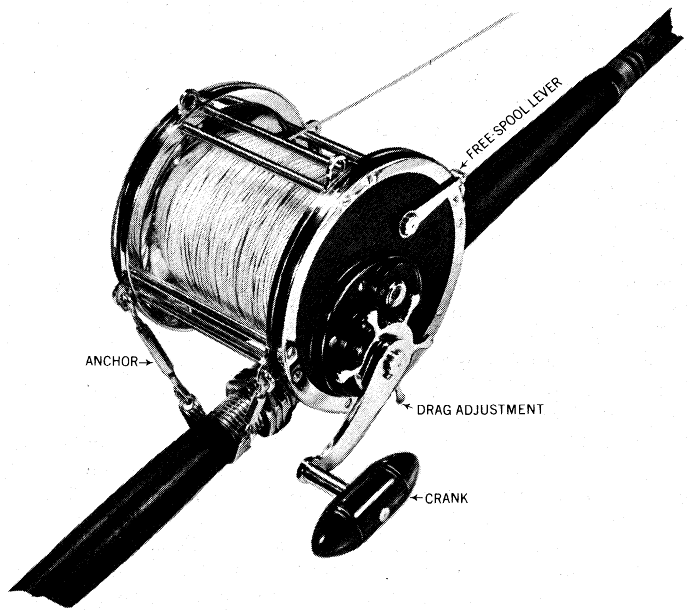
4. Bait Casting. — Casting and spinning for salt-water fish is becoming more and more popular every&-here,in particular where big predatory fish are found close to the shore and in sheltered waters. Tackle and methods are in many cases identical with those used in fresh water.

5. Fly-Fishing. — The flies used in this particularly sporting method are lures imitating small fish, shrimps. etc. Generally a strong, nine-foot rod is used, for long casts have to be made and many of the fish caught are relatively big and powerful. Europe and the British Isles have few places suitable for fly-fishing in the sea. but Florida and some of the other southern states of the U.S. offer splendid fly-fishing for bonefish, small tarpon and other species. Farther north the striped bass takes a fly well in places on both the Atlantic and Pacific coasts while on the latter fly-fishing for coho salmon offers splendid sport.

6. Big Game Fishing. — The fish sought in this form of angling are the big fish of the world, principally the members of the tuna. shark and swordfish or billfish families which may run from 100 lb. in weight to well over 2,000 Ib. Although such trophies are caught on heavy bait fishing tackle, the most popular, effective and sporting method is trolling. Deep-sea trolling is a highly specialized form of fishing requiring a boat designed for the purpose and heavy-duty tackle designed for handling very big fish.

The craft ior big game fishing must be capable of withstanding heavy seas and is equipped with a "fighting seat," a turntable chair from which the angler can exert the maximum pressure on a fish many times his own weight. The rod, a massive one of glass fibre or laminated wood. has a butt that fits into a socket in the chair. The reel is usually a very large multiplying reel, although some British big game fishermen prefer a centre-pin reel, and is usually designed so that a harness that fits over the angler's shoulders or around the small of his back can be connected to it. thus allowing the fisherman to use all his strength against the fish. The reels have a throwout lever or other device to release the spool and allow it to run free, and usually a braking device or drag to regulate line tension. The line is made of Dacron or Terylene and the leader of wire.

Craft designed for such fishing generally have outriggers — long poles to which the lines are attached by what Americans call clothespins and the British clothes pegs, which hold the lines well clear of the boat, thus allowing more than one line to be used. The age-old problem of locating fish and determining the depth at which they are feeding has been solved in part by the use of echo sounders and other electronic aids.



BY COURTESY OF PENN FISHING TACKLE MFG CO.

FIG. 10. — BIG GAME REEL BUCKLED TO HEAVY-DUTY ROD

Big game fish are sought throughout the world and since. as with other sports, the establishing of records is no small part of the interest. the International Game Fish association was formed in 1939. Having its headquarters in Miami. Fla., with a committee of experts in the sport, the I.G.F.A. acts as a clearinghouse for information. as arbiter in disputes and as the awarding authority for world records of big game fish, according to species and the type of tackle, classed by strength, on which each record was made.

IV. FISH AND FISHING IN THE PRINCIPAL ANGLING COUNTRIES OF THE WORLD

A. North America

U.S. and Canadian anglers are extremely fortunate in their native fishing for, although in so vast an area fish and types of fishing vary, and, as always in a society becoming increasingly industrialized, the town-dwelling angler needs to travel a long way to obtain good sport, wonderful lake, river and sea fishing exists in North America. Furthermore, in most U.S. states and Canadian provinces fishing is not private but is open to all who hold the necessary licence. Licence fees (and nonresident licence fees) vary widely from state to state as do regulations covering. species by species, size limits and catch or creel limits and establishing open and closed seasons. Fees are used to help finance hatcheries and other fishery management and conservation programs. (See Fish Culture; Wildlife Conservation.) Especially after World War II, new highway construction and increasing use of light airplanes made many previously hard-to-reach fishing waters–particularly in northern Wisconsin and Minnesota and the remoter regions of the western United States and of Canada–more easily accessible. (See also Boating.)

In North America as elsenhere various fishes are known by many local names The following discussion is based on the more generally accepted common names; the scientific nomenclature follows that of the American Fisheries society. Some fish caught in more than one country are separately dealt with only under the country in which they are most important to fishermen, for example, *Carp* under Great *Britain and Ireland*.

1. Fresh-Water Fish. — Atlantic *Salmon* (*Salmo salar*).—The Atlantic salmon, sometimes knonn as the Kennebec salmon, is found in North America from northern Maine, its last stronghold in the United States, to northern Canada. The same fish is found in northern Europe and the British Isles.

Salmon ascend from the sea to the headwaters of the rivers in which they were born to spawn. When the eggs hatch in the early spring the tiny fish. which are known as alevins, live upon the contents of a yolk sac until they grow into uhat are called salmon parr or pink. The immature salmon spends from one to three or more years in the river until, usually when two years old. and in the spring or early summer. it descends the river and migrates to the sea. At this stage, when it is known as a smolt, it is about six inches long and weighs only a few ounces. A fish that has spent one year in the sea is known as a grilse. The salmon increases very rapidly in size and the average run of fish returning for the first time to fresh water weighs between 8 and 20 lb. After spawning, individuals that do not die return to the sea but they invariably lose condition in fresh water, becoming thin and often suffering from fungus diseases. In this state they are known as kelts. (For details of the life cycle of the salmon see SALMON AND SALMONIDAE.)

For the angler the one notable difference between the North American and the European salmon is that the former will take a dry fly. Fly-fishing only is the rule in North America and no bait casting or live bait fishing for these fish is allowed. Some, of the best rivers in Quebec and New Brunswick, like the Miramichi and the Restigouche, are wholly or partly in private hands but many other salmon rivers including all those in Nova Scotia are open to everyone.

Landlocked Salmon (Salmo salar sebago and *Salmo* salar *ouananiche*). — These two fish are Atlantic salmon which do not migrate to the sea, the difference being that the former, originally only found in Maine, lives in lakes with no access to the sea while the latter lives in rivers in the Lake St. John area in Quebec which have access to salt water. Neither run as big as the migratory fish but both are very fine sporting fish which take fly and spinner very well. An eight-pound landlocked salmon is a big one.

King *Salmon* (*Oncorhynchus tshawytscha*).—The largest of the Pacific salmon, known also as Tyee, Chinook and spring, these huge fish are found from California as far north as Alaska. They are usually caught by trolling in the river estuaries but at times can be caught by strip casting and "mooching," by fly-fishing and by bait or plug casting. Many west coast rivers have a run of small male grilse, known as "jack springs." which give great sport on a fly rod. In certain rivers very big fish run — for instance at River's inlet on the mainland of British Columbia, fish of between 40 and 60 lb. are common.

Coho Salmon (*Oncorhynchus kisutch*).—Known also as the silver salmon, the coho is a great sport fish, being principally caught in the sea, in estuaries and low down in rivers. Its distribution is similar to the king and like all Pacific salmon its condition deteriorates rapidly in fresh water. It can be caught trolling, strip casting, bait casting and on a fly. Generally the fly, a long lure made from deer or polar bear hair, is trolled, but on occasions coho will take a fly cast to them. A very game fish, it jumps repeatedly when hooked. It is not as large as the king. averaging about nine to ten pounds.

Lake Trout (*Salvelinus* [*Cristivomer*] *namaycush*).—The largest of the North American char (*q.v.*) and a very fine table fish. the lake trout, also known as Great Lakes trout, is found only in the northern states of the United States and across Canada. in deep lakes. Though it can be caught on the surface on fly and casting and spinning tackle in the spring when the ice melts. it is usually caught by very deep trolling. It reaches a weight of 50 to 100 lb.

Brook *Trout, or* Speckled Trout (*Salvelinus fontinalis*).—Originally native to the northeastern states of the U.S. and to eastern Canada. this beautiful fish has been widely planted all over North America. Being a char it requires cold water. and although it will feed on the surface in the spring it prefers deep water. Very voracious, it will take most baits and lures and taks a well-sunken fly very well. The brook trout is excellent eating. It runs to the sea in the maritime provinces and Maine. Depending on the food supply weights range from less than one to more than ten pounds.

Dolly *Varden Trout* (*Salvelinus malma*).—A voracious, bottom-feeding char, this fish is found in British Columbia and the western states. It will take any bait or lure and will run to the sea if it has access to it. A gvod table fish) it weighs up to 30 lb.

Arctic Char (*Salvelinus alpinus*).—The same migratory char that runs up the Icelandic rivers also ascends the rivers of northern Canada. Little is known about its distribution but fish over 15 lb. in weight are not uncommon.

Cutthroat Trout (*Salmo clarki*).—This is a true trout and a native of the Pacific drainage from California to Alaska. It is a voracious fish which will take fly, bait or lure. It runs to the sea when it has access. Excellent for eating, the record is more than 40 lb.. though a four-pounder is a good fish in most waters.

Rainbow *Trout* (*Salmo gairdneri*).—Rainbow trout is the other of the North American true trout and a wonderful sporting fish; it has been transplanted from the Pacific drainage to many other areas of North America and to many other countries. A very strong fighter which takes fly, lure and bait. it weighs from 1 to more than 30 lb. The extremely large rainbow caught in Lake Pend Oreille. Ida.. are locally called Kamloops (because the lake was stocked with trout from the Kamloops area of British Columbia) or Rootenay. The rainbow trout has strong migratory tendencies and when it has access to the sea or a large lake, as one of the Great Lakes, becomes sea-run and is known as a steelhead. Steelhead trout are caught on bait, fly and spinner.

Brown Trout (*Salmo trutta*). — Introduced into North America from Europe, the brown trout gives the same excellent sport there as it gives in the lands where it is native (see Great Britain and Ireland, below).

Arctic Grayling (*Thymallus arcticus* or *signifer*).—The grayling is native to Montana (a subspecies, tricolor) and to Alaska and northern Canada. It is a splendid sporting fish which takes fly, spinner and bait.

Smallmouth Block Bass (*Micropterus dolomieui*).—A fish of extraordinary strength for its size, the smallmouth black bass is one of the world's great sporting fish. Originally native to the northern states and northeastern Canada, it has been transplanted to many other areas. Excellent eating. these fish will take fly, spinner, plug and bait. Fish between four and five pounds are not unusual.

Largemouth Black Bass (*Micropterus* salmoidesj. — Though bigger than the smallmouth, it is not quite so game but will take fly, spinner. plug and bait.

Yellow Perch (*Perca* flavescens). — The yellow perch, also known as the ringed perch, is one of the most popular North American pan fish. It is a close relative of the European perch (*Perca fluviatilis*). It is caught on live bait (minnows, crayfish and worms are popular) and on flies. The average weight is less than one pound but many lakes have larger perch and catches may average two pounds and over.

Northern Pike (*Esox lucius*).—The northern pike is common to northern states of the U.S. and across Canada. Although it will take worms and other bait. its main food is fish of all species. For this purpose the pike has a large mouth equipped with hundreds of teeth. It is a long. streamlined fish with great power of propulsion at its tail giving high speed in swimming over a short distance. Its eyes are placed well forward so that its vision is likewise forward and its green, dappled body is perfectly camouflaged for the ambushing of smaller fish. At times a voracious feeder. it takes bait. live or dead fish and lures. Northern pike of 10 to 15 Ib. are not rare and some weigh more than 40 lb.

Muskellunge (*Esox masquinongy*).—A very large member of the pike family. the muskellunge is native to the northeastern and north central states of the U.S. and to eastern Canada. It takes dead or live fish and large lures. Muskellunge weigh up to about 70 Ib.

Walleye (*Stizostedion vitreum vitreum*).—This game fish is known by many names including walleyed pike, pike perch, walleyed perch and. in Canada. *doré*. Its original range was in Canada west to Alberta and southward in the Great Lakes-Mississippi valley region: it is non· found all over the United States and Canada. It is excellent eating. Mostly it takes bait: live and dead fish and lures. Weights average 2 to 5 lb. and go up to more than 20 lb.

Pan-fish.—In many parts of the United States the fishes known as pan-fishes give sport to many anglers. This group includes, in addition to yellow perch, the white crappie (Pomoxis *annularis*), the black crappie (Pomoxis *nigromaculatus*), the bluegill (*Lepomis* macrochirus) and a number of other members of the *Lepomis* species usually referred to as sunfishes. All the above will take bait, small flies and small lures. All are good eating.

2. Salt-Water Fish. — Salt-water fishing is probably the fastest growing phase of the sport of angling. not only in North America but in many other parts of the world, with thousands of new fishermen and boatmen joining the quest for the sporting fish of the sea each year. In the following discussion several of the more important big game and other salt-water fish, and methods of fishing them, are described briefly to illustrate various aspects of the sport, and the more popular quarry are identified. The range of many species is, of course, world-wide and major occurrences of interest to sportsmen are mentioned below as well as in sections dealing with particular waters, as Central and South America.

Sailfish —Noblest of the salt-water species must be the billfishes or spearfishes. which include the sailfish, marlins and swordfish. Certainly none of the true finfishes approaches them in size except the bluefin tuna. Most numerous member of the tribe, or at least the one most often caught, is the sailfish, of which there are two valid species and possibly others. The two are known as the Atlantic sailfish (*Istiophorus americanus*) and the Pacific sailfish (*Istiophorus* greyi). As in all spearfishes, the cylindrical spear of the sailfish is an elongation of the upper jaw. But the sailfish is unique in that its dorsal fin is enlarged to saillike proportions. When the fish swims deep the great fin is lowered and folded into a groove on its back. However, when it feeds on the surface the sail is often partly raised as it pursues bait fish or bait. Sailfish are coveted as trophies, and no fish is more widely sought by neophyte big game anglers. In the Atlantic ocean, the average fish caught runs 6 or 7 ft. in length and ranges in weight between 40 and 50 lb.; some weigh up to about 100 lb.

The Pacific sailfish is a heavyweight by contrast, with average weight of 100 Ib. A Pacific sailfish caught with hook and line off Galapagos Islands in 1947 weighed 221 lb. The range extends from California to Ecuador, Japan. the Marianas and the Philippines, into the Red sea and Persian gulf and off the east African coast. Acapulco, Mex., was developed as a tourist area largely as a result of its excellent sailfishing The centre of fishing activity for the Atlantic sail is off the seaboard coast of Florida and the Gulf of Mexico, but the fish are also taken in many other areas including the Bahamas, Cuba, Puerto Rico, Jamaica, Venezuela, British Honduras and Brazil.

Sailfish are occasionally caught by drifting a deep bait, but most often they are sought on the surface and usually seen before the strike. Baits of balao, needlefish, flying fish or mullet or strips of large fish smoothly filleted and shaped are favourites. They are trolled behind a slowly moving boat, preferably from outriggers which, together with the rolling of the boat, cause the baits to skip and swim over the nave tops. The sailfish may rush and strike a bait or it may rise up under it. In any event, the fisherman in the fighting chair takes the rod and puts his reel into free-spool. Should the fish strike, a sharp rap will be felt by the fisherman who then takes his fingers off the spool and gives line freely until. gauging by the speed of the reel. he feels certain the fish has the bait. The brake is then applied, and the hook is driven home. The sailfish, as all spearfish, is believed to first strike a bait with its bill to stun it. The theory is that it then circles and takes the bait as it drifts down from the free-running reel.

A hooked sailfish provides a spectacle which lures the fisherman again and again to the sport. Suddenly the blue water seems to explode, and the huge fish. sail erect, surges upward. It "walks" the waves momentarily. Then it plunges. "greyhounding" in a series of cascading leaps. It yields only when exhausted. The mate on the boat, with gloved hands, seizes the wire leader as it emerges from the water, reaches down and grabs the fish by the bill. A sailfish or small marlin is never gaffed. At the angler's command the mate either slides the fish into the boat or snips the leader and lets it go free. Most sailfish, unless they are wanted for mounting. are released to fight another day. The flesh is palatable only when smoked.

Marlins. — Similar in many ways to the sailfish, except for its lack of an enlarged dorsal fin, is the white marlin (Makaira *albzda*). This billfish grows somewhat heavier than the Atlantic sail and somewhat smaller than the Pacific sail. Average weight may be 60 to 70 lb. although 100-pounders are frequently taken. A fish of 161 lb. was caught with rod and reel off Miami Beach, Fla., in 1938. Dark blue, and silver underneath. the white marlin is distinguished from the blue marlin, which is found in the same waters, by its rounded first dorsal and pectoral fins. The blue marlin has sharply pointed dorsal and pectoral fins. It is also much darker than the white and much heavier. Surface feeding, a white marlin shows the top section of its tail, or caudal fin, in the northern part of its range. Off Bimini, the same fish usually shows no fins until it moves in on the bait, when the raised dorsal fin is seen cutting the water. White marlin strike baits similar to the kind used for sailfish although off Long Island and New England whole squid or a rigged eel is used rather than bait fish. Once they rap the bait they must be given the "drop-back" with a free-spooled reel. They prove just as spunky as the sails when hooked, rearing and plunging to rid themselves of the hook. The range of the white marlin pretty much overlaps that of the Atlantic sailfish except that it extends northward into chilly New England waters as well. When the July run of whites is on at Ocean City, Md., some boats may catch and release a dozen of these game fish.

The huge blue marlin (Makaira *nigricans*) is often a running mate of the white. In the Atlantic ocean, big game anglers troll for the smaller white marlin or for sailfish and hope to spot the sharp, triangular dorsal fin of the cruising blue. The boat may troll a strip bait or a small bait fish. At the same time it may have a sewn mackerel (with backbone removed to give added "life" to the bait) bouncing along from an outrigger. Many captains who fish for the big marlins and swordfish keep the best bait aboard and wait for sight of the quarry before presenting it, as baits are torn up from too much trolling. In the Bahamas a fair-sized bonefish is considered an excellent marlin bait. Once the fish is sighted the bait is put over and is drawn past the blue. Should the fish rap the bait with his bill, the angler free-spools the reel and gives the familiar drop-back. Blue marlin are powerful fish. They leap and "greyhound" but they also dive very deep. At times they will dive and then die from exhaustion many fathoms beneath the boat Unless the angler has heavy tackle he will be unable to pump the fish to the surface. Blues are caught along the eastern Atlantic coast as far north as New England but they are more plentiful in the warm tropical waters of the Bahamas. Cuba and Puerto Rico. They are also taken in Venezuela and Barbados. Average weight of blue marlin is between 300 and 400 lb. A 780 lb. blue was caught off San Juan, P.R., in 1959.

There are two other marlins, less fished for because of their remote habitat but in the same class with the blue. One of them, the black marlin (Istiompax *indicus* or *marlina*), is considered the greatest of the finfishes. It is a native of the Pacific, ranging from the Gulf of California south to Peru. It is known off many of the Pacific islands including Hawaii and the Philippines, and in waters off Australia and New Zealand. But the black made its mark with anglers off Peru; big game fishermen from many lands visit the Cabo Blanco club to fish for 1.000 lb. specimens. The fishing for it is typical of all marlin trolling.

The striped marlin (*Makaira audax*) grows almost to the size of the blue. Its range is largely that of the Pacific black marlin but it is more abundant. Average fish run from 250 to 350 lb. A fish neighing 692 lb. was caught with rod and reel off Balboa, Calif., in 1931.

Swordfish —Most striking of the billfishes is the broadbill swordfish (*Xiphias gladius*), distinguished by the prolongation of its upper jaw into a long, flattened, sharp-edged and pointed sword which is nearly one-third the total length of the fish. Snordfish are especially prized among big game fishermen. To begin with they cannot be fished for until they are seen on the surface. And when they are on the surface they are often surfeited with food and not interested in the angler's offering of a whole fish or a squid. Again, when they do rush the bait they are not easily hooked, and when they are hooked their relatively soft mouths leave room for the familiar mishap of the pulled-out hook. The fish average from 250 to 350 lb. but 500-pounders are common. Exceptional was the 1,182-lb. swordfish caught off the famed grounds at Iquique, Chile, in 1953, by big game angler Lou Marron of New Jersey.

Swordfish are from common to rare over much of the world. They are a valuable market fish and because of their habit of lolling on the surface and their fearlessness of boats, they are easily harpooned for the commercial market.

Tuna.—While there are several species of tuna and all of them are eagerly sought by fishermen, none approaches the magnificent bluefin (Thunnus *thynnus*) for sheer size or abundance. The bluefin has been reported in most of the warm or temperate seas of the world. Young fish of the species—fish of 8 to 15 lb. or more—are often found with false albacore and the bonitos, cousins in the family tree. Fishermen trolling feather or nylon lures in the wakes of fast cruisers may catch one or the other. If a watch is kept on the boat's wake, the fish may be seen to snatch the lures within 20 ft. of the stern. This is particularly true in the Atlantic ocean. In some Pacific fishing areas, among them California, the small bluefins are more readily taken with live bait after having been chummed to the boat with live sardines. Even in such miniature sizes the bluefins recklessly strip line from the reels in their steep dives. Tuna of 75 lb. have been known to completely empty reels of 500 yd. of 15-thread line.

But while the peppery little tuna provide great sport for legions of sport fishermen and a summertime charter boat business on both coasts of the United States, it is the giant bluefins that fascinate one coterie of anglers to the extent that they spend small fortunes to catch just one. Records of giant tuna being taken by nets or harpoon are centuries old. Not until 1898, however, when Charles A. Holder succeeded in boating a 183-lb. bluefin with rod and reel off Catalina, Calif., did anglers everywhere raise their sights on these leviathans of the deep. Holder organized the Catalina Tuna club the day after his catch. The fish were caught without benefit of the friction brakes which are built into modern reels. Improvement of equipment was accompanied by a comparable increase in the size of the fish caught. Bluefin tuna are rumored to grow as large as 1 600 lb. A specimen harpooned off Rhode Island in 1913 weighed 1,225 Ib. One weighing 977 lb. was caught on rod and reel at St. Ann's bay, Nova Scotia, in 1950.

Giant tuna are fished for in several different ways, of which the chumming method is the most frequently used in the United States and Canada, and off the Scandinavian coast. Whole or large chunks of herring or menhaden are used to lure the fish. A similar fish or chunk of fish is drifted or floated out on a large hook which is twisted to a steel leader. Chum is used to lure the huge fish to the baits in the tide rips off Nova Scotia. The same method is used at Montauk point, Block Island, and along the New England coast. A system of slowly swimming a live mackerel or whiting is also successful when the tuna are seen on the surface.

During the May run of giant tuna off Bimini and Cat cay in the Bahamas, the schools of northbound fish are spotted from lookout perches on fast cruisers. The boat races ahead to intercept the school. Near the point of interception a whole mullet is sent overboard and jigged rapidly. If the maneuver has been correctly timed. one of the tuna may break away from the school and seize the bait.

The torpedo-shaped tuna, with body grooved to receive certain of the fins for streamlined speed swimming, is among the fastest fish in the sea (estimated 40 m.p.h.). A giant hooked on a line is almost tireless in its deep-boring rushes. However, skilled anglers have brought 500- and 600-lb tuna to the boat in as little as 20 minutes. The average fight may last two hours. Should the fight go to five and six hours, the odds are with the tuna. The tuna is still fresh or "green" and the angler is exhausted. Once the tuna has been brought alongside the boat. the mate grabs the leader with a gloved hand and sinks a "flying gaff" into the fish The flying gaff has a detachable head which is fastened with heavy manila hemp to a cleat on the boat. After the death flurry, a noose is swung over the tuna's mackerellike tail and it is pulled aboard with the hoist.

Other tuna prominent in the angler's book are the yellowfin or Allison's tuna (Thunnus *albacares*) and the bigeye tuna (*Thunnus obesus*). Neither approaches the size of the bluefin tuna although they may reach several hundred pounds. Smaller still is the albacore (*Thunnus* alalunga) which averages from 15 to 50 lb.

Tarpon.—Trophy of the brackish waters, the rivers, inlets and back bays of tropical climates, the tarpon (*Megalops* atlanticus) also is often referred to as the silver king, grande *écaille*, sabalo, and by many other names. It sometimes reaches a weight of nearly 300 lb. and is highly prized for its spectacular, leaping fight. A fish of 283 lb. was taken with rod and reel from Lake Maracaibo, Venez., in 1956. When a school is rolling on the surface each tarpon breaks the surface with its snout, and the dorsal fin with its whiplike appendage comes into view. Finally the broad tail sweeps up, and the fish is gone to repeat the roll in another moment. Tarpon gulp air during their rolling to augment gill breathing. Scientists believe this direct absorption of air explains their ability to thrive in stagnant pools and poorly oxygenated water.

Excellent baits for tarpon are live pinfish or mullet. Most tarpon fishermen, however, prefer to use artificial lures. Sometimes the fish will strike at slow-moving, deep-running plugs. Other times they will engulf noisy surface plugs. Fly-fishermen catch baby tarpon on white and silver flies. These restless fish may be taken on spinning rod and bait-casting tackle as well as strong deep-sea rod and reel. As a rule the light tackle is most effective when the fish are in shallow water or narrow drains. Their fight then consists of leapfrogging and tail-walking rather than long, swift runs. Cnder such conditions tarpon as large as 160 lb. have been caught on 14-lb. test lines. When tarpon are swimming in strong currents, however, they will rush down tide, and heavy tackle is needed. Most important in tarpon fishing are needle-sharp hooks to penetrate the bony plates of the jaws. Even more horny than the mouth surfaces are the great silver scales of the fish. Gaffs will hardly penetrate the scales, and as a result tarpon are always gaffed in the mouth. The same bright scales, larger than silver dollars on 100-lb. fish, are the souvenirs of the tarpon fishing trip. As food the tarpon is worthless. Therefore, unless the fisherman wants the fish for a mount, he pulls a scale from the exhausted quarry and then sends the tarpon back to the school.

Bonefish.—Few fish have been so widely acclaimed for their swiftness as the bonefish (*Albula vulpes*). Although a relatively small fish, nith average weight running from four to six pounds and only rarely caught over ten pounds, the silvery bonefish can flee at sizzling speed when hooked or alarmed. A favourite of the light-tackle fishermen, the bonefish will often strip a reel and break free in the first surging run to escape into deep water. This first flight invariably is in a straight line and sometimes will continue for 100 yd. or more before the nervous energy that made it possible is spent. If the fisherman stops the first run, the fight is half won. Barring accidents with sharp coral which could cut the line, the tiring quarry eventually will be brought alongside the boat and netted. Bonefish prefer to feed on shallow, grassy flats, or banks, following the incoming tide into only a foot or two of crystal-clear water. They have piglike snouts, ideal for rooting in the bottom and digging out small shellfish and crustaceans which are then crushed between a rock-hard tongue and an equally hard palate. Often when rooting up the bottom their tails break the surface. Fishermen poling the flats in shallow-draft skiffs look for these signs of "tailing fish." Another clue to the presence of fish are little puffs of mud stirred up by the feeding. Fishermen hastily, although stealthily, intercept the feeding fish and cast to them with baits of shrimp, hermit crab, conch or crayfish.

Light bait-casting rods and reels once were the favourite for bonefish. They have been largely replaced by spinning tackle. Fly-fishermen, using a heavy salmon-type rod and a forward-tapered fly line with plenty of backing and special streamer flies. also catch them. These fish may also be chummed to an anchored boat with bits of shrimp. Bonefish are native to many areas of the world including the Florida keys, Bermuda, the Bahamas, Cuba, Puerto Rico, Venezuela, California, Mexico, Hawaii, Australia, Japan and India. Some of the best bonefish flats are at Andros Island in the Bahamas. A bonefish taken in Hawaii in 1954 meighed 18 Ib. 2 oz. Sometimes confused with bonefish and also eagerly sought are ladyfish, or chiro (Elops *saurus* in the Atlantic, Elops *affinis* in the Pacific). The permit (*Trachinotus falcatus*) is a swift but scarce fish of the Florida keys and Bahama flats and may be taken while bonefishing. It has been caught at over 40 lb.

Striped Bass.—The striped bass (Roccus *saxatilis*), a member of the perchlike fishes of the sea bass family Serranidae, is said to be the most popular inshore fish of the United States. At least this is true along much of the east coast where the striped bass, also called striper, rockfish, greenhead or lineside, is sought throughout much of the year, from South Carolina to Maine. It is equally popular in parts of California and in Coos bay, Oregon, where the fish now flourishes as a result of being transplanted in San Francisco bay from New Jersey in 1877 and 1882 The original stock of 434 small fish multiplied until striped bass became important as a recreational fish in California second only to the salmon. Commercial fishing for stripers was permitted in California until 1935 when a law was passed making it a game fish, setting fishing limits on size and numbers, and forbidding its sale. California authorities estimated that by the second half of the 20th century 200,000 anglers fished for stripers in the state's waters and spent $10,000,000 annually in pursuit of their sport. Striped bass are fish of brackish and fresh water as well as the salt sea. They spawn in swift currents of rivers several miles inland. The young fish may spend a year or two in fresh water before descending to the ocean. Adult bass are known for their extended migrations. On the Atlantic coast the principal spawning area of the striper is Chesapeake bay. During the spring movement Chesapeake bay bass or "rocks" as they are known in that area. travel northaard to populate hundreds of miles of surf and bays. In California waters and in such Oregon waters as Coos river, bait fishing for the species has been brought to a fine art Favourite baits are chunks of pilchard or other herringlike fishes. Live bullheads up to six inches in size are used, as well as clams and worms.

Throughout much of the east coast range of the striper. most fish. particularly the larger ones, are caught on artificial lures—plugs of various shapes and sizes, bucktail jigs and lures shaped of tin or chrome-finished lead. However, eels of a foot or so in length, killed and carefully rigged with hooks. prove excellent lures for night casting. Striped bass are most often sought at night in the boiling surf by casters or "squidders" who aear nading boots of armpit height. Less hardy anglers charter fishing boats and troll lures along the edge of the surf or over rocks and wrecks. Striped bass generally attain greater size on east coast grounds of their origin. Fish of 20 and 25 lb. are common. During the fall run in New England, scores of 35- to 45-lb. fish are taken daily, with occasional 50- and 60-lb. fish.

Bluefish—The hard-fighting bluefish (Pomatomus saltatrix) best illustrates the phenomenon of cyclic abundance and scarcity among the pelagic fish of the sea. Bluefish have always been an important food species. Over the years, catch records show the bluefish has repeatedly gone from peak periods to poor periods and back again. Basis for an intensive sport fishery along the east coast of the United States, the bluefish, sometimes described as elft, tailor, snapper, or greenfish, is spread through many of the warm seas of the world. Some of the largest specimens have been reported from Africa although a hook and line record of 24 lb. 3 oz. was established in the Azores in 1953. A savage predator of the ocean, a school of bluefish will chop shoals of bait fish to fragments, providing a feast for the sea gulls and food for creatures of the ocean's bottom. Bluefish are taken from the surf by casters who use lures and plugs. Immature blues, or snappers. are a favourite of the cane-pole fishermen of the bays Most bluefish. honever. are caught by trolling metal or feathered jigs from slow-moving boats. The troller "follows the gulls" to find feeding bluefish. Bluefish when they are in teeming numbers respond quickly to chum of ground menhaden A piece of fish on a hook with a nire leader as protection against the sharp teeth of the blue is the bait.

Yellowtail.—The Pacific yellowtail (Seriola dorsalis) is beautifully streamlined and solidly muscular. Anglers seek it in many waters for the fish is abundant in Australia, New Zealand, and off South Africa, as well as along the Pacific shores of California, Mexico, and throughout the range to Chile. In California. at least, the fish supports a large party boat business. The Pacific yellowtail is a surface feeder, rising from kelp beds to take chum of live sardines tossed overboard by slowly cruising boats. Once the fish have found the chum, a live sardine is baited on a hook and allowed to drift back to the fish.

Yellowtails are strong fighters and delicious eating. Average size may run from 5 to 20 lb. but specimens up to more than 100 Ib. have been caught.

Flatfish.—There are said to be over 50 genera and 500 species of flatfish starting with the giant Atlantic halibut (Hippoglossus hippoglossus) and ranging down to the tiny hogchoker (Trinectes *maculatus*). The Atlantic halibut is rarely found by the angler, but the California halibut (Paralichthys *californicus*) which grows to about 60 lb.. in contrast with more than 600 lb. reported for the Atlantic halibut, is caught by sport fishermen. Flatfish have colour and both eyes on one side only, right or left. When very young they have normally placed eyes but with growth one eye migrates over the top of the head and settles beside the other. Other names in general usage for the various flatfishes are flounder, fluke, dab, sole and plaice. Some species cling to the deep offshore grounds and are never taken by angling. But in inshore waters, whether warm or cold, there is almost always one member of the huge family which will take the fisherman's baited hooks. Some species such as the winter flounder (*Pseudopleuronectes americanus*) spend their lives within an inch or two of the bottom where they feed by digging out worms and small crustacea from the mud. Other flatfish such as the summer flounder. or fluke (*Paralichthys* dentatus) will even break the surface in pursuit of bait fish. The summer flounder, which may weigh up to 20 Ib., is most often taken with a live minnow on a hook that is dragged with the tide along the bottom. Less active members of the family such as the winter flounder are usually caught with bits of sea worms or clams on small hooks fished right on the bottom.

Channel Bass, Snook, Bonito and *Others*.—The channel bass or red drum (Sciaenops ocellata) is found on the Atlantic coast south of New England and caught on lures and bait, particularly by surf casting. A large fish, it weighs up to 80 lb. A number of species of snook (Centropomus *undecimalis*) are found in both the Atlantic and Pacific oceans. It is a very game fish which can be caught by most fishing methods and it takes a fly well. Average weight is 4 to 9 lb. but the record is more than 50 lb. The common Atlantic bonito (Snrda sarda) is a fish of the mackerel family, found in the Atlantic and the Mediterranean, similar in form to but smaller than the tuna; the striped bonito (S. *orientalis*), which is world-wide, and the Pacific bonito or Chilean bonito (S. *chiliensis*) of the Pacific also are caught as bonito (*q.v.*). These very fast fish give great sport, although the average weight is well under 15 Ib.

Among other salt-water quarry the crevallé, jack crevallé or common jack (*Caranx* hippos), a very strong fish found on both coasts, can be caught on bait and by casting or trolling. It may weigh from 2 or 3 lb. to about 30 lb. The genus includes the blue runner. the skipjack, yellow jack and other crevallés. The dolphin (*Coryphaena hippurus*), a very beautiful fish (not to be confused with the aquatic mammal of the same name) and excellent eating, is found on both coasts and off Hawaii. Its principal food is the flying fish and it is generally caught by trolling. The average weight is under 25 lb.; some weigh more than 80 lb

The weakfish or sea trout (Cynoscion *regalis*) and the spotted weakfish or spotted sea trout (Cynoscion *nebulosus*) are found south of New York state on the Atlantic coast. They take various baits, especially shrimps. and can be caught on a fly and on lures. They make excellent eating. A large one weighs ten pounds.

4 great many other salt-water fish are sought by U.S. and Canadian fishermen. Among the more popular are pompano, barracuda (or barracouta), amber jack, grouper. coney, snapper, cod, mackerel, pollack, sea bass. shark and flounder.

B. Central and South America

1. Mexico.—Though there is good river fishing in Mexico, particularly for rainbow trout, it is for the superb fishing off its coasts that this country is renowned among anglers. The world's biggest tarpon are caught in the mouth of the Panuco at Tampico, Acapulco is famed for Pacific sailfish, while Veracruz offers a wide variety of sporting sea fish—bass, marlin, grouper and many others. All three are well-known angling resorts and all three have famous "rodeos"—competitions among anglers for the largest fish of a species caught during the period of the event.

2. Bahamas.—This group of islands offers some of the finest sea and big game fishing in the world and Bimini and Cat cay are as famed among salt-water anglers as the Restigouche, the Spey or the Aaro are famed among salmon fishermen. Giant tuna and marlin offer sport to the big game enthusiasts while tarpon, barracuda, kingfish. wahoo, bonefish and many other species can be caught on lighter tackle.

3. Jamaica, Barbados, Tobago, Trinidad and the Leeward Islands.—These are similar to the Bahamas in the sport they offer: big game fish, barracuda or great barracuda. tarpon and kingfish. In Jamaica there is a fresh-water fish, the mountain mullet (Agonostomus monticola), which gives good sport on light tackle.

4. Cuba.—Highly famed for its sea and big game fishing which is similar to that of the Bahamas, Cuba also has fine fresh-water angling. Large tarpon are caught in some of the fresh-water lakes and there is splendid fishing for largemouth black bass and bonefish.

5. South America.—The great native sporting fish of this vast subcontinent is the dorado (*Salminus maxilosus*), a very strong fish which runs to more than 40 lb. Usually it is caught on heavy bait-casting tackle in the Orinoco, Uruguay, Paraguay and Paraná rivers, in the Amazon and its tributaries and in Bolivia. One of the world's largest fresh-water fish, the pirarucu, or arapaima (*Arapaima gigas*), is caught in the Amazon and its tributaries and in British Guiana. It runs up to several hundred pounds in weight. It is usually caught on live bait. Other good native sporting fish are the tucunare (Cichla *ocellaris*) of British Guiana, a perchlike fish which takes a big fly well; the boga, a characid, and the pacú, also a characid of Argentina, which are caught on bait; and the trucha of Chile, which will take fly or spinner.

Of greatest importance perhaps to the fresh-water angler is the fact that brown and rainbow trout, char and Atlantic salmon have been introduced with great success into many of the rivers and lakes of Colombia, Peru, Chile and Argentina. Particularly in the latter two cases, brown and rainbows grow to a very large size in the glacier-fed rivers of the southern Andes and Patagonia and the trout fishing in these areas is probably unequalled in the world.

Off Cabo Blanco in Peru is some of the finest big game fishing in the world. Here the cold Humboldt current meets the equatorial current and in this area there is an enormous concentration of all big game fish. Most sought of these is the giant black marlin (Makaira indica) which runs over 1,500 lb.

All round the coast of South and Central America there is good fishing. Surf casting is growing in popularity, particularly in Argentina and a small band of enthusiasts enjoys excellent sport.

C. Great Britain and Ireland

Fishing in this area is divided into game fishing, that is, fishing for salmon, trout and sea trout, coarse fishing, which includes all the other fresh-water species, and sea fishing. The salmon season, varying according to river, runs roughly from January to October, the trout season, likewise variable, from March to September and the statutory coarse fish season runs from June 16 to March 14.

1. Game Fish.—Salmon (Salmo *salar*).—This is the Atlantic salmon described under North America, above, and its life history is the same, the chief difference being that in Great Britain and Europe the salmon rarely will rise to a dry fly. The salmon do not feed in fresh water but will take a large wet fly and are also caught on spinning lures and on worms and prawns. Salmon run up most rivers in the British Isles except those of northeastern, eastern and southeastern England. Some of the best rivers are the Wye and the Eden (England), the Usk, Teifi and Dee (Wales), the Dee, Tweed, Tay and Spey (Scotland), and the Blackwater, Lee and Boyne (Ireland). The record British salmon was caught in the Tay and weighed more than 60 lb.

Trout (Salmo *trutta*).—There is one native species of trout in the British Isles, the brown trout, and apart from some rivers in eastern and southeastern England, these fine fish are widely distributed. They do, however, vary greatly in size and colour, the latter depending greatly on the colour of their background. In the chalk streams of Hampshire a two-pound trout is common, due to the vast amount of food obtainable in these alkaline rivers. A trout the same age from the acid rivers of Devonshire would probably weigh between four and six ounces.

Trout live on insects in their various stages, small fish including their own species, worms and most small forms of life living in the water. They are caught on artificial flies and on spinning lures and will take most forms of bait. The principal English trout rivers are the Test and Itchen in Hampshire, the Kennet in Berkshire, the Dove in Derbyshire, the Wharfe and Ure in Yorkshire and the Eden in Cumberland. The Usk is the best trout stream in Wales while Scotland and Ireland both have great numbers of fine trout streams, the best in Scotland probably being the Don while the Suir and Maigue in Ireland would be hard to beat. Trout, too, thrive in lakes and reservoirs like the Irish limestone lochs, Loch Leven in Scotland and many man-made reservoirs throughout the British Isles. The largest trout weigh up to about 40 lb. This is most exceptional and a four-pound trout is a big one anywhere. The American rainbow trout has been introduced into Britain but only with success in certain reservoirs and in the river Wye in Derbyshire. Both brown and rainbow trout are excellent table fish.

Sea *Trout* (Salmo *trutta*).—This fish, one of the great sporting fishes of the world, is the same species as the brown trout but has seagoing habits like the North American rainbow steelhead. The sea trout is spawned in November at the same time as the brown trout and spends about two years is the river before migrating to the sea. Unlike the salmon it remains close to the shore during its salt-water life and a great deal is known about its existence in the sea. After several months in salt water the young sea trout will probably return to the river for the first time and thereafter will return each year of its life to spawn.

Sea trout are caught on wet and dry flies, on spinning lures and on bait. They are very strong fish and are great leapers, jumping clear of the water many times in their efforts to escape the hook. Although much of their life is spent away from man, they are very shy and are generally best caught at night.

Sea trout run up most of the unpolluted rivers of the British Isles and are known by many local names. In Scotland the small fish returning for the first time are called finnock or harling. In Ireland sea trout are called white trout, in Wales sewin and in many other parts they are referred to as salmon trout. Weights of more than 20 lb. have been recorded but any fish over 6 lb. can be accounted a good one. They are particularly good table fish.

The west country is well blessed with good runs in streams like the Tavy, Taw and Torridge. In Wales the Dovey holds very big fish and both Scotland and Ireland have an embarrassment of riches in this regard, with Loch Maree in the former particularly worthy of note.

2. Coarse Fish.—Besides casting or floating his bait to the fish, the skilled coarse fisherman brings the fish to his bait and holds them in the vicinity by the use of ground bait. This usually consists of bread or poultry meal, soaked to varying consistencies. For heavy water a solid, doughy ground bait is needed to sink down in the current. For still waters, ground bait that acts like a cloud is used. A certain quantity of the bait the angler is using on his hook is mixed in the ground bait so that the fish are conditioned to feeding on it.

The diverse character of rivers and lakes, and the differing species in them, have led to the development of a number of fishing "styles." The Hampshire Avon in England, for example, is a deep, fast and very clear stream; the normal method of float fishing there is long trotting. A big float and heavily weighted terminal tackle are allowed to drift away with the current to perhaps 30 yd. below the angler. The rod used is limber, between 10–11 ft. in length, and the reel, usually a Nottingham reel, is very free running. The Thames, England, style on the other hand requires a very light, stiff,14-ft. rod. The float is fished very close to the rod tip with a very short length of line between them. The float travels along with the current as far as the length of rod allows it, and then is lifted and cast into the water again. Indeed there are still Thames fishermen who use, a "roach pole"—a light rod about 20 ft. long, with no rings, and the line tied to its end. In Europe, a somewhat similar long rod with tight line is still widely used for float fishing.

Another method of float fishing is float ledgering. The terminal tackle is heavily leaded, particularly close to the hook, and the distance between hook and float is greater than the depth of the water. Some of the lead thus rests on the river bed, anchoring the bait in a current, and allowing it to lie on the bottom. (See also Ledgering, below.)

The following method is typical of float fishing. A float fisherman seated at the head of a fast stream about six feet deep, with maggots as bait, will adjust his tackle so that the bait is just tripping the bottom of the stream. He throws in a handful of maggots as ground bait and then follows them down the stream with his hook bait. As his bait is carried down with the current, the angler watches his float. Should a fish take it, the float will stop, or dip, or be pulled under the water. At this indication the angler sets the hook by jerking his rod sharply, thus pulling his hook home in the fish. If the fish is of any size it has to be "played" by keeping pressure on it with the flexible rod and allowing it to swim away by giving it line off the reel. When the fish has been tired in this way, it is brought back close to the angler and lifted out by means of the landing net, a small hoop net on the end of a shaft.

Ledgering.—A basic method of angling all over the world, ledgering is closely allied to float fishing, but no float is used. Although there are many differing applications, the idea is to anchor the bait on the river or lake bottom by means of a sliding weight, or sinker, in Great Britain called a ledger. These vary in design, but it is essential that the weight hold the bottom and allow the line to pass freely when a fish takes the bait so that no resistance is felt. Various lengths of rod are used, probably the most popular being one of about seven feet in length, used with a fixed-spool reel. Ground bait is used in the same way as for float fishing.

As no float is used other methods of detecting a "bite" must be employed. Some watch the tip of the rod which is pulled down when a fish takes the bait. Indicators of various simple types are used which are attached to the line. When the indicator moves the angler sets the hook. A form of ledgering has been devised to catch carp, a very shy fish, at night, and for this purpose a simple electrical buzzer is used which sounds when the line is pulled out.

Fishing Matches.—Match fishing for coarse fish is a sport of enormous popularity on the continent of Europe and in England. The match organized by the Birmingham Anglers' association, for instance, draws 4,000 competitors, all fishing in one afternoon on one stretch of river. As can be imagined the organization of such an event is a considerable undertaking.

Matches usually last four or five hours. The river is divided into the required number of "swims," each marked with a numbered peg. The competitors draw for peg numbers and the purpose of the match is to catch the heaviest weight of fish. As each fish is landed it is placed in a "keep net" (a large, sack-shaped net) and thus kept alive until the end of the competition. At the end of the allotted time each angler's catch is weighed and the fish are then returned to the river.

Considerable sums of money are won in such contests, in prize money, in sweepstakes and in betting. It is not unusual for the winner of a big match to leave the waterside several hundred pounds the richer.

Pike (Esox *lucius*).—The largest purely fresh-water fish in Britain, the pike is the only fish of this type common to both Europe and North America.

Pike are caught on spinning (bait-casting) tackle, by trolling and by live baiting with a small fish. Despite their size they are not strong fighters, although in some of the cold-water Irish lochs their performance in this regard is more spectacular. They vary a good deal in size—in some parts of England a ten-pounder would be thought a good fish while in Ireland anything under 20 lb. would be considered of no account.

Many are the stories of the pike's rapacity though, like all predators, it ignores the smaller fish around it when not hungry.

Perch (Perca *fluviatilis*).—Olive green in colour, with dark bars down its side and red fins, the perch, a relative of the North American yellow perch, is a very handsome fish and, although troublesome to prepare, a fine table fish. It is most voracious and can be caught with a fly. by casting and trolling and by all types of bait fishing. Gregarious in habit, like all shoal fish it becomes more solitary as it becomes older and bigger.

Perch are caught all over the British Isles and weigh up to about six pounds. When unhooking a perch the angler must watch out for the spines in its front dorsal fin.

Roach (*Rutilus rutilus*).—In England the roach is to the coarse fisherman what the trout is to the game angler: there are hundreds of thousands of men whose ambition is to catch a "two-pounder." The roach is a silvery fish with a dark back and red fins, very timid and invariably the member of a shoal. Its diet mainly is composed of insects, fresh-water shrimps and weed, although after spawning big roach will feed on very small fish and can be caught on small spinners. Roach will take an artificial fly but for the most part they are caught on the very many different styles of bait fishing. They are common in nearly all English counties. in eastern Wales and southern Scotland, but are not native to northern Scotland or Ireland. In North America the name has been applied to several fish (see ROACH).

Rudd (*Scardinius* erythrophthalmus).—Looking like a roach but more golden in colour, the rudd is more localized in distribution, although unlike the roach it is common in Ireland. The rudd (*q.v.*) is a surface feeder, will take a fly well and can be caught by many of the different forms of bait fishing. Weights of more than four pounds have been recorded. It has been introduced to the United States where it is sometimes knoun as the pearl roach.

Chub (Leuciscus *cephalus*).—Big (up to about ten pounds), voracious, gregarious except when very large, and extremely shy, chub are greatly prized by coarse fishermen. They are widely distributed throughout England, eastern Wales and southern Scotland and can be caught by all means of angling provided due caution is employed. They take a fly well in summer. Famous chub rivers are the Hampshire Avon, the Herefordshire Wye and the Annan in Dumfriesshire. (For North American chub see CHUB.)

Dace (Leuciscus *leuciscus*).—Looking rather like a small chub, the dace never grows to a large size (under two pounds). It is nevertheless a good sporting fish and is usually caught on light float tackle. It takes the fly well, with a very fast rise. (For North American dace see DACE.)

Carp (*Cyprinus carpio*).—An exceedingly powerful and shy fish, the carp was considered almost impossible to catch except under exceptional circumstances and with the lightest of tackle. After World War II a means of capturing these fish was found. The method of fishing has already been described under *Ledgering*. Carp weighing 25 to 30 Ib. are not rare. The carp, originating in Asia, is also found in Europe and North America, where fly-fishing tackle often is preferred. (See also CARP.)

Barbel (*Barbus* barbus).—Originally native only to the Thames, the Trent and rivers of Yorkshire in Great Britain (but also found in central Europe), the barbel has been introduced into others, notably the Hampshire Avon via the Dorset Stour. It is an exceedingly powerful fish, beautifully shaped for living in very fast, strong water on clean gravel. A bottom feeder, the barbel is usually caught by deep-bait fishing although after spawning it will take a spinning bait. It is a very powerful fish running to a good size, up to 14 lb. and more.

Tench (Tinca *tinca*).—A handsome greenish fish, the tench feeds entirely on the bottom and is generally caught in the summer months at dawn or dusk. Living mostly in slow rivers and in lakes and ponds, the tench is usually caught on float tackle and is a powerful fish to handle. Tench are big at five pounds. Although they are little eaten in Britain, tench are excellent table fish.

Bream (Abramis brama).—A flat-sided fish. living mostly in slow muddy rivers and in lakes, the bream is another bottom feeder. It is caught by most forms of bottom fishing, is common to most of the English counties and is caught in quantity in Ireland. Weights of more than 13 lb. have been reported. In North America the name sometimes is given to a number of fish including bluegills and pinfish.

Eel (*Anguilla anguilla*).—Born in the Sargasso sea, the European fresh-water eel runs up most British rivers as an elver, a tiny, wriggling, wormlike creature two or three inches long. It spends several years in fresh water, during this time feeding voraciously. Having the ability to cross wet grass, it is found in landlocked ponds. It returns to the sea to spawn and die. The eel is mostly regarded as a nuisance by British anglers but big eels, those weighing several pounds, are powerful fish and the flesh is delicious. The eel of eastern North America is the Anguilla rostrata; that of Japan the Anguilla *japonica*. (See also EEL.)

Grayling (Thymallus thymallus).—The grayling is a beautiful silvery fish with a large, often deep purple, dorsal fin. It is of the same family as the highly prized North American game fish, the Montana grayling (*Thymallus* signifer tricolor) and the arctic grayling (Thymallus *arcticus* or *signifer*). It is closely related to the salmon and the trout and indeed behaves very much like the latter. These fine sporting fish are at their best from October to December, take both wet and dry flies well, and are also caught on float tackle. They are river fish and are only found in the cleanest of streams. Being by origin arctic fish, they will feed in the coldest of weather. They are much more prized on the European continent than in Britain both for the sport they offer and for their excellence as table fish. A two-pounder is a good fish anywhere.

3. Sea Fish.—The following are the most common sea fish sought by anglers in the British Isles:

European Sea Bass (*Morone* labrax).—The sea bass, a member of the sea perch family (Serranidae), is to the sea fisherman what the salmon is to the fresh-water angler. These fine predatory fish are found everywhere in British water and indeed members of the bass family are found all over the world. Silver, with a blue back and a spined dorsal fin, the bass is particularly fond of river estuaries. It is caught by every method of fishing and can at times be taken on the fly. An eight-pounder is a big fish. (See also BASS.)

Mackerel (Scomber *scombrus*).—The Atlantic mackerel, a widely distributed fish, is the strongest fish ounce for ounce in British waters. Like the sea bass it is predaceous and can be caught by most angling methods. On light tackle mackerel give wonderful sport and can sometimes be taken on a fly. It weighs up to four pounds. (See also MACKEREL.)

Gray Mullet.—There are a number of gray mullets, forming the family Mugilidae, the commonest British species being *Mugil* cephalus, known in North America as the striped or black mullet. Generally very difficult fish to catch, on occasions they lose all caution. Like the European sea bass they are fond of estuaries and will snim up into fresh water. They are usually caught by float or bottom fishing. Weights run up to about ten pounds.

Skate (Raja batis).—A very large member of the ray (*q.v.*) family, the skate is caught by fishing with heavy tackle on the bottom. It uses its flat body to obtain maximum resistance from the water and thus puts a very great strain on the rod and tackle. Excellent eating, the skate runs up to several hundred pounds in weight, particularly off the Irish coast.

Plaice (Pleuronectes *platessa*).—The plaice (*q.v.*) is a flatfish which is excellent eating. It is caught in a variety of ways, the most interesting being drifting with a worm as bait with a small spoon above the norm. It is thought that the spoon revolving suggests to the plaice that another fish is about to take the bait. The common European flounder (*q.v.*) (*Platichthys flesus*) is caught in the same way.

Pollack (*Gadus* pollachius).—A very strong and sporting fish, the European pollack, or pollock, is caught in a variety of ways. When hooked, it dives with great force for the bottom. It reaches a weight of more than 20 lb.

Blue Shark (Prionace *glauca*).—The sport of fishing for these large fish was unknown before the 1950s. They are principally caught off the Cornish coast by the methods already described. A large blue weighs up to 180 lb.

Mako Shark (*Isurus oxyrhynchus*).—This very large shark is caught in the same way as the blue shark and in the same waters. It weighs up to 350 lb. in British waters.

Tope (*Eugaleus* or *Galeus* galeus).—A small but very game member of the shark family, tope are caught in a variety of ways. The females are always bigger than the males and weigh up to about 70 lb.

Conger (Conger *oceanicus* or conger).—A very large and fierce eel, the conger is usually caught on bait of fresh fish. Fishing over a wreck is generally the best way of taking conger, which may weigh more than 80 lb.

D. EUROPE

The fish, both sea and fresh-water, just described are likewise common to European waters. Their distribution of course depends on geographical factors. There are, however, several fish not native to British waters which afford sport to anglers of the European continent. Principal among these is the European pike perch (*Lucioperca* lucioperca), a close relative of the American walleyed pike and a good sporting and table fish which can be caught on casting or spinning tackle and by bait fishing, and the huchen (Salmo hucho), a salmon found only in the Danube and its tributaries. The huchen runs as big as the Atlantic salmon and is usually caught in winter by casting with a mounted dead fish. In eastern Europe and in Russia there are several fish, particularly members of the chub family, which are not found farther west. Little is known about them from a fishing point of view and they have no common English names. Members of the char family (*Salvelinus* species), a troutlike fish found in some of the deep British lakes, are much more common in some of the more northerly countries and run to a good size. They do, however, vary greatly in size and colour from one locality to another and again have no common names in English.

1. Northern Europe.—Iceland has wonderful trout, sea trout and salmon fishing and also has a run of migratory arctic char (*Salvelinus alpinus*), the fish which runs into northern Canadian waters. Pike and perch are common in Norway but so are the even more sporting salmon, sea trout, trout, char and grayling. Salmon run very big (to more than 75 Ib.) on some of the Norwegian rivers, notably rivers like the Namsen and the Aaro. Sea trout also run big and on rivers like the Aurland and the Laerdal take the dry fly well. There is excellent salt-water fishing for most of the sea fish already mentioned. There are good salmon rivers in Sweden, too, although not as good as those in Nonvay. The Em is without doubt the best sea trout river in the world. There is also excellent fishing for pike and perch both in the lakes and, most unusually, in the Baltic where both fish are sea-run. Denmark has only one salmon river but does have excellent trout and sea trout fishing. The Danes have developed a technique for catching sea trout in the sea on spinning lures. There is also excellent sea fishing off the Danish coast and big game fishing for bluefin tuna, or tunny (Thunnus *thynnus*), running up to near the 1,000-lb. mark in the waters between Denmark and Sweden. There is salmon fishing in northern Finland and excellent fishing for trout, sea trout, char, grayling, pike and perch all over the country. The trout run big, particularly those which go up the streams from the larger lakes in order to spawn.

2. Central and Southern Europe.—All the fish so far mentioned are found in Germany, although pollution has killed off the salmon run in rivers like the Rhine. There is particularly good trout and grayling fishing in southern Germany and wonderful carp fishing in Schleswig-Holstein. Excellent trout and particularly fine grayling fishing is found in most parts of Austria as well as good fishing for pike and perch, char and huchen. The Traun is one of the best rivers in the world for trout and big grayling. The rivers of Czechoslovakia offer good trout and grayling fishing; there is an abundance of splendid pike, perch, pike perch and particularly carp. There is also good huchen fishing. In Switzerland there is very good fishing for most of the fish found in Europe, and trout and pike run very big in some of the lakes.

Good coarse fishing is to be found in some of the slower rivers of France and still excellent trout fishing in the more mountainous regions and in Normandy where there are chalk streams of the type found in southern England. The North American black bass has been introduced into some French waters and there are some good salmon rivers in Brittany. The sea fishing in the Mediterranean is very good. There is very good trout fishing in the Ardennes, good coarse fishing in the slower rivers and also plenty of sea fishing. The Netherlands has no trout fishing to speak of, but offers much water containing pike, perch, pike perch, roach, bream and carp. Sea fishing resembles that of Great Britain. Most of the European fish can be caught in Luxembourg and there is good trout fishing in the mountain streams.

Trout and grayling are fished in the mountain rivers of Italy and there are pike, perch, tench, carp, roach and chub in the slower rivers and lakes. The sea fishing is excellent. Spain has very fine salmon fishing in the Eo and Narcea and plenty of good trout fishing in mountain streams. There is very good trout and sea trout fishing and some salmon fishing in Portugal, which also has some of the best sea bass fishing in river estuaries. Swordfish and tuna can also be caught off the coast. Yugoslavia probably has the best trout fishing in Europe and every year trout up to ten pounds and more are taken on the dry fly. There is also excellent grayling fishing, huchen fishing in the Danube tributaries, and good fishing for carp, perch and pike.

3. U.S.S.R.—Angling is a very popular sport in the U.S.S.R. where there are many species of sporting fish, some of which are not known elsewhere. In the western part of the Soviet Union most of the European fish already described are found—Atlantic salmon in the north, trout, char and grayling well distributed, and in the slower rivers pike, perch, pike perch, roach, chub, carp and bream. There are several members of the chub family not found farther west, the taimen, a close relative of the Danube huchen, a landlocked Atlantic salmon (*Salmo relictus*) found in the northern lakes, and a number of members of the whitefish family (Coregonidae). The Pacific salmon which ascend the rivers of Canada and the United States also run in the Soviet rivers.

E. Africa

In the vast territory of Africa there are countless fresh-water and salt-water fish which have no common names in English. Certain of the native species give good sport and are thus sought by the angler, while trout, black bass and carp have been introduced into many parts.

Trout, both brown and rainbow, have been introduced into most of the mountain rivers in Cape Province, Natal and the Transvaal in South Africa, and on some of these rivers the fishing can be very good by any standards. The North American black bass, both the smallmouth and the largemouth, have also been successfully transplanted, and while they do not fight with quite the vigour they display in their native, colder waters, they are a very welcome addition to the fish available to anglers. The carp has also been introduced and runs to weights over 40 lb., particularly in the Transvaal. Of the native fresh-water fish a barbel called the yellowfish (*Barbus carpensis*) is a good fighter and will sometimes take a fly, and various members of the cichlid (*q.v.*) family (genus *Tilapia*), known locally as kurper, give good sport. The sea fishing off the coast of South Africa is magnificent, including big game fish like sharks, tuna and swordfish and smaller fish like elft (the North American bluefish), kabeljau, snapper and countless others.

There is very fine trout fishing for both brown and rainbow trout in Kenya, particularly in the Nyeri district. and the largemouth black bass has been introduced. There are also native fish of the *Barbus* genus. Off the coast sailfish, marlin, swordfish, tuna and barracuda are very numerous.

The great sporting fish of central Africa is the tiger fish (*Hydrocyon*) and this provides the best sport in that territory, including Northern Rhodesia. There are several species of tiger fish, the smaller ones running up to about 6 lb. and the larger ones to more than 20 lb. They are beautifully coloured fish with huge, dangerous teeth and can be taken on bait-casting lures with a steel leader. The giant Nile perch (*Lates niloticus*) runs up to hundreds of pounds in weight. There is good trout fishing in Southern Rhodesia, and the American black bass has also been introduced there. Of the native fish both the tiger fish and *Tilapia,* known locally as bream, are much sought after. In Uganda, trout have been introduced, both brown and rainbow. There are also Nile perch, members of the *Barbus* genus, tiger fish and a sporting fish called locally a barbel, which takes a casting lure well.

Tiger fish provide the best sport in West Africa, particularly in the Niger and its tributaries, although huge Nile perch and a fish called pella are fished for. There is excellent sea fishing, particularly for barracuda and also for tarpon.

F. Asia

1. India and Pakistan.—During the long British rule in India, brown and rainbow trout were introduced into the rivers of Kashmir and into some other mountain rivers. The principal native sporting fish of India and indeed of other parts of Asia is the mahseer (*Barbus tor*). A large fish running up to 200 lb. and more and with extremely powerful jaws, the mahseer thrives best in cold, fast rivers. Small fish will take a wet fly but the bigger ones are usually caught on bait or on spoons. Very strong hooks are required.

Other sporting fish are the carnatic carp (*Barbus carnaticus*), the baril (*Barilius bola*), which take a fly well, the rohu or labeo (*Labeo rohita*), and a predatory fish, the murral, which is widely distributed. There is also good fishing in the river estuaries for fish called bahmin, nair and seer.

2. Ceylon.—Rainbow trout have been introduced with success into some of the rivers of Ceylon, particularly into the streams in the Nuwara Eliya district. European carp have also been planted in some of the lakes and run to a good size. There are mahseer in some of the rivers but they run very small. A predatory fish called a walliya can be caught on bait-casting or spinning tackle.

3. China and Southeast Asia.—Sport fishing has flourished in the countries where British or American influence has been strong; although there are many species of fish in the vast area of China and southeast Asia, and fish represent a major item of diet, sport fishing with western equipment is little practised. There is, however, no keener angler anywhere than the Chinese and in Malaya, due to both British and Chinese enthusiasm, angling has grown in popularity. The local fish have no English names but in the rivers members of the mahseer family (*Barbus*) and off the coast many different kinds of sea fish, including sharks and swordfish, are caught in large numbers.

Pacific salmon run in the waters of Japan but although the Japanese are first-class commercial fishermen, fishing is not generally popular as a sport.

G. Oceania

1. New Zealand.—All the fresh-water sporting fish of New Zealand have been introduced and no finer trout fishing, both for brown and rainbow trout, but particularly for the latter, exists. The trout run very big, particularly in the North Island. Salmon, both the Pacific and Atlantic species, have been introduced to the South Island. The Atlantic salmon has become landlocked but the quinnat salmon (the Chinook or Tyee salmon of North America) remains seagoing and is taken in the rivers on spoons and similar baits.

The big game fishing, particularly in the Bay of Islands and the Bay of Plenty, is first class, swordfish and sharks being the principal quarry. Since World War II sea fishing, particularly surf casting, has become increasingly popular in New Zealand.

2. Australia.—A number of native fish of high edible and sporting value are found in the Australian rivers, the principal ones being the Murray cod *(Maccullochelia macquariensis),* the perch *(Prectoplites fluviatilis)* and the golden perch *(Prectoplites ambiguus)*. Brown and rainbow trout have been introduced with success on a very wide scale. Australia is blessed with splendid sea fishing, both for big game fish—swordfish, tuna, shark—and for smaller fish like jewfish, kingfish, barracuda, grouper and yellowtail. Some of the world's finest trout fishing is found in Tasmania.

See also references under "Fishing" in the Index volume.

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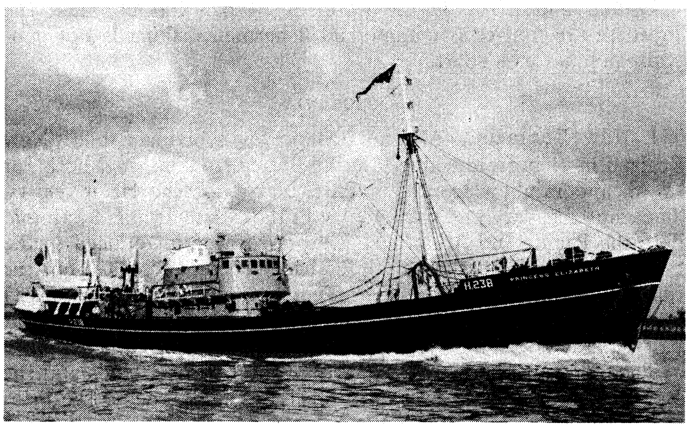
(T. B. T.; F. E. KE.)

FISHING FROG: *see* ANGLER.

FISHING VESSELS. The first fishing vessel was probably a log pushed from a river bank by a primitive fisherman who straddled it to get to a good hole across the river. This desire for mobility has been the guiding force in the development of these craft. The log soon proved unsatisfactory, so it was hollowed out and the ends pointed. As explorations extended, canoes were built by making frameworks of wood and covering them with skins or bark, and later by strips of wood planking. Lengthening, deepening and widening the canoes made them more and more seaworthy. At first the deck covered only the bow, but it was later extended to the stern and finally all over to take rougher water. Houses and quarters were installed for longer voyages. Oars and sails provided motive power for the earliest types, but in modern times mechanical propulsion and equipment for hauling lines and nets were developed. Eventually there evolved such modern monsters as the 700-ft. whale mother ships.



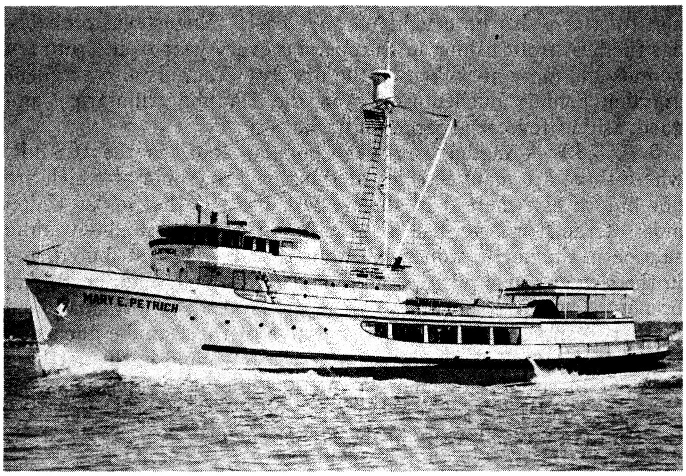
BY COURTESY OF ST. ANDREW'S STEAM FISHING CO., LTD., HULL

BRITISH LONG-RANGE DEEP-SEA TRAWLER, OPERATED IN THE NORTH ATLANTIC TO CATCH COD AND OTHER BOTTOM FISH BY MEANS OF TRAWL NETS

As shipbuilding technology developed, so did the techniques of catching fish, and the character of fishing vessels changed to suit the methods employed. Three basic types of fishing evolved: fishing with a spear or harpoon; fishing with a hook and line; and fishing with a net. Vessels for spear fishing developed from the primitive canoe to the modern whale-killer ships that catch whales with explosive harpoons. Hook-and-line vessels developed in a wide range of types and sizes up to the modern tuna clipper or long-liner. Net fishing vessels developed an equal range of varieties extending in size up to the 200-ft. trawlers used on the Atlantic codfish banks.

Vessels used for fishing in the protected waters of rivers, lakes and sounds are small and are nearly always open vessels without closed decks. Although subject to many variations in shape and in materials of construction, they are essentially the same the world over. While the open boat is still widely used for commercial fishing in many parts of Africa, Asia and South America, in Europe and the United States most such craft are used by fishermen who fish for sport only.

Short-range boats designed to fish in exposed bays or to make short runs out into the ocean are by far the most numerous of commercial fishing vessels and are used throughout the maritime world. Generally about 20 to 45 ft. in length, they are either partly or totally enclosed; they always have partial decks over the bow and stern and quite often have full decks broken only by fish holds or hatches. There is an infinite variety of craft of this kind. Sails are still used to a limited extent in some areas. but the internal combustion engine is now practically the universal source of Dower.



BY COURTESY OF JAMES E. PETRICH

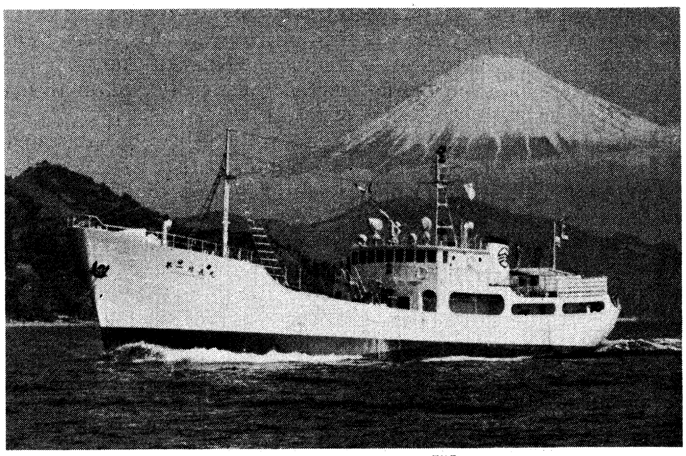
U.S. TUNA CLIPPER

Live bait is carried in the large tank on the after part of the vessel. Tuna are caught from it by poles with short lines and hooks

Intermediate-range boats can go out into the open sea and stay for several days. They range from 45 to 80 ft. in length and use various types of fishing gear. With fully enclosed decks, mechanical propulsion, and accommodations, they can fish in relatively exposed waters a considerable distance from their home port. They operate mainly out of ports in the more highly industrialized countries.

Long-range vessels range from 80 to 200 ft. in length. Among the various types are the trawlers that operate from both sides of the Atlantic into the Atlantic fishing grounds; the tuna clippers that operate off the western coasts of the Americas; the tuna handliners and bait boats operated by the Japanese; and the whale-killer ships operated by Japanese and European interests in the Antarctic. All such craft are highly mechanized and expensive.

Means of preserving a catch of fish is a necessity for intermediate-range and long-range fishing vessels. Salt was the first medium but it was largely replaced in the 20th century by ice. Modern vessels, particularly the long-range type, use mechanical refrigeration extensively. In such fisheries as the Pacific tuna, fish are held for three or four months before the vessel returns



BY COURTESY OF FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

JAPANESE **LONG-RANGE TUNA VESSEL** THAT USES **LONG** LINES SPREAD BETWEEN **BUOYS** WITH BAITED HOOKS SUSPENDED FROM SHORT VERTICAL LINES

to port.

Mother ships that accompany smaller fishing vessels to distant fishing grounds form a special category. These ships are equipped to supply, feed and maintain large numbers of men for a long period of time and to process the fish on board. The codfishing schooners of the North Atlantic were probably the first mother ships. They remained at sea for long periods while individual fishermen in dories brought the fish aboard to be salted down. Many types of mother ships have been tried and many are still operating. The whale factory ships are the largest. Salmon, tuna, cod and crab canneries and freezer ships of various kinds operate in different parts of the world.

In early times, as distinctive types of vessels were developed in different areas, they generally were named for the area plus an additional name, the derivation of which has often been lost in time. The Yorkshire "Coble," Hasting's "Lugger" and Chesapeake "Sharpie" are examples.

As communications developed and fishing spread throughout the world, the old names and place designations have been dropped and they are now generally named for the type of fishing gear they use. Vessels fishing with nets are called trawlers, draggers, seiners, gill netters and drifters. Vessels using hooks and lines are called long-liners, hand-liners, trollers: pole boats and bait boats. *See* also FISHERIES; SEINING, NETTING AND TRAWLING. (G. C. NM.)

FISH LOUSE, small Crustacea, viz., members of the orders Eucopepoda, Branchiura, Isopoda and Amphipoda which are external and gill parasites of fishes and other marine animals. *See* CRUSTACEA; COPEPODA; MALACOSTRACA.

FISK, JAMES (1834–1872), U.S. financier whose flamboyant techniques in promoting securities earned for him the name "Barnum of Wall Street," was born April 1, 1834, at Bennington, Vt. He was successively a circus hand, waiter, peddler, dry-goods salesman, stockbroker and corporate official. In 1864 he formed the brokerage firm later known as Fisk and Belden and became a stock market operator for Daniel Drew. In 1867 Fisk joined Drew and Jay Gould in wresting control of the Erie railroad from Cornelius Vanderbilt. As vice president and comptroller of the road, Fisk used corporate funds to corrupt public officials,produce Broadway shows and support Broadway beauties, including the well-known Josie Mansfield, to such an extent that he was also called "The Prince of the Erie." Fisk was Gould's lieutenant in the attempted corner of the gold market which led to the fateful "Black Friday" of Sept. 24, 1869. Fisk was shot by E. S. Stokes, a former business associate, on Jan. 6, 1872, and died the following day in New York city.

See W. A. Swanberg, *Jim Fisk: the Career of an Improbable Rascal* (1959). (J. R. LT.)

FISK, WILBUR (1792–1839), U.S. educator and Methodist clergyman, was born at Brattleboro, Vt., on Aug. 31, 1792, the son of Isaiah and Hannah (Bacon) Fisk. He studied at Peacham academy and the University of Vermont, and graduated from Brown university in 1815 (A.M., 1818). Licensed as a local preacher at Lyndon, Vt., in 1818, he was received into the New England Conference of the Methodist Church in June of that year. While stationed at Charlestown, Mass. (1819–20), Fisk attended a camp meeting, where—according to his statement—he experienced "a supernatural work of grace leading him into a higher Christian life." In 1823 he married Ruth Beck of Providence, R.I., and for three years thereafter was presiding elder of the Vermont district, becoming in 1826 chaplain of the Vermont legislature. While in Europe (1835–36) he was elected bishop of the Methodist Episcopal Church (May 1836) but declined consecration. His high repute as an educator did much to raise the estimate of Methodism in New England, where before his time it had suffered because of its indifference to learning. He was a founder and principal of Wesleyan academy, Wilbrahm, Mass. (1825–30); a founder and first president of Wesleyan university, Middletown, Conn. (1831–39); and a member of the Connecticut board of education (1838). Pulmonary hemorrhages, from which he had suffered since childhood, resulted in his death on Feb. 22, 1839, at the height of his career.

See J. Holdick, *The Life of Wilbur Fisk, D.D.;* J. H. Brown (ed.), *Lamb's Biographical Dictionary of the United States.* (W. C. B.)

FISKE, BRADLEY ALLEN (1854–1942), U.S. naval officer who invented a number of instruments that revolutionized naval warfare, was born in Lyons, N.Y., June 13, 1854. He graduated from the United States Naval academy in 1874. At the battle of Manila bay (1898) he was navigator of the gunboat "Petrel," and was cited by Adm. George Dewey for heroic action in inaugurating fire control from a fighting top. During the Philippine insurrection, Fiske commanded the monitor "Monodnock."

His fame rests, however, upon his inventive genius. Chief among his inventions were the electric range finder, an electric ammunition hoist, a naval telescope mount and sight, and the torpedoplane (*q.v.*). Bluff and outspoken, Fiske was in controversy with secretaries of the navy through several administrations. He was one of the ablest exponents of adequate naval preparation, and his enthusiasm frequently ran afoul of a conservative navy department. His resignation, in May 1915, was the outcome of a long dispute on naval policy. Fiske saw many of his inventions developed and used successfully in World Wars I and II. He wrote *From Midshipman to Rear Admiral* (1919), an account of his experiences in the U.S. navy.

He died in New York city on April 6, 1942.

See D. W. Knox, *A History of the United States Navy* (1936). (W. B. CK.)

FISKE, JOHN (1842–1901), U.S. historical writer and popular lecturer, was born in Hartford, Conn., March 30, 1842. His name, originally Edmund Fisk Green, was legally changed to that of a great-grandfather, John Fisk, in 1855; he later adopted the spelling Fiske. Graduated from Harvard in 1863, Fiske practiced law for a short time, delivered two series of lectures at Harvard in 1869 and 1871, was assistant librarian from 1872 to 1879, and thereafter devoted himself to writing and lecturing.

In his best known philosophical work, *Outlines of Cosmic Philosophy* (1874), Fiske undertook to demonstrate the compatibility of science and religion by maintaining that both could be comprehended under the generalizations of the then vigorously disputed concept of evolution.

Fiske wrote 13 volumes of United States history, 10 of them dealing with the colonial period and all of them based on his public lectures. Fiske's historical writing, although concerned largely with the development of governmental institutions, also contained material on social life and economic interests. One of his last works, *The Mississippi Valley in the Civil War* (1900), reflected the newer interest of historians in sectional influences in political life. He died at Gloucester, Mass., on July 4, 1901.

BIBLIOGRAPHY.—Josiah Royce, "Introduction," *Miscellaneous Writings of John Fiske,* 12 vol. (1902) is the best analysis of Fiske's thought; John S. Clark, *The Life and Letters of John Fiske,* 2 vol. (1917), furnishes personal data; Edward Arthur White, *Science and Religion in American Thought* (1952), provides interpretation and context. (E. A. WE.)

FISKE, MINNIE MADDERN (MARIE AUGUSTA DAVEY) (1865–1932), U.S. actress whose career in the theatre was long and distinguished, was born in New Orleans, La., Dec. 19, 1865. Her father, Thomas W. Davey, was a theatrical manager. Mrs. Fiske first appeared on the stage at the age of three under her mother's maiden name as "Little Minnie Maddern." At five she made her New York debut in *A Sheep in Wolf's Clothing* and later the same year performed as Eva in *Uncle Tom's Cabin.* The next several years were spent as a child actress; she made her first appearance as an adult star in 1882. In 1890 she married Harrison Grey Fiske, a playwright and theatrical manager. In 1893 she enjoyed a modest success in *Hester Crewe,* a play written by her husband, but *Tess of the D'Urbervilles* (1897) was her first truly great success. At about this time also, she began to specialize in the plays of Ibsen and Shakespeare, and her interpretations of Ibsen's heroines were especially acclaimed.

In 1901 Fiske opened the Manhattan theatre in New York to oppose Charles Frohman's Theatrical Syndicate, which then dominated the U.S. theatre. Although Fiske lost a great deal of money during the six years this theatre was in operation, he and his wife gave New York some of its greatest theatre. The most important plays in which Mrs Fiske starred during this period were Paul Heyse's *Mary of Magdala* (1902), *Hedda Gabler* (1903), *Becky Sharp* and *Leah Kleschna* (1904), Langdon Mitchell's *The New York Idea* (1906) and Ibsen's *Rosmersholm* (1907). After the closing of the Manhattan, Mrs. Fiske appeared in Edward Sheldon's *Salvation Nell* and in several Ibsen plays. On Feb. 1j, 1932, she died of a heart ailment.

BIBLIOGRAPHY.—William Winter, *The Wallet of Time* (1913); Walter Pritchard Eaton, "The Theatre Mrs Fiske Knew," *Theatre Arts Monthly* (May 1932); F. C. Griffith, *Mrs. Fiske* (1912). (S. W. H.)

FISK UNIVERSITY, an institution of higher education in Nashville, Tenn., named for Gen. Clinton B. Fisk of the Freedmen's bureau, was established in 1865 and opened in Jan. 1866 as the Fisk school to provide for the education of southern Negroes. In 1867 it secured a charter as Fisk university under the auspices of the American Missionary association to educate young people "irrespective of color." Shortly thereafter, a Tennessee statute restricted attendance to Negroes, but later the college again admitted foreign and U.S. students of all races and creeds.

See NEGRO, AMERICAN: *Educational and Cultural Developments.*

FISTULA, a term used in surgery to designate an abnormal communication leading either from the surface of the body to a normal cavity or canal, or from one normal cavity or canal to another. These communications are the result of disease or may be congenital. Fistulas between arteries and veins also may occur, usually as the result of injury. (F. L. A.)

FIT. In medicine, a fit is an extreme emotional outbreak, a spasm or paroxysm. More commonly the term is used to describe a convulsive state which may be followed by semiconsciousness or unconsciousness or coma. *See* CONVULSIONS; EPILEPSY.

FITCH, (WILLIAM) CLYDE (1865–1909), U.S. playwright, whose best-known play was *Beau Bruntmel,* produced in 1890, was born on May 2, 1865, in Elmira. N.Y., and graduated from Amherst college, Amherst, Mass., in 1886. An interest in literature led him to establish himself in New York city, where he began writing short stories for various magazines. He was a prolific writer, producing 33 original plays and 22 adaptations. His best plays were social satires and character studies focusing on some human strength or weakness. Among the more important aside from *Beau Brummel* were *The Climbers* (1901), *The Girl With the Green Eyes* (1902), *The Truth* (1907) and *The City* (1909). He also wrote a large number of frank melodramas and historical plays. Fitch excelled in comedy, realistic dialogue and theatre technique, but in general his plays lack strength and universality. He died in France on Sept. 4, 1909.

See M. J. Moses and V. Gerson (eds.), *Plays by Clyde Fitch* (1915) and *Clyde Fitch and His Letters* (1924).

FITCH, JOHN (1743–1798), U.S. metal craftsman and one of the earliest builders of steamboats, designed and built a steamboat which operated successfully in 1787.

Born Jan. 21, 1743. in Windsor, Conn, he received but six years of common schooling. He was then put to work, first on a farm and later apprenticed to a brass founder and clockmaker. He set up his own business but did not succeed financially, and in all his later efforts he was always short of funds.

Settling in Bucks county, Pa., in 1785, Fitch became interested in propelling boats by steam power, an interest that continued until his death. He failed to obtain subsidies from the Continental congress and applied to the state governments, who refused funds but granted him exclusive rights to operate steamboats on their waters. He built several models of steamboats and with these persuaded some Philadelphians to form a company which furnished money to build a 45-ft. boat. On Aug. 22, 1787, in the presence of members of the Constitutional Convention, this vessel was successfully operated on the Delaware river. He built a larger boat propelled by steam-powered paddle wheels, which made regularly scheduled trips, carrying passengers and freight, between Philadelphia, Pa., and Trenton, N.J. The schedule was maintained and published in the Philadelphia daily papers.

Fitch's claims to invention of the steamboat were challenged by James Rumsey, and this controversy resulted in the issuance of pamphlets in 1787–88 in which both men set forth their claims.

Fitch was granted a U.S. patent for steamboats on Aug. 26, 1791, and a French patent in the same year.

He started construction of another steamboat but it was wrecked by a storm. This so discouraged the members of his company that they declined to advance any more money. He went to France in 1793 but failed in his attempts to interest that country in steam navigation. He returned to the U.S. despondent and in poor health. He died at Bardstown, Ky., on July 2, 1798.

Fitch built steamboats propelled by oars. paddle wheels and a crude type of screw propeller. These vessels operated reliably, but he did not give thought to building and operating costs and so failed to demonstrate the economic value of steam propulsion. As a result, the use of steam power was not continuous following his early efforts; and Robert Fulton, who did not launch a boat until after Fitch's death, is given more credit for the origin of this type of transportation. (M. R. D.)

FITCH, RALPH (fl. 1583–1606), London merchant, one of the earliest English travellers and traders in Mesopotamia, the Persian gulf and Indian ocean, India proper and Indochina. In Jan. 1583 he embarked in the "Tiger" for Tripoli and Aleppo in Syria (*see* Shakespeare, *Macbeth,* act i, sc. 3), together with J. Newberie, J. Eldred and two other merchants of the Levant company. From Aleppo he reached the Euphrates, descended the river to Fallujah, crossed southern Mesopotamia to Baghdad and dropped down the Tigris to Basra (May to July 1583). There Eldred stayed behind to trade, while Fitch and the rest sailed down the Persian gulf to Ormuz, where they were arrested as spies and sent prisoners to the Portuguese viceroy at Goa (September to October). Through the sureties procured by two Jesuits (one being Thomas Stevens, formerly of New college, Oxford, the first Englishman known to have reached India by the Cape route, in 1579) Fitch and his friends regained their liberty, and escaping from Goa (April 1584) travelled through the heart of India to the court of the great Mogul Akbar, then probably at Agra. In Sept. 1585 Newberie left on his return journey overland via Lahore (he disappeared in the Punjab), while Fitch descended the Jumna and the Ganges, visiting Benares, Patna, Kuch, Behar, Hugli, Chittagong (1585–86), and on by sea to Pegu and Burma.

He visited the Rangoon region, ascended the Irawadi some distance, acquired a remarkable acquaintance with inland Pegu and even penetrated to the Siamese Shan states (1586–87). Early in 1588 he visited Malacca; in the autumn of this year he began his homeward travels, first to Bengal; then round the Indian coast, touching at Cochin and Goa, to Ormuz; next up the Persian gulf to Basra and up the Tigris to Mosul (Nineveh); finally via Urfa, Bir on the Euphrates, Aleppo and Tripoli, to the Mediterranean. He reappeared in London on April 29, 1591. His experience was greatly valued by the founders of the East India company, who specially consulted him on Indian affairs. He died *c.* Oct. 5, 1611.

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FITCHBURG, a city of Massachusetts, U.S., located on the Mohawk trail 46 mi. N.W. of Boston, was named for John Fitch who did much to secure incorporation. It is one of the seats of Worcester county. Originally known as Turkey Hills, Fitchburg was first settled in 1740 and was essentially an agricultural community until the first decade of the 19th century. It was established as a town Feb. 3, 1764, and incorporated as a city March 8, 1872.

For years Fitchburg's principal industries were the manufacture of machinery, paper and textiles.

After mid-20th century the leading industries were the manufacture of metal products, paper and allied products, and machinery. Fire arms, leather goods, juvenile wheel goods and toys, locksmith supplies and padlocks, saws, shoes and slippers, and synthetic yarns are other major products. A state teachers college was established there in 1894.

For comparative population figures *see* table in MASSACHUSETTS: *Population*. (J. F. Z.)

FITCHEW, a nameapplied to the ferret and also to the polecat (*qq.v.*). Earlier forms of the word are ficheux, fecheu and fitcholl.

FITTIG, RUDOLF (1835–1910), German organic chemist, known for the reaction by which aryl hydrocarbons may be synthesized, was born on Dec. 6, 1835, in Hamburg. After studying for his Ph.D. (1856–58) under Friedrich Wöhler at Göttingen, he was assistant to Wöhler, then became professor at Tübingen in 1869, and successor to Adolf von Baeyer at Strasbourg in 1876. He helped to edit *Annalen* der Chemie from 1895 to 1910. The Wurtz-Fittig reaction, first used by Fittig in 1864 to prepare toluene from brombenzene, methyl iodide and sodium, is a general method by which aryl halides react in ether with sodium to produce hydrocarbons. Fittig and his students published approximately 400 papers which contributed much to synthetic organic chemistry. Among the subjects treated in the papers were the discovery of pinacone reaction (1859); diphenyl (1862); isophthallic acid (1869); complex potassium manganese cyanides (1868); and the synthesis of mesitylene (1869). In the course of later research cumerone, diacetyl and phenanthrene were produced; piperine and unsaturated acids were studied; the diketone formula for quinone was proposed; alpha-naphthol was synthesized; and the relationship between gamma-hydroxy acids and lactones was clarified. Fittig had tremendous influence on organic chemistry. He died on Nov. 19, 1910, in Strasbourg. (V. Bw.)

FITTON, MARY (*c.* 1578–1647), identified by some writers with the "dark lady" of Shakespeare's sonnets although there is no hint in her authenticated biography that she was acquainted with Shakespeare. The daughter of Sir Edward Fitton of Gawsworth, Cheshire, she was baptized there on June 24, 1578. She became maid of honour to Elizabeth I c. 1595. She was the mistress of William Herbert, later earl of Pembroke; she married Capt. William Polwhele and, on his death, a Captain Logher. She died *c.* 1647 and is represented, apparently as dark in colouring, on the Fitton monument in Gawsworth church.

FITTON, WILLIAM HENRY (1780–1861), British geologist, was born in Dublin in Jan. 1780. Educated at Trinity college, in that city, and at Edinburgh university, he took a medical practice at Northampton in 1812, and for some years the duties of his profession engrossed his time. In 1820 he settled in London and devoted himself to the science of geology. His "Observations on some of the Strata between the Chalk and the Oxford Oolite, in the South-east of England" (Trans. Geol. *Soc.* ser. 2, vol. iv.) embodied a series of researches extending from 1824 to 1836, and form the classic memoir familiarly known as Fitton's "Strata below the Chalk." In this great work he established the true succession and relations of the Upper and Lower Greensand, and of the Wealden and Purbeck formations, and elaborated their detailed structure. He had been elected F.R.S in 1815, was president of the Geological Society of London 1827–29, and was awarded the Wollaston medal by the Geological Society in 1852. He died in London on May 13, 1861.

See the obituary notice by R. I. Murchison in *Quart. Journ. Geol Soc.* vol. xviii., 1862, p. xxx.

FITZGERALD, the name of a historic Irish house, which descends from Walter, son of Other, who at the time of the Domesday survey (1086) was castellan of Windsor and a tenant-in-chief in five counties. From his eldest son, William, known as "de Windsor," descended the Windsors of Stanwell, of whom Andrew Windsor was created Lord Windsor of Stanwell by Henry VIII; the barony is now vested in the earl of Plymouth, his descendant in the female line. Of Walter's younger sons, Robert was given by Henry I the barony of Little Easton, Essex; Maurice obtained the stewardship (*dapiferatus*) of the great Suffolk abbey of Bury St. Edmunds; Reinald the stewardship to Henry I's queen, Adelaide; Gerald (also a dapifer) became the ancestor of the Fitz-Geralds.

As constable and captain of the castle that Arnulf de Montgomery raised at Pembroke, Gerald strengthened his position in Wales by marrying Nesta, sister of Griffith, prince of south Wales, who bore to him famous children, "by whom the southern coast of Wales was saved for the English and the bulwarks of Ireland stormed." Of these sons William, the eldest, was succeeded by his son Odo, who was known as "de Carew," from the fortress of that name at the neck of the Pembroke peninsula; William's eldest son, Gerald, had been slain by the Welsh. The descendants of Odo held Carew and the manor of Moulsford, Berks, and some of them acquired lands in Ireland. But the wild claims of Sir Peter Carew, under Queen Elizabeth I, to vast Irish estates, including half of "the kingdom of Cork," were based on a fictitious pedigree. Odo de Carew's brothers. Raymond Fitz-gerald (*q.v.*) and Griffin, took an active part in the conquest of Ireland.

Returning to Gerald and Nesta, their son David "Fitz Gerald" became bishop of St. David's (1147–76), and their daughter Angharat mother of Gerald de Barri (Giraldus Cambrensis; *q.v.*). A third son, Maurice, obtained from his brother the stewardship of St. David's, c. 1174, and having landed in Ireland in 1169, on the invitation of King Dermod, founded the fortunes of his house there, receiving lands at Wexford, where he died and was buried in 1176. His eventual territory, however, was the great barony of the Naas (in Kildare), which Richard Strongbow, earl of Pembroke, granted him with Wicklow castle; but his sons were forced to give up the latter. His eldest son, William, succeeded him as baron of the Naas and steward of St. David's, but William's granddaughter carried the Naas to the Butlers and so to the Loundreses. Gerald, a younger son of Maurice, who obtained lands in Offaly, was father of Maurice "Fitz Gerald," who was justiciar of Ireland from 1232 to 1245. In 1234 he fought and defeated his overlord, the earl marshal, Richard, earl of Pembroke, and he also fought for his king against the Irish, the Welsh and in Gascony, dying in 1257. He held Maynooth castle, the seat of his descendants.

Earls of **Kildare.**—The justiciar left a grandson Maurice (son of his eldest son Gerald) and a younger son Maurice; the latter was justiciar for a year in 1272, while the former, as heir male and head of the race, inherited the Offaly lands, which he is said to have bequeathed at his death (1287) to John "Fitz Thomas," whose military life was crowned by a grant of the castle and town of Kildare, and of the earldom of Kildare to him and the heirs male of his body (May 14, 1316). Dying shortly after, he was succeeded by his son Thomas, son-in-law of Richard de Burgh, the "red earl" of Ulster, who received the hereditary shrievalty of Kildare in 1317, and was deputy justiciar in 1320 and justiciar of Ireland in 1327–28. His younger son Maurice "Fitz Thomas" (1331–90), 4th earl, was frequently appointed justiciar, and was great-grandfather of Thomas (1427–77), 7th earl, who between 1455 and 1475 was repeatedly in charge of the government of Ireland as "deputy," and who founded the "brotherhood of St. George" for the defense of the English Pale. His son Gerald (*c.* 1456–1513), 8th earl, called Mór ("the Great"), was deputy governor of Ireland from 1481 for most of the rest of his life, though imprisoned in the Tower of London t o years (1494–96) on suspicion as a Yorkist. He was mortally wounded while fighting the Irish as "deputy." Gerald (d. 1534), 9th earl, followed in his father's steps as deputy, fighting the Irish, till the enmity of the earl of Ormonde, the hereditary rival of his house, brought about his deposition in 1520. In spite of temporary restorations he died a prisoner in the Tower.

In his anger at his rival's successes the 9th earl had been led, it was suspected, into treason, and while he was a prisoner in England his son Lord Thomas Fitzgerald (*q.v.*) broke out into open revolt (1534). He and his five uncles were hanged as traitors in Feb. 1537, and acts of attainder completed the ruin of the family.

But the earl's half-brother Gerald, a mere boy, had been carried off and, after many adventures at home and abroad, returned to England after Henry VIII's death, and to propitiate the Irish was restored to his estates by Edward VI (1552). Having served Mary I in Wyat's rebellion, he was created by her earl of Kildare and Lord Offaly on May 13. 1554, but the old earldom (though the contrary is alleged) remained under attainder. Although he conformed to the Protestant religion under Elizabeth I and served against the Munster rebels and their Spanish allies, he was imprisoned in the Tower on suspicion of treason in 1582. But the acts attainting his family had been repealed in 1569, and the old earldom was thus regained. In 1585 he was succeeded by his son Henry ("of the Battleaxes"), who was mortally wounded when fighting the Tyrone rebels in 1597. On the death of his brother in 1599 the earldom passed to their cousin Gerald, whose claim to the estates was opposed by Lettice, Lady Digby, the heir-general. She obtained the ancestral manor of Geashill with its territory and was recognized in 1620 as Lady Offaly for life. George (1611–60), 16th earl, had his castle of Maynooth pillaged by the insurgents in 1642, and after its subsequent occupation by them in 1646 it was finally abandoned by the family.

The history of the earls of Kildare after the Restoration was uneventful save for the reacquisition in 1739 of Carton, which thenceforth became the country seat of the family. James (1722–73), 20th earl, who obtained a viscounty of Great Britain in 1747, built Leinster house (now the place of assembly of the oireachtas, "national parliament") in Dublin, and formed a powerful party in the Irish parliament. In 1756 he was made lord deputy; in 1760 he raised the Royal Irish regiment of artillery; and in 1766 he received the dukedom of Leinster, which remained the only Irish dukedom till that of Abercorn was created in 1868. His wealth and connections secured him a commanding position. Of his younger children, one son was created Lord Lecale; another was the well-known rebel, Lord Edward Fitzgerald; another was the ancestor of Lord De Ros; and a daughter was created Baroness Rayleigh. William Robert (1749–1804), 2nd duke, was a cordial supporter of the Union, and received nearly £30,000 for the loss of his borough influence. In 1883 the family was still holding more than 70,000 ac. in County Kildare; but, after a tenure of nearly 750 years, arrangements were made to sell the land to the tenants under the land purchase acts. In 1893 Maurice Fitzgerald (1887–1922) succeeded his father, Gerald (1851–93), 5th duke; Maurice's brother Edward (1892–) succeeded as 7th duke in 1922.

Earls of **Desmond.**—The other great Fitzgerald line was that of the earls of Desmond, who were undoubtedly of the same stock and claimed descent from Maurice, the founder of the family in Ireland, through a younger son Thomas. Thomas "Fitz Maurice" Nappagh ("of the ape"; 1261–98), justiciar of Ireland in 1295, obtained a grant of the territory of "Decies and Desmond" in 1292. His son Maurice Fitz Thomas or Fitzgerald (d. 1356). inheriting vast estates in Munster, and strengthening his position by marrying a daughter of Richard de Burgh, earl of Ulster, was created earl of Desmond (*i.e.*, south Munster) on Aug. 22, 1329. The greatest Irish noble of his day, he led the Anglo-Irish party against the English. He surrendered in England to the king and was imprisoned, but eventually regained favour, and was even made deputy in 1355. Two of his sons succeeded in turn. Gerald (1359–98), 3rd earl, being appointed deputy in 1367, despite his adopting his father's policy which the crown still wished to thwart. But he was superseded two years later, and defeated and captured by the native king of Thomond shortly after. Yet his sympathies were distinctly Irish. The remote position of Desmond in the southwest of Ireland tended to make the succession irregular on native lines, and a younger son succeeded as 6th earl in 1420. His son Thomas, earl from 1462 to 1467, governed Ireland as deputy from 1463 to 1467, and upheld the endangered English rule by stubborn conflict with the Irish. Yet John Tiptoft, earl of Worcester, who superseded him, procured his attainder with that of the earl of Kildare, on the charge of alliance with the Irish, and he was beheaded on Feb. 15, 1468, his followers in Munster avenging his death by invading the Pale. His younger son Maurice, earl from 1487 to 1520, was one of Perkin Warbeck's Irish supporters, and besieged Waterford on his behalf. Maurice's son James, earl from 1520 to 1529, was proclaimed a rebel and traitor for conspiring with the French king and with the emperor. At his death the succession reverted to his uncle Thomas (1454–1534), at whose death there was a contest between his younger brother Sir John "of Desmond" and his grandson James, a court page of Henry VIII. Sir John secured possession till his death (1536), when his own son James succeeded de facto, and de *jure* on the rightful earl's being murdered by the usurper's younger brother in 1540. Intermarriage with Irish chieftains had by this time classed the earls among them, but although this James looked to their support before 1540, he thenceforth played so prudent a part that in spite of the efforts of the Butlers, the hereditary foes of his house. he escaped the fate of the Kildare branch and kept Munster quiet and in order for the English till his death in 1558. His four marriages produced a disputed succession and a break-up of the family. His eldest son, Thomas "Roe" (the Red) was disinherited, and failed to obtain the earldom, which was conferred by Elizabeth I on his half-brother Gerald, "the rebel earl" (c. 1533–83) (see DESMOND, GERALD FITZGERALD).

But the influence of the Fitzgeralds remained powerful even after the forfeiture of their estates following the murder of the 15th earl. The disinherited Thomas "Roe" left a son, James "Fitz Thomas," who, succeeding him in 1595 and finding that the territory of the earls would never be restored, assumed the earldom and joined O'Neill's rebellion in 1598, at the head of 8,000 of his men. He was eventually seized (1601) by his kinsman the White Knight, Edmund Fitz Gibbon, whose sister-in-law he had married, and was sent to the Tower. The sugan ("man of straw") earl lingered there obscurely as "James M'Thomas" till his death in 1607. In consequence of his rebellion and the devotion of the Irish to his house, James, "the queen's earl," son of Gerald, "the rebel earl," who had remained in the Tower since his father's death (1583), was restored as earl of Desmond and sent to Munster in 1600, but as a Protestant he achieved nothing, and he died the following year. Later claimants to the title lived abroad, taking service under the Habsburgs until the last, the condé de Desmond, was killed in 1632.

The **Fitzmaurices.**—There can be no doubt that the house of Fitzmaurice was also of this stock, although their actual origin, in the 12th century, is doubtful. From a very early date they were feudal lords of Kerry, and their dignity was recognized as a peerage by Henry VII in 1489. The isolated position of their territory (Clanmaurice) threw them even more among the Irish than the earls of Desmond, and they often adopted the native form of their name, "MacMorrish." Under Elizabeth I the lords of Kerry narrowly escaped sharing the ruin of the earls. The conduct of Thomas (c. 1520–90) in the rebellion of James "Fitzmaurice" Fitzgerald (*q.v.*) was suspicious, and his sons joined in that of the earl of Desmond, while he himself was a rebel in 1582. Patrick, his successor (c. 1541–1600), was captured in rebellion (1587), and when free. joined the revolt of 1598, as did his son and heir Thomas, who continued in the field till he obtained pardon and restoration in 1604, though suspect till his death in 1630. His grandson withdrew to France with James II, but the next peer became a supporter of the Whig cause, married the eventual heiress of Sir William Petty, and was created earl of Kerry in 1723. From him descended the family of Petty-Fitzmaurice, who obtained the marquessate of Lansdowne (*q.v.*) in 1784, and still hold among their titles the feudal barony of Kerry together with vast estates in that county.

From the three sons by a second wife of one of the earls of Desmond's ancestors descended the hereditary White Knights, knights of Glin and knights of Kerry, these feudal dignities having, it is said. been bestowed upon them by their father, as lord of Decies and Desmond. Glin castle, County Limerick, is still the seat of the (Fitzgerald) knight of Glin. The knights of Kerry received a baronetcy in 1880. (J. H. R.; E. A. MACL.)

FITZGERALD, LORD EDWARD (1763–1798), one of the most attractive and gallant of Irish rebels, was the fifth son of James, 1st duke of Leinster, and Emilia Mary, daughter of the 2nd duke of Richmond. Born at Carton house, County Kildare, on Oct. 15, 1763, he was brought up in France, where his mother lived, after his father's death, in the duke of Richmond's house at Aubigny. Returning to England in 1779, he joined the Sussex militia and went on active service in America in 1781 on the staff of Lord Rawdon. He was severely wounded at the battle of Eutaw Springs (1781). He returned to Ireland in 1783 and was elected to the Irish parliament as member for Athy. He voted with the opposition minority, led by Henry Grattan and J. P. Curran, but took no active part in public affairs. He toured Spain in 1787, and then sailed for New Brunswick as a major in the 54th regiment. He showed his high sense of adventure by traveling (1789) across Canada through unexplored territory, from Fredericton to Quebec. The Bear tribe of Hurons made him one of their chiefs, and he went on down the Mississippi to New Orleans, before returning to England.

Elected member for Kildare, Fitzgerald refused Pitt's offer to command an expedition against Cádiz. In London he associated with the Whigs who followed Charles James Fox and R. B. Sheridan, and joined the Society of the Friends of the People. Visiting Paris in Oct. 1792, he lodged with Thomas Paine and attended the debates of the convention. On Nov. 18 he attended a British banquet in Paris, where he joined in the toast to "the speedy abolition of all hereditary titles and feudal distinctions." He also repudiated his own title, and for these actions he was cashiered from the army. On Dec. 27, 1792, he married Pamela, a protégé of Madame de Genlis. It was commonly believed that Madame de Genlis was Pamela's mother; the father was claimed to be Philippe Égalité, duc d'Orléans.

Fitzgerald and his young wife returned to Dublin in Jan. 1793. There the United Irishmen society was rapidly expanding and Wolfe Tone. as secretary of the Catholic committee, was preparing a popular agitation under the inspiration of the French Revolution. Fitzgerald at once resumed his seat in the Irish parliament and within a few weeks was ordered to apologize for his defiance of the government. Wolfe Tone was actively engaged in Paris by May 1796, trying to obtain French military aid for an Irish insurrection. Fitzgerald had already joined the United Irishmen, who were openly advocating an independent Irish republic. In the same month he and his friend Arthur O'Connor went to Hamburg to negotiate for French assistance in an Irish rising. They contacted Gen. Lazare Hoche in Basel, but the Directory would not negotiate with Fitzgerald because of his wife's connection with the Orléans family. Fitzgerald therefore left O'Connor to continue the mission which resulted in Hoche's abortive expedition to Bantry bay in Dec. 1796. After his return to Ireland Fitzgerald became increasingly involved with the United Irishmen.

In July 1797 Fitzgerald declined to stand again as member for Kildare because free elections were impossible under martial law. A military committee was formed, under Fitzgerald, to prepare for co-operation with a French landing, or, if necessary, to organize an Irish insurrection, for which they claimed that 280.000 men were now ready to rise. Delays on the French side decided the committee to prepare for a general rebellion on May 23, 1798. Informers had revealed all the main plans to the English authorities, and on March 12 the members of the Leinster provincial committee were arrested while meeting at Oliver Bond's house. Fitzgerald was not present, since he had been warned to keep away; but he refused to escape and leave his friends. On May 11 a reward of £1,000 was offered for his capture; he was betrayed by an informer and arrested, after a fierce struggle, in a house in Thomas street, Dublin, on May 19. He mortally wounded one of his captors and was himself shot in one arm and disabled. Fitzgerald was removed to Newgate jail and there died of his wounds on June 4, 1798. Lord Edward—gay, humorous, entirely unselfish and courageous—lacked the qualities that were needed either for international conspiracy or political leadership in his own country.

Fitzgerald's widow had to leave Ireland before he died. She went to Hamburg and there later married the American consul, J. Pitcairn, but remained devoted to Fitzgerald's memory. She died in Paris in Nov. 1831.

See Thomas Moore, ***Memoirs of Lord Edward Fitzgerald,*** rev. ed. **(1897).** **(D. G.)**

FITZGERALD, EDWARD (1809–1883), English writer, translator of Omar Khayyám, was born as EDWARD PURCELL, at Bredfield. Suffolk, on March 31, 1809. His father, John Purcell, who had married a Miss FitzGerald, assumed in 1818 the name and arms of his wife's family. From 1816 to 1821 the FitzGeralds lived at St. Germain and at Paris, but Edward was educated at Bury St. Edmunds and at Trinity college, Cambridge, where he became acquainted with Thackeray and W. H. Thompson. In 1830 he returned to Paris, but soon chose to settle in the Suffolk town of Woodbridge where he passed a secluded, leisurely life devoted to flowers, music and books. With Tennyson, his intimacy began about 1835 and with Carlyle about 1842. In 1851, FitzGerald published *Euphranor,* a Platonic dialogue. born of memories of the old happy life at Cambridge. In 1852 appeared *Polonius,* a collection of aphorisms, some original, the rest borrowed from English classics. In the following year he issued *Six Dramas of Calderdn,* freely translated, and having turned to oriental studies under the guidance of his friend E. B. Cowell, afterward professor of Sanskrit at Cambridge. in 1856 he anonymously published a version of the *Salámán and Absál* of Jámi in Miltonic verse. In the same year he married Lucy, daughter of Bernard Barton. the Quaker poet, but they were soon separated. In Jan. 1859 a little anonymous pamphlet was published as *The Rubáiyát of Omar Khayydm.* The poem seems at first to have attracted no attention, until in 1860 Rossetti discovered it, and Swinburne and Lord Houghton quickly followed. The expression which it gave to the perplexity of the times led to the demand for a second edition in 1868. Meanwhile FitzGerald had produced in 1865 a version of the *Agamemnon,* and two more plays from Calderón. In 1880–81 he issued privately translations of the two Oedipus tragedies; his last publication was *Readings in Crabbe,* 1882.

From 1861 onward FitzGerald's greatest interest centred in the sea, and for some years, till 1871, he spent the months from June to October mainly in "knocking about somewhere outside of Lowestoft." On June 14, 1883, he passed away painlessly in his sleep. He was "an idle fellow, but one whose friendships were more like loves"; his wit and human side are displayed in his inimitable letters. Tennyson's dedication of his *Tiresias* to FitzGerald's memory, in some touching reminiscent verses to "Old Fitz" (1885) was the signal for the universal appreciation of Omar Khayyám in his English dress. (E. G.)

An edition of FitzGerald's works appeared in 2 vol. **(1887)**; his ***Letters and Literary Remains*** were edited **by** W. Aldis Wright (7 vol., 1902–03); other ***Letters*** were edited ***by*** F. R. Barton (1923), and those to Bernard Quaritch **by** C. O. Wrentmore **(1926).** His *Dict.* **of *Mme. de Sévigné was*** edited by his great niece, M. E. F. Kerrich, 2 vol. (1914). ***See*** also **T.** Wright, ***Life of*** E. ***FitzGerald,*** 2 vol. (1904); A. **C.** Benson, E. *FitzGerald* (1905); Morley Adams, ***Omar's Interpreter, a New Life of E. FitzGerald*** (1909).

FITZGERALD, F. SCOTT (FRANCIS SCOTT **KEY** FITZGERALD) (1896–1940), U.S. novelist famous for his depictions of the "jazz age" (the 1920s), was born in St. Paul. Minn., Sept. 24, 1896. He attended a series of schools—St. Paul academy, Newman, Princeton—which tended to confirm his feelings that he was always tantalizingly near, but never endowed with, great wealth. an emotion explored fully in some of his finest fiction. Princeton, which he left without finishing in 1917, and the army, in which he served. 1917–19, disappointed him profoundly as he later confessed: Princeton did not put him on its football team and the army did not send him overseas. He began *This Side of Paradise* (1920) in the army and rewrote it on the advice of Maxwell Perkins at Scribner's. Largely autobiographical, it sounded the rallying cry of the rebellious youth of the decade of revolt just beginning. Two volumes of short stories, Flappers and Philosophers (1920) and Tales of the Jazz Age (1922), were followed by a second novel, The *Beautiful* and Damned (1922), which purported to treat the exciting revolt of sophisticated youth while affirming the meaninglessness of life. Fitzgerald's real genius was revealed with the appearance of The Great Gatsby (1925), a story about Jay Gatsby's pursuit of an immense but elusive dream and the resulting destruction of both Gatsby and dream through the casual cruelty of fabulous wealth—a story of the fantastic '20s but also a story which probes deeply the American character. Some of Fitzgerald's finest stories appeared in All the Sad Young Men (1926), but it was not until 1934 that another novel appeared—Tender *Is* the Night, a frightening story of Dick Diver's spiritual bankruptcy and disintegration of character. A final volume of short stories followed—Taps at Reveille (1935). Fitzgerald himself, like Diver, was discovering that his moral resources were disappearing—a process he described with agonizing vividness in a series of essays, "The Crack-Up" (1936). He was attempting to recapture his lost talent in a novel about Hollywood when he died in 1940 The unfinished novel together with Fitzgerald's notes was published in 1941 as The Last Tycoon.

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(J. E. MR)

FITZGERALD, GEORGE FRANCIS (1851–1901), Irish physicist, whose researches were mainly concerned with electromagnetism, radiation and electrolysis. He was born in Dublin on Aug 3, 1851, and educated at Trinity college there. where he spent the rest of his life, becoming fellow in 1877, tutor in 1879, and professor of natural and experimental philosophy in 1881. He was elected a fellow of the Royal society in 1883 and was awarded the society's Royal medal in 1899. FitzGerald was renowned for his extensive knowledge of physics, his critical powers and his brilliant speculations. His studies on radiation led him to the conclusion, shortly afterward established experimentally by H. R. Hertz (*q.v.*), that the oscillatory discharge of an electric condenser might produce electric waves, the basic discovery in wireless telegraphy. In his study of the negative result of the Michelson-Morley experiment he formulated the hypothesis that the length of a body in motion through the ether is contracted in the direction of the motion, an assumption since known as the FitzGerald-Lorentz contraction because of the independent derivation and considerable development of it made by H. A. Lorentz (*q.v.*). FitzGerald's papers, edited by J. Larmor, were published as The Scientific Writings of the Late George Francis *FitzGerald* (1902). In addition to his scientific work, FitzGerald was interested in education and it was largely through his efforts that technical education was established in Ireland. He died in Dublin on Feb. 22, 1901. (D. McK.)

FITZGERALD, JAMES (called FITZMAURICE) (d. 1579), Irish leader, styled by English writers "the arch traitor," who was constantly in rebellion against the English government from 1565 until his death, was the son of Maurice, brother of James Fitzgerald, 14th earl of Desmond. In 1568, during the detention (1565–73) in England of his cousin, Gerald, the 15th earl, James assumed the leadership of the family and proceeded to rouse the southern chieftains to rebellion against the English by appealing to the necessity for them to protect both their lands and their religion.

In alliance with the brothers of the earl of Ormonde, with the earl of Thomond and with the son of the earl of Clanricarde. Fitzgerald had by July 1570 extended the rebellion as far as Kilkenny. At this point, however, an expedition under Sir Henry Sidney was mounted against Munster, Fitzgerald and his followers were forced into hiding, and the province was placed under the command of Sir John Perrot. Fitzgerald had sacked Kilmallock early in 1570 and Perrot, vowing to "hunt the fox out of his hole," took the field against him in 1571. However, the following year, in alliance with a Scots force landed in Ulster, Fitzgerald burned Athlone. Eventually, in Feb. 1573, he submitted to the English and took an oath of loyalty to Elizabeth I.

Earl Gerald refused, on his return to Ireland, to join in a fresh rising and in 1575 James Fitzgerald went abroad. He made unsuccessful appeals for support against the English in Ireland to Henry III of France and Philip II of Spain, but was favourably received by Pope Gregory XIII who appointed him leader of a holy war in Ireland against Elizabeth. Aided by Thomas Stucley, an English adventurer at the papal court, Fitzgerald made two unsuccessful attempts to launch an expedition against Ireland before, in 1579, a force was fitted out in Lisbon. Fitzgerald set out, ahead of the main body, in June 1579. With the papal nuncio and a few troops he landed at Dingle in Kerry in July but the expected general rising did not take place, mainly because the earls of Desmond and Kildare failed to lend adequate support. Fitzgerald was killed on Aug. 18, 1579, in a skirmish a few miles east of Limerick. Subsequently his body was hung, drawn and quartered by the English at Kilmallock.

See J O'Donovan, The Irish Correspondence of James *Fitzmaurice* of Desmond, Royal Society of Antiquaries of Ireland, 2nd series (1859).

FITZGERALD, RAYMOND or REDMOND (d. *c.* 1182), surnamed Le Gros, was the son of William Fitzgerald and brother of Odo de Carew. He was sent by Strongbow to Ireland in 1170, and had the chief share in the capture of Waterford and in the successful assault on Dublin. He was sent to Aquitaine to hand over Strongbow's conquests to Henry II, but was back in Dublin in July 1171, when he led one of the sallies from the town. Strongbow offended him later by refusing him the marriage of his sister Basilea, widow of Robert de Quenci, constable of Leinster. Raymond then retired to Wales, and Hervey de Mountmaurice became constable in his place. At the outbreak of a general rebellion against the earl in 1174 Raymond returned with his uncle Meiler Fitz Henry, after receiving a promise of marriage with Basilea. Reinstated as constable he secured a series of successes, and with the fall of Limerick in Oct. 1175 order was restored. Mountmaurice meanwhile obtained Raymond's recall on the ground that his power threatened the royal authority, but the constable was delayed by a fresh outbreak at Limerick, the earl's troop refusing to march without him. On the death of Strongbow he was acting governor until the arrival of William Fitz Aldhelm, to whom he handed over the royal fortresses. He was deprived of his estates near Dublin and Wexford, but the Geraldines secured the recall of Fitz Aldhelm early in 1183, and regained their power and influence. In 1182 he relieved his uncle Robert Fitzstephen, who was besieged in Cork.

FITZGERALD, LORD THOMAS (10th earl of Kildare) (1513–1537). known as "Silken Thomas," the eldest son of Gerald Fitzgerald, 9th earl of Kildare, was born in London in 1513. He spent much of his youth in England, but in 1534 when his father was for the third time summoned to England to answer for his maladministration as lord deputy of Ireland, Thomas, at the council held at Drogheda, in February was made vice-deputy. In June the Ormond faction spread a report in Ireland that the earl had been executed in the Tower, and that his son's life was to be attempted. Inflamed with rage at this apparent treachery, Thomas rode at the head of his retainers into Dublin, and before the council for Ireland (June 11, 1534) formally renounced his allegiance to the king and proclaimed a rebellion. His enemies, including Archbishop John Allen (of Dublin), who had been sent by Henry VIII to watch Fitzgerald, took refuge in Dublin castle. In attempting to escape to England, Allen was taken by the rebels, and was murdered (July 28, 1534) by Fitzgerald's servants in his presence. He was solemnly excommunicated by the Irish Church. Leaving part of his army (with the consent of the citizens) to besiege Dublin castle, Fitzgerald himself went against Piers Butler, earl of Ossory, and succeeded at first in making a truce with him. But the citizens of Dublin now rose against him, Ossory invaded Kildare, and the approach of an English army forced Fitzgerald to raise the siege. Fitzgerald from his stronghold at Maynooth ravaged Kildare and Meath throughout the winter. He succeeded to the earldom of Kildare, on his father's death in the Tower on

Dec. 13, 1534, but he does not seem to have been known by that title. On March 23, 1535, the Geraldine stronghold fell and most of the garrison were put to the sword. This proved the final blow to the rebellion. Fitzgerald spent the next few months in raids against the English and their allies, but his party gradually deserting him. on Aug. 18, 1535, he surrendered himself to Lord Leonard Grey (d. 1541), probably on conditions. He was placed in the Tower of London. In Feb. 1536 his five uncles were also seized, some of them with great injustice, and brought to England. The six Geraldines were hanged at Tyburn on Feb. 3, 1537.

BIBLIOGRAPHY.—Richard Stanihurst, *Chronicles of Ireland* (vol. ii of *Holinshed's Chronicles)*; *The Earls of Kildare, by* C. W. Fitzgerald, duke of Leinster *(1858)*; Richard Bagwell, *Ireland under the Tudors* (1885); *Calendar State Papers, Hen. VIII, Irish.*

FITZHERBERT, SIR ANTHONY (1470–1538), English judge and legal systematizer, was born at Norbury, Derbyshire, and from 1523 until shortly before his death in 1538 was justice of the court of common pleas. He was the author of *La Graunde Abridgement* (1514), a digest of important legal cases written in Old French; *The Office and Authority of Justices of the Peace,* first printed in 1538 (last ed. 1794); *New Natura Brevium* (1534, last ed. 1794), with a commentary ascribed to Sir Matthew Hale.

FITZ NEAL or **FITZ NIGEL, RICHARD** (d. 1198), treasurer of Henry II. and Richard I. of England, and bishop of London. Richard, who was born before 1133, succeeded to the office of treasurer in 1158, and held it continuously for 40 years. His name appears in the lists of itinerant justices for 1179 and 1194, but these are the only occasions on which he exercised that office. Before 1.184 he became dean of Lincoln and in 1189 Bishop of London.

Richard Fitz Neal's *De necessariis observantiis Scaccarii dialogus,* commonly called the *Dialogus de Scaccario,* is of unique interest to the historian. It is an account, in two books, of the procedure followed by the exchequer in the author's time, a procedure which was largely the creation of his own family. When read in connection with the Pipe Rolls the *Dialogus* furnishes a most faithful and detailed picture of English fiscal arrangements under Henry II. The speakers in the dialogue are Richard himself and an anonymous pupil. The date of the conversation is given in the prologue as 1176–77. This probably marks the date at which the book was begun; it was not completed before 1178 or 1179. Soon after the author's death we find it already recognized as the standard manual for exchequer officials. It was frequently transcribed and has been used by English antiquarians of every period. Hence it is the more necessary to insist that the historical statements which the treatise contains are sometimes demonstrably erroneous; the author appears to have relied excessively upon oral tradition. Richard Fitz Neal also compiled in his earlier years a register or chronicle of contemporary affairs, arranged in three parallel columns. This was preserved in the exchequer at the time when he wrote the *Dialogus,* but has since disappeared. Stubbs' conjectural identification of this *Liber tricolumnis* with the first part of the *Gesta Henrici* (formerly attributed to Benedictus Abbas) is now abandoned as untenable.

See Madox's edition in his *History* of *the Exchequer (1769)*; and that of A. Hughes, C. G. Crump and C. Johnson (Oxford, 1902). F. Liebermann's *Einleitung in den Dialogus de Scaccario* (Gottingen, *1875)* contains the fullest account of the author.

FITZ-OSBERN, ROGER [ROGER FITZWILLIAM] (*fl.* 1070), succeeded to the earldom of Hereford and the English estate of William Fitz-Osbern in 1071. In 1075, disregarding William I.'s prohibition, he married his sister Emma to Ralph Guader, earl of Norfolk, at the famous bridal of Norwich, at which the two earls plotted a conspiracy against the king. Roger, who was to bring his force from the west to join the earl of Norfolk, was held in check at the Severn by the King's forces. On the collapse of his confederate's rising, Roger was tried before the Great Council (1075) deprived of his lands and earldom. and sentenced to perpetual imprisonment. He died in prison.

FITZ-OSBERN, WILLIAM, Earl of Hereford (d. 1071), was an intimate friend of William the Conqueror, and the principal agent in preparing for the invasion of England. He was the son of Osbern the seneschal, one of William's guardians during his minority, who had been murdered by the young duke's unruly barons. Fitz-Osbern founded a monastery at Lire about 1042. He became seneschal to the duke, and urged on the plans for the invasion of England. At the Conquest he received the earldom of Hereford with the special duty of pushing into Wales. During William's absence in 1067, English affairs were left in the hands of Fitz-Osbern and of Odo, bishop of Bayeux. Fitz-Osbern also acted as William's lieutenant during the rebellions of 1069. Fitz-Osbern was one of the feudal lords of the Welsh marches, and built several castles for the defence of the border. In 1070 William sent him to assist Queen Matilda in the government of Normandy. But Richilde, widow of Baldwin VI. of Flanders, having offered to marry him if he would protect her son Arnulf against Robert the Frisian, Fitz-Osbern accepted the proposal and joined Richilde in Flanders. He was killed, fighting against Robert, at Cassel in 1071.

See E. A. Freeman, *Norman Conquest,* vols. iii. and iv. (1867–79); Sir J. Ramsey, *Foundations of England,* vol. ii. (1898).

FITZ OSBERT, WILLIAM (d. 1196), was a Londoner who had served in the Third Crusade, and on his return took up the cause of the poorer citizens against the magnates who monopolized the government of London. He complained in particular of the unfair assessments of the "aids" for the king's ransom (1194). The chronicler Roger of Hoveden gives Fitz Osbert a high character, and he was implicitly trusted by the poorer citizens. He attempted to procure redress for them from the king; but the city magistrates persuaded the justiciar Hubert Walter that Fitz Osbert was planning a general rising. The troops were sent to seize the demagogue, smoked him out of the sanctuary of St. Mary-le-Bow, in which he had taken refuge, and dragged him to the Tower where he was sentenced to death. He was hanged in chains at Smithfield on April 6, 1196 with nine of his followers.

FITZ PETER, GEOFFREY (d. 1213), earl of Essex and chief justiciar of England, was a sheriff, a justice itinerant and a justice of the forest under Henry II. During Richard's absence on crusade he was one of the five justices of the king's court who stood next in authority to the regent, Longchamp. In 1190 Fitz Peter succeeded to the earldom of Essex, in the right of his wife, who was descended from the famous Geoffrey de Mandeville. In attempting to assert his hereditary rights Over Walden priory Fitz Peter came into conflict with Longchamp, and revenged himself by joining in the baronial agitation through which the regent was expelled from his office. Though refusing to give him formal investiture of the Essex earldom, Richard appointed him justiciar in succession to Hubert Walter (1198). Fitz Peter continued Walter's policy of encouraging foreign trade and the development of the towns; many of the latter received, during his administration, charters of self-government. He was continued in his office by John, who found him an able instrument of extortion. He profited to no small extent by the spoliation of church lands in the period of the interdict. But he was not altogether trusted by the king. The contemporary *Histoire des ducs* describes Fitz Peter as living in constant dread of disgrace and confiscation. In the last years of his life he endeavoured to act as a mediator between the king and the opposition. It was by his mouth that the king promised to the nation the laws of Henry I. (at the council of St. Albans, Aug. 4, 1213). But Fitz Peter died a few weeks later (Oct. 2). Fitz Peter was neither a far-sighted nor a disinterested statesman; but he was the ablest pupil of Hubert Walter, and maintained the traditions of the great bureaucracy which the first and second Henries had founded.

See the original authorities specified for the reigns of Richard I. and John. Also Miss K. Norgate's *Angevin England,* vol. ii. (1887) and *John Lackland* (1902); A. Ballard in *English Historical Review,* xiv. p. *93;* H. W. C. Davis, *England under the Normans and Angevins* (1905).

FITZROY, ROBERT (1805–1865), English vice-admiral, hydrographer and meteorologist, who commanded the "Beagle" on its famous voyage of circumnavigation, was born at Ampton Hall, Suffolk, on July 5, 1805, a grandson on his father's side of the third duke of Grafton and, on his mother's, of the first marquis of Londonderry. He entered the navy in 1819. After service in the Mediterranean and on the South American station he was promoted in 1828 to the command of the "Beagle," a brig of 240 tons, which was employed on the survey of the coasts of Patagonia and Tierra del Fuego.

She returned in 1830, and Fitzroy brought with him four Fuegians. Three survived and were taken back the next year, when he was reappointed to the "Beagle" to continue the survey. She sailed on Dec. 27, 1831, carrying, as a supernumerary. Charles Darwin. On Oct. 2, 1836, she returned, having surveyed the Strait of Magellan and part of the coast of South America and run a chronometric line around the world. In 1839 Fitzroy published in two volumes *Narrative of the Surveying Voyages of H.M.S.S. Adventure and Beagle . . .*, with a third volume by Darwin.

In 1842 he became a member of parliament for Durham and was appointed conservator of the Mersey. Early in 1843 he was appointed governor and commander in chief of New Zealand. His policy favoured the Maoris, and the settlers secured his recall in Nov. 1845. After serving as superintendent of the Woolwich dockyard and as commander of the "Arrogant," an experimental screw frigate fitted out under his supervision, he retired in 1850. In 1854 he was appointed chief of the newly formed meteorological department of the board of trade, and henceforward his career was devoted to practical meteorology.

In 1863 he published his *Weather Book;* the views in it were far in advance of his time. His last years were devoted to the Lifeboat association. He committed suicide on April 30, 1865.

Fitzroy's other publications included *Remarks on New Zealand* (1846), *Sailing Directions for South America* (1848) and occasional papers in the *Journal of the Royal Geographical Society.*

See *Symons's Met. Mag.*, no. 33, pp. 161–164 (1898), and *Mar. Obs.*, vol. i, pp. 50–52 (1924). (G. My.)

FITZSTEPHEN, WILLIAM (d. *c.* 1190), biographer of Thomas Becket and justice itinerant, was born in London. He entered Becket's service between 1154 and 1162. The chancellor employed him in legal work, made him sub-deacon of his chapel and treated him as a confidant. Fitzstephen appeared with Becket at the council of Northampton (1164) when the disgrace of the archbishop was published to the world; but he did not follow Becket into exile. He joined Becket's household again in 1170, and was a spectator of the tragedy in Canterbury cathedral. His life of Becket is the most valuable we have. Though he writes as a partisan he gives a precise account of the differences between Becket and the king. It also contains a description of London which is our chief authority for the social life of the city in the 12th century. Despite his connection with Becket, William was sheriff of Gloucestershire from 1171 to 1190, and a royal justice in the years 1176–80 and 1189–90.

See his "Vita S. Thomae" in J. C. Robertson's *Materials for the History of Thomas Becket,* vol. iii. (Rolls series, 1877). Sir T. D. Hardy. in his *Catalogue of Materials,* ii. 330 (Rolls series, 1865), discusses the manuscripts of this biography and its value. W. H. Hutton, *St. Thomas of Canterbury,* pp. 272–274 (1889), gives an account of the author.

FITZ THEDMAR, ARNOLD (1201–1274), London chronicler and merchant, was born in London: Aug. 9, 1201, of parents whose families had come to London from Germany. He became, as he tells us, alderman of a London ward and an active partisan in municipal politics. In the Barons' War he took the royal side against the populace and the mayor, Thomas Fitz Thomas. The popular party planned, in 1265, to try him for his life before the folk-moot. but he was saved by the news of the battle of Evesham which arrived on the very day appointed for the trial. In 1270 he was one of the four citizens to whom the muniments of the city were entrusted. To this we probably owe the compilation of his chronicle. *Chronica Maiorum et Vicecomitum,* which begins at the year 1188 and is continued to 1274. From 1239 onwards this work is a mine of curious information. Though municipal in its outlook. it is valuable for the general history of the kingdom, owing to the important part which London played in the agitation against the misrule of Henry III. Arnold was by no means blind to the faults of Henry's government, but preferred an autocracy to the mob-rule which Simon de Montfort countenanced in London.

The *Chronica Maiorum et Vicecorniturn,* with the other contents of Arnold's commonplace book. were edited ior the Camden Society by T. Stapleton (1846), under the title *Liber de Antiquis Legibus.* Our knowledge of Arnold's life comes irom the *Chronica* and his own biographical notes. Extracts, with valuable notes, are edited in G. H. Pertz's *Mon. Gerrnaniae historica, Scriptores,* vol. xxviii. *See* also *J. M.* Lappenberg's *Urkundliche Geschichte des Hänsischen Stahlhofes zu London* (Hamburg, 1851).

FITZWALTER, ROBERT (d. 1235), leader of the baronial opposition against King John of England, served John in the Norman wars, and was taken prisoner by Philip of France, and forced to pay a heavy ransom. He was implicated in the baronial conspiracy of 1212. He was outlawed, but returned under a special amnesty after John's reconciliation with the pope. He continued. however. to take the lead in the baronial agitation against the king, and upon the outbreak of hostilities was elected "marshal of the army of God and Holy Church" (1215). He secured the support of the city of London. The famous clause of Magna Carta (§ 39) prohibiting sentences of exile, except as the result of a lawful trial, refers more particularly to his case. He was one of the 25 appointed to enforce the promises of Magna Carta; and his aggressive attitude was one of the causes which contributed to the recrudescence of civil war (1215). He was one of the envoys who invited Louis to England. and was the first of the barons to do homage when the prince entered London. Though slighted by the French as a traitor to his natural lord, he served Louis with fidelity until he was captured at the battle of Lincoln (May 1217). Released on the conclusion of peace he joined the Damietta crusade of 1219, but returned at an early date to make his peace with the regency.

BIBLIOGRAPHY.—The *Histoire des ducs de Normandie et des rois d'Angleterre* (ed. *F.* Michel, 1840) gives the fullest account of his quarrel with the king. *See* also Miss K. Norgate's *John Lackland* (1902), W. McKechnie's *Magna Carta* (1905), and Stubbs's *Constitutional History,* vol. i. ch. xii. (1897).

FITZWILLIAM, a family with English and Irish branches: important in English history. The alleged descent of the Fitzwilliams from an illegitimate son of William the Conqueror is almost certainly fictitious. The fortunes of the English branch of the family really began with Sir William Fitzwilliam (1460–1534), sheriff of London, who acquired the future family seat at Milton, Northamptonshire, in 1506. His grandson, also Sir William Fitzwilliam (*q.v.*), was thrice deputy of Ireland. The latter Fitzwilliam's grandson took the Irish title of Baron Fitzwilliam of Lifford in 1620. In later generations the Irish titles of Viscount Milton and Earl Fitzwilliam (1716) and the English titles of Baron Milton (1742) and Viscount Milton and Earl Fitzwilliam (1746) were added.

William Wentworth Fitzwilliam (1748–1833), 2nd earl (English peerage), was an active Whig and inherited the large Wentworth estates in Yorkshire on the death in 1782 of his uncle the marquess of Rockingham, thus becoming one of the richest members of the nobility. He was lord lieutenant of Ireland (1794–95) and, in opposition to Pitt, strongly supported Grattan's Catholic emancipation campaign. He was president of the council in 1806 and thereafter mainly in opposition. He died at Milton in 1833.

Fitzwilliam's son. Charles (1786–1857), 3rd earl: officially adopted the surname Wentworth-Fitzwilliam. William Thomas George Wentworth-Fitzwilliam (1904–), 8th earl, succeeded to the title in 1952.

An Irish branch of the family, the Fitzwilliams of Meryon, were descended from a 12th-century member of the family who went to Ireland under Prince John. The titles of Baron and Viscount Fitzwilliam died out with the 8th viscount in 1833. The most celebrated member of this branch was Richard (1745–1816), 7th viscount, who left his library to Cambridge university and also a fund for creating the Fitzwilliam museum at Cambridge.

FITZWILLIAM, SIR WILLIAM (1526–1599), lord deputy of Ireland, was the eldest son of Sir William Fitzwilliam (d. 1576) of Milton, Northamptonshire. where he was born. In

1559 he became vice-treasurer of Ireland and a member. of the Irish House of Commons: and between this date and 1571 he was (during the absences of Thomas Radclyffe, earl of Sussex. and of his successor, Sir Henry Sidney) five times lord justice of Ireland. In 1j71 Fitzwilliam himself was appointed lord deputy. but like Elizabeth's other servants he received little or no money, and his period of government was marked by continuous penury and its attendant evils, inefficiency, mutiny and general lawlessness. Moreover, the deputy quarrelled with the lord president of Connaught, Sir Edward Fitton (1527–1579), but he compelled the earl of Desmond to submit in 1574. Returning to England in 1575 he was governor of Fotheringhay Castle at the time of Mary Stuart's execution. In 1588 Fitzwilliam was again in Ireland as lord deputy, and although old and ill he displayed great activity in leading expeditions. and found time to quarrel with Sir Richard Bingham (1528–1599), the new president of Connaught. In 1594 he finally left Ireland. and five years later he died at Milton. From Fitzwilliam. whose wife was Anne. daughter of Sir William Sidney. were descended the barons and earls Fitzwilliam.

See R. Bagwell. *Ireland under the Tudors,* vol. ii. (1885).

FIUME: *see* Rijeka.

FIVE NATIONS: *see* Iroquois.

FIVES. *A* ball game played by two or four players in a court enclosed on three or four sides, the ball being struck with the hand protected by a glove. Certain forms of the game in the United States and in Ireland are known as handball (*q.v.*). The etymology of "fives" is uncertain. Nevertheless. since "fives" has been used to describe handball play and boxing it is reasonable to conclude that the word is associated with the five fingers of the hand acting in unison. Long before the present games of fives were known Dr. Samuel Johnson defined the word as "a kind of play with a bowl" and, later, a "bunch of fives" was a familiar expression for the closed fist. Games using hand. ball and wall were various and without set rules or carefully defined areas until late in the 19th century. They were played in the tennis courts from mediaeval times to at least the end of the 18th century. in the Fleet prison and against any straight wall or angle of walls which presented itself to child or man. Most of these games could also be played with the racket. As Nicholas says in the *Familiarum Colloquiorum Opus* (1526) of Erasmus: "We shall sweat less if we play with a racket." And Jerome replies: "Let us leave nets to fishermen; the game is prettier if played with the hands."

The three versions of the modern game are named after well-known English schools. (J. Ae.)

Eton Fives.—The peculiar features of the Eton fives court arose from the game's being first played at Eton college against the chapel wall with buttresses forming the side walls and with the balustrade of the chapel steps projecting into the left-hand side of the court. which was divided latitudinally by a step.

The modern standard court has retained all these characteristics, being enclosed on three sides and open at the back, with a shallow "step" dividing the upper or top portion from the lower or bottom portion. The buttress which projects from the left-hand wall is now called the "pepperbox" which, with the "step," encloses a small square section of the floor called "Dead Man's Hole." The "line" of the court is the lower angle of a sloping ledge running across the front wall at the height of 4 ft. 6 in. Items of equipment required are padded gloves and special balls about $1\frac{3}{4}$ in. in diameter and $1\frac{3}{4}$ oz. weight, covered in white kid.

The game is played by four persons, two against two, the server standing in the upper court; the taker of service stands in the lower court ready to return the service. The partners of both server and taker of service also stand in the lower court, the server's partner having choice of position. To start the game, the server must throw the ball above the line on to the front wall so that it then hits the right-hand wall before dropping into the lower court to suit the taker of service. who is said to be "cutting." The rally is not started until the "cutter" has received a service to his liking and returned it above the line; thereafter the ball is returned alternately by either side, the rally ending when the ball is hit either below the line or out of court. Only the side serving may score, game being 12 points. The Eton Fives association, to which schools and clubs are affiliated, regulates the game and is responsible for the organization of the amateur championship for the Kinnaird trophy presented by Lord Kinnaird in 1926 and the Public Schools competition for the challenge cup presented by the association in 1949. (P. C. C.)

Rugby Fives is played in a four-walled court without any form of hazard. The dimensions of the standard court are length 28 ft., width 18 ft., height of front wall 1j ft., height of back wall 6 ft. The front wall is distinguished by a wooden board running horizontally across it at an even height of 2 ft. 6 in. from the floor. A few courts have no back wall and others have a lower one. The ball is hard and solid, approximately 2 in. in diameter and weighing about $1\frac{1}{4}$ oz. Specially padded gloves are worn. The game may be played by two or four players and is won by the first side to win 1j points or the first player to score 2 points after each has 14. Only the receiver can score points and when he wins a rally he scores one point. but should his opponent (the server) win it, he becomes receiver. The server starts a rally by throwing the ball up so that it first hits the front wall and then the nearest side wall; he must strike it after the first bounce and before the second so that it hits first the side wall and then the front mall. The opponent must return the service. before the second bounce, on to the front wall above the board, either directly or after it has hit any of the other walls. The players then hit the ball alternately.

The game is regulated by the Rugby Fives association. Open singles and doubles championships, schools' singles and doubles competitions and Scottish and north of England championships are held. Most courts are owned by schools and universities.

Winchester Fives is similar to Rugby Fives except that the court has a "buttress" on the left-hand side wall about 10 ft. from the front wall, which means that the rest of the court is that much narrower. There are fewer courts of this type. (R. A. C.)

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FIX, THEODORE (1800–1846). French journalist and economist: was born at Soleure. Switz. He contributed most of the geographical articles to the *Bulletin universal des sciences.* In 1840 his essay on *L'Association des douanes allemandes* won him a prize from the Xcademie des Sciences Morales et Politiques. In his *Observations sur les classes ouvrières,* published in 1846. he argued against all attempts to regulate artificially the rate of wages. He died at Paris on July 31, 1846.

FIZEAU, ARMAND HIPPOLYTE LOUIS (1819–1896), French physicist best known for his experiments in light, particularly the speed of light, was born at Paris. Sept. 23, 1819. As he was wealthy, he was able to follow his inclinations and devote himself to experimental work in physics. Between 184j and 1849 he worked in conjunction with Foucault (*q.v.*). They investigated the infrared portion of the solar spectrum and made other observations in heat and light. In 1849 Fizeau published the results of his experiments on the velocity of light; he also gave the first reliable value of this velocity by a terrestrial method, as well as the correct explanation of the Doppler principle (*see* Light: *Wanes and Interference*) as applied to the light coming from a star (*q.v.*), and showed how it could be used to measure the relative velocities of stars in the line of sight.

In 1851 he carried out a series of experiments on the velocity of light in a moving medium, and measured the shift of interference fringes resulting from light passing through a column of moving water. These experiments were designed to see if any relative motion of ether and matter could be detected (*see* Ether). Later experiments describe the use of a condenser for increasing the efficiency of an induction coil and the application of interference methods for measuring the expansion of crystals. He became a member of the French Academy in 1860 and of the Bureau cles Longitudes in 1878; in 1863 he was appointed *inspecteur de physique* at the École Pblytechnique Paris.

Fizeau died at Venteuil. Sept. 18. 1896.

FLACH, JACQUES GEOFFROI (1846–1919), French jurist, was the author of several works on the history of medieval

France. Born at Strasbourg on Feb. 16, 1846, he settled in Paris after the war of 1870. From 1884 he was professor of comparative legislation at the Collège de France, and he also held posts at the École des Sciences Politiques and at the École d'Architecture in Paris, He died in Paris on Dec. 5, 1919.

Flach's great work, *Les Origines de l'ancienne France,* was produced in four volumes—Le *Régime seigneurial* (1886); *Les Origines communales, la féodalité et la chevalerie* (1893); *Le Renaissance de l'état. La Royaute' et le principat* (1904); and *Les Nationalités régionales. Leurs Rapports avec la couronne de France* (1917)—which, although not always consistent, were characterized by originality and vigour and were based on a wide use of manuscript sources.

Flach also wrote *Études critiques sur l'histoire du droit romain au ntoyen âge* (1890) and *L'Origine historique de l'habitation et des lieux habités en France* (1899).

FLACIUS, MATTHIAS (1j20–1j75), surnamed ILLYRICUS. Lutheran reformer, was born at Albona, in Illyria, on March 3, 1520. He studied under Baptista Egnatius in Venice, and from 1j39 onward at Basel, Tiibingen and Wittenberg. There he was welcomed (1541) by Melanchthon and there he came under the decisive influence of Luther. In 1j44 he was appointed professor of Hebrew at Wittenberg. He took his master's degree on Feb. 24, 1546, ranking first among the graduates. He opposed strenuously the Xugsburg Interim and the compromise of Melanchthon known as the Leipzig Interim *(see* ADIAPHORISTS). Melanchthon wrote of him with venom as a renegade (*alumnus in sinu serpentem*), and Wittenberg became too hot for him. He removed to Magdeburg (Nov. 9, 1551), where his feud with Melanchthon was patched up. On May 1;, 1557, he was appointed professor of New Testament theology at Jena: but he was soon involved in controversy with Strigel, his colleague, on the synergistic question (relating to the function of the will in conversion). In Oct. 1j66 he became pastor of the Lutheran community at Antwerp. In 1567–73 he sought asylum both in Frankfurt and Strasbourg. but in both cases was compelled to leave. Then the prioress Catharina von Meerfeld of the convent of White Ladies at Frankfurt harboured him and his family in despite of the authorities. He died on March 11, 1jjj. His son Matthias was professor of philosophy and medicine at Rostock. In spite of his harried life, Flacius was a pioneer of the scientific study of church history and—if we except. a great exception, the work of Laurentius Valla—of hermeneutics also. There is permanent and continuous value in the principles embodied in Flacius' *Catalogus testium veritatis* (1jj6; rev. ed. by J. C. Dieterericus, 1672) and his *Clavis scripturae sacrae* (1567), followed by his *Glossa compendiaria in N. Testamentum* (1jjo).

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FLAG, a word of Teutonic (Germanic) origin used from the 15th–16th centuries in various northern European languages (*flag* in English, *flagg* in Swedish, *vlag* in Dutch and *Flagge* in German), to signify a piece of cloth, bunting or similar material displaying the insignia of a community, an armed force, an office or an individual. A flag is usually (not always) oblong and attached by one edge to a staff or halyard. It can be viewed from either side. The part nearest the staff is called the hoist, the outer half is called the fly. The width usually exceeds the depth. Flags of various forms and purpose are known as standards, banners, ensigns, pendants (or pennants), pennons. guidons and burgees. Originally used mainly in warfare, flags were (and to some extent remain) insignia of leadership, serving for identification of friend and of foe. and useful as rallying points. They are now also extensively used for signalling, for decoration and for display. As the usefulness of a flag for purposes of identification must depend on its blowing out freely in the wind, the material preferred is, with a few exceptions, light. It is thus obviously advantageous to choose a device or pattern which will be the same on both sides of the flag, which would otherwise have to be made of a heavy, opaque cloth, probably doubled. This consideration tends to exclude any wording, and further considerations of visibility tend to favour the simpler patterns. Any colours or devices may be used. but European usage normally follows the practice of heraldry and of common sense in discouraging the juxtaposition of "metal" and "metal" (*i.e.*, of yellow and white) or colour and colour without "metal" interposed. The flag of the Vatican City is an exception to this rule.

HISTORY

Historically, the use of terms such as "banner" and "standard" has varied considerably. but modern usage would restrict the term "banner" to a piece of cloth attached by its upper edge to a pole or cord. A banner in this sense differs from a flag in having. frequently, a reverse side on which the device is either different from the front or unrecognizable; as, for example. with lettering reversed. It may likewise be questioned whether the pennon attached to a lance—that is, to a weapon and not merely to a staff—is a flag in the modern use of the word.

Early History.—The earliest insignia, used in battle, were not flags at all. These are usually described as standards and are not to be confused with the later flags (serving the same purpose) to which that term is now applied. These standards consisted of some solid object fixed on a bracket at the top of a pole, sometimes with streamers attached. The object displayed was a sacred symbol; of the four standards carried before the kings of ancient Egypt, for example, one is claimed to have represented the king's placenta. Predynastic monuments dating from the reign of Rameses II show these sacred standards "as the actual agents of the enemies' discomforture." A similar standard is shown on an early tomb at Ur of the Chaldees, and there can be little doubt that these standards were known to and venerated by peoples of the earliest civilizations. Evidence is abundant, for example. of such standards being borne in Assyria from the 9th century B.C. They are shown as associated with such kings as Xssur-nasir-pal (in 88j B.C.), Sargon and Sennacherib, and they were evidently used not only in battle but in hunting. The standards are shown mounted on chariots, with streamers or tassels (usually two) attached; and they were evidently guarded with some care.

While these especially sacred emblems were carried before kings, other similar insignia were borne by military units and ships. An Assyrian statue of 671 B.C. shows a soldier with the standard of his unit, and Egyptian vessels are shown on pottery as bearing signs of the harpoon or fish, probably associated with their ports of origin. In some instances the streamers may have become more prominent than the sign itself, and a lance with a pennon is shown in Assyrian sculpture of 885–860 B.c.; but the standard in its solid form remained normal and was evidently transmitted via Crete to the Aegean. An occasional variant may have been the display (as in China) of the head of some previously discomfited enemy. This might be the origin of the Greek custom of bearing a helmet or other piece of armour on a spear point. The various Greek cities, however, had more distinctive signs, such as a sphinx or Pegasus, and the Romans followed suit, using the effigies of gods. of generals or of animals (wolves, horses and bears). According to Pliny, it was G. Marius who, in his second consulship, ordered that the Roman legions should have only the eagle as standard. This eagle effigy was later revived by Napoleon as a deliberate archaism and, more recently, in fascist Italy. It has otherwise fallen into disuse.

The vexillum, or Roman cavalry flag, was nearer to being a flag in the accepted sense and is still used in ecclesiastical ceremony. It is described by Livy as a square piece of cloth fastened to a bar fixed crosswise on a spearhead. This description is confirmed by reference to Roman coins: medals and sculpture. The labarum, the imperial standard of the later Roman emperors, was of similar pattern but on a larger scale, of purple silk and embroidered in gold. The vexillum may have had special appeal to Christians because it was cruciform. It gained in importance from the time of Constantine's conversion and bore thereafter the monogram of Christ or some other religious emblem. Used in Byzantine religious processions, the ecclesiastical banner has thus an unbroken continuity with ancient Rome. Its attachment to a horizontal bar makes it suitable for the display of elaborate scenes and figures, visible only from the one direction, and the foot of the banner often ends with a gold fringe coming to two or more points. This form of banner was also used in the middle ages on warlike expeditions, more particularly perhaps on those which had some religious significance. The banner bearing the device of St. Martin's hood, originally kept by the monks of the abbey of Marmoutier and used in battle by the counts of Anjou, was presumably of this pattern. It was said to have been taken into battle by Clovis in 507, and Charlemagne fought under it at the battle of Narbonne. It mas used by the kings of France but was replaced by the oriflamme of St. Denis, first taken into battle by Louis VI in 1124 and last seen on the battlefield at Agincourt in 141j. By one account the oriflamme would seem to have been a plain red square, but it is also said to have had three points with tassels of green silk. Similar in form may have been the banner entrusted to William the Conqueror by Pope Alexander II, and similar again the English standard which gave its name to the battle of the Standard in 1138 The latter, however, was a ship's mast on wheels and carried, as well as a silver pyx, three sacred banners dedicated respectively to St. Peter. St. John of Beverley and St. Wilfrid of Ripon. A banner of this ecclesiastical pattern was known in the middle ages as a gonfalon or gonfanon and was borne by the chief magistrates of certain Italian cities, and also used at sea. Banners of this type are still sometimes hoisted on the masts which front the cathedral church of St. Mark's at Venice, It.

Oriental Flags.—The examples so far given illustrate the use formerly made in ancient and mediaeval times of insignia which, serving the same purpose as flags, were essentially different in form. Flags recognizable as such were the invention. almost certainly, of the Indians or Chinese. It is said that the founder of the Chou dynasty in China (1122 B.C.) had a white flag carried before him; and it is known that in A.D. 660 one of the minor princes was punished for failing to lower his standard before his superior. Chinese flags had devices such as a red bird. a white tiger or a blue dragon. They were carried on chariots and planted upon the walls of captured cities. The royal flag had, however, all the attributes of kingship, being identified with the ruler himself and treated with a similar respect. It was thus a crime even to touch the flag-bearer. The fall of the flag meant defeat. and the king mould rarely expose his flag and his person together, the flag being normally entrusted to a rather reluctant general.

Flags had equal importance in ancient India, being carried by chariots and on elephants. The flag was the first object of attack, and its fall would mean confusion if not defeat. Indian flags were evidently of modern pattern but often triangular in shape, scarlet or green in colour, having a figure embroidered in gold and a gold fringe. If these and the Chinese flags had a common origin in the standards of ancient Egypt and Assyria, they might have developed from the streamers attached to the pole. This possibility gains some likelihood from the fact that some Indian flagstaffs were surmounted by a figure similar to that displayed on the flag itself. Mogul royal insignia included, however, other things besides the flag, and more especially yaks' tails and the state umbrella. Indian flags seem also to have been used, as in China, for signalling, and there is an instance of a white flag being used as a signal for a truce as early as A.D. 1542. Indian and Chinese usage spread to Burma, Siam and southeastern Asia generally, and the *Kidung Sunda* (A.D. 1357) contains many references to the flags used by Majapahit and other heroes, and also to the pennons on their lances. Flags with a background of white, yellow or black silk are mentioned, with devices (of an elephant or bull or water hen, for example) embroidered on them in gold. A Siamese treatise on war gives the impression that the flags were unfurled as the march began.

The use of flags was probably transmitted to Europe by the Saracens. But Islam influenced this usage in that the use of any identifiable image is forbidden by the Koran as idolatrous. Flags are often mentioned in the early history of Islam and may have been copied from India. But these are greatly simplified and appear to have been plain black or white or red. Black was supposed to have been the colour of Mohammed's banner: the colour of vengeance. We learn of a black flag being used by the Abbasids in A.D. 746 (A.H. 129), the Omayyads and 'Alids choosing white by contrast and the Khawarij (Kharijites), red. A plain red flag is thus retained by the state of Oman. Green was the colour of the Fatimite dynasty and eventually became the colour of Islam. In adopting the crescent sign, however. c. 1250, the Osmanli Turks were reverting to a sacred symbol used by King Assur of Assyria in the 9th century B.C. and probably of greater antiquity than that. The crescent moon, with or without an additional star or stars, has since become the accepted symbol of Islam. It appears, usually white, in the flags of Egypt. Turkey, Tunis, Libya, Madagascar, Pakistan and some of the Malay states. with backgrounds of green. red or black. The Egyptian flag has three stars representing Egypt, Nubia and the Sudan, but this is of fairly recent date.

The Use of the Cross.—The use of the flag and the pennon was probably copied by the Europeans from their Saracen opponents during the third crusade (1189–91). or perhaps slightly earlier. It was the assembly, in one army, of knights from almost every nation in Christendom that necessitated their differentiation from the enemy and from each other. Heraldry first appeared in England in 1127 but was undoubtedly established during the decade 1190–1200, hastened both by the crusade and by the adoption of closed helmets in which the wearer was unrecognizable. Closely connected with heraldry was the adoption of the flag. Thus, the Knights of St. John adopted as their standard a white cross on a red field: this was confirmed to them by a papal bull of 1259 which enjoined them to wear surcoats of the same pattern. This wearing of a cross in some form had considerable significance. In assuming it, the crusader at once proclaimed his vow and demanded the aid of all Christians toward its fulfilment. It partly superseded his own personal device—associated as that may have been with local quarrels and feuds—and marked him out as a man with a mission approved by the church. Once in the Holy Land, it showed on which side he was fighting and tended to show further, by the variation in its form, from what part of Christendom he came. Knights of the religious orders displayed no such local affinities. but the ordinary knights discovered the germs of nationality in realizing that men whose religion might be the same spoke languages which were different. The knights who followed the emperor Frederick I Barbarossa, Philip II Augustus of France and Richard I of England copied the flag and the pennon from their opponents and the cross from each other, but they saw to it, in some instances, that their crosses should differ in shape and colour. Thus, the French adopted a scarlet flag with a white cross, the English and Germans a white flag with a scarlet cross. It is not clear to what extent other variants were adopted by other national groups; but it is known that the returning crusaders retained their uniform after their return to Europe and with it their "national" flag, associated with their respective patron saints. This was certainly the case in England, where the cross of St. George was firmly established in the 13th century. It contrasted with the flags used by the king and the nobility to symbolize more personal and local loyalties. It was not entirely peculiar to England and was known as the cross of St. George in 13th-century Germany. The French cross in white on scarlet also remained in use and was revived on a national basis by Louis XI in 1479. In general, these flags rose or fell in esteem with the idea of nationalism which they symbolized. They were not so much in evidence in periods when the conflict was less between France and England than between Burgundy and Valois or between Lancaster and York.

Other national flags with the cross device either developed during the third and later crusades or were imitated by nations which had not been strongly represented in the Holy Land. Thus, the flag of Denmark (a white cross on a red field, called the *Danebrog*) was certainly used from 1308 and may well date from 1219, the year indicated by tradition and well supported by probability. The Norwegian flag was similar, but the Swedish flag developed as a yellow cross on a blue field. The Swiss flag, a white cross on red, first appears in 1339 and in a context that shows a significant identification of a national with a holy cause. The Scottish flag of St. Andrew, a diagonal white cross on a blue ground, is of uncertain but clearly mediaeval origin, and the same is true of the

Irish flag of St. Patrick with the cross borne diagonally red on white and perhaps as old as the 12th century. The European nations which thus adopted and still use the cross in some iorm include Great Britain, Denmark, Finland, Greece, Iceland. Norway, Portugal. Sweden and Switzerland. It was formerly used by Latvia. Outside Europe the cross is used by the British dominions. the Dominican Republic and Samoa. At an international conference held at Geneva in 1863 it was further agreed that the hospitals. ambulances and medical personnel of all armed forces should bear a red cross on white, the Swiss flag with reversed colours. This has since remained the symbol of the International Red Cross organization.

Tricolour Flags.—The French Revolution began a new phase in flag design. The revolutionary tricolour was to invade the rest of Europe and to spread by example to other parts of the world. But if the tricolour was revolutionary in intent, it was not wholly novel in design. Austria had a flag with horizontal stripes of red, white and red in 1200 or earlier. and a previous revolution, that of the Dutch against Spain. had left the Netherlands with a flag (from 1574) of orange. white and blue in horizontal strips of equal width. Orange was probably found to be an unstable colour, and it was gradually replaced by red in the 17th century, leaving the Dutch flag exactly as it is now, although the use of the orange colour was not actually prohibited until 1795. The tricolour thus stood for revolution, and it is important to remember, in this connection, that the revolutionary movement which transiormed France did not wholly originate there but derived something from the revolt of the Austrian Netherlands in 1787–89. This revolt centred at first in Brabant, where a tricolour in black. yellow and red vertical stripes. these being the Belgian colours, appeared as early as 1790. This gave the French revolutionaries a good precedent for hoisting their vertical tricolour. which also first appeared officially in 1790, with the red stripe in the hoist and the blue in the fly. In 1794 this order was reversed so as to have the blue in the hoist with the white (as before) in the middle. It was eventually found more pleasing to the eye to vary the width of the stripes in the percentage of blue 30, white 33 and red 37. This French tricolour replaced the Bourbon device of the fleur-de-lis (used since 1589) and, with one short interruption in 1815–30, has remained the French flag ever since, being used, unmodified! for almost every purpose.

During the 19th and 20th centuries, as monarchies were replaced in most countries by republics, a tricolour was usually taken as the proper symbol of republicanism and even copied. perhaps largely for considerations of legibility and economy of manufacture. by countries still monarchical. The following countries now use the tricolour in some form, occasionally with some slight addition: Afghanistan. Andorra, Belgium, Bolivia. Bulgaria, Colombia, Ecuador. Ethiopia. France. Germany. Guatemala, Honduras, Hungary, India, Iran. Iraq, the Republic of Ireland. Italy, Jordan, Luuembourg, hladagascar, Mexico, the Netherlands, Paraguay, Perak, Rumania. the Union of South Africa, Syria. Venezuela and Yugoslavia (see also below). It was also used. during their period of independence, by Estonia, Latvia and Lithuania. Very similar to the tricolour are the flags with three stripes, horizontal or vertical, using only two colours, such as are used in Spain, Honduras, Nicaragua, El Salvador. Peru and Argentina.

Other National Flags.—Flags which are based neither on the cross, nor the stars and stripes nor the tricolour are either heraldic or oriental. The heraldic flags, embodying part or the whole of a coat of arms. include the flags of Portugal. the Vatican City, San Marino and formerly Albania. Oriental flags include those of Israel. Yemen, Saudi Arabia, Kuwait. Ceylon, Thailand (Siam), Cambodia, Tibet, Nepal, South Korea. Mongolia and Japan. These vary greatly in pattern: some, like that of Saudi Arabia, are open to criticism as illegible at a distance; others, like that of Japan. are simple and effective.

Forms and Functions.— It has been shown that many of the flags of Christendom date from the period of the .third crusade or have developed since by imitation. There mere always certain exceptions. Spain being one; but the use of flags was widespread, and the cross occurred in most flags which could be called national. But these flags were subdivided according to shape and purpose into standards. banners, guidons. pennons and streamers. There were also many flags of a personal. family or local significance which were of a different and usually more complex pattern. To distinguish first between the main types, it should be said that the standard was the largest flag and intended. from its size, to be stationary. It marked the position of an individual before a battle, during a siege, throughout a ceremony or at a tournament. Its use was that of the royal standard which marked the palace, castle, saluting base. tent or ship where the sovereign was actually present. Standards were also used formerly by the greater nobles and bore their own personal insignia. Standards were originally long and tapering toward the fly. ending in two points. Banners were square or oblong and were borne in action (as the standard was not) before royal and noble warriors down to the rank of knight banneret. These again bore the personal or family device. The guidon. a word derived from the French *guyd-homme,* was similar to the standard but rounded in the fly or with two swallow tails, both rounded. Guidons were borne by leaders in battle who were of merely knightly rank and so not entitled to display a banner. In the British army they have thus come to be borne by dragoon regiments of cavalry, such as the 1st (Royal) dragoons. the 2nd (Royal Scots Greys) arid the 6th (Inniskilling) dragoons. The household cavalry regiments and Dragoon Guards have standards, by contrast. and the hussars and lancers have no flags at all. The pennon. a small triangular flag. was carried by each knight on his lance. One purpose of the pennon was to obviate accidents on the line of march in much the same way as a red flag is tied to any long pole or rod which extends beyond the tailboard of the truck which carries it. But the pennon served as well to strike terror in the enemy and also to denote rank. To create a knight banneret, the king or his representative might tear off the fly of the knight's pennon and so turn it into a small banner, which would serve at least until a proper banner was made. The streamer (now known as a pendant or pennant) was a long. tapering flag from 20 to 60 yd. long and about 8 yd. broad at the hoist and ending in two points. From its shape it could hardly be used except at sea. and it was there used in the 1jth century, flown from a pole rising above the fighting top and later from the yardarm or topmast. It came eventually to distinguish the warship from the merchantman and, more specifically, the warship in commission from the warship laid up in harbour. The pennant is now white in the royal navy, with a St. George's cross near the hoist, and denotes a warship in commission, being hoisted when the captain assumes his command. As the oblong flag or banner might be used in a variety of ways, it came to have different names according to its exact use. In Great Britain these names included ensign (*q.v.*), jack (*q.v.*) and colour, all of which are still in use.

BRITISH AND COMMONWEALTH FLAGS

British Flags.—While it would be impossible to trace here the process in all European countries by which the feudal heraldic flags gave way to flags of national significance—a process especially complex where the amalgamation of territories was involved—it is at least practicable to indicate in outline how the British flags developed.

First of these is the royal standard, about the exact origin of which there is some doubt. The three lions of England would seem, however. to date from the period when other flags and heraldic devices first appeared; that is, the end of the 12th century. Originally described as "leopards," they seem to have been used as a personal device by Richard I c. 1195. They appeared on the standards of John, Henry III, Edward I and Edward II and at first by Edward III. But this last king claimed in 1340 to be king of France as well as of England, and therefore quartered the English lions with the French lilies, giving the lilies the place of honour. The French lilies of that period were scattered over the whole field as if taken from a piece of patterned cloth. with incomplete lilies round the edge. The standard of this type was used with only temporary variation until 140j. when Henry IV followed the French example of 1365.and reduced the lilies to three. two above and one below. The standard thus revised was used without

VIKING FLAG (A.D. 1000) · FLAG OF SPAIN (1492) · BANNER OF COLUMBUS (1492)

FLAG OF JOHN CABOT (1497) · FLAG OF CHAMPLAIN · FLAG OF HENRY HUDSON (1609)

ANDROS FLAG (1683) · THREE COUNTY TROOP FLAG · BOURBON FLAG OF FRANCE

BRITISH RED ENSIGN · BEDFORD FLAG (1775) · TAUNTON FLAG (1774)

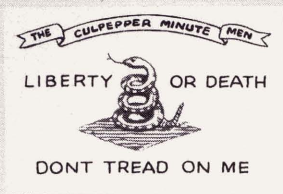
LIBERTY TREE FLAG (1775) · NEWBURY, MASSACHUSETTS FLAG (1775) · BUNKER HILL FLAG (1775)

LINKED HANDS FLAG (1775) · CONTINENTAL FLAG (1775-77) · CONNECTICUT FLAG (1775)

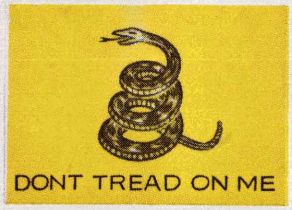
DRAWN FOR ENCYCLOPÆDIA BRITANNICA, INC., BY GEORGE ARMSTRONG

FLAGS IN UNITED STATES HISTORY

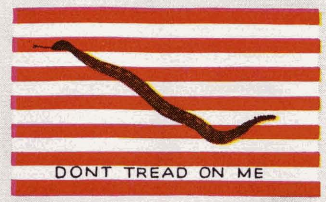
FLAG



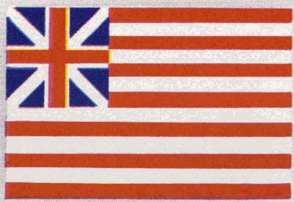
CULPEPPER FLAG (1775)



GADSDEN FLAG (1775)



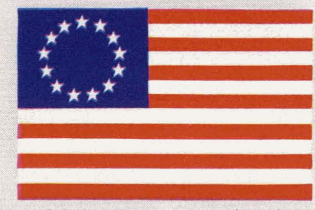
FIRST NAVY JACK (1775)



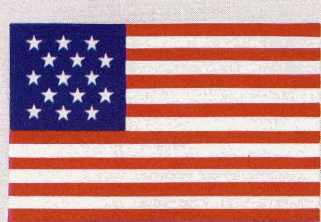
GRAND UNION FLAG (1775)

RHODE ISLAND FLAG (1776)

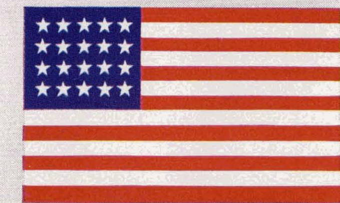
COL. MOULTRIE FLAG (1776)



FIRST NATIONAL FLAG (1777)



NATIONAL FLAG (1794-1818)



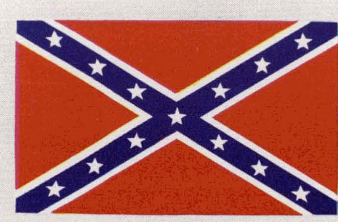
NATIONAL FLAG (1818)

ALAMO FLAG

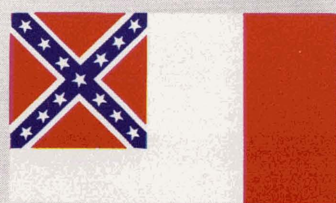
NATIONAL FLAG (MEXICAN WAR)

NATIONAL FLAG (JULY 12, 1861)

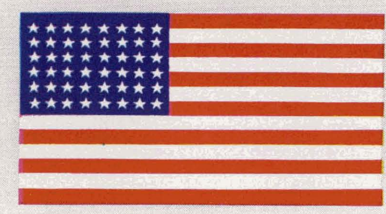
"STARS AND BARS" OF THE CONFEDERACY (1861)



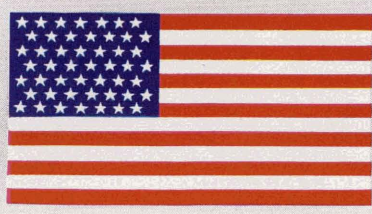
BATTLE FLAG OF THE CONFEDERACY



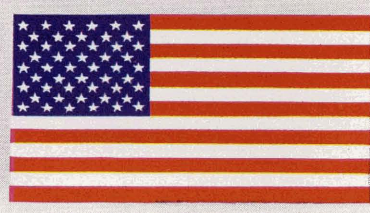
LAST CONFEDERATE FLAG (1865)



NATIONAL FLAG (1912-1959)



NATIONAL FLAG (1959-1960)



NATIONAL FLAG FROM JULY 4, 1960

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FLAGS IN UNITED STATES HISTORY

DRAWN FOR ENCYCLOPEDIA BRITANNICA, INC., BY GEORGE ARMSTRONG

FLAGS OF THE STATES OF THE UNITED STATES

DRAWN FOR ENCYCLOPÆDIA BRITANNICA, INC., BY GEORGE ARMSTRONG

FLAGS OF THE STATES OF THE UNITED STATES

OREGON

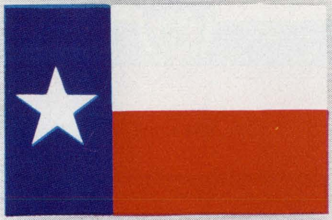

PENNSYLVANIA

RHODE ISLAND


SOUTH CAROLINA

SOUTH DAKOTA

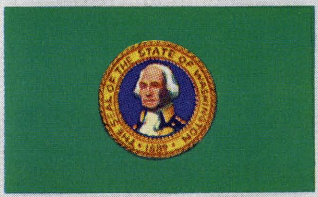

TENNESSEE


TEXAS

UTAH


VERMONT

VIRGINIA



WASHINGTON

WEST VIRGINIA


WISCONSIN


WYOMING

GUAM

PANAMA CANAL ZONE


PUERTO RICO

VIRGIN ISLANDS

DRAWN FOR ENCYCLOPÆDIA BRITANNICA, INC., BY GEORGE ARMSTRONG

FLAGS OF THE STATES OF THE UNITED STATES, AND MAJOR U.S. POSSESSIONS

DRAWN FOR ENCYCLOPÆDIA BRITANNICA, INC., BY GEORGE ARMSTRONG

FLAGS OF LATIN AMERICA

DRAWN FOR ENCYCLOPEDIA BRITANNICA INC. BY GEORGE ARMSTRONG

EVOLUTION OF THE UNION JACK, AND FLAGS OF THE BRITISH COMMONWEALTH

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FLAGS OF EUROPE

DRAWN FOR ENCYCLOPADLA BRITANNICA, INC., BY GEORGE ARMSTRONG

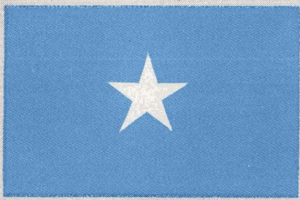
FLAGS OF ASIA

DRAWN FOR ENCYCLOPEDIA BRITANNICA, INC., BY GEORGE ARMSTRONG

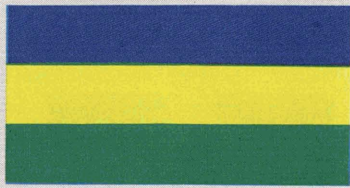
FLAGS OF ASIA

DRAWN FOR ENCYCLOPÆDIA BRITANNICA, INC., BY GEORGE ARMSTRONG

FLAGS OF AFRICA



SOMALI REPUBLIC



SUDAN

TOGO

TUNISIA

UNITED ARAB REPUBLIC

UPPER VOLTA

FLAGS OF AFRICA

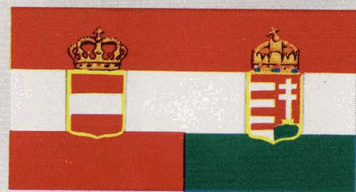
FLAG OF SAN MARTIN
(LIBERATOR OF ARGENTINA)

CHINA, REPUBLIC (1912)

FLAG OF SIMON BOLIVAR

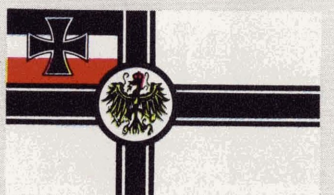
CZARIST RUSSIA
ENSIGN

FREE PORT OF DANZIG
(1923-1939)



AUSTRIA-HUNGARY, ENSIGN
(1869-1923)

GERMANY
(1867-1918)



GERMANY, WAR FLAG
(1871-1918)

GERMANY, HAKENKREUZ FLAG
(1935-1945)

ITALY (1861-1945)

JAPAN ENSIGN

UNITED NATIONS

DRAWN FOR ENCYCLOPÆDIA BRITANNICA, INC., BY GEORGE ARMSTRONG

HISTORIC FLAGS OF THE 19TH AND 20TH CENTURIES modification until 1603, when James VI of Scotland came to the English throne. James's standard displayed the quartered arms of France and England in the first and fourth quarters, the Scottish lion (in its border, or tressure) in the second and the Irish harp in the third. This standard remained in use until the reign of William III, when the arms of Nassau mere embodied. Fresh complications were introduced by George I and George II, nho placed the arms of Hanover in the fourth quarter. After the French Revolution, however, by the treaty of Amiens in 1802, George III renounced the title of king of France and removed the lilies from his standard. The arms of Hanover, borne in pretense ovtr those of England. Scotland and Ireland. were dropped in 1837, and the royal standard has ever since appeared in its present form, with the lions of England in the first and fourth quarters. the lion of Scotland in the second and the harp of Ireland in the third. The royal standard in one or another of these forms has been displayed by the kings of England and Great Britain throughout their history and, generally speaking. by them alone. To this rule, however, there are two exceptions. In the first place, the royal standard went out of use during the period of the Commonmealth, its place being taken by a special flag devised by the protector. Oliver Cromwell. for himself—the cross of St. George in the first and fourth quarters, the cross of St. Andrew in the second and the Irish harp in the third. with his own arms in pretense. In the second place. the royal standard used to be displayed by the lord high admiral when in command of the fleet and was thus used by Lord Howard of Effingham in 1588, by the duke of Buckingham in the reign of Charles I and by the duke of York during the Dutch Wars. This usage died out nith the office of lord high admiral itself, the royal standard now being flown only by the sovereign.

The union flag of Great Britain first appeared (in its early form) at the accession of James I. It displayed the red cross of England superimposed on the nhite cross of Scotland, with the blue field of the latter. As red on blue is not permissible, the red cross had to be bordered with nhite. its own correct field. It is clear from James I's proclamation that this flag was primarily intended for use at sea. to be hoisted on the maintop. Ships from English ports would hoist St. George's cross at the foretop while those from Scottish ports would hoist St. Andrew's flag. Charles I however, in 1634 restricted its use at sea to the royal navy. This usage was interrupted during the Commonwealth period and complicated for a time under Cromwell by the addition of an Irish harp, but mas resumed on the restoration of Charles II in 1660. So the old flag. the Great Union. continued in use until 1801, the date of the legislative union with Ireland. The object was then to incorporate the cross of St. Patrick (diagonal, red on white) nith the union flag as it then existed. Thus to combine the three crosses. without losing their identity. was no easy task. Each had to be distinct and each had to retain its fimbriation. or bordering, nhich denotes its original ground. In the first union flag, the red cross of St. George uith the white fimbriation that represented the original white field was simply imposed upon the white saltire of St. Andrew with its blue field. To place the red saltire of St. Patrick on the white saltire of St. Andrew would have been to obliterate the latter, nor would the red saltire have its proper bordering denoting its original uhite field; even were the red saltire narrowed in width, the portion of the white saltire that would appear would be not the St. Andrew's saltire but only the fimbriation appertaining to the saltire of St. Patrick. The difficulty was resolved by making the white broader on one side of the red than on the other. In fact. the continuity of direction of the arms of the red St. Patrick's saltire was broken by its portions being removed from the centre of the oblique points that iorm the St. Andrew's saltire. Thus both the Irish and Scottish saltires can be distinguished easily from one another, while the red saltire has its proper white fimbriation.

The union flag, both in its old and new forms. has been used and is still used, in two nays. It can be flown by itself or it can be incorporated as part of another flag (an ensign or military colour, for example). Flown by itself. the union flag has a sharply differentiated use afloat and ashore. At sea and hoisted at the mainmast of a king's ship, it is the flag of an admiral of the fleet. At sea and hoisted at the jack staff in the bows of a ship, it indicates a man-of-war and is properly called the union jack (a jack being any flag flown from that staff). It must be used at sea in no other way, and its misuse can involve, for the offender, a heavy fine. On shore it is flown over fortresses and military headquarters but is also used indiscriminately by all British subjects for merely decorative purposes. It has come to be called the union jack, and this usage, inaccurate as it may be. would now be difficult to change.

Ensigns.——Whereas the jack is flown from the jack staff in the bows of a ship and whereas a special significance attaches to the flag hoisted at the main masthead. the ensign is the flag flown at a ship's stern. The word "ensign" means "insignia," and there can be no doubt that an ensign was originally the banner of the highest-ranking person on board a mediaeval ship when equipped for war. It is thus strictly comparable with the ensign formerly borne by a company of infantry and actually entrusted to a young officer, the ensign-bearer or simply ensign. The conversion of a sailing ship for warlike purposes involved the construction of a wooden castle in bows and stern, and it was the sterncastle which housed the steering gear. The senior military officer on board needed to be near the helmsman, and his banner would be flown near his own station in battle; that is, in the stern. By Tudor times the national ensign was tending to supersede personal insignia as part of a general process which might he called the nationalization of war: the process by which the hereditary military ranks of earl, baron. banneret and knight were replaced by the commissioned ranks of general, captain, lieutenant and ensign. Pictures of English ships in the reign of Henry VIII show the St. George's cross at all mastheads and also on the ensign poles. After 1603 the union flag seems to have been as universally used, but with the streamer or pennant of the older St. George's pattern. The "Prince Royal" is shown wearing these flags in 1610, with the royal standard at the main topgallant masthead to show the king's presence on board.

Even in the Elizabethan period it was the custom to divide a fleet (like an army) into three divisions. the centre, the van and the rear. These came to be known, respectively, as the red. the white and the blue squadrons. They were distinguished by ensigns of the appropriate colour with the St. George's cross in the upper canton. An ensign of this pattern is shown in a picture of the "Sovereign of the Seas" in 1637, reminding us that the canton with the union flag pattern did not immediately take its place. After 1660 the royal navy was reorganized during the second and third Dutch Wars. The main fleet of about 100 ships. with merchantmen now excluded from battle, continued at this period to fight in a strict formation first introduced *c.* 1652. Each of the three main squadrons was commanded by an admiral and subdivided into three divisions. Each squadron had a centre division directly commanded by the admiral, a van division commanded by a vice-admiral and a rear division commanded by a rear admiral. As the admiral of the red squadron was also in supreme command (and might in fact be the lord high admiral in person',; he flew the union flag at the main. There was therefore no admiral of the red squadron designated as such (until 1805), the flag officers (or flagmen as they were sometimes called) numbering nine in all, with the admiral of the fleet as the senior and the rear admiral of the blue squadron as the junior of all. All the ships flem their appropriate ensign but shifted it on transfer to a different squadron. When the legislative union of England and Scotland took place in 1707, the cross of St. George was replaced in the ensign by the union flag pattern. At the same time merchantmen were instructed to fly the red ensign. being later forbidden to use either of the other ensigns or the pennant or the jack. In the 18th century the concentration of the entire battle fleet under one flag officer became unusual. Smaller fleets. of 30 ships at most, could be commanded as a single squadron without rigid subdivision: and it became the custom for all ships to fly the ensign of the commander in chief. The system of red and white and blue became a mere system of seniority among flag officers, whose number now far exceeded the original nine. An admiral of the blue squadron flem his flag at the main topgallant mast and all his ships. the flagship included, bore the blue ensign. A vice-admiral of the red flew his flag at the fore topgallant mast, his ships hoisting the red ensign. A rear admiral of the white flew his flag at the mizzen, his ships following suit with white ensigns. The system was defective in that the ensigns varied in colour without differing much in significance. They were altered in 1801. when the present union flag took the place of the old, but otherwise remained in simultaneous use until 1864. when the royal navy adopted the white ensign as its own (influenced, perhaps, by the fact that Lord Nelson was vice-admiral of the white when he died, with the result that all the ships at Trafalgar flew that ensign during the battle). The red ensign was now restricted to the mercantile marine, and the blue ensign was assigned to the royal naval reserve and to ships not of the royal navy but nevertheless in the public service.

The white ensign is therefore essentially the flag of the royal navy. It should not be flown anywhere or on any occasion except by a ship (or shore establishment) of the royal navy, with but one exception: by a grant of William IV dating from 1829, vessels belonging to the Royal Yacht squadron, the chief of all yacht clubs,. are allowed to fly the white ensign. From 1821 to 1829 ships of the squadron flew the red ensign, as that of highest dignity, but as it was also used by merchant ships, they obtained the grant of the white ensign as being more distinctive. Some few other yacht clubs flew it until 1842. when the privilege was withdrawn by an admiralty minute. By some oversight the order was not conveyed to the Royal Western of Ireland, whose ships flew the white ensign until 1857 when the usage was stopped. Since that date the Royal Yacht squadron alone has had the privilege. Any vessel of any sort flying the white ensign, or pennant, of the navy is committing a grave offense. and the ship can be boarded by any officer of Her Majesty's service, the colours seized, the vessel reported to the authorities and a penalty inflicted on the owners or captain or both. The penalty incurred is £500 fine for each offense, as laid down in section 73 of the Merchant Shipping act, 1894.

The blue ensign is exclusively the flag of the public service other than the royal navy and is as well the flag of the royal naval reserve. It is flown also by certain authorized vessels of the British mercantile marine, the conditions governing this privilege being that the captain and a certain specified portion of the officers and crew shall belong to the ranks of the royal naval reserve. When flown by ships belonging to British government offices the seal or badge of the office is displayed in the fly: for example, hired transportsfly it with the yellow anchor in the fly; themarine department of the board of trade has in the fly the device of a ship under sail; the telegraph branch of the post office shows in the fly a device representing Father Time with his hourglass shattered by lightning; the ordnance department displays upon the fly a shield with a cannon and cannon balls upon it. Certain yacht clubs are also authorized by special admiralty warrant to fly the blue ensign. Some of these display it plain; others show in the fly the distinctive badge of the club. Consuls general, consuls and consular agents also have a right to fly the blue ensign, the distinguishing badge in their case being the royal arms.

The royal air force uses: as its distinctive flag, an ensign of the colour known as R.A.F. blue with the union device in the upper canton and the R.A.F. aircraft distinguishing mark (a target of red, white and blue, with red in the centre) in the fly. This ensign is hoisted at R.A.F. establishments and is also seen afloat. flown by the launches of the Air-Sea Rescue service. Another ensign variant is flown by vessels belonging to the war department and navigated by men of the British army service corps fleet.

Until the later years of the 18th century the ensign was always flown from a flagpole in the stern of the ship called the ensign staff. As the old type of lateen mizzen sail came to be replaced, however, by the new fore-and-aft rigged mizzen, the ensign staff was found to be in the way of the new spanker boom and was therefore removed. The ensign was henceforward hoisted on a halyard which led to the spanker gaff. This arrangement has since been faithfully observed in shore establishments of the royal navy and also by the royal air force, the flagpole being a miniature version of a mizzenmast complete with gaff. The hoisting and lowering of the ensign is usually made with a ceremony each morning and night, with the appropriate bugle calls and with all present at attention.

Commonwealth Dominion Flags.—Various countries of the British Commonwealth have national flags which are based upon the British ensigns or which otherwise incorporate the union flag pattern. Canada flies as its national flag a red ensign with the arms of the dominion in the fly, the red ensign being similarly used as the merchant flag. Australia uses the blue ensign with the addition of six white stars of which five are arranged as in the constellation called the Southern Cross. New Zealand has the blue ensign but with four red stars outlined in white, also suggesting the Southern Cross as a symbol of the Antipodes. The Union of South Africa has a flag of which the union pattern forms a part. The colonies in the British Commonwealth mostly use the union flag with a badge or shield placed in a white disk covering the centre. Their ships mostly use the ordinary red ensign. (For descriptions of the flags of the Asian countries of the Commonwealth of Nations. see Flags *of Other Countries,* below.)

The Admiralty and Trinity House.—There are two other British sea flags which are worthy of brief notice. These are the admiralty flag and the flag of the master of Trinity House. The admiralty flag is a plain red flag with a clear anchor in the centre in yellow. In a sense it is a national flag, for the sovereign hoists it when afloat in conjunction with the royal standard and the union jack. It would appear to have been first used by James, duke of York, as lord high admiral, who flew it when the sovereign was afloat and had the royal standard flying in another ship. When a board of commissioners was appointed to execute the office of lord high admiral, this was the flag adopted, and in 1691 the admiralty ordered the navy board. then a subordinate department, "requiring and directing it to cause a fitting red silk flag, with the anchor and cable therein, to be provided against Tuesday morning next, for the barge belonging to this board." In 1725, presumably as being more artistic: the cable in the device was twisted round the stock of the anchor. It was thus made into a foul anchor, the thing that a sailor most hates, and this despite the fact that the first lord at the time, the earl of Berkeley, was himself a sailor. The anchor retained its unseamanlike appearance and was not cleared till 181j, and even to this day the buttons of the naval uniform bear a foul anchor. The anchor flag is solely the emblem of an administrative board; it does not carry the executive or combatant functions which are vested in the royal standard, the union or an admiral's flag. But on two occasions it has been made use of as an executive flag; in 1719 the earl of Berkeley, who at the time was not only first lord of the admiralty but also vice-admiral of England, obtained the special permission of George I to hoist it at the main instead of the union flag; and in 1869, when H. C. E. Childers, then first lord, accompanied by some members of his board, went on board the "Agincourt," he hoisted the admiralty flag and took command of the combined Mediterranean and channel squadrons, thus superseding the flags of the two distinguished officers who at the time were in command of these squadrons. (It is hardly necessary to add that throughout the navy there was a very distinct feeling of dissatisfaction at the innovation.) When the admiralty flag is flown by the sovereign it is hoisted at the fore! his own standard being of course at the main and the union at the mizzen.

The flag of the master of Trinity House is the red cross of St. George on its white ground, but with an ancient ship on the waves in each quarter; in the centre is a shield with a precisely similar device surmounted by a lion.

The sign of a British admiral's command afloat is always the same. It is the St. George cross. Formerly it was borne on the main, the fore or the mizzen, according to whether the officer to whom it pertained was admiral, vice-admiral or rear admiral; but, as ironclads superseded wooden ships. and a single pole mast took the place of the old three masts, a different method of indicating rank was necessitated. Today the flag of an admiral is a square one, the plain St. George cross. When flown by a vice-admiral, it bears a red ball on the white ground in the upper canton next to the staff; if flown by a rear admiral there is a red ball in both the upper and lower cantons. As most modern battleships have two masts, the admiral's flag is hoisted at the one which has no masthead semaphore. The admiral's flag is always a square one, but that of a commodore is a broad white pennant with the St. George cross. If the commodore is of the first class, the flag is plain; if of the second class, the flag has a red ball in the upper canton next to the staff. The same system of differentiating rank prevails in most navies, though very often a star takes the place of the ball. In some cases the indications of rank are differently shown; for instance, in the Japanese navy the distinction is made by a line of colour on the upper or lower edges of the flag.

(C. N. P.)

FLAGS OF THE UNITED STATES

The first flag flown in the British colonies in America was a square of white bunting or silk adorned with a large red cross of St. George. the arms of which extended to its full length and breadth. It was carried by John Cabot when he discovered the North American continent in 1497, and the ships that brought the colonists to Jamestown, Va., in 1607, and to Plymouth, Mass., in 1620, displayed it as a matter of course as it was the English flag.

The Puritans of New England objected to the cross and in 1634 John Endecott, who was to become governor of Massachusetts ten years later, cut part of the cross from the flag at Salem. Formal complaint was entered in November of that year that the flag had been defaced by Endecott, and it was charged that the mutilation might be construed as an act of rebellion against England. When the case was tried, it was testified that the mutilation had been done not as an act of disloyalty but from the conscientious conviction that. as the cross had been given to England by the pope, it was a relic of Antichrist and that to allow it to remain was an act of idolatry. Endecott was found guilty of "a great offence" for which he was worthy of admonition, and he was debarred from holding public office for a year.

When Sir Edmund Andros was commissioned as governor of New England in 1686, he designed a flag showing the cross of St. George on a white ground nith the initials "J R." signifying "Jacobus Rex" in the centre of the cross surmounted by a crown. A New England flag of *c.* 1700 was blue with the cross of St. George in the canton and a tree in the upper-left-hand corner.

At the time the British took over New York city from the Dutch in Sept. 1664, the union jack mas displayed in place of the Dutch flag. Banners of many different designs were used by the different colonies. In the early days of the revolutionary struggle each state adopted a flag of its own. That of Massachusetts bore a pine tree. South Carolina had a flag adorned with a rattlesnake. The rattlesnake with 13 rattles was a common decoration, usually accompanied by the inscription. "Don't tread on me." The snake and the motto appeared on the banner of John Proctor's battalion raised in Westmoreland county, Pa.. and was carried by this battalion in the Revolutionary War. The New York flag was white with a black beaver on it, and the Rhode Island flag also was white adorned with a blue anchor and with 13 white stars in its blue canton. The colours carried by different regiments differed with the taste of their commanders.

The first flag containing the stars of which there is any record was hoisted in 1775 on the armed schooner "Lee," captain, John Manley, of Massachusetts. The flag was nhite with a blue canton containing 13 five-pointed stars. In the centre of the flag was a blue anchor at the top of which was a scroll bearing the word "Hope." Virtually this was Rhode Island's flag.

The importance of a flag for the ships which congress had ordered to be outfitted in 1775 was recognized; a letter from Col. Joseph Reed Washington's military secretan, dated Oct. 20, 1775, recommended that a flag be adopted "by which our vessels may know one another" and suggested the pine tree flag, then in use on other ships. Primarily. flags uere designed for naval ships. Differing from various regimental banners carried by individual units, the Stars and Stripes was not carried by any U.S. army land forces until 1834 (by the artillery). The colours were not carried by the infantry until 1841. and the standard mas not carried by the cavalry until 1895. In the navy it is called the ensign.

On Jan. 1. 1776 the day the new continental army "came into being." to use Washington's own words. a new flag was displayed on Prospect hill, in the American lines besieging Boston. It had 13 red and white stripes and the British union jack, with its crosses of St. George and St. Andrew, on a canton. This showed loyalty to the crown, as the colonists were not then planning independence. This flag was merely the British red ensign, modified by placing six white stripes on the red field. It was known contemporaneously as the continental flag or congress colours. in recent years as the Grand or Great Union or Cambridge flag.

This flag was flown from the ships of the new continental navy when it sailed from Philadelphia three days later. As that interval of time was too limited for information to have arrived from Boston, it is evident that some prior arrangement had been made. That this was the work of a committee of congress which conferred with Washington in Oct. 1775 has been suggested, but this is unlikely as there is no mention of it in the report of the committee.

The continental flag continued to be used even after the Declaration of Independence had made the crosses of England and Scotland inappropriate. Congress even tacitly approved it in the following September by directing that it be used on privateers. That the inappropriateness was recognized is shown by a letter written by William Richards, a navy quartermaster, in Oct. 1776, complaining of the lack of a suitable flag and that one could not be obtained until a design was fixed, so the navy continued to use the continental flag.

It was not until June 14, 1777, almost a year after the adoption of the Declaration of Independence, that the Continental Congress adopted a design for the national flag. It resolved that "The flag of the United States shall be thirteen stripes, alternate red and white, with a union of thirteen stars of white on a blue field, representing a new constellation." A comparison of this design with that of the continental flag shows that the only change was a union of stars to replace the union of the crosses of England and Scotland, using the same blue field. Hence the Stars and Stripes evolved in two stages from the British red ensign.

Although the 13 stars were usually arranged in a circle, no rule had been made and there was thus no uniformity. Some flags were made with 12 stars in a circle and 1 in the centre, others with three horizontal rows of 4. 5 and 4. In others the stars were arranged as if they had been placed on the arms of the combined crosses of St. George and St. Andrew. one row horizontal and another perpendicular for the cross of St. George and two diagonal rows representing the cross of St. Andrew.

The first record of the Grand Union flag being hoisted on a naval ship is that of 2nd Lieut. John Paul Jones on board the "Alfred," at which time he wrote: "I had the honor to hoist with my own hands the flag of Freedom, the first time it was displayed on the Delaware." Although his appointment was dated Dec. 22, 1775, the squadron did not sail until Feb. 17, 1776. That Jones hoisted the Stars and Stripes on the "Ranger" July 4, 1777, is in error, for he then had not taken command, and there can be found no printed official announcement of the new flag (adopted June 14, 1777) until Sept. 3, 1777.

The belief that the flag raised at Ft. Stanwix (Ft. Schuyler) near what is now Rome. N.Y., mas the first Stars and Stripes in battle is incorrect, because that flag had no stars. William Colbreath, a soldier at the fort, wrote in his diary (still extant): "Aug. 3d. Early this Morning a Continental Flagg made by the Officers of Col. Gansevoorts Regiment was hoisted and a Cannon Levelled at the Enemies Camp was fired on the Occasion."

Col. Marinus Willett's report, Aug. 21, 1777, to Gov. Jonathan Trumbull, reads: "Aug. 8 brought off 5 of the enemies' colours and displayed them on the flagstaff of the impromptu made continental flag." John McGraw, aiso a soldier there, carved on his powder horn a plan of the fort with a continental flag flying.

The first Stars and Stripes flown in battle by land forces (and still preserved in the North Bennington, Vt., museum) is the famous 76 flag. its outer stripes white, flown in the battle of Bennington, Aug. 16, 1777.

The theory that Washington's coat of arms, which contained stars and stripes, suggested the new flag has no supporting evidence, nor was a suggestion from such a source necessary, as there were several striped flags in existence at the time, and mention has already been made of flags in America with stars.

Later investigators leaned to the conclusion that the design was drawn by Francis Hopkinson, a member of the naval committee and a signer of the Declaration of Independence. He was an artist, and there are extant bills which he presented to congress for artistic work.

The first public assertion that Elizabeth, or Betsy, Ross made the first Stars and Stripes appeared in a paper read before the historical society of Pennsylvania on March 14, 1870, by William J. Canby, a grandson of Betsy Ross. In 1857 his aunt, a daughter of Betsy by her third husband, asked him to write from her dictation the story of the making of the flag she had heard her mother tell many times. The story was that in June 1776, before the adoption of the Declaration of Independence. General Washington, Robert Morris and George Ross, representing a committee of the congress, came to her upholstery shop in Arch street, Philadelphia, Pa., shoued her a rough draft of a flag with stars and stripes and asked if she could make such a flag. She did. and it was taken to the state house. where the congress was in session, and shown to the members; they adopted it as the flag of the United States and ordered her to make many of them.

This story was long regarded as authentic. but nowhere can there be found any record of the appointment of a committee to design a flag in June 1776; no record of the adoption of any flag by the congress prior to June a year later. and, no "United States" for over a decade to come. The only record of any flags made by Betsy Ross is at Harrisburg, Pa., voucher dated May 29, 1777, for £14 and some shillings for making flags for the Pennsylvania navy.

There was no change in the number of stars or stripes from the adoption of the design until Jan. 13, 1794, when congress in recognition of the admission of Vermont and Kentucky, voted to add two stripes and two stars, one for each of the new states to take effect May 1. 1795. This new Aag, with 1 j stripes and 15 stars, remained unchanged until 1818, when there were 20 states in the union. Tennessee. Ohio, Louisiana. Indiana and Mississippi having been admitted, and so congress on April 18 of that year voted that the flag should contain 13 alternate red and white stripes representing the original 13 states, and that a star for each new state should be added on July 4 following its admission. The table gives the date of admission to the union of each state, following the first 20.

Admissions of States to the Union

State	Date of admission	Star added	Number of stars
Illinois	Dec. 3, 1818	July 4, 1819	21
Alabama	Dec. 14, 1819	July J, 1820	23
Maine	Mar. 15, 1820	July 4, 1820	
Missouri.	Aug. 10, 1821	July 3, 1822	24
Arkansas	Jan. 15, 1836	July 4, 1836	25
Michigan	Jan. 26, 1837	July 4, 1837	26
Florida	Mar. 3, 1845	July 4, 1845	27
Texas	Dec. 29, 1845	July J, 1846	28
Iowa	Dec. 28, 1846	July 4, 1847	29
Wisconsin	May 29, 1848	July 4, 1848	30
California	Sept. 9, 1850	July 4, 1851	31
Minnesota	hlay 11, 1858	July 4, 1858	32
Oregon	Feb. 14, 1859	July 4, 1859	33
Kansas	Jan. 29, 1861	July 4, 1861	34
West Virginia	June 20, 1863	July 4, 1863	35
Nevada	Oct. 31, 1863	July 4, 1865	36
Nebraska	Feb. 9, 1867	July 4, 1867	37
Colorado	Aug. 1, 1876	July 4, 1877	38
North Dakota	Nov. 2, 1889	July 4, 1890	
South Dakota	Nov. 2, 1889	July 4, 1890	
Montana	Nov. 8, 1889	July 4, 1890	43
Washington	Nov. 11, 1889	July 4, 1890	
Idaho	July 3, 1890	July 4, 1890	
Wyoming	July 10, 1890	July 4, 1891	44
Utah	Jan. 4, 1896	July 4, 1896	45
Oklahoma	Nov. 16, 1907	July 4, 1908	46
New Mexico	Jan. 6, 1912	July 4, 1912	48
Arizona	Feb. 14, 1912	July 4, 1912	
Alaska	Jan. 3, 1959	July 4, 1959	49
Hawaii	Aug. 21, 1959	July 4, 1960	50

Display of **the U.S.** Flag. — The national flag of the United States has 13 horizontal stripes, 7 red and 6 white, with a red stripe at the top and bottom, and a union or canton of blue in the upper quarter next to the staff and extending down to the bottom of the fourth red stripe. As of July 4, 1960, the union contained 50 five-pointed stars, arranged in nine horizontal rows of, alternately, six and five stars. This arrangement was fixed by the executive order of Pres. Dwight D. Eisenhower of Aug. 21, 1959, which also fixed the proportions of the flag: hoist (width) of the flag, 1; fly (length) of the flag, 1.9; hoist (width) of the union,&; fly (length) of the union, 0.76; width of each stripe, $\frac{1}{13}$.

C.S. military forces display the flag during daylight hours. Aboard navy ships there are occasions when the flag is also displayed at other times. When a ship is at anchor, the ensign is normally displayed on the flagstaff at the stern. When the ship is under way, the ensign is usually hoisted to the gaff, a spar on the after mast. Whenever the flag, or ensign, is hoisted or lowered, the national anthem is played. On Memorial day the army half-staffs the flag only until noon. On that day the navy's ensign is half-staffed only during the few minutes of firing the salute. The flag flies day and night over Francis Scott Key's grave (Frederick, Md.), the war memorial (Worcester, Mass.), Ft. McHenry (spotlighted) and in several cemeteries over plots where U.S. soldiers and sailors lie.

There are five federal laws dealing with the display of the flag. The first provided that no trade-mark could be registered if it contained the flag, the coat of arms or other insignia of the United States. The second authorized the display of the flag on Mother's day. The third fixed penalties for the improper use or desecration of the flag in the District of Columbia, and the fourth provided for the dismissal of any employee or official of the government who, when the country was at war, criticized the flag in an abusive manner. According to a warning issued by the department of justice, based on a proclamation by the president, any alien tearing down or mutilating the flag would be 'regarded as a menace to the public peace and subject to arrest and punishment. The fifth federal law, signed by Pres. Dwight D. Eisenhower on July 9, 1953, penalizes the display of flags of international organizations or other nations in equal or superior prominence or honor to the flag of the United States at any place within the United States or any of its territories or possessions, except at the headquarters of the Cnited Nations.

Nearly every state has its own criminal codes prohibiting misuse of the flag, or any pictures of it, in connection with advertising. The penalties run from $10 to $1,000, or imprisonment from 30 days to five years.

Most of the states direct that the flag shall be displayed at all schoolhouses while the school is in session and also that pupils shall pledge allegiance to the flag. Some states forbid the display of any red or black flag along with the national flag in any procession or public hall.

Lack of uniformity in the matter of displaying the flag by civilians led to the adoption of a flag code. The National Americanism committee of the American Legion called a conference in Washington, Flag day. June 14, 1923, and delegates from 72 patriotic organizations there assembled adopted a universal flag code. Although that code lacked any federal authority, it was generally followed. When World War II came. congress was asked to enact a federal flag code. This was done. and on Dec. 22, 1942, the president signed the joint resolution, known as public law 829. The first section declares the codification of existing rules and customs for the guidance of civilians not required to conform to the regulations issued by the different official branches of the government.

SEC. 2. (a) It is the universal custom to display the flag only from sunrise to sunset on buildings and stationary flagstaffs in the open. However, the flag may be displayed at night upon special occasions when it is desired to produce a patriotic effect.

(b) The flag should be hoisted briskly and lowered ceremoniously.

(c) The flag should not be displayed on days when the weather is inclement.

(d) The flap should be displayed on all days when the weather permits, especially on New Year's Day, January 1; -Inauguration Day, January 20: Lincoln's Birthday, February 12; Washington's Birthday, February 22; Armed Forces Day (third Saturday in May); Easter Sunday (variable); Mother's Day, second Sunday in May; Memorial Day (half staff until noon), May 30; Flag bay, June 14; Independence Day, July 4; Labor Day, first Monday in September; Constitution Day, September 17; Columbus Day, October 12; Veterans Day, October 27: Armistice Day, November 11; Thanksgiving Day, fourth Thursday in November; Christmas Day, December 25; such other days as may be proclaimed by the President of the United States; the birthdays of States (dates of admission); and on State holidays.

(e) The flag should be displayed daily, weather permitting, on or

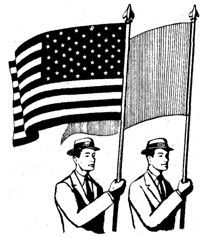


FIG. 1. IN PROCESSION WITH ANOTHER FLAG. U.S. FLAG ON MILITARY RIGHT OF LINE

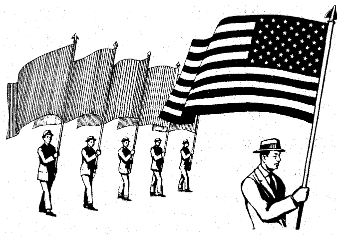


FIG. 2. IN PROCESSION WITH OTHER FLAGS. RIGHTHAND UPPERMOST ON STAFF

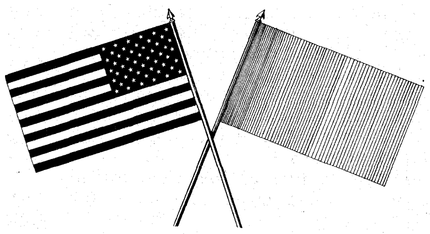


FIG. 3. WITH ANOTHER FLAG ON WALL. U.S. FLAGSTAFF IN FRONT OF OTHER STAFF

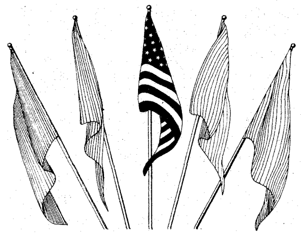


FIG. 4. WITH GROUP OF OTHER FLAGS. U.S. FLAG IN CENTRE AND ABOVE ALL OTHER FLAGS

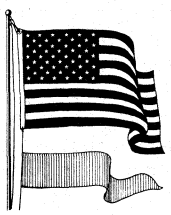


FIG. 5. WITH OTHER FLAG ON THE SAME HALYARD U.S. FLAG ABOVE

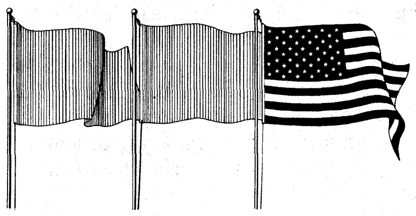


FIG. 6. WITH TWO OR MORE FLAGS IN LINE. U.S. FLAG AT RIGHT OF ALL OTHER FLAGS

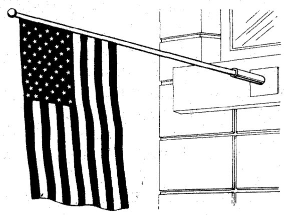


FIG. 7. ON STAFF PROJECTING FROM BUILDING

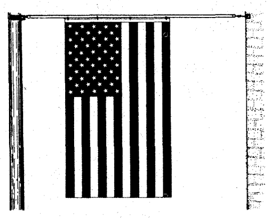


FIG. 8. SUSPENDED FROM A ROPE OVER A SIDEWALK

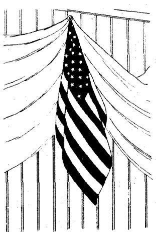


FIG. 9. STAFFLESS BUT STAFFLIKE

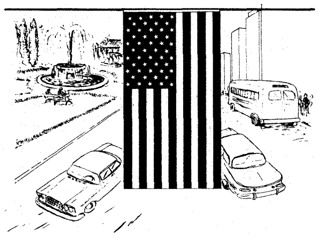


FIG. 10. OVER CENTRE OF PUBLIC STREET

FIG. 11. UNSTAFFED FLAG ON WALL BEHIND AND ABOVE SPEAKER. BUNTING WITH BLUE ON TOP IN DECORATING STAND

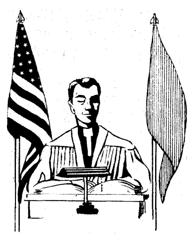


FIG. 12. IN CHANCEL OF CHURCH. U.S. FLAG ON SPEAKER'S RIGHT; ALL OTHER FLAGS ON HIS LEFT.

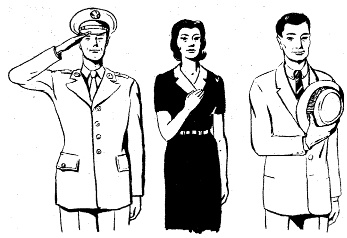


FIG 13. OUTDOOR SALUTE

PROPER METHODS OF DISPLAYING AND SALUTING THE FLAG OF THE UNITED STATES OF AMERICA

near the main administration building of every public institution.

(f) The flag should be displayed in or near every polling place on election days

(g) The flag should be displayed during school days in or near every schoolhouse

SEC. 3. That the flag, when carried in a procession with another flag or flags, should be either on the marching right; that is, the flag's own right, or, if there is a line of other flags, in front of the centre of that line [figs. 1 and 2].

(a) The flag should not be displayed on a float in a parade except from a staff, or as provided in subsection (i).

(b) The flag should not be draped over the hood, top, sides, or back of any vehicle, or of a railroad train or a boat When the flag is displayed on a motorcar, the staff shall be fixed firmly to the right side (only) of the chassis or clamped to the radiator cap.

(c) No other flag or pennant should be placed above or, if on the same level, to the right of the flag of the United States of America, except during divine services conducted by naval chaplains at sea, when the chaplain's private pennant may be flown above the flag during divine services for the personnel of the navy.

No person shall display the flag of the United Nations or any other national or international flag equal, above, or in a position of superior prominence or honor to, or in place of, the flag of the United States at any place within the United States or any Territory or possession thereof. *Provided,* That nothing in this section shall make unlawful the continuance of the practice heretofore followed of displaying the flag of the United Nations in a position of superior prominence or honor, and other national flags in positions of equal prominence or honor, with that of the flag of the United States at the headquarters of the United Nations.

(d) The flag of the United States of America, when it is displayed with another flag against a wall from crossed staffs, should be on the right, the flag's own right, and its staff should be in front of the staff of the other flag [fig. 3].

(e) The flag of the United States of America should be at the centre and at the highest point of the group when a number of flags of States or localities or pennants of societies are grouped and displayed from staffs [fig. 4].

(f) When the flags of States, cities, or localities, or pennants of societies are flown on the same halyard with the flag of the United States, the latter should always be at the peak [fig. 5]. When the flags are flown from adjacent staffs, the flag of the United States should be hoisted first and lowered last. No such flag or pennant may be placed above the flag of the United States or to the right of the flag of the United States.

(g) When flags of two or more nations are displayed, they are to be flown from separate staffs of the same height. The flags should be of approximately equal size. International usage forbids the display of the flag of one nation above that of another nation in time of peace [fig. 6].

(h) When the flag of the United States is displayed from a staff projecting horizontally or at an angle from a window sill, balcony or front of a building, the union of the flag should be placed at the peak of the staff unless the flag is at half staff [fig. 7]. When the flag is suspended over the sidewalk from a rope extending from a house to a pole at the edge of the sidewalk, the flag should be hoisted out, union first, from the building [fig. 8].

(i) When the flag is displayed otherwise than by being flown from a staff, it should be displayed flat, whether indoors or out, or so suspended that its folds fall as free as though the flag were staffed.[1]

(j) When the flag is displayed over the middle of the street, it should be suspended vertically with the union to the north in an east and west street or to the east in a north and south street [fig. 10].

(k) When used on a speaker's platform, the flag, if displayed flat, should be displayed above and behind the speaker [fig. 11]. When displayed from a staff in a church or public auditorium, if it is displayed in the chancel of a church, or on the speaker's platform in a public auditorium [or on the floor], the flag should occupy the position of honor and be placed at the clergyman's or speaker's right as he faces the congregation or audience. Any other flag so displayed in the

[1]When displayed either horizontally or vertically against a wall, the union should be uppermost and to the flag's own right; that is, to the observer's left. When displayed in a window, the flag should be displayed in the same way; that is, with the union or blue field to the left of the observer in the street.

chancel or on the platform should be placed at the clergyman's or speaker's left as he faces the congregation or audience [fig. 12]. But when the flag is displayed from a staff in a church or public auditorium elsewhere than in the chancel or on the platform [as the congregation's flag] it shall be placed in the position of honor at the right of the congregation or audience as they face the chancel or platform. Any other flag so displayed should be placed on the left of the congregation or audience as they face the chancel or platform.'

(l) The flag should form a distinctive feature of the ceremony of unveiling a statue or monument, but it should never be used as the covering for the statue or monument.

(m) The flag, when flown at half staff, should be first hoisted to the peak for an instant and then lowered to the half-staff position. The flag should be again raised to the peak before it is lowered for the day. By "half staff" is meant lowering the flag to one-half the distance between the top and bottom of the staff. Crepe streamers may be affixed to spear beads or flagstaffs in a parade only by order of the President of the United States.

(n) When the flag is used to cover a casket, it should be so placed that the union is at the head and over the left shoulder. The flag should not be lowered into the grave or allowed to touch the ground.

SEC. 4. That no disrespect should be shown to the flag of the United States of America; the flag should not be dipped to any person or thing. Regimental colors, State flags, and organization or institutional flags are to be dipped as a mark of honor.

(a) The flag should never be displayed with the union down save as a signal of dire distress.

(b) The flag should never touch anything beneath it, such as the ground, the floor, water, or merchandise.

(c) The flag should never be carried flat or horizontally, but always aloft and free.

(d) The flag should never be used as drapery of any sort whatsoever, never festooned, drawn back, nor up, in folds, but always allowed to fall free. Bunting of blue, white, and red, always arranged with the blue above, the white in the middle, and the red below, should be used for covering a speaker's desk, draping the front of a platform, and for decoration in general.[2]

(e) The flag should never be fastened, displayed, used, or stored in such a manner as will permit it to be easily torn, soiled, or damaged in any way.

(f) The flag should never be used as a covering for a ceiling.

(g) The flag should never have placed upon it, nor on any part of it, nor attached to it any mark, insignia, letter, word, figure, design, picture, or drawing of any nature.

(h) The flag should never be used as a receptacle for receiving, holding, carrying, or delivering anything.

(i) The flag should never be used for advertising purposes in any manner whatsoever. It should not be embroidered on such articles as cushions or handkerchiefs and the like, printed or otherwise impressed on paper napkins or boxes or anything that is designed for temporary use and discard ; or used as any portion of a costume or athletic uniform. Advertising signs should not be fastened to a staff or halyard from which the flag is flown.

(j) The flag, when it is in such condition that it is no longer a fitting emblem for display, should be destroyed in a dignified way, preferably by burning.

SEC. 5. That during the ceremony of hoisting or lowering the flag or when the flag is passing in a parade or in a review, all persons present should face the flag, stand at attention, and salute. Those present in uniform should render the military salute. When not in uniform, men should remove the headdress with the right hand holding it at the left shoulder, the hand being over the heart. Men without hats should salute in the same manner. Aliens should stand at attention. Women should salute by placing the right hand over the heart. The salute to the flag in the moving column should be rendered at the moment the flag passes [fig. 13].

SEC. 6. That when the national anthem is played and the flag is not displayed, all present should stand and face toward the music. Those in uniform should salute at the first note of the anthem, retaining this position until the last note. All others should stand at attention, men removing the headdress. When the flag is displayed, all present should face the flag and salute.

SEC. 7. That the pledge of allegiance to the flag, "I pledge allegiance to the flag of the United States of America and to the Republic for which it stands, one Nation under God, indivisible, with liberty and justice for all,"[3] be rendered by standing with the right hand over the heart. However, civilians will always show full respect to the flag when the pledge is given by merely standing at attention, men removing the headdress. Persons in uniform shall render the military salute.

The eighth section empowers the commander in chief of the army and navy to change or add to the rules whenever desirable.

A U.S. flag painted on the side of a ship should have the union toward the bow of the ship and the stripes flowing aft, as if flying in the wind. The flag is the same when looked upon from either side, and depending upon the direction in which it is moving.

Personal and Official Flags. — As it is the prerogative of the U.S. president to design his own flag (though not all presidents have exercised this privilege), there is no set pattern. but the field is always blue. The flagstaff is ebony and is the only flagstaff authorized (army regulations, 1917) to bear the "eagle, alert" staff head. The correct staff head of all other U.S. flags is the spear (or "acorn, ball"; navy staffs may bear the star, lance, ball or flat truck), never the eagle. The vice-president's flag design includes a part of the great seal in colour, encircled by 13 blue stars, on a rectangular white field. The flag of the secretary of the treasury exhibits crossed anchors encircled by 13 white stars on a rectangular blue field. That of the secretary of the army includes part of the great seal, in colour, and four white stars on a rectangular red field; while the design of the secretary of the navy's flag exhibits a fouled anchor and four white stars on a rectangular blue field. For five-star generals of the army the flag is a rectangular "scarlet field with five white stars placed on an imaginary circle," and for fleet admirals it is a rectangular "dark blue field with five white stars placed on an imaginary circle." Other cabinet officers, undersecretaries, assistant secretaries and staff officers have distinguishing flags indicative of their office and rank. The United States shield, taken from the great seal, has seven white stripes and six red vertical stripes (pales), representing the original 13 colonies supporting the nation, indicated by the blue band in which there are no stars.

Confederate Flag. — When a bloc of southern states seceded from the union, the selection of a suitable flag was much discussed. Early in Feb. 1861, a convention of six of the states met in Montgomery, Ala., to consider the form of government to be set up, and a committee, appointed to select a flag, recommended that

> . . . the flag of the Confederate States of America shall consist of a red field with a white space extending horizontally through the centre equal to one-third the width of the flag, the red spaces above and below to be of the same width as the white; the union blue, extending down through the white space and stopping at the lower space; in the centre of the union a circle of white stars corresponding to the number of States of the Confederacy.

This report was adopted on March 4, 1861. The flag thus approved came to be known as the Stars and Bars. It was first displayed over the state house in Montgomery.

At the battle of Bull Run, or Manassas as the Confederates called it, the similarity in colours of the flags of the Northern and Southern armies led to confusion, and at the suggestion of Gen. G. T. Beauregard a battle flag was devised and used by the Southern armies throughout the war. It was based on a design suggested by Col. William Porcher Miles and Col. Walton, and consisted of a red field on which was placed a blue St. Andrew's cross separated from the field by a white fillet, and adorned with white stars to the number of Confederate states. The Stars and Bars having proved to be unsatisfactory, demand was frequently made for the adoption of a flag of different design. Finally, in May 1863, the Confederate congress, in session in Richmond, Va., adopted a new design.

The resolution recommending it set forth that the flag should be a red square containing the battle flag designed by General Beauregard, the only objection being that it resembled the white English ensign and might be mistaken for a flag of truce, and so on March 4, 1865, a broad transverse strip of red was added to it.

(GY. A.; G. W. Do.; X.)

FLAGS OF OTHER COUNTRIES

Europe. — France. — The Chape de St. Martin and the oriflamme were succeeded by the *cornette blanche* of the Bourbons, when Henry IV came to the throne in 1589. This was a white flag, usually carrying the fleur-de-lis arms of royalty, and it was used until the Revolution. The origin of the well-known French tricolour, which was then adopted, is clear from a perusal of contemporary papers. When the Bastille was taken and destroyed on July 14,

[1]Subsection (k) is often read too literally. The flag always holds the position of honour, the "military right of line." This is at the right of a person or persons facing people who are facing them, whether the staffed flag is in chancel, on platform or on the floor. Honour is a matter of position, not altitude.

[2]Note the order of the colours—blue, white and red—as the government enumerates them.

[3]On Flag day, 1954, public law 396 added the two words "under God" to the pledge, making it read: "I pledge allegiance to the flag of the United States of America and to the Republic for which it stands, one Nation under God, indivisible, with liberty and justice for all."

1789, the Parisians wore cockades of red and blue, the colours of the coat of arms of the city, in conformity with instructions from the national assembly the preceding day. Three days later the king went to the *hôtel* de *ville* and the newspaper Le *Moniteur,* in its issue of July 20, in describing the incident, related that the mayor of Paris "presented to the king a cockade, the same as that which the citizens had adopted. His majesty received it and put it on his hat," where the white cockade of the Bourbons was already placed. Red. white and blue were thenceforth known as "the national colours," symbolizing the unity of king and people. The white flag flown by the navy was not changed until the following year. On Oct. 24, 1790, the assembly passed a law providing for a flag of three vertical stripes of red, white and blue to be flown from the jackstaff on the bowsprit, and the ensign had the same combination as a canton on the white flag. On Feb. 15, 1794, the ensign was denounced in the assembly as "an outrageous caricature" inasmuch as "the republican colours are relegated to a corner of the flag." The white ensign was thereupon abolished and the tricolour jack was substituted for it. The law provided that the colours be reversed so that the blue stripe would be next to the staff.

The restoration of the Bourbons after Waterloo brought back the cornette blanche, but with the accession of Louis Philippe in 1830 the tricolour returned to stay. It is the only French flag, being used for all purposes.

The Netherlands.—The flag of this country had its origin in the colours of the prince of Orange, the leader of the Dutch in their War of Independence. His colours were orange, white and blue, and two flags used in 1574 are still preserved. Just how or why the top stripe was changed from orange to red, as it is today, is not clear. As early as 1597 the use of red is recorded, and in 1634 the governor general of the Dutch East Indies, in placing an order for bunting for the manufacture of flags, requested either orange or red. This indicates that the two colours were considered interchangeable. Orange remained the official colour and in at least four flag books published in the first half of the 18th century the Dutch flag is described as orange. white and blue, although the accompanying illustrations show a red stripe, not orange. It was not until Feb. 17, 1795 that the states-general prohibited the use of orange and on the following Sept. 25 described the red, white and blue emblem as the national flag.

Belgium.—The Belgian flag has three vertical stripes of black, yellow and red. These colours were first used by the Brabançons in 1790 and were probably taken because they are the colours of the coat of arms of Brabant. However, it should be noted that they are also the same as the colours of the arms of all the principal provinces of Belgium. In 1830, when the Belgians revolted against the Netherlanders. the French tricolour, as the symbol of liberty, was flown. When success was achieved and the kingdom of Belgium established, the Brabançon colours were taken for the national flag.

Germany.—Each kingdom and principality had its own local flag and coat of arms, and there never was a flag common to all of Germany until the establishment of the empire in 1871. Then the flag which had been adopted four years before by the north German confederation—black. white and red in three horizontal stripes—was taken for the national flag of Germany. These colours came from the black and white arms of Prussia and the red and white colours of the Hanseatic league. When the republic was inaugurated in 1918, the colours were changed to black, red and gold, a flag which had been flown during the revolutions of 1848.

Austria.—After the incorporation of Austria with Germany the Austrian flag ceased to exist, but no account of national flags would be complete without mentioning it. as it was probably the oldest one in use. It dates from early in the 13th century when Duke Frederick II of Austria adopted a horizontal white stripe on a red field for his coat of arms and banner. The earliest authentic date for this is 1232, and it continued to be the flag of Austria with no intermission until the *Anschluss* of 1938. It was restored after World War II.

Czechoslovakia.—When Czechoslovakia was formed after World War I, it adopted a flag of red, white and blue, the colours of the coats of arms of Bohemia, Moravia and Slovakia. The flag had two horizontal stripes of red and white with a blue triangle at the hoist. After the occupation by Germany in 1939 the colours were retained but in Bohemia and Moravia they were arranged in three horizontal stripes, with white at the top and blue at the bottom.

Switzerland.—The origin of the Swiss flag. a white couped cross on a red field, is usually ascribed to the year 1339, but the only authority for that date is an account written 100 years later. The first historical mention of the white cross emblem occurs in 1444, when the Swiss were charged with having worn red crosses on their military tunics, instead of the customary mhite, to deceive the enemy. However, this shows that the white cross was already the established Swiss device, although not on a flag. Apparently its use was by custom only; not until May 16, 1814, was it officially recognized as "the military emblem of the ancient Swiss."

Spain.—In mediaeval times and until 1785 the royal armorial banner was the only flag in Spain which could be considered as national. In that year it became a cornette *blanche.* A Bourbon was on the throne and he used the white flag of that family charged with the royal arms. In order to difierentiate clearly between the ships of Spain and those of other countries nhich were ruled by Bourbons, all of whom used the white flag, a new national flag of red and yellow was adopted, taken from the Spanish coat of arms. A central horizontal stripe comprising half the area, was yellow; on each side was a strip of red. This flag lasted until the overthrow of the monarchy in 1931 when a tricolour of red, yellow and purple was adopted. The Iiacionalistas under Gen. Francisco Franco used the flag of the monarchy in the civil war and restored it as the national flag when they became victorious in 1939. The coat of arms is placed on the centre.

Portugal.—Armorial banners were used in Portugal until well into the 19th century. In 1821 the *cortes* approved a resolution which provided that the national cockade be blue and white, "the colours used on the shield of Alfonso Henriquez." the first king of Portugal. in the 12th century. In 1830 a flag was adopted of those two colours. blue occupying two-fifths of the flag next the staff, white the remainder. The coat of arms was centred on the line dividing the two colours. In 1910 the monarchy was overthrown and green and red replaced the blue and white.

Italy.—The flag of Italy is green, white and red in three vertical stripes. This flag first appeared on May 14, 1795, at Bologna in a student demonstration. These three colours, however, had been favourites in northern Italy for several hundred years, ever since Dante used them as symbols of the three cardinal virtues, faith, hope and charity. In Sept. 1796 the newly formed Cisalpine republic adopted the flag for its troops taking part in the Napoleonic campaigns in Lombardy. When Napoleon was crowned king of Italy in 1805, he took the flag for his new kingdom, but with his downfall Italy again disintegrated and the flag ceased to exist. On March 4, 1848, Charles Albert, king of Sardinia, resurrected the flag, and when Italy was again united under his son in 1861 it became the emblem of the entire country.

Scandinavia.—The flag of Denmark has a white cross on a red field and is known as the Danebrog. Historically the first evidence of use of this flag is on the seal of Waldemar, duke of South Jutland. on a document of 1308. The merchant flag is of the usual rectangular shape; the naval ensign is swallow-tailed.

The flags of the other Scandinavian countries are all based on the Danebrog. Sweden uses a yellow cross on a blue field; yellow and blue are also the colours of the national coat of arms. uhich consists of three gold crowns on blue. This flag dates from the reign of Gustavus Vasa, who was crowned in 1528. The naval ensign is swallow-tailed with a tongue; *i.e.*, it has three points.

Iiornay was united to Denmark for 400 years, until 1814, when it came under the Swedish cronn. The Danish flag nas retained, but with the addition of the lion of Norway in the upper corner. Because of the difficulty of distinguishing this from the flag of Denmark, a change was made in 1821, the lion being eliminated and a blue cross superimposed on the white cross of the Danish flag. Norway was completely independent after 1905 but continued to use the same flag. The naval ensign has three points.

The flag of Finland has a blue cross on a white field, "the blue for the colour of the lakes, the white as the emblem of the snow-fields," as a member of the Finnish diet said when the flag was first suggested in the 1860s. The coat of arms is placed on the cross. The naval ensign is swallow-tailed.

The flag of Iceland is the reverse of that of Norway, a red cross bordered with white on a blue field.

Hungary.—The Hungarian flag has three horizontal stripes of red, white and green. In the early midde ages the royal banner had red and white horizontal stripes. In some way green came to be associated with them, and a coat of arms was developed in the 14th century with those three colours. During the reign of Maria Theresa (1740–80) a national flag of red, white and green made its appearance, but it does not seem to have come into general use. It was not until 1848 that the diet prescribed that "the ancient flag shall again be used." This definitely established the national flag of Hungary. After the establishment of the Communist government the new national emblem—a rising star, above a hammer crossed with an ear of wheat, the whole encircled by sheaves of wheat—was placed on the tricolour flag.

Poland.—The national flag was flown after 1919 but was not officially adopted until 1927. The colours, red and white, go back to the old Polish banner of Lech. a white eagle on a field of solid red. According to legend the brothers Czech and Lech set out from Yugoslavia to find a new home for their people; Czech stopped and founded Prague; Lech kept on. and seeing a white eagle in a tree he chose it as part of his emblem when he founded Warsaw.

U.S.S.R.—The flag of the Russian empire was white, blue and red in three horizontal stripes and was first displayed in the reign of Alexis in 1667. His son, Peter the Great. founded the Russian navy, and about the year 1712 a blue cross, shaped like the letter X, on a white field mas taken for the naval flag. With the fall of the empire in 1917 and the establishment of the Soviet government all imperial emblems were abolished and the red flag of revolution became the national flag. A crossed hammer and sickle in yellow are in the upper corner, symbolizing the artisan and the husbandman, and above them is a five-pointed star outlined in yellow. This star is said to typify the five continents which, according to Soviet belief, are eventually to embrace the doctrines of Marx.

It is strange, but nevertheless true, that the red flag, symbolical of revolution, originally had precisely the opposite connotation. After the fall of the Bastille in 1789 rioting became frequent in Paris, which induced the assembly to pass an act providing for martial law; the hoisting of the red flag was to be the signal that martial law had been declared. It was so displayed several times during the ensuing two years; then came the fateful day of July 17, 1791, when the red flag was raised and the troops, under the marquis de Lafayette, fired on a riotous mob on the Champ de Mars, killing several hundred. Popular indignation at this act strengthened the extreme radical elements. and the next year the mob used a red flag inscribed "Martial law of the people against the revolt of the court," on the principle that the people constitute the sovereign power, and that whenever a government opposes the people it is the government which is in revolt and the people are justified in declaring martial law against it. Several similar instances occurred in the next few years, both in France and elsewhere, firmly establishing the red flag as the symbol of opposition to the government.

Yugoslavia.—Yugoslavia has three horizontal stripes of blue, white and red for its national flag, with a red star outlined in yellow on the centre. The flag of Serbia until the close of World War I had the same three colours, but the top stripe was red. the bottom white. It had its origin in the uniform worn by the Serbs in their insurrection against the Turks. They wore white shirts uhich hung to the knees, under a blue coat, with red caps. A company of soldiers thus garbed presented three lines of red. blue and white.

Rumania.—The flag of Rumania has three vertical stripes of blue, yellow and red, adopted in 1859. The colours are taken from the coat of arms, shown in the centre stripe.

Bulgaria.—The Bulgarian flag has three horizontal stripes of white, green and red. The naval ensign carries the national coat of arms—a gold lion—on a red canton.

Albania.—The flag of Albania is a resurredtion of the banner of the national hero, Skanderbeg, who successfully fought the Turks for 24 years in the 15th century. It has a black double-headed eagle on a red field. After the occupation of the country by the Italians a gold fasces was superimposed on the eagle, and after World War II a red star, outlined in yellow, was placed above it.

Greece.—The Greek War of Independence started on March 25, 1821, when Bishop Germanos raised a banner of blue, surmounted by a white cross, at Lavra. In the following January a flag of five blue and four white stripes, with a white cross in the upper corner, was adopted by the revolutionary assembly at Epidaurus.

Ireland—The national flag of Ireland, adopted in 1921, has three vertical stripes: green, the old colour of the Irish clans; white, for peace; and orange, the colour of the Orangemen.

Asia and Africa.—Turkey.—The Turkish flag has a white star and crescent on a red field. The story usually told is that the star and crescent was the emblem of Constantinople and that Mohammed II appropriated it when he captured the city in 1453. In fact. however, the crescent became the symbol of the followers of Mohammed the Prophet very early in the spread of Islam, and it was on the red flag of the Osmanli Turks 200 years before the capture of Constantinople. The Osmanlis were then a small tribe in the sultanate of Roum in Asia Minor. but they expanded rapidly, overrunning eastern Asia and the Balkans and establishing the country that came to be Turkey. On the other hand, the star was not added to the crescent on the flag until about 1798.

Egypt.—The flag of Egypt is green, charged with a white crescent and three white stars. Green is the colour sacred to Mohammed, and it was used by the Fatimite dynasty which ruled Egypt in the middle ages. The three stars represent the triple sovereignty over Egypt, Nubia and the Sudan.

Jordan and *Iraq*.—The two Moslem countries Jordan (formerly Transjordan) and Iraq, formed after World War I, have nearly identical flags. Both are based on one adopted by the Sharif Husain of Mecca, which had three horizontal stripes of black, white and green, with a triangle of red next the staff. The symbolism of green has already been explained. White and black were the colours of the first two dynasties of caliphs, the Omayyads and the Abbassids, respectively, and red was the colour used by Husain's ancestors. Arabia was conquered by Ibn Sa'ud. who introduced his own green flag, but in the meantime Husain's two sons had become kings of Transjordan and Iraq, and they preserved his flag. In Jordan a white star is placed on the red triangle; Iraq uses two white stars and the point of the triangle is cut off, forming a red trapezoid.

Iran.—The flag of Iran is a horizontal tricolour of green, white and red, with an ancient device. the lion and sun, on the centre. The lion and sun device is omitted when the flag is flown by the people and on the merchant flag.

Ismel.—The national flag of the state of Israel is white with two Yale-blue bands extending the full length of the flag. In the centre of the wide white stripe is a shield of David, made of six Yale-blue bands, forming two equilateral triangles with their bases parallel to the two blue bands.

Japan.—The naval ensign of Japan has a red rising sun with 16 rays on a white field; the national flag has a red ball on white. These flags were adopted in 1859, although the sun banner had long been an emblem of the mikado.

China.—The flag of China in the days of the Manchu emperors was the imperial dragon. The republic established in 1912 adopted a flag having five horizontal stripes of red, yellow, blue, white and black, representing the five races or clans of China. This lasted until 192j when the banner of the Kuomintang party replaced it. This flag has a red field with a canton of blue charged with a white sun having 12 rays.

India.—The national flag has three horizontal stripes: deep saifron, symbolizing the spirit of renunciation and humility; white, the path of light, truth, simplicity; bottle green, relation with the soil. In the centre of the white stripe, in dark blue, is the wheel of the Law of Dharma, a representation of Chakra of Asoka, the Buddhist ruler of the 3rd century B.C.

Ceylon.—The national flag is known as the lion flag. It has two vertical stripes, green and saffron; the balance is a red field in which is shown a lion holding a sword. The whole has a border of yellow. This flag was first hoisted on the morning of Feb. 4, 1948, and proclaimed a new era in the history of Ceylon, when it became a self-governing dominion of the British Commonwealth.

Pakistan. — The national flag has one vertical white stripe one-quarter the flag's width, the remaining three-quarters being a field of solid bottle green in which is shown a white crescent and one white star.

Burma.—The national flag has a solid red field, with a dark-blue canton in which is one large white star surrounded by five smaller white stars.

Siam.—The flag of Siam (Thailand) has five horizontal stripes of red, white, blue, white and red. The naval ensign has the Siamese badge, a white elephant, on a red disk placed on the centre of the flag.

Latin America. — Mexico. — The flag of Mexico, three vertical stripes of green, white and red, was adopted in 1821, when Mexico gained its independence. The Mexican device — an eagle with a serpent in its beak, standing on a cactus — is on the centre stripe.

Argentina and Uruguay. — The flag of Argentina is a white stripe placed horizontally on a light-blue field, with a golden sun, taken from the coat of arms, on the centre. It originated in the colours of the uniforms worn by the Argentinians when they repulsed a British invasion in 1806. The flag was adopted Feb. 13, 1813. Uruguay, which co-operated with Argentina in the early wars, uses the same colours in horizontal stripes, five white and four blue, with the same golden sun on a canton.

Venezuela, Colombia and Ecuador. — The flags of these countries — three horizontal stripes of yellow, blue and red — are all taken from the ensign hoisted by Gen. Francisco Miranda over his expedition of 1806, when the revolutions in South America against Spain commenced. Venezuela has seven white stars in a semicircle on the blue stripe. The yellow stripe occupies the upper half of the Colombian and Ecuadorian flags, as it did on Miranda's ensign. Colombia has a white star on the centre of the merchant flag and the coat of arms on the naval ensign. The coat of arms is placed in the centre of the Ecuadorian flag; the merchant marine flag is plain.

Peru. — The Peruvian flag has a white vertical stripe on a red field, with the coat of arms on the centre. It is said that these colours were suggested by a dream which José de San Martin, the Argentinian, had the night after he landed in Peru with an army to assist in the Peruvian war for independence. The flag as now designed was adopted Feb. 25, 1825.

Brazil. — The flag of Brazil is green with the coat of arms on a yellow lozenge. The day Dom Pedro proclaimed the independence of the country, Sept. 7, 1822, he wore an arm band of green and gold.

Paraguay.—The flag of Paraguay is red, white and blue in three horizontal stripes, with national badges on the centre, a different badge on each side. In its present form it dates from Nov. 17, 1842.

Bolivia. — The flag of Bolivia was adopted July 14, 1888. It is a tricolour of red, yellow and green, representing the country's animal, mineral and vegetable riches. The coat of arms appears on the yellow stripe of the flag used on public buildings and by official institutions.

Chile. — The flag of Chile dates from Oct. 18, 1817. It is divided horizontally into white and red and has a blue canton on which is a white star of five points, one point for each letter of the name Chile.

(R. E. Wy.; Gy. A.)

OTHER FLAGS

International Flags.—Besides the flags flown by separate nation-states there are now several flags, apart from the red cross already mentioned, which are used internationally. The flag of the United Nations is blue with the globe (as seen from the north pole) surrounded by a wreath all in white. Then there is the flag of the European union, in green and white; and the flag of the Americas, a white flag with three blue Maltese crosses, which offends the laws of heraldry by placing yellow (of the sun's rays) on white. The flag used at the Olympic games is white with five interlaced circles in blue, yellow, black, green and red. Other international flags are the flag indicating condition of health aboard ship, plain yellow, and the pilot flag, yellow and blue vertical stripes. But these, like the flags of the international code and the white flag indicating surrender or truce, are really signals and are dealt with elsewhere under that heading (see SIGNAL COMMUNICATION). All flags, it should be noted, however, can be used to some extent as signals Striking the flag denotes surrender. Dipping the flag (lowering it slowly and rehoisting it smartly) is a form of salute A flag hoisted at half-mast is a sign of mourning. A ship's ensign hoisted upside down is a signal of distress. In a ship that has surrendered, the captors may hoist their own ensign above the ensign of their opponents, primarily to persuade their own side to cease fire. In World War II, submarines re-entering their base used sometimes to hoist a black flag with some symbol to indicate a recent success.

Yachting Flags. — In Great Britain yachts may fly on occasion an ensign, a racing flag and a burgee. Ensigns may be white, blue, blue with a badge, red with a badge or plain red. The white ensign has been confined (since 1858) to yachts of the Royal Yacht squadron. The blue ensign may be flown by any yacht which is entitled to a royal naval reserve warrant on the conditions applicable to any merchantman. The blue ensign with a club badge in the fly is flown by yachts belonging to clubs which have the prefix "Royal" and an admiralty warrant The red ensign with a club badge is flown by yachts belonging to clubs which have only a royal and not an admiralty warrant. The red ensign may be flown by any yacht, whether belonging to a club or not. The burgee is essentially a club flag, being triangular and more often seen than the ensign. Burgees are numerous in Great Britain and still more numerous in the United States; that of the Royal Thames dates from 1775, others from the period 1820–50. The racing flag is flown only during a race to indicate which yachts are competing. It may be hauled down as a signal that a yacht has given up the race. The racing flag is intended to distinguish one yacht from another and may be of any design the owner pleases. A white-bordered union flag may also be carried, to use as a protest or pilot signal.

House Flags. — Merchantmen in British registry fly certain flags in addition to the blue or red ensign. Although they may not fly the union jack, they map fly at the jack staff a white-bordered union jack as a sign of nationality. They may fly from their foremast, when leaving port, the flag of the country for which they are bound. They may also fly their house flag indicating the shipping line to which they belong. House flags originate, it has been claimed, from the flags hoisted on Bidston hill (overlooking the old entrance to the Mersey) to inform the owners in Liverpool of their ships' arrival or departure from the Hoyle lake, which was invisible from their office windows. But the ownership of 18th-century ships was complex, and the permanently established shipping lines appeared more after 1815. Earliest of these was, of course, the East India company Its functions were largely taken over by the Blackwall frigates, which had their own house flag; and these eventually yielded place to the ships of the Peninsular and Oriental Steam Navigation company whose house flag dated from 1832. Few existing house flags can claim much greater antiquity (except that of the Hudson's Bay company), because the earlier sailing-ship lines went out of business after a period of competition with steamship companies of an almost equal seniority. Among the better-known British house flags are those of the Cunard White Star, Clan, British India, Royal Mail, Orient, Union-Castle, Canadian Pacific, Anchor, Bibby, Ellerman's Wilson and Blue Funnel lines. House flags are also flown by merchantmen of other countries, such flags as those of the Messageries Maritimes, the Batavier, the Lloyd Triestino and the Nippon lines being among the most familiar.

For flags carried by troops, see COLOURS, MILITARY. (C. N. P.)

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FLAGELLANTS, in religion, the name given to those who scourge themselves, or are scourged, by way of discipline or penance (Lat. *flagellare,* to whip). Voluntary flagellation, as + form of exalted devotion, occurs in almost all religions. According to Herodotus, it was the custom of the ancient Egyptians to beat themselves during the annual festival in honour of Isis. In Sparta children were flogged before the altar of Artemis Orthia till the blood flowed. At Alea, in the Peloponnese. women were flogged in the temple of Dionysus. In the Christian church flagellation was originally a punishment, and was practised not only by parents and schoolmasters but also by bishops, who thus corrected offending priests and monks. Gradually, however, voluntary flagellation appeared in the *libri poenitentiales* as a very efficacious means of penance. In the 11th century this new form of devotion was extolled by some of the most ardent reformers in the monastic houses of the west. The early Franciscans flagellated themselves with characteristic rigour, and it is no matter of surprise to find the Franciscan St. Anthony of Padua preaching the praises of this means of penance. But the flagellant fraternities were the result of spontaneous popular movements, the real sources of which are not easily analyzed. About 1259 these fraternities were distributed over the greater part of northern Italy. The contagion spread very rapidly, extending as far as the Rhine provinces and across Germany into Bohemia. Day and night, long processions of all classes and ages, headed by priests carrying crosses and banners, perambulated the streets in double file, reciting prayers and drawing the blood from their bodies with leathern thongs. The magistrates in some of the Italian towns expelled the flagellants with threats, and for a time the sect disappeared. The disorders of the 14th century, however, the numerous earthquakes, and the Black Death, which had spread over the greater part of Europe, produced a condition of ferment and mystic fever which was very favourable to a recrudescence of morbid forms of devotion. The flagellants reappeared from eastern Europe, and, in spite of discouragement, spread to the Rhine, and penetrated as far as Holland and Flanders. A band of 100 marched from Basle to Avignon to the court of Pope Clement VI who saw in the movement a menace to the priesthood, and in Oct. 1349 published a bull commanding the bishops and inquisitors to stamp out the growing heresy. In pursuance of the pope's orders numbers of the sectaries perished at the stake or in the cells of the inquisitors and the episcopal justices. In 1389 the leader of a flagellant band in Italy called the ***bianchi*** was burned by order of the pope, and his following dispersed.

John Gerson insisted that the flagellants were creating a cultus and ritual of their own in antagonism to those of the church. This view was borne out by the facts, in Germany in 1414, when there was a recrudescence of the epidemic of flagellation which was preached as the only way to salvation. It was suppressed by the Inquisition, but held its ground among the lower ranks of Catholic piety. In the 16th century it subsisted in Italy, Spain and southern France. Henry III of France met with it in Provence, and attempted to acclimatize it at Paris. Flagellation was occasionally practised as a means of salvation by certain Jansenist convulsionaries in the 18th century. In 1820 a band of flagellants appeared during a procession at Lisbon; and in the Latin countries, at festivals, one may still see brotherhoods of penitents flagellating themselves before the assembled faithful.

FLAGELLATA, single-celled animals (Protozoa [*q.v.*]) characterized by the possession of flagella—delicate, hairlike, protoplasmic processes which serve as organs of locomotion (functioning similarly to an oar or to the propeller of an airplane).

FLAGELLUM, a relatively long, filamentous organelle characteristic of many protozoans, bacteria and certain algae having flagellated stages in their life cycles, as well as of specialized cells (choanocytes) of sponges. Flagella serve primarily as swimming devices, but in some cases may be used to create food-bearing water currents or to investigate the surroundings Each filament consists of a sheath and an inner axoneme nhich generally is attached to a cytoplasmic granule (blepharoplast). In electron micrographs the axoneme typically shons 11 fibrils (2 central, 9 peripheral). Although they are usually placed anteriorly, flagella sometimes are attached posteriorly or laterally. and occasionally form the margin of a ribbonlike undulating membrane as in certain parasites (*e.g., Trypanosoma, Trichomonas*). Cilia (*q.v.*), similar in structure to flagella, are typically shorter, more numerous and usually arranged in rows. See also PROTOZOA; BACTERIOLOGY; ALGAE; SPONGES. (R P. H)

FLAGEOLET, in music, a kind of *flûte à bec* aith a new fingering, invented in France at the end of the 16th century and in vogue in England from the end of the 17th to the beginning of the 19th century. The flageolet differed from the recorder (*q* v.) in that it had four finger holes in front and two thumb holes at the back instead of seven finger holes in front and one thumb hole at the back.

FLAGET, BENEDICT JOSEPH (1763–1850), U.S. Roman Catholic prelate. first bishop of the old west, was born Nov. 7, 1763, in Contournat, France. Entering the Sulpician society, he mas ordained a priest in 1786 (or 1787), thereafter teaching theology. He was one of several Sulpicians sent in 1792 to establish the first seminary in the United States. During the following 17 years he served as missionary to Vincennes, Ind.; attempted to found a college in Havana. Cuba; and taught at Georgetown college in Washington, D.C., and at St. Mary's seminary in Baltimore, Md.

When Bishop John Carroll's (see CARROLL, JOHN) diocese of the United States was divided in 1808, Flaget was nominated for one of the four new sees; and on Nov. 4, 1810, he was consecrated by Carroll as bishop of Bardstown, Ky. His diocese extended from Kentucky to the Great Lakes, from the Alleghenies to the Mississippi; eventually 35 dioceses were created from it.

Flaget's various religious establishments were the wonder of the Roman Catholic world, and he became one of the most influential men in the councils of the American church of that period. The Sisters of Loretto and the Sisters of Charity of Nazareth, founded in 1812. were engaged in the elementary education of girls. St. Thomas seminary uas followed by the foundation of two boys' colleges near Bardstown, St. Joseph and St. Mary's, which became noted for the education of many leading southern statesmen. Among his priests were the famed missionaries Stephen T. Badin and Charles Nerinckx. His cathedral of St. Joseph in Bardstown, dedicated in 1819, is today a national monument. The see was moved to Louisville just prior to Flaget's death on Feb. 11, 1850.

See J. H. Schauinger, *Cathedrals in the Wilderness* (1952) and *Stephen T. Badin: Priest in the Wilderness* (1956). (J. H. S.)

FLAGLER, HENRY MORRISON (1830–1913), U.S. financier, a pioneer in Florida development, was born at Hopewell, N.Y., on Jan. 2, 1830. At the age of 14 he went to work as a clerk in a country store in Ohio. About 1850 he became a grain dealer and accumulated a small fortune, but lost it in a salt-manufacturing venture. He borrowed money in 1867 and entered into partnership nith John D. Rockefeller and others who owned oil refineries. The business uas incorporated as the Standard Oil company in 1870, and Flagler was prominently associated with its management for many years. He built a number of palatial hotels in Florida, spending nearly $50,000,000 there. He died May 20, 1913, in West Palm Beach, Fla. (H. J. SG)

FLAGSTAD, KIRSTEN (1895–), Norwegian opera and concert singer, was born in Hamar on July 12, 1895. At the age of 18 she sang as Nuri in Eugen d'Albert's *Tiefland*. Her debut was so successful that she uas sent to Stockholm for study. There followed years in the Oslo and Gothenberg operas; and then, nith her marriage in 1919, came several years of retirement. In 1933 she sang at the Wagner festival in Bayreuth, Ger. This led to her engagement in the Metropolitan Opera, New York city, and her debut there, Feb. 2, 1935, as Sieglinde in Die *Walküre*. Her success at the Metropolitan, in London and elsewhere was remarkable, and she was hailed as one of the great Wagnerian singers.

FLAGSTAFF, a city of northern Arizona, U.S., seat of Coconino county Of the 60 sq mi. within the city limits about 48 sq.mi., comprising Coconino national forest lands, are unoccupied Arizona State college, founded in 1899, the Lowell observatory, the Naval observatory's Flagstaff station, the Atmospheric Research observatory and the Museum of Northern Arizona are located in Flagstaff. Once a mere cow-and-lumber town, it became a tourist centre, the railhead for the Glen canyon dam, 135 mi. N., the base of extensive logging and lumber operations and a trading centre for ranchers. The average annual precipitation is 19 in.; the altitude is 6.900 ft. Nearby are the Grand canyon, Oak Creek canyon, Hopi and Navaho reservations and five national monuments. Lumberjacks celebrating the 4th of July 1876, nailed a U S. flag to the top of a tall pine and called the unnamed settlement Flagstaff. A council-manager form of government was adopted in 1958. For comparative population figures see table in ARIZONA: Population. (GA. D.)

FLAHAUT DE LA BILLARDERIE, AUGUSTE CHARLES JOSEPH, COMTE DE (1785–1870), French general and statesman, was born in Paris on April 21, 1785. He entered the army as a volunteer in 1800 and received his commission after the battle of Marengo. He became aide-de-camp to Joachim Murat and was wounded at Landbach in 1805. He served at Friedland (1807), in Spain (1808) and then in Germany. Flahaut fought in the Russian campaign of 1812, and in 1813 became general of brigade, aide-de-camp to the emperor and, after the battle of Leipzig, general of division. After Napoleon's abdication in 1814 he was placed on the retired list. The Hundred Days brought him into active service again. A mission to Vienna to secure the return of Marie Louise resulted in failure. He was saved from exile by Talleyrand's influence, but was placed under police surveillance. Later he settled in England.

Flahaut returned to France in 1827, and in 1830 was made a peer of France. He remained intimately associated with Talleyrand's policy, and was for a short time in 1831 ambassador at Berlin. He was afterward attached to the household of the duke of Orleans, and in 1841 was sent as ambassador to Vienna, where he remained until 1848, when he was dismissed and retired from the army. After the coup *d'état* of 1851 he was again actively employed, and from 1860 to 1862 was ambassador at the court of St. James.

Flahaut died on Sept. 1, 1870.

FLAHERTY, ROBERT JOSEPH (1884–1951), U.S. film maker and explorer, called the father of the documentary film, was born at Iron Mountain, Mich., on Feb. 16, 1884. His Nanook of the North (1920–22), based on 16 months of living with and photographing Eskimos, set a new standard for dramatic interpretation of a way of life. In a review of his Samoan film, Moana, in the New York Sun (Feb. 8, 1926), John Grierson first called Flaherty's methods documentary. Flaherty collaborated with F. W. Murnau (Tabu, 1929–31) and John Grierson (Industrial Britain, 1933) and then spent 18 months on a tiny ocean-battered Irish island, filming Man of Aran (1933). He worked for Alexander Korda on Elephant Boy, for the U.S. Film service and Pare Lorentz on The Land (1941) and for the Standard Oil company on Louisiana Story (1948). His death occurred at Dunnerston, Vt., on July 23, 1951.

Flaherty preferred filming life in faraway places, declaring that primitive man had a freedom that modern man has lost. His inexhaustible curiosity and patient, probing camera provided accepted models of excellence for all nonfiction film makers. He was also the author of two novels and of *A* Film-Maker's Odyssey (1939). See also MOTION PICTURES: Art of the Motion Picture.

See Richard Griffith, *The World of Robert Flaherty* (1953).

(R. D. MACC.)

FLAIL, a farm hand-implement used for threshing grain. A flail consists of two pieces of wood, the handstaff or helve and the beater, held together at one end by a thong. The former usually is a light rod about 5 ft. long. and the latter a cylinder about 30 in. long and $1\frac{1}{4}$ in. in diameter. With this implement one man could thresh 7 bu. of wheat, 8 of rye, 1 j of barley, 18 of oats or 20 of buckwheat in a day. The flail is of immense but unknown antiquity, and until the middle of the 19th century flailing by hand was one of the chief methods of threshing. Variants were still used in less developed areas, such as west China, in the second half of the 20th century, and variants were used on vegetable and flower seeds and special crops when the quantity involved did not justify a special machine.

FLAMBARD, RANULF, or RALPH (d. 1128), bishop of Durham and chief minister of William Rufus, was the son of a Norman parish priest. Migrating at an early age to England, the young Ranulf entered the chancery of William I. He was disliked by the barons, who nicknamed him Flambard in reference to his talents as a mischief-maker. He appears to have played an important part in the compilation of the Domesday survey. in which he is mentioned as a clerk by profession, and as holding land both in Hants and Oxfordshire. Before the death of the old king he became chaplain to Maurice, bishop of London, but early in the next reign Ranulf returned to the royal service. He is usually described as the chaplain of Rufus; he seems in that capacity to have been the head of the chancery and the custodian of the great seal. But he is also called treasurer; and there can be no doubt that he was an agent of the extortion from which all classes suffered between 1087 and 1100. He profited largely by the tyranny of Rufus, farming for the king a large proportion of the ecclesiastical preferments which were illegally kept vacant, and obtaining for himself the wealthy see of Durham (1099). On the accession of Henry I, he was imprisoned, but escaped from the Tower of London. A popular legend represents the bishop as descending from the window of his cell by a rope which friends had conveyed to him in a cask of wine. He took refuge with Robert Curthose in Normandy. and received the administration of the see of Lisieux. After the victory of Tinchebrai (1106) the bishop made his peace with Henry, and was allowed to return to Durham where he passed the remainder of his life. His private life created much scandal, but he distinguished himself, even among 'the bishops of that age, as a builder and a pious founder. He all but completed the cathedral which his predecessor, William of St. Carilef, had begun; fortified Durham; built Norham Castle; founded the priory of Mottisfout and endowed the college of Christchurch. Hampshire. As a politician he ended his career with his submission to Henry. Ranulf died on Sept. 5, 1128.

FLAMBOROUGH HEAD, a promontory on the Yorkshire coast, England, between Filey and Bridlington bays of the North sea. It is a lofty chalk headland capped with boulder clay, pierced with caves and fringed with rocks of fantastic outline. Sea birds breed abundantly on the cliffs. A lighthouse, 214 ft. above sea level, marks the point lat. 54° 7' N., long. 0° 5' W. Flamborough village is 2 mi. west of the extreme point.

FLAMBOYANT STYLE, in architecture, the last phase of the Gothic in France, characterized by the dominance in tracery (*q.v.*) of the line of double curvature, known as the "ogee curve," which generates the flamelike forms that give the name flamboyant to the style. Flamboyant forms begin to appear in the late 14th century, as in one of the chapels of Amiens cathedral (1373). By the middle of the 15th century they were almost universal. Borrowing from the English the idea of the reversed curve and of flowing tracery, the French developed them with greater freedom (see DECORATED PERIOD and GOTHIC ARCHITECTURE). The best flamboyant tracery is often simpler and more direct than the English curvilinear work; grace of form and attenuation of line, a restrained use of cusps and generally slim proportions are the aims sought. In the 16th century, tracery returned to lower and more stumpy proportions with a great use of round and elliptical arches.

All work of the flamboyant period is characterized by lavishness of detail, multiplication of miniature niches, fantastic and elaborate crockets, pierced, traceried gables, curved-sided pinnacles and the practice of intersecting and interpenetrating mouldings of different profiles as, for instance, a cornice and a raking gable mould. Double and triple bases are frequent, the upper bases being penetrated by projecting shafts which have their own bases below. Among the outstanding examples of the style are the church of St. Maclou at Rouen (begun 1432); St. Wulfram at Abbéville (1480); upper part of the cathedral at Rouen (1481–92); the Palais de Justice at Rouen (c. 1500); north transept of the cathedral of Beauvais (1500–48); and the spire of the northwest tower of the cathedral at Chartres (1506). (T. F. H.; P. F.)

FLAME, as a phenomenon of the physical world, is generally understood to be burning gas. Its prerequisite is the formation of an explosive mixture, as, for example, coal gas and air. If such a mixture is ignited by a spark or small flame, the combustion spreads from the ignition source to the adjacent layer of gas mixture; in turn, each point of the burning layer serves as an ignition source for the next adjacent layer, and so on. In this way, reminiscent of Christiaan Huygens' principle for the propagation of a light wave, a combustion wave (also called flame front, combustion zone) is formed which propagates through the gas mixture leaving in its wake hot burned gas. (See also COMBUSTION.) The mixture propagates a flame only above some minimum and below some maximum percentage of fuel gas. These percentages are called the lower and upper limits of inflammability. Mixtures of average coal gas and air, for example, will not propagate flame if the proportion of gas is less than about 5% or more than about 31%. For natural gas the limits are about 4% and 15%, respectively. If the mixture is enclosed in a small vessel, or if it flows through a narrow tube, the chilling effect of the wall of the vessel narrows the limits of inflammability; and below some critical diameter whose exact magnitude depends mainly upon the nature of the fuel gas and the temperature of the enclosure, flame is quenched altogether, even if the mixture ratio is the optimum for combustion of the fuel gas to carbon dioxide and water vapour.

The combustion wave travels against the unburned mixture at a definite velocity, called the burning velocity. This velocity depends upon the composition of the mixture, increasing from zero at the two limits of inflammability to a maximum at some intermediate percentage of fuel gas. It does not exceed 270 cm. per second for air and hydrogen (hydrogen, the fastest-burning gas, comprises about 50% of coal gas) and about 50 cm. per second for most other common fuel gases; it remains much less than 1,000 cm. per second for mixtures of fuel gases with oxygen, except under conditions of turbulence or detonation (see COMBUSTION). Close to chilling surfaces the burning velocity always drops to zero. The distance over which the chilling is effective, the "quenching distance," is a well-defined measurable quantity. It increases as the composition of the mixture changes from the optimum to either the lean or rich side and decreases as the temperature of the wall is raised. It does not exceed 2 mm. for common fuel gases and air, and drops to the order of 0.01 mm. for mixtures of oxygen and hydrogen or acetylene.

Depending upon the conditions of mixture formation and gas flow, several types of flame structure may be distinguished and are described below.

Diffusion Flame.—Consider a slow stream of fuel gas flowing from a tube into the open atmosphere. From the mouth of the tube upward air diffuses across the boundary of the stream toward the centre of the stream and forms an envelope of explosive mixture around a core of flowing fuel gas. This latter core diminishes with height until, at some distance above the tube, it has disappeared. It thus assumes the shape of a cone. Near the surface of the cone the mixture is overrich in fuel, and farther outward it becomes progressively leaner. On ignition a combustion wave rapidly spreads through the whole envelope of explosive mixture, pressing forward from the faster-burning outer layers to the slower-burning inner layers until it hugs the cone of fuel gas. The wave is now in a position of equilibrium, being unable to penetrate farther into the gas stream because oxygen necessary for combustion is lacking there, and also unable to detach itself because the increased burning velocity in the oxygen-enriched outer layers would drive it back again toward the cone. The combustion zone thus maintains itself as a hollow cone above the tube, while the gas stream passes continually through it, carrying with it fresh molecules of fuel gas and sweeping away the hot combustion products (water vapour and carbon dioxide) and the incombustible atmospheric nitrogen which remains after the oxygen is consumed. At the same time, fresh air is penetrating by diffusion into and against this stream of hot burned gas, to meet the fresh fuel gas in the combustion zone; and by the same process of diffusion a fraction of the burned gas, and also a fraction of the heat of combustion, penetrates into and against the inner cone of flowing fuel gas, diluting and heating it. Since common fuel gases contain hydrocarbons which at high temperature crack to form hydrogen and free carbon, the inner cone thus acquires a shell of hot, carbon-bearing gas adjacent to the combustion zone. This shell increases in thickness from the base of the cone upward. The hot carbon particles, being small, solid bodies, glow brightly and impart to flames of this type their characteristic luminosity. They burn in contact with oxygen at high temperatures. They accumulate readily on chilling surfaces; and when there is an oxygen deficiency in the stream, they cool below their ignition temperature and escape as soot into the atmosphere.

The combustion zone is visible as a faint bluish glow surrounding the inner cone. In a carbon-monoxide flame, which does not form free carbon and whose inner cone thus remains completely dark, the combustion zone is the only source of luminosity. This glow is chemiluminescent in character. The hot combustion products emerging from the zone emit no visible light but only infrared radiation of certain wave lengths.

In the flame of a candle or pocket lighter, liquid fuel is drawn into the wick by capillary suction and volatilized over the exposed length of the wick by heat supplied from the surrounding combustion zone. The quantity of streaming vapour, and therefore the height and volume of the flame, can thus be regulated by adjusting the length of the wick. In a candle the wick consists of braided cotton yarn in the form of a flat band which rises from a little pool of molten paraffin and curls over so that its tip projects into the air and burns. It thus remains constant in size. The wick material is chemically treated so that the ash residue is fusible and does not form a skeleton but collects at the tip in the form of a small bead. In the early days of straight-wicked tallow candles (the wick being merely twisted) the wick did not regulate itself and had to be cut from time to time ("snuffing the candle"). Irregularly shaped diffusion flames are also formed by burning wood, bituminous coal and other materials which give off combustible gases on heating.

When a gas stream issuing into the stagnant atmosphere has reached a certain height, it curls up into vortices which follow each other at more or less regular intervals. In large flames, vortices of combustion products may form around burning portions of the flame, shutting off the supply of oxygen, and the unburned core momentarily elongates, then contracts again as the vortex is carried away. This may repeat itself periodically, giving rise to the flicker of flames, sometimes accompanied by sooting. The regular rounded cone shape is lost.

If the flame is placed in an open, upright cylinder, the resulting chimney effect carries the air along with the burning gas; this eliminates the tendency to form vortices, and the flame is correspondingly steadied.

If air is added to fuel gas, the mixture still being above the upper limit of inflammability, the flame continues to burn by diffusion, though the combustion zone moves deeper into the core of fuel gas and less carbon is formed. The region of vorticity then is confined to the invisible burned gas well outside the luminous zone and a steady flame of regular rounded-cone shape results.

If sufficient air is added so that the mixture is below the upper limit of inflammability, an inner combustion zone is formed, surrounded by an outer mantle; the latter continues to burn as a soot-free diffusion flame as long as the volume of air in the stream is less than required for complete combustion (see below).

Flames of Turbulent Jets.—When a gas stream issuing from an orifice into the atmosphere exceeds a certain critical velocity, it breaks up into a turbulent jet which entrains the surrounding air and broadens out in the form of a cone. The flame in such a jet consists of a highly irregular interplay of vortices of gas and air mixture, forming transitory random patches of combustion waves throughout the jet, and no cohesive combustion surface exists. The hissing or roaring sound associated with turbulent jets is augmented by the combustion, and such flames are often very noisy. With common fuel gases the burning velocity is too low, and the flame readily blows off the jet, unless an effective pilot flame is provided at the base of the jet. A successful design consists in blowing a jet of oxygen from an orifice mounted concentrically in the mouth of a much wider tube, from which a comparatively slow stream of fuel gas flows. The oxygen jet entrains most of the fuel gas; however, some of the gas burns from the wide mouth as a slow diffusion flame that serves as a pilot for the jet flame.

Flames of Streams of Explosive Mixture.—Consider a mixture (*e.g.,* coal gas and air) of a composition well within the explosive range, flowing from a tube into the atmosphere. From some point of ignition, a combustion wave spreads out until it forms a continuous surface over the whole cross section of the stream. This surface can be distorted into various shapes by uneven gas velocities, but by the principle of wave propagation it maintains its continuity and propagates as a unit against the flow of unburned gas, in a contest between the burning velocity and the gas velocity. Three cases may arise: (1) if the gas velocity exceeds the burning velocity everywhere along the surface, the combustion wave blows off into the atmosphere and becomes extinct; (2) if the gas velocity is at any point smaller than the burning velocity, the combustion wave flashes back against the stream; and (3) if the gas velocity is maintained equal to the burning velocity at some point, though exceeding it everywhere else, the combustion wave becomes fixed in the gas stream and forms a stationary flame.

The gas velocity is zero at the boundary of the stream as a re-

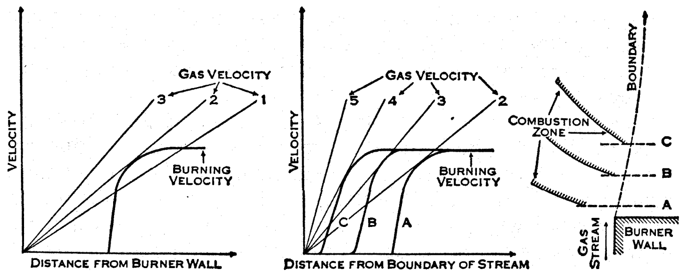


FIG I FIG 2

BY COURTESY OF U S. BUREAU OF MINES

FIG. 1.—BURNING VELOCITY AND GAS VELOCITY INSIDE THE BURNER TUBE. CURVE 1, FLASH BACK; CURVE 2, FLASH-BACK LIMIT; CURVE 3, NO FLASH BACK

FIG 2 —BURNING VELOCITY AND GAS VELOCITY ABOVE THE TUBE RIM. CURVES A. B, C, BURNING VELOCITY AT HEIGHTS A, B, C; CURVE 2, FLASH-BACK LIMIT. CURVE 3, STABLE FLAME; CURVE 4, BLOWOFF LIMIT: CURVE 5, BLOWOFF

sult of friction and rises steadily in the direction of the centre of the stream. Fig. 1 shows the conditions within the tube. The heavy curve shows the magnitude of the burning velocity near the wall. It is zero within the quenching distance, and beyond this distance it rises to a constant value. The other lines are curves of the gas velocity for three different gas flows. If the flow corresponds to curve 1, the gas velocity falls partly below the burning velocity, and the flame flashes back through the tube. If the flow corresponds to curve 2, the combustion wave can theoretically maintain itself at any position in the tube. In practice, however, it will not be possible to regulate the gas flow with the absolute accuracy required for this purpose. If the flow corresponds to curve 3, the gas velocity is everywhere larger than the burning velocity, and the flame is blown out of the tube.

In the latter case, as the combustion zone moves past the rim of the tube, it enters a region over which the chilling effect of the wall of the tube is gradually reduced, and consequently the curve of the burning velocity shifts toward the boundary of the stream. This is illustrated in fig. 2. Three burning-velocity curves are shown, corresponding to three heights, A, B and C, above the rim. At height A, close to the rim, the burning-velocity curve is about the same as in the diagram of fig. 1. At height B it has shifted toward the boundary. At height C the shift has become a maximum; here the chilling effect of the tube is small; nevertheless, the burning velocity drops to zero because the mixture is diluted by interdiffusion with air and because the adjacent air is carried along by the stream, thus forming an outermost boundary of nonexplosive gas. At greater heights the nonexplosive boundary layer broadens and correspondingly the burning-velocity curve recedes from the boundary; hence, if the gas velocity is as large as shown in curve 5, it exceeds the burning velocity everywhere and the flame blows off the tube. At any flow between limiting curves 2 and 4 the flame settles down to such a height above the rim that gas-velocity curve and burning-velocity curve meet each other tangentially. For example, let us suppose that the gas stream is adjusted to correspond to gas-velocity curve 3. If the combustion zone drops below height B, the burning-velocity curve shifts to the right, the gas velocity is larger everywhere, and the combustion zone lifts up again toward height B. If it should exceed this height, the burning-velocity curve shifts to the left, the gas velocity falls below the burning velocity at some distance from the boundary, and the combustion zone is driven back to its equilibrium position at height B.

The flame thus remains stable between a critical lower and upper gradient of the gas velocity at the stream boundary, represented by the slopes of curves 2 and 4 and corresponding to flash back and blowoff, respectively. For a flame burning in air, the blowoff gradient increases sharply as the mixture is enriched with fuel gas, because in this case the interdiffusing air increases the burning velocity at the boundary, and blowoff can occur only when an appreciable layer of outer air is carried along by the stream. Rich flames are therefore much more stable. However, if the surrounding atmosphere does not consist of air, but of some inert gas, such flames blow off readily.

The critical boundary velocity gradients are measurable, and by means of hydrodynamic equations of flow they permit calculation of the stability of flame at any flow for various burner tubes.

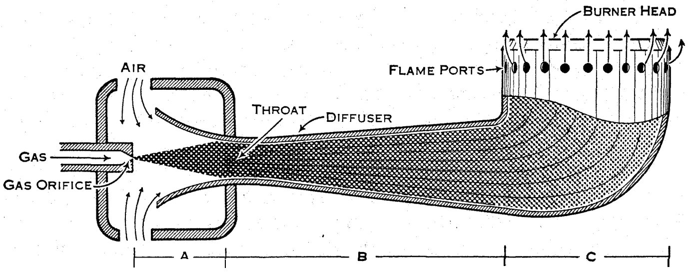
In a stable flame the combustion wave is thus anchored to the rim of the tube, while inside the stream—where the gas velocity exceeds the burning velocity—it is blown up to a cone which is clearly visible because of its bluish or greenish luminosity. The angle of the cone surface against the direction of the gas flow is everywhere such that the burning velocity equals the component of the gas velocity normal to the surface; this is the condition of equilibrium governing the shape of the cone. If the flow lines remained parallel to the stream axis and if the combustion wave were a very thin mathematical surface moving everywhere with constant velocity, the tip of the cone would be exceedingly sharp and pointed. However, at the tip the flow lines diverge in fanshape manner, and the combustion wave (being of not inconsiderable width) is disposed in a curve so that the various wave layers meet the above condition. Hence the luminous layer at the tip appears as a rounded dome.

The blowoff stability of a flame can be considerably increased by placing some solid object in the middle of the stream where dilution of the boundary by the surrounding air does not penetrate. The combustion wave anchors itself to such objects by the same process as described before, but the conditions within the stream favour stability at higher gas velocities than before. The principle of placing an obstacle inside the gas stream is widely used in flame-retaining devices and in grids for flame ports.

Flame Temperature.—The temperature in the luminous part of a candle flame and similar diffusion flames is generally lower than 1,500° C. In a flame of coal gas and air of optimum composition the temperature may be as high as 2,000° C., and in a corresponding natural-gas flame, 1,900° C. These figures increase if the gases are preheated before combustion. A gas-air flame cannot be used for welding and similar operations, although its temperature much exceeds the melting point of steel, because the heat is not delivered rapidly enough to overcome losses by radiation from the heated surface and conduction to colder parts of the metal. Oxygen-acetylene flames used for such operations are not only hotter but also deliver a much more rapid and concentrated heat flux as a result of the high burning velocity of such mixtures. The performance of gas-air flames is improved in blast lamps and blowtorches, which deliver rapidly a great volume of flame gas; such flames are used by glass blowers and plumbers.

Burners.—In air-injection gas burners used for domestic gas ranges and many industrial applications, the fuel gas issues from a small hole—the orifice—as a turbulent jet which entrains the surrounding air; the turbulent, fast-flowing mixture is then distributed to the flame ports by means of a Venturi duct (fig. 3). In this gradually expanding duct the gas motion decreases and a slight pressure is built up which forces the mixture uniformly through the portholes and thus permits any desired pattern of small flames on the burner head. The percentage of air in the mixture increases when the orifice is made smaller or the flame ports are enlarged. In the design of such burners, the tendency has been to keep the volume of entrained air noticeably below that required for complete combustion because in this way better flame stability is obtained; hence, a part of the fuel gas burns in the outer mantle by diffusion (see above). Air shutters are usually provided around the jet. The flame ports are spaced close together to form a grid, which further stabilizes the flame. Burners with closely spaced square grids are known as Méker burners.

In the ordinary Bunsen burner (*q.v.*) only a single flame is wanted; hence, a Venturi duct is unnecessary and the jet is passed into a short straight tube within which the turbulence subsides somewhat. The gas flow and air shutters are adjusted to produce a stable flame at the outlet of the tube. Enough turbulence usually persists to produce an unruly and slightly noisy flame. This is much more pronounced in the plumber's blowtorch; here a large jet of hot gasoline vapour burns partly in the zone of turbulent air entrainment. Such jet flames blow off readily and must be stabilized; this is accomplished by a perforated tube around the jet. The perforations near the jet base admit air and farther along



BY COURTESY OF U S BUREAU OF MINES

FIG. 3.— AIR INJECTION BURNER. APPLICATION OF THE VENTURI PRINCIPLE TO OBTAIN UNIFORM DISTRIBUTION OF THE GAS MIXTURE TO THE FLAME PORTS (A) TURBULENT GAS JET ENTRAINS AIR, (B) VELOCITY DECREASES. STREAM MOMENTUM IS TRANSFORMED INTO PRESSURE. (C) SLOW-MOVING, SLIGHTLY COMPRESSED GAS MIXTURE FLOWS UNIFORMLY THROUGH THE FLAME PORTS

the tube serve as a grid for a flame attachment. The tube also passes enough heat back to the fuel line to vapourize the liquid fuel. The latter is usually delivered to the jet by air pressure from a hand pump. The blowtorch must be primed before use by heating the perforated shield and the fuel line with a flame; otherwise, liquid fuel spurts from the orifice and no vapour jet is formed.

Burners in which a jet of air or oxygen is passed into fuel gas are termed blowpipes or blast lamps. As mentioned above, the jet flame is stabilized by the surrounding slow-burning diffusion flame of the portion of fuel gas that is not entrained by the turbulent jet (fig. 3). By using jet nozzles of various orifice diameters, and adjusting the control valves, sharp flames of very small and very large size can be produced. Burners of this type are made as hand torches and desk burners and are widely used for glass blowing and soldering. For blowing quartzware, blast lamps burning hydrogen and oxygen are suitable. The mouth blowpipe, a conical brass tube curved at the small end and terminating in a small round orifice, was first adopted for testing minerals in the 18th century. A small jet flame is blown within an alcohol flame and directed against a small sample of the mineral on a piece of charcoal or some other support. The flame gas above the jet tip tends to reduce and, below, to oxidize the sample. A grain of lead ore is thus alternately reduced to a small globule of metal and oxidized to a characteristic red and yellow oxide. Other minerals give various other characteristic reactions.

Hand torches for welding are equipped with regulating valves, a mixing chamber and exchangeable nozzles for various sizes of orifices, depending on the thickness of the material to be welded. For oxyacetylene welding, which came into general use in 1900, an approximate 1:1 ratio of oxygen and acetylene is maintained because the resulting normal or neutral flame, as it is called. is the. one required in practically all welding operations. This neutral flame, characterized by a brilliant, white inner cone and a faint, blue outer envelope, also serves as a reference point for adjustment of gas composition to produce other types of flame. If the gas ratio is increased with respect to acetylene, the carburizing flame, which is easily recognized by its additional zone of luminosity, is obtained; flames of this type are employed in welding steel and in hard-facing processes. Similarly, an increase in oxygen concentration gives rise to the oxidizing flame, which differs slightly in appearance from the neutral flame by reason of its shorter inner cone and which finds its special application in the welding of brass and bronze.

The cutting of iron and steel, as distinguished from welding, consists in raising the material to its ignition temperature and continuously oxidizing it with a stream of oxygen. In addition to the chemical reaction. there is a mechanical eroding effect of the oxygen stream ahich assists in the cutting process by washing molten metal out of the cut. Hence the tip of a cutting torch contains a central orifice supplying the cutting jet of oxygen surrounded by several other orifices which deliver the oxyacetylene mixture necessary for the preheating flame. In practice the preheating flame must be maintained during the cutting to compensate for heat losses by conduction and radiation. Industrially, use of the oxyacetylene flame has taken precedence over that of the oxyhydrogen flame, since the maximum temperature of the former is more than 400° C. higher than the highest temperature achieved in the oxyhydrogen flame.

The atomic hydrogen flame and its mode of generation are basically different from all other oxy-fuel-gas flames. Thus, the arc welding torch bears little resemblance to the common gas welding torch. It consists principally of a pair of tungsten electrodes around which a stream of hydrogen gas is passed. The action of the electric arc produces a dissociation into atomic hydrogen, the formation of which is visible as a pink cone-shaped area above the electrodes. This is the characteristic colour of the Balmer series spectrum of atomic hydrogen. On recombination of the hydrogen atoms the heat of formation of molecular hydrogen is liberated, which is responsible for the attainment of the high flame temperature (about 3,800° C.). Aside from the development of temperatures higher than those of other arcs and gas flames, the hydrogen atmosphere excludes contaminating gases, such as oxygen and nitrogen, from contact with the weld.

Fluorine and hydrogen are distinguished by a very high heat of reaction and a low specific heat of the reaction product, hydrogen fluoride. These, coupled with the fact that hydrogen fluoride is very stable and thus dissociates very little, result in exceedingly high flame temperatures between 4,000° and 5,000° C.

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FLAMEN (from *flare*, "to blow up" the altar fire), a Roman sacrificial priest. The flamens were subject to the pontifex maximus and were consecrated to the service of some particular deity. The highest in rank were the *flamen Dialis, flamen martialis* and *flamen quirinalis*, who were always patricians. When the number of flamens was raised from 3 to 15, those already mentioned were entitled *maiores;* the other 12, called *minores*, were chosen from the *plebs.* Toward the end of the republic the number of the lesser flamens diminished. The flamens were elected for life, but they might be compelled to resign for neglect of duty or on the occurrence of some ill-omened event during the performance of their rites. The characteristic dress of the flamens was the apex. a white conical cap; the *laena* or mantle; and a laurel wreath. The official insignia of the *flamen Dialis* (of Jupiter), the highest of these priests, were the white cap (*pileus, albogalerus*), at the top of which was an olive branch and a woolen thread; the *laena*, a thick woolen *toga praetexta* woven by his wife; the sacrificial knife; and a rod to keep the people from him when on his way to offer sacrifice. He was entitled to a seat in the senate and a curule chair. The sight of fetters being forbidden him, his house was a sanctuary for a prisoner, and a criminal who met him in the street was respited. He mas not allowed to leave the city for a single night, to ride or even touch a horse, to swear an oath, to look at an army. to touch anything unclean, or to look upon people working. His marriage, performed with the ceremonies of *confarreatio*, was dissoluble only by death, and on the death of his wife (called *flaminica Dialis*) he mas obliged to resign his office. The *flaminica Dialis* assisted her husband at the sacrifices and other religious duties which he performed. The main duty of the flamens was the offering of daily sacrifices; on Oct. 1 the three *maiores* drove to the capitol and sacrificed to *Fides Publica* (the Honour of the People).

Distinct from the above were the *flamen curialis*, who assisted the *curio* with the religious affairs of each *curia* (*q.v.*), the flamens of various sacerdotal corporations, such as the Arval Brothers (*q.v.*), and the *flamen Augustalis*, who superintended the worship of the emperor in the provinces.

See C. Jullian in Daremherg and Saglio, *Dictionnaire des antiquités;* J. E. Sandys, *Companion to Latin Studzes* (1921).

FLAME PHOTOMETRY is the study of spectra emitted in flames. The atoms of each element exhibit characteristic spectra; the wave lengths of light which they emit or absorb are invariable for all practical purposes. These spectra are emitted readily when elements are exposed to the very high energies of an electric arc, spark or high-temperature flame. The light emitted is seen as discrete lines when viewed through a suitable spectroscope, and its intensity depends on the amount of the element energized. Measurement of the wave lengths and intensities of light emitted by the excited atoms therefore constitutes a convenient device for qualitative and quantitative analysis (see SPECTROSCOPY).

The principles of flame spectroscopy were established in the middle and late 19th century. The construction in 1945 of a photoelectric flame photometer employing filters placed its practical utilization on a firm basis. The instrument, called a flame photometer, proved extremely popular for the simple, sensitive and precise analysis of sodium and potassium. Since this time, the field of flame photometry has become of the greatest scientific, medical and industrial importance. Studies of large numbers of fuels, burners and photoelectric detection devices have extended the analytical applications to many elements contained in materials varying from rocks, alloys and metals to biological tissues. Very sensitive applications are limited to the elements of the first two groups and the first transition group of the periodic table (see PERIODIC LAW), but in particular to those which require relatively little thermal energy to emit light. The advent of very hot flames in the 1950s began to remove this limitation.

All substances are prepared for flame photometry by similar procedures. The sample is dissolved in a liquid which is then aspirated and sprayed into a flame. The emitted light enters a spectrograph which isolates the wave lengths to be measured by means of a filter, prism or grating. A photocell receives the light and converts it into electric energy which in turn is displayed by a meter. A millionth of a gram in one millilitre of fluid is readily measured with a precision of 1% to 2%. Modern instruments permit the simultaneous measurement of several elements—instead of one at a time—by the employment of multiple photoelectric receivers. Such instruments are called flame spectrometers. Flame photometry has brought about the development of completely new areas of knowledge. An example in medicine is the field of salt and water or electrolyte metabolism, which was virtually nonexistent prior to the advent of the flame photometer. This instrument has revolutionized the recognition and treatment of a wide variety of conditions.

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(B. L. V.)

FLAME THROWER. A military assault weapon that projects a stream of blazing oil or thickened gasoline against enemy positions. As used in World War II and the Korean war it consisted basically of one or more fuel tanks, a cylinder of compressed gas to supply the propelling force, a flexible hose connected to the tanks and a trigger-nozzle equipped with some means of igniting the fuel as it was spewed forth. The portable type, carried on the backs of ground troops, had a range of about 45 yd. and enough fuel for about 10 sec. of continuous "firing." Larger and heavier units installed in tank turrets could reach out more than 100 yd. and carried enough fuel for about 60 sec. of fire. To achieve maximum results, several short bursts were usually fired rather than one long blast.

Modern flame throwers first appeared in the early 1900s when the German army tested two models, one large and one small. submitted by Richard Fiedler. The smaller *flammenwerfer*, light enough to be carried by one man, used gas pressure to send forth a stream of flaming oil for a distance of about 20 yd. The larger model, based on the same principle, was cumbersome to transport, but had a range of more than 40 yd. and enough fuel for 40 sec. of continuous firing. Favourably impressed, the German army adopted these weapons and used them with surprise effect against Allied troops in 1915. The British and French soon countered with flame throwers of their own, but none of the World War I types had sufficient range or duration of fire to be satisfactory. Their chief effect seems to have been to terrorize the troops they were used against.

All major powers employed flame throwers in later years, both the back-pack type and the tank-mounted variety. Based on the same principle as Fiedler's early models, they incorporated technical refinements that made them far more effective, though still limited in range and duration of fire. British and U.S. flame throwers were fueled with napalm, a type of thickened gasoline that carried much farther than ordinary gasoline, burned with intense heat and clung like jelly to whatever it touched. These fearsome weapons were valuable for attacking enemy troops, burning away camouflage material and probing underbrush or the gunports of enemy positions. They were especially effective in World War II against the defensive-type warfare of the Japanese who stubbornly defended their caves and coconut-log bunkers on Pacific islands.

(See also CHEMICAL WARFARE; GREEK FIRE; NAPALM.)

(H. C. T.)

FLAMINGO, the name for six species of large water birds with remarkably long neck and legs, webbed feet and heavy ducklike bill bent abruptly downward. Related to herons (*q.v.*), they constitute the family Phoenicopteridae, in the order Ciconiiformes. They have black wing quills, and most are rosy-white with scarlet shoulders, but the American flamingo (Phoenicopterus ruber) is bright vermilion.

The American flamingo occurs on the Atlantic and gulf coasts of tropical and subtropical America, breeding locally in large colonies along mud flats in the Bahamas, Cuba, Haiti, Yucatán, Guiana and formerly the Florida Keys. They are gregarious birds; flocks numbering hundreds may be seen in long, curving flight formations and in wading groups along the shore. In feeding, the flamingo tramps the shallows, stirring up organic matter, especially small mollusks and crustaceans, which it strains from the muddy water by means of its sievelike lamellated bill. The nest is a truncated cone of clayish mud piled up a few inches in a shallow lagoon; both parents share 30 days incubating one or two chalky white eggs which are laid in the hollow of the cone. Downy-white young, with short legs and straight bills, leave the nests in two or three days and are fed by regurgitation on partly digested food of the adults.

Phoenicopterus *antiquorum* breeds in west-central Asia, northwest India, Caspian sea and Persian gulf, South Africa and the Cape Verde Islands. P. chilensis ranges from Peru and Uruguay to Tierra del Fuego. The smaller Phoenicoparrus *andinus* and P. jamesi live in Chilean and Argentine Andes, the latter to southern Peru. Phoeniconaias minor is abundant in the lake district of east Africa, also occurring in south Africa, Madagascar, northwest India and possibly Senegal.

Fossil forms have been found in France and Oregon.

(G. F. Ss.; X.)

FLAMININUS, TITUS QUINCTIUS (c. 228–174 B.C.), Roman general and statesman. He was military tribune under M. Claudius Marcellus, the conqueror of Syracuse. In 199 he was quaestor, and consul the next year.

Flamininus was one of the first and most successful of the rising school of Roman statesmen, the opponents of the narrow patriotism of which Cato was the type, the disciples of Greek culture and the advocates of a wide imperial policy. His personal charm, his knowledge of men and his intimate knowledge of Greek all marked him out as the fittest representative of Rome in the east. Accordingly, the province of Macedonia and the conduct of the war with Philip V of Macedon were assigned to him. Flamininus modified both the policy and tactics of his predecessors. He spent most of his first year in gaining control of Greece by diplomacy and force. Hostilities were renewed in the spring of 197, and Flamininus took the field supported by nearly the whole of Greece. At Cynoscephalae the Roman legion met the Macedonian phalanx for the first time, and defeated it. Philip lost all his foreign possessions. but retained his Macedonian kingdom almost entire; he was required to reduce his army, to give up all his decked ships except five and to pay an indemnity of 1,000 talents. All the Greek states which had been subject to the king became free and independent. Flamininus' last act before returning home was to ask the Achaeans to ransom the Italian captives who had been sold as slaves in Greece during the Hannibalic War. These were presented to him on the eve of his departure (spring 194) and formed the chief ornament of his triumph. In 192. on the rupture between the Romans and Antiochus III the Great, Flamininus returned to Greece as the civil representative of Rome. He secured the wavering Achaean states! cemented the alliance with Philip and contributed largely to the Roman victory at Thermopylae (191). In 183 he undertook an embassy to Prusias, king of Bithynia. to induce him to deliver up Hannibal, who took poison. Nothing more is known of Flamininus.

FEAMINIUS, GAIUS, Roman statesman and general, of plebeian family. During his tribuneship (232 B.C.), in spite of the determined opposition of the senate and his own father, he carried a measure for distributing among the plebeians the *ager Gallicus Picenus,* an extensive tract of newly acquired territory to the south of Ariminum (Cicero. De *senectute,* 4. *Brutus,* 14). In 223, when consul with P. Furius Philus, he took the field against the Gauls, who were said to have been roused to mar by his agrarian lam. Having crossed the Po to punish the Insubrians, he at first met with a severe check and was forced to capitulate. Reinforced by the Cenomani. he gained a decisive victory on the banks of the Addua. He had previously been recalled by the optimates, but ignored the order. The victory seems to have been due mainly to the admirable discipline and fighting qualities of the soldiers; the decree of the senate against his triumph was overborne by popular clamour. His name is further associated with two great works. He erected the Circus Flaminius on the Campus Martius for the accommodation of the plebeians. and continued the military road from Rome to Ariminum. which had hitherto only reached as far as Spoletium. He probably also instituted the "plebeian" games. In 218. as a leader of the democratic opposition, Flaminius was one of the chief promoters of the measure which debarred senators from commercial speculation (Livy xxi, 63). His support of this measure vastly increased his popularity with his own order and secured his second election as consul in the following year (217), shortly after the defeat of T. Sempronius Longus at the Trebia. He hastened at once to Arretium to protect the passes of the Apennines, but was defeated and killed at the battle of the Trasimene lake *(see* PUNIC WARS; TRASIMENUS, LAKE).

FLAMSTEED, JOHN (1646–1719), English astronomer and clergyman and first astronomer royal at the newly founded Greenwich observatory, was horn at Denby, near Derby, on Aug. 19. 1646. He was educated at the free school of Derby, but was forced to leave in 1662 because of bad health. During his illness he began to study astronomy, observing a solar eclipse on Sept. 12, 1662, and corresponding with several astronomers. His early studies were communicated to the Royal society in 1670 and were published in the *Philosophical Transactions,* gaining him general scientific recognition. In 1670 Flamsteed entered his name at Jesus college, Cambridge, and in 1674 took a degree of M.A. by letters-patent. He was ordained in 1675. He attracted the attention of Sir Jonas Moore whose influence with Charles II secured for him the position of astronomical observator upon the establishment of the Greenwich observatory in 1675. Except for a few gifts from Moore. Flamsteed supplied all of his own instruments from his salary of £100 a year and the income of the living of Burstow. Surrey, bestowed upon him in 1684 by Lord North. On the death of his father in 1688, a small inheritance provided Flamsteed with the means to construct a mural arc, with which he began systematic observations on Sept. 12, 1689. The latter part of Flamsteed's life passed in a turmoil of controversy regarding the publication of his results. He struggled to withhold them for presentation in completed form; but they were urgently needed. by Sir Isaac Newton and by Edmund Halley among others, for the testing of current theories. Newton. through the Royal society, led the movement for immediate communication, whence arose much ill-feeling between him and Flamsteed. In 1704 Prince George of Denmark undertook the cost of printing, and. despite the prince's death in 1708 and Flarnsteed's objections, the observations were printed. The *Historia coelestis,* embodying the first imperfect Greenwich star catalogue, was issued under Halley's editorship in 1712. Flamsteed denounced the production (400 copies) as surreptitious and later. when Newton's influence with the government declined, secured and burned 300 of them. Flamsteed died at Greenwich on Dec. 31. 1719. The preparation of his monumental work. *Historia coelestis Britannica* (3 vol. folio, 1725), was finished by his assistants Joseph Crosthwait and Abraham Sharp. The first two volumes included the whole of Flamsteed's observations, the third the *British Catulogue* of nearly 3,000 stars. The extent and quality of his work, which forms the basis of modern star catalogues, were the more remarkable considering his severe physical sufferings and straitened means.

See F. Baily, *Account of the Rev. John Flamsteed* (1835).

(O. J. E.)

FLANDERS, COUNTY OF, a powerful medieval principality in the southwest of the Low Countries, which occupied territories that are now divided between the French *département* of Nord, the Belgian provinces of East Flanders and West Flanders, and the Dutch province of Zeeland *(qq.v.).* The name appears in the 8th century and is believed to mean "flooded land." The pagus Flandrensis was at first an inconspicuous Frankish district, but a remarkable line of Flemish counts succeeded in erecting a quasi-independent state on the borders between the French and the German kingdoms out of French and German fiefs. As the treaty of Verdun (843) had made the Scheldt river the dividing line between West and East Francia. the count of Flanders came to be a vassal of the French king for what he held west of the Scheldt (Crown Flanders or Kroonvlaanderen, the most important part of his countship) and a vassal of the German king for what he held east of it (Aalst, etc.; collectively called Imperial Flanders or Rijksvlaanderen as part of the Holy Roman empire). Linguistically also Flanders mas a borderland, including Romance-speaking and Germanic-speaking peoples.

The Counts of Flanders in the Middle Ages. — In the Carolingian period the pagus Flandrensis was the region around Bruges. The rise of the Flemish dynasty began when the count or official administrator of the pagus, Baldwin I Iron-Arm or Ferreus, married the Frankish king Charles II the Bald's daughter Judith in 862 and mas established as count with control over a number of pagi between the North sea and the Scheldt. His son and successor, Baldwin II (count from 879 to 918). who married the English king Alfred the Great's daughter Xelfthryth, was the founder of the *de facto* autonomous county and reigned independently over a vast territory along the coast of the North sea; he fought the Danish raiders (invasion of 879–883). His son. Arnulf I the Great (918–965), continued the policy of independence and territorial expansion: extending the southern frontiers of Flanders to the Canche river: the main enemy at this time was Normandy. Arnulf's son Baldwin III. however. who had been associated with him as count from 959, died before him (962). and when Arnulf himself died an internal crisis broke out under the rule of his grandson Arnulf II (965–988); but authority was restored under the latter's son Baldwin IV (988–1035), who consolidated his internal position and resumed the expansionist policy. This count looked eastward, coveting imperial territory. and succeeded in conquering lands in the Scheldt estuary and also Valenciennes. an important town on the Scheldt; clearly he thought of the Scheldt as the natural frontier for Flanders on the east. His son Baldwin V (1035–67), an equally able ruler. continued the eastward expansion, adding imperial territories such as Aalst and Termonde. east of the Scheldt, to his dominions. His son and successor Baldwin VI (1067–70), by marrying Richildis, heiress of the neighbouring Hainaut *(q.v.)*, and thus becoming count of that principality himself, was the first to establish personal union between Hainaut and Flanders; but the succession of his son Arnulf III in 1070 was contested by Robert I the Frisian (d. 1093), another son of Baldwin V, who became count in 1071.

Robert the Frisian was a powerful ruler and a stern upholder of public order. who also took useful initiatives for the economic development of the county. His son Robert II, who had been associated with him as count from 1087, was succeeded in 1111 by his son Baldwin VII (d. 1119), called Baldwin with the Axe because of his repression of violence and crime. On his death the male line of the first dynasty of Flemish counts became extinct.

The next count, designated by Baldwin VII, was his cousin Charles, son of the Danish king Canute IV by Count Robert II's sister Adela. Surnamed the Good for his wise administration, Charles was assassinated at Bruges in 1127 and left no children. The French king Louis VI then intervened and had his candidate accepted as count: namely William Clito or the Aetheling, son of Robert Curthose, duke of Normandy (whose mother was a daughter of Baldwin V), and thus an enemy of Henry I of England, against whom the move was directed (1127). This intervention showed that the French crown was emerging from its period of weakness and consequently that Flanders would no longer enjoy undisturbed independence. William Clito, however, soon proved unacceptable to the Flemish population and on his death (1128) the county went to Thierry or Diederik (Dietrich) of Alsace, the son of Gertrude, another sister of Robert II. Thierry and his son Philip (1168–91) consolidated the counts' position and won great international prestige for the county, especially since Philip married Elizabeth of Vermandois and thus reigned over territories that stretched far south toward the region of Paris.

Philip's death without issue and the strong policy of Philip II Augustus of France brought Flanders to a perilous position, but the king failed to annex the county itself, to which Baldwin V of Hainaut, a brother-in-law of Philip of Alsace, succeeded as Baldwin VIII (1191–95), though considerable territory was lost in the south (Vermandois and Artois). Then Baldwin VIII's son Baldwin IX (VI of Hainaut), who became Latin emperor of Constantinople in 1204 (see BALDWIN I), was succeeded in 1205 by his five-year-old daughter Joan. The French king obtained custody of Joan and made her marry Ferdinand (Ferrand), a younger son of Sancho I of Portugal, in 1212, but in spite of his calculations Ferdinand took sides against him under Flemish pressure and joined the anti-French coalition formed by the emperor Otto IV and John of England. On the defeat of the coalition in the battle of Bouvines (*q.v.*) in 1214, Ferdinand was taken to Paris as a prisoner, but Joan was permitted to administer Flanders by the grace of the French crown. She died childless in 1244 and was succeeded in Flanders and Hainaut by her sister Margaret.

Margaret's reign (1244–80) was unfortunately marked by the struggle between the houses of Avesnes and Dampierre, the former being children of her marriage with Bouchard of Avesnes, which was annulled, the latter of her subsequent marriage with William of Dampierre (d. 1241). Finally Louis IX of France adjudged Flanders to Dampierre and Hainaut to Avesnes, but the rivalry between the two houses went on. It became rather dangerous for Flanders when the house of Avesnes obtained the county of Holland, on the northern flank of Flanders, in 1299, just when Margaret's younger son Guy of Dampierre, count of Flanders from 1278 to 1305, had to face a major crisis in Franco-Flemish relations. The French king Philip IV the Fair was in fact trying to bring Flanders directly under royal control and was finding support in the town oligarchies (such as the 39 *échevins* of Ghent), who were the count's political opponents. Guy, however, had the support of the rest of the population, especially in the towns, who felt themselves oppressed by the oligarchies. Against the French threat, Guy allied himself with Edward I of England (1294 and 1297), but when Edward had to withdraw his forces from Flanders in order to deal with the Scots the county was open to invasion. The French overran it in 1300 and took the old count prisoner. The people, however, detested the foreign rule, and on May 18, 1302, the French in Bruges were attacked by surprise and many of them killed (the "Matins of Bruges"). A powerful French army under Jacques de Châtillon then marched on Flanders for revenge, but the Flemings inflicted a disastrous defeat on it in the battle of Courtrai or battle of the Golden Spurs (July 11, 1302). This saved Flanders from French occupation, but the war dragged on till the treaty of Athis-sur-Orge (*q.v.*) in 1305. This treaty recognized Flemish independence, but imposed heavy financial burdens on Flanders and consequently led to considerable loss of territory in the south (Lille, Douai, Orchies) under the treaty of Pontoise (1312) between Philip IV and Guy's son and successor Robert of Béthune, now Robert III of Flanders (1305–22).

The 14th century brought a new political problem: the big towns, especially Ghent (about 50.000 inhabitants), tried to establish communal autonomy against the count and went far toward founding independent city-states. In consequence the counts looked for support to the king of France. Under Louis of Nevers, who succeeded his grandfather Robert of Béthune as count of Flanders in 1322, the outbreak of the Hundred Years' War led to another crisis: the count took the side of his suzerain, the king of France, but the Flemish towns, under the leadership of Jacob van Artevelde (*q.v.*), refused to follow him and took the English side instead, seeing as they did that English wool was indispensable for Flemish industry and prosperity. Louis of Nevers was killed fighting for the French in the battle of Crécy (1346). His successor Louis of Male (1346–84) established peace and followed an independent policy toward France, but his last years were obscured by the rising of Ghent under Philip van Artevelde (*q.v.*) and by the defeat of the Ghent militia by a French royal army in the battle of Roosebeke (West Rozebeke) in 1382.

The Burgundians and the Habsburgs.—Louis of Male left only a daughter, Margaret. Her first husband (1357), Philip of Rouvre, duke of Burgundy, had died in 1361, but in 1369 she had been married again, to Philip (*q.v.*) the Bold, brother of Charles V of France and, from 1363, himself duke of Burgundy. Thus when Louis died Philip the Bold succeeded to the county of Flanders. This was the starting point of an evolution that was to result in the unification of the Low Countries under the dukes of Burgundy and the house of Habsburg (see BURGUNDY). At first the Burgundians, Philip the Bold (count from 1384 to 1404), John the Fearless (1405–19) and Philip the Good (1419–67), acted as French royal princes and strove to play a role in French politics, taking sides against the Armagnacs and with the English. This changed under Charles the Bold (1467–77), who turned against France and attempted to build a Netherlandish-Burgundian realm between France and Germany and to give it strongly centralized institutions. On his death his young daughter Mary (*q.v.*), duchess and countess from 1477 to 1482, faced an internal and external crisis and found support by marrying Maximilian of Austria (see MAXIMILIAN I, Holy Roman emperor), thus bringing Flanders under the Habsburgs.

During the religious upheavals of the 16th century Protestantism won many adherents in Flanders, but the military occupation of the country by the Spaniards undid this development. The Counter-Reformation triumphed, and Flanders remained with the other southern provinces of the Netherlands under Spanish rule in the 17th century (during which it suffered severe territorial losses to the France of Louis XIV) and then under Austrian rule till it disappeared as a political entity in the course of the French Revolutionary Wars (see NETHERLANDS; BELGIUM: History). The title count of Flanders (comte de Flandre) remains in use, however, for princes of the Belgian royal family.

Institutions.— In the early middle ages Flanders shared the institutions of the Frankish kingdom. With the decay of these institutions under the later Carolingians the country became feudalized and was ruled by powerful princes—wealthy landowners—who sought to expand their territory by force of arms and to safeguard it by building castles. The population, though united under a common rule, was far from homogeneous. In the southernmost area it was mainly Gallo-Roman and Romance-speaking; farther north the Frankish settlement had been denser, so that the language was Germanic; and the coastal areas had been settled with people of Saxon and Frisian origin, of a less civilized way of life. The counts effectively united these peoples into one nation. An important new development set in from the 12th century onward, as the counts substituted for the old feudal structure an orderly administration and fiscal organization, with salaried officials (*baillis* instead of *châtelains* in the basic administrative circumscriptions), set up a centralized judicial system (using professional judges instructed in Roman law) and began extensive legislation. One of the main starting points of this development was the safeguarding of public order by the counts (pax comitis). The role of Philip of Alsace was capital in this field. He gave to a great number of towns charters (*keuren*), the contents of which varied little and which all went back to the charter of Arras of 1157–63. At the same time, but quite distinctly, there developed a powerful communal movement. For a full account of this development see COMMUNE (MEDIEVAL): Flanders. This led to the establishment in the numerous and wealthy towns of a town government with a considerable measure of independence. The towns were ruled by aldermen called in Flemish *schepenen* or in French *échevins* (Lat. scabini), who were administrators and judges at the same time. The constitutional history of Flanders is largely that of the struggle for supremacy between comital and communal authority. Finally the central authority was victorious and in the 16th century monarchical authority was firmly established. Representative institutions (estates) had grown up round the counts, especially from the 14th century onward; they were largely controlled by the three main towns of Ghent, Bruges and Ypres (see ESTATES-GENERAL).

Ecclesiastically, Flanders was divided between three bishoprics, none of which had its seat in an important Flemish city: Thérouanne and Tournai (in the metropolitan province of Reims) and Utrecht (in the metropolitan province of Cologne). In the 14th century Flanders was on the side of Rome against Avignon in the great schism of the papacy.

Economic Life.—At the outset the Flemish economy was agricultural, but there are very early signs of clothmaking of more than local importance. This was linked with the fact that the country raised large herds of sheep. Around the 12th century Flemish trade and industry became of real international importance. There also took place a crisis in the old manorial organization of agriculture and an expansion of money economy together with the rise of towns as centres of trade and industry. The role of the counts in fostering urban development was important. The cloth industry, which was soon working mainly with English wool and producing quality goods, had its largest centres at Ghent and at Ypres. International trade, however, was also very important. Till the 13th century the Flemish merchants conducted their trade abroad, especially at the fairs of Champagne (*q.v.*), but later merchants of all nations came to Flanders. The seaport of Bruges became a centre of world commerce. Flanders profited from its geographical situation, being an intermediary between the Mediterranean and the Scandinavian and Baltic countries and also between England and the Rhineland (especially Cologne). Toward the end of the middle ages the Flemish economy suffered for tuo main reasons: (1) the silting-up of the seaway to Bruges and the competition of Antwerp; and (2) the attempts by the towns to conserve artificially an industrial monopoly against normal development in the rest of the country. Even so, Flanders was a rich country whose contribution was of capital importance to the revenues of the Burgundian dukes.

Arts and Sciences.—Flemish architecture found its outstanding expression in civic buildings, belfries and town halls, though there were also some fine cathedrals (the Gothic style penetrated early in the 13th century). In literature, satire (for example Van den *Vos Reinaerde;* see REYNARD THE FOX) and the didactic genre (Jacob van Maerlant) flourished particularly. The names of the Flemish painters, the Van Eycks, Rogier van der Weyden, Hugo van der Goes, etc., belong to world art history (see PAINTING). For the sciences, the 16th century was very brilliant in the humanities, law and mathematics.

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FLANDRIN, HIPPOLYTE (1809–1864), French academic painter, was born in Lyon. He was the second of three sons of a miniature painter, and all three brothers became prominent painters. Auguste (1804–1842), the eldest, passed the greater part of his life as professor at Lyon; Jean Paul (1811–1902) became a well-known landscapist. After studying for some time in Lyon, Hippolyte and Paul set out for Paris in 1829. They entered the atelier of J. A. D. Ingres, who became their model as well as their friend and patron. Ingres led Flandrin from his original interest in horses and soldiers toward history painting. In 1832 Flandrin received the Grand Prix de Rome for his canvas, the "Recognition of Theseus by His Father." He remained in Rome until 1838 and was greatly inspired by early Renaissance painting--especially Fra Angelico—during his stay in Italy. Turning toward religious painting, he developed a rather dry and cold pseudoclassic style related to that of the earlier German Nazarenes. Upon his return to France he received important church commissions for large-scale mural decorations. Most noteworthy among these are the murals in St. Séverin, St. Vincent de Paul, and St. Germain des Prés in Paris; St. Paul at Nismes; and St. Martin d'Ainay in Lyon. In mid-19th century he was also greatly in demand as a portraitist among the ladies of the second empire, but his portraits are rather imitative of Ingres, without his master's linear strength. Flandrin became an important teacher at the Academy and also inspired Dante Gabriel Rossetti and the English Pre-Raphaelites. In 1863 he returned to Rome where he died of smallpox the following year.

See Louis Flandrin, *Hippolyte Flandrin,* 2nd ed. (1909); H. Delahorde, *Lettres et Pensies de H. Flandrin* (1865). (P. H. S.)

FLANNAGAN, JOHN BERNARD (1895–1942), U.S. 20th-century sculptor, one of America's most original "primitivising" sculptors. was born on April 7, 1895, in Fargo, N.D. Trained as a painter, he turned to sculpture a scant 17 years before his death, maturing his style during the last decade of his life despite many handicaps. Defining his sculpture as a species of occult fossil, Flannagan with a queer atavistic nostalgia dredged the subconscious for inspiration. Common fieldstone was the material he preferred for images which were only freed by an act of realization. "Jonah and the Whale" (1937), for example, was conceived as a rebirth motif, the fish being the symbol of the female principle. It was created with minimal modification of natural bluestone. The traumatic state of becoming was Flannagan's most effective poetic theme; it informed his major works. *e.g.,* "New One" (1935), "Triumph of the Egg" (1937 and 1941), "Not Yet" (1940), "Beginning" (1941), influencing mother and child subjects and perhaps even the tumid "Dragon" motifs or monster fantasies (1933 and 1941). Consonant with their iconography was a technique permitting the emergence of indwelling spirit from inert matter. Hence, in both formal and philosophical regards Flannagan was close to the artists of ancient India. He had broached new subjects and techniques in wrought bronze when he took his life on Jan. 6, 1942.

See Flannagan's *Letters* (1942); Dorothy C. Miller, *The Sculpture of John B. Flannagan* (1942). (J. S. BT.)

FLANNEL. A woolen stuff of various degrees of weight and fineness, made usually from loosely spun yarn. Baize, a kind of coarse flannel with a long nap, is said to have been first introduced to England about the middle of the 16th century by refugees from France and the Netherlands. The manufacture of flannel has naturally undergone changes and, in some cases, deteriorations. Flannels are frequently made with an admixture of silk or cotton, and in low varieties cotton has tended to become the predominant factor. Formerly a short staple wool of fine quality from a Southdown variety of the Sussex breed was principally in favour with the flannel manufacturers of Rochdale, who also used largely the wool from the Norfolk breed, a cross between the Southdown and Norfolk sheep.

In Wales the short staple wool of the mountain sheep was used and in Ireland that of the Wicklow variety of the Cottagh breed, but now the New Zealand, Cape and South American wools are extensively employed and English wools are not commonly used alone. Rochdale is the historic seat of the industry, and a good deal of flannel is now made in the Spen Valley district, Yorkshire. Blankets are largely made at Bury in Lancashire and Dewsbury in Yorkshire.

Welsh flannels have a high reputation, and make an important industry in Montgomeryshire. There are also flannel manufactories in Ireland

A moderate export trade in flannel is done by Great Britain and Australia.

FLANNELETTE, a descriptive term signifying a particular style of finishing and applied to an important class of cotton fabrics of simple texture. which have either one side only or, more usually, both sides formed with a short fleecy "nap" or fur. This nap is developed after weaving, by submitting the fabric to a finishing operation variously described as "teasling," "raising," or "perching," during which the fibrous filaments of cotton are scratched up and raised, thereby producing the short furry nap which is the distinctive characteristic of flannelette.

Flannelette is made in many different qualities ranging from comparatively coarse to fine textures that are used for a variety of domestic purposes, but mainly for clothing, and especially for undergarments and night attire, for which it is very suitable owing to its flannel-like and woolly character which imparts to the body a feeling of comfort and warmth. This attribute of flannelette results, of course, more especially from the presence of air in the short nap, which, being a poor conductor of heat, serves the more effectively to insulate the body, and thus prevents the radiation of heat, after the manner of the furry coats of animals.

It is this aerated property of flannelette which increases its susceptibility to ignition, for until the nap is formed on the surface it is no more inflammable than any other type of fabric, whether produced from cotton or other textile material. Flannelette does not possess the inherent properties of highly inflammable volatile and ethereal fluids of an explosive character, which are liable to ignition by a flame at some distance. Unless it comes into actual contact with fire, it is as immune from the risk of ignition as fabrics of any other textile material. Garments made of flannelette are in wide use, especially as night attire for children, but before the advent of central heating. children were often foolishly alloaed to crouch near the fire just before bedtime, or to go to bed with a lighted lamp or candle. These were the occasions when flannelette became a dangerous material, and therein lay the only risk of its use, not in any inherent property of inflammability. Indeed, it is highly probable that by providing a cheaper material for warm clothing, flannelette saved infinitely more lives than it destroyed. Nevertheless, so strong mas the prejudice of many people against the risk of fire incurred by using flannelette that it was, in some cases, submitted to chemical treatment to render it harmless. The additional cost of that process, however, prevented its becoming a commercial success.

There is no feature of special technical interest attaching to the manufacture of flannelettes, which are usually based on plain calico, three-end 1x2 twill, four-end 2x2 twill, or a similar weave structure, calculated to produce a relatively close and firm texture, free from long "floating" threads that would be liable to break during the operation of raising the nap. Also, since the nap is formed by raising the fibres composing the weft yarn. this is spun "soft," with less twist and of coarser counts than the warp yarn, which requires to be stronger than the weft.

Flannelettes are produced in a variety of different styles, as "plain," striped, checked, and sometimes printed with simple diapered figuring. (H. N.; X.)

FLARE. The term flare in pyrotechny is applied either to coloured fire composition burnt in a loose heap, or to a similar composition charged into a rolled paper case, thus ensuring longer and more regular burning Flares are used in pyrotechnic displays for the illumination of the surroundings and in a suitable setting, such as a background of trees and foliage, rocks or old buildings.

The flare, or light, in its present form can claim no greater antiquity than the early part of last century. when the introduction of chlorate of potash permitted the development of genuine colour composition (See FIREWORKS) Previous to this the only colour achieved. in addition to flame colour, had been the bluish-white light produced by a mixture of sulfur, saltpetre and orpiment. These blue lights, as they were called, were much used at sea for signaling and illuminating purposes.

Signal Flares and Lights. — The introduction of colours nhich could readily be recognized at a considerable distance opened up a much wider field for the use of flares at sea, and from the middle of the 19th century many patents were taken out; most of these had for their object a means of self ignition. The first of these inventions ignited the flare by breaking a hollow bead containing sulfuric acid which came into contact with a pellet of chlorate of potash. Subsequent inventions provided for ignition on the same principle as the modern safety match.

During World Wars I and II, a number of flares were developed for purposes such as battlefield illumination. target marking. aircraft identification and distress signals. Illuminating flares, dropped by airplanes or fired from artillery and naval pieces. were usually attached to parachutes, which prolonged the period of illumination over a greater surface area. (A. St. H. B.; X.)

FLAT: see APARTMENT HOUSE: LANDLORD AND TENANT.

FLAT (in music): see ACCIDENTALS.

FLATFISH is the common name of fishes of the order Pleuronectiformes (Heterosomata), which differ from all other fishes in having both eyes on one side. As adults they live on the bottom, with the eyed side uppermost; this side is coloured whereas the underside is usually white (but exposure of underside to light will cause some development of pigment). Nearly all flatfishes are marine. The have minute floating eggs. The larval flatfish. which is symmetrical, with an eye on each side, swims near the surface of the sea; but after a time one eye moves round over the top of the head to the other side, some of the fins change position and the fish, leaning over gradually on the eyeless side, sinks to the bottom. In most flatfishes the dorsal fin grows forward onto the head; in some species with a long larval life this happens before the eye "migrates," so that in pushing its way between the dorsal fin and the head. the eye seems to go through the head from one side to the other. Many flatfishes are remarkable for their power of changing colour to resemble the ground on which they lie, and it has been established experimentally that they must see the ground in order to imitate it. The eyes stand out from the head and can be turned independently in different directions looking sideways, or sometimes one looking forward and the other backward.

Certain variant types are known. Many albino (pigmentless) flatfish have been found. Some species. which have the underside coloured, tend to have the fin arrangement symmetrical. Another abnormality commonly found is to have the eyes on the reverse side from that normal for the species. In these individuals the optic nerves, which normally cross only once, may be "doubly crossed."

The most primitive genus, Psettodes, from west Africa and the Indo-Pacific has perchlike features (dorsal fin not extending on the head; symmetrical pelvic fins, nostrils and skull characters) and indicates the derivation of flatfishes from some percoid ancestor allied to the sea basses (Serranidae). The other flatfishes, numbering about 600 species, are generally called either flounders, when the lower jaw is prominent, or soles, when the rounded snout projects beyond the small curved mouth; each of these groups includes a family with the eyes on the right side and another with the eyes on the left. The family Pleuronectidae, or dextral (right-eyed) flounders. include the halibut. plaice and other important food fishes of northern seas. The Bothidae, or sinistral (left-eyed) flounders; include the turbot; some of the American species of *Paralichthys* are also valued as food. The Soleidae, or true soles, with eyes on the right side include the well-known common sole (*Solea solea*) of Europe. The Cynoglossidae, or tongue soles, with eyes on the left side. inhabit tropical and subtropical waters.

In the more specialized forms, which feed .exclusively on bottom-living invertebrates, the jaws of the blind side are more strongly developed than those of the eyed side, and have stronger teeth; in the soles the jaws of the eyed side are toothless. Most flatfishes grow to about one foot long. but the Atlantic halibut (*Hippoglossus hippoglossus*) may attain a length of 10 ft. and a weight of more than 500 lb. See also FISHES. (C. Hu.)

FLATFOOT is the term used in medicine to designate a depression of the arch of the foot. Usually associated with loss of the arch is a rolling outward of the foot and heel, resulting in a splayfoot position. Normally the arch is maintained by the shape of the bones and by the ligaments and muscles of the foot. Of these three, the muscles are most important. At an early stage the flat foot may be flexible and result from stretching of ligaments and weakness of muscles. At a later stage the shape of the bones may be altered and the deformity rigid.

Little is known regarding the causation of flatfoot. All infants have flat arches at birth. The normal arch does not appear until the infant begins to walk, thus developing muscle power. Failure of development of the arch may be a normal racial or familial characteristic; it is often seen, for example, in Negroes. In general, the problem is a disproportion between the weight to be borne and the muscles to bear it. In a few patients the deformity follows an injury.

Many symptoms have been attributed to flat feet—pain, swelling, muscular spasm, stiffness and awkward gait. Other vague symptoms in the extremities and back, sometimes considered as caused by flatfoot, probably are the result of the generalized muscle weakness which also produced flatfoot. Many persons with flat feet are entirely without disability or pain.

The aim of treatment is to secure proper position of the arch and heel by the use of adequate shoes. with or without supports, and to preserve that position by strengthening the muscles maintaining correction of arch and heel. Supports are indicated if pain is severe or fatigue excessive, but their prolonged use may weaken muscles and be harmful. Few persons have pain severe enough to require surgery. Rarely surgery is indicated for cosmetic reasons. (J. S. Ms.)

FLATHEAD (SALISH), a Salishan-speaking Indian tribe of western Montana whose territory extended from the crest of the Bitterroot mountains to the continental divide. centring on the upper reaches of the Clark fork of the Columbia river. Their tribal neighbours were: north, the linguistically unrelated Kutenai; east, the Algonkian Blackfoot; south, the Sahaptin Nez Percé; west, the Salishan Coeur d'Alene and Kalispel. Friendship prevailed with all but the Blackfoot, against whose raids the tribe frequently had to defend itself. Salish was the native name of the tribe, but Flathead is the customary designation in both popular and anthropological usage. Head flattening, however, was not practised. Flathead customs were typically those of the Plateau culture area, of which they were the easternmost representatives (*see* PLATEAU INDIANS). Political organization was tribal. Bison hunting was basic to the economy. Horses were plentiful. The Flathead were consolidated with the Upper Pend d'Oreille and Kutenai in the treaty which the three tribes signed with the U.S. on July 16, 1855. Since 1872 they have resided primarily on a reservation at Flathead lake, Montana. *See* also INDIAN. NORTH AMERICAN; SALISHAN. (V. F. R.)

FLATMAN, THOMAS (1637–1688), English poet and miniature painter, was educated at Winchester (1649–54) and New college, Oxford (1654–56). He left Oxford without a degree in 1657, having been made fellow of his college the previous year. In 1666 he was created M.A. of Cambridge by the king's letters. As a miniature painter he is highly esteemed by modern critics, but only a few of his poems have survived in anthologies. He died in London, Dec. 8, 1688. His collected works first appeared in 1674, as *Poems and Songs,* and an enlarged edition in 1686; many of his verses, however, were printed separately, the most notable being "A Thought of Death" (imitated by Pope); "Death, a Song"; and "Hymn for Morning." *Montélion's Almanack* for 1661 and 1662 and a mock romance, *Don Juan Lamberto,* have also been ascribed to Flatman by Wood.

See Anthony à Wood, *Athenae Ovonienses,* P. Bliss (ed.), vol. iv (1813–20); H Walpole, *Anecdotes of Painting* (1762–71, later ed. 1879); S. Redgrave, *Dictionary of Artists* (1878); F. A. Child, *Life and Uncollected Poems of T. Flatman* (1921).

FLATWARE is the term introduced toward the end of the 19th century to denote spoons, forks and similar articles such as fish knives, fish forks and serving utensils. Strictly speaking, it excludes knives, but in the U.S. the term flatware or flat silver is generally understood to include all table knives. This article is concerned with the manufacture of forks and spoons; for the manufacture of knives *see* CUTLERY. *See* also FORK; KNIFE; SPOON.

Flatware is made in a wide variety of designs in silver, silver plate, unplated nickel alloys, stainless steel and aluminum, tinned iron, brass and plastics; luxury services are made in gold. Wood is sometimes used for salad and spaghetti servers, mother-of-pearl for egg spoons and bone for mustard spoons. Handles, plain or ornamented, are either in one piece with the spoon bowl or the fork or fitted separately to tangs. Another wide range of spoons and forks is manufactured, usually in stainless steel, for use in cooking and preparing food.

Modern flatware is produced in all the cutlery centres of the world. During the 20th century the processes used in its manufacture developed to a high degree of mechanization. The metal, carefully refined, is cast into small ingots, each weighing (in the case of nickel alloys) about 40 lb. The ingots are reheated and rolled until sheets of the desired thickness are obtained; the sheets are then cut into strips of the required width. These processes involve the strictest control of metal behaviour and correct annealing to remove excessive strains. The strips are fed into machine "presses" to cut out each spoon or fork in its rough shape, one end being at first almost square for a spoon and rectangular for a fork. The ends of these "blanks" are rolled again in a direction at right angles to the centre line, thus reducing the thickness there without altering the thickness of the handle. The bowls of the more expensive spoons are at least half as thin as their handles. After being trimmed in another press, the blanks for spoons are ready for stamping in alloy steel dies that hollow the bowls and stamp a pattern on the handles. In the case of forks, slots are cut out to form the prongs, which are then stamped in dies to the required curvature, tapered and pointed on abrasive belts. These processes are approximately the same whatever metal is used, although in manufacturing the cheaper products, made from thinner sheets, cross-rolling can be omitted and the stamping can be done in one operation. In the early 1960s large quantities of these thinner types were being made in stainless steel.

Subsequent finishing processes vary according to the metal used. In the case of silver, successively finer stages of buffing prepare the surfaces for final polishing or satin finishing. In the case of alloys that are to be plated, the articles, after being buffed, are wired individually on frames; quantities of 100 or more can be immersed simultaneously in the series of cleaning baths and plating vats. The articles to be plated become cathodes in the vat, the metal to be deposited, *e.g.,* silver, being the anode. In most factories the complete frames of articles are transferred automatically from baths to vats and finally to washing and drying. Strict control is maintained of the composition, strength and temperature of the plating solutions as well as of the voltage and amperage of the direct current to ensure that the correct thickness of coating is deposited. (*See* ELECTROPLATING.) The thickness of deposit is increased by some makers at the places of maximum wear, for example, on the centre of the convex surface of spoon bowls. The deposit of silver is specified in grams or pennyweights per dozen pieces and sometimes in actual thickness in millimetres or thousandths of an inch; but the more popular method of indication is use of the terms "30 years," "25 years" or "20 years" plate. The designation A one (A 1) is satisfactory as a guarantee of the quality of the deposit provided it is given by a manufacturer of good repute.

When the pieces have been plated their surfaces are dull and require polishing. Hand polishing is done by holding the articles upon rapidly rotating mops dressed with an aluminum compound or rouge. In the case of silver and silver plate a little of the metal is removed; in the plating process allowance is made for this by depositing more silver than is called for by the specification, the makers guaranteeing a "finished deposit." Mechanical polishing is done by machines in which numbers of spoons or forks are secured in racks and applied en masse to rotating cylindrical mops.

The least expensive plating process is "bright plating," in which a very thin coating of silver or chromium can be deposited bright, thus eliminating the cost of final polishing. Such a coating does not last long and the process is therefore restricted to the cheaper grades of flatware.

Stainless steel is more difficult to polish than silver, silver plate or unplated nickel alloys. Techniques have been developed for stamping the cheaper varieties of stainless steel spoons and forks from prepolished sheet. In some countries electrolytic polishing of stainless steel has been satisfactorily developed.

Where cheapness and lightness are especially desired aluminum or plastics are employed in the making of flatware. Aluminum articles are stamped in one operation from metal sheets; plastic articles are molded.

In Europe, silver articles usually bear a hallmark (*q.v.*), which indicates that the metal contains a prescribed amount of silver. Other marks record the year of manufacture and the maker. United Kingdom hallmarks include the lion passant, which is the guarantee that the silver is not less than 92.5% pure; the assay office (town) mark; the monarch's head; the date letter recording the year of manufacture and the maker's full name, initials and/or trademark. In the United States the word "sterling" is accepted as a sufficient guarantee when used by a reputable supplier.

While well-proved 18th- and 19th-century patterns for flatware continue to be popular, the advent of new fashions in furnishings during the first half of the 20th century resulted in the introduction of many new flatware designs by all the manufacturing centres. Designs in stainless steel as well as in silver flatware are available to harmonize with any table appointments. furniture or room decoration. Although stainless steel articles need only to be washed after use there is still great demand for silver and silver plate flatware. (W. G. I.)

FLATWORM, a general name for members of the phylum Platyhelminthes (*q.v.*), including the flukes (*see* TREMATODES), tapeworms (*q.v.*) and certain free-living forms (*see* TURBELLARIA).

FLAUBERT, GUSTAVE (1821–1880), French novelist, whose work constitutes an epoch in the history of the art of fiction, was born in Rouen, Dec 12, 1821. His father. Achille Cléophas Flaubert (1784–1846), who came from Champagne, was one of Guillaume Dupuytren's most brilliant pupils and was chief surgeon and clinical professor at the Hôtel-Dieu in Rouen. His mother (Caroline Fleuriot), a doctor's daughter from Pont-l'Évêque, belonged on her mother's side to the Cambremer de Croixmare family, which had, produced a number of distinguished magistrates and was typical of the great provincial *bourgeoisie.*

Gustave Flaubert began his literary career in his school days in Rouen, his first published work appearing in a little review, *Le Colibri,* in 1837. He early formed a close friendship with the young philosopher Alfred Le Poittevin (1816–48), whose pessimistic outlook had a strong influence on him. No less strong was the impression made by the company of great surgeons and the environment of hospitals, operating theatres and anatomy classes with which his father's profession brought him into contact. It was, for instance, with Jules Cloquet, the most learned anatomist of his time, that Flaubert, on receiving his *baccalaurdat* in 1840, was sent by his father to visit the Pyrenees and Corsica. Later, on reading *Graziella,* Flaubert was to remark that Lamartine would have written a more powerful novel if he had had a doctor's eye.

Flaubert's intelligence, moreover, was sharpened in a general sense. He conceived a strong dislike of accepted ideas *(iddes reçues)*, of which he was to compile a dictionary for his amusement. He and Le Poittevin invented a grotesque imaginary character, called "le Garçon," to whom they attributed whatever sort of remark seemed to them most degrading. Flaubert came to detest the "bourgeois," by which he meant anyone who "has a low way of thinking."

In Nov. 1841 Flaubert was enrolled as a student at the faculty of law in Paris. At the age of 22, however, he was recognized to be suffering from a nervous disease which was taken to be epilepsy, although the essential symptoms were absent. This made him give up the study of law, with the result that henceforth he could devote all his time to literature. His father died in Jan. 1846. and his beloved sister Caroline died in the following March after giving birth to a daughter. Flaubert then retired with his mother and his infant niece to his estate at Croisset, near Rouen, on the Seine. He was to spend nearly all the rest of his life there.

On a visit to Paris in July 1846, at the sculptor James Pradier's studio, Flaubert met the poet Louise Colet (*q.v.*). She became his mistress, but their relationship did not run smoothly. Her jealousy made separation inevitable, angry scenes took place, and they parted in 1855.

In 1847 Flaubert went on a walking tour along the Loire and the coast of Brittany with the writer Maxime du Camp, whose acquaintance he had made as a law student. The pages written by Flaubert in their journal of this tour were published after his death under the title *Par les champs et par les grèves* (1886). This book contains some of his best writing; *e.g.,* his description of a visit to Chateaubriand's family home, Combourg.

So far it has been possible to deal chronologically with the events of Flaubert's life, but from this point the close interrelation between his works and his life, as well as his habit of recasting his books in his search for perfection, makes this difficult. It therefore seems more convenient to deal with the creation of each of his major works separately, linking with it the concomitant events of his life.

L'Éducation Sentimentale. — Some of the works of Flaubert's maturity dealt with subjects on which he had tried to write earlier. At the age of 16, for instance, he completed the manuscript of *Mkmoires d'un fou,* which contains elements that eventually appeared in *L'Éducation sentimentale* (2 vol., 1869; dated 1870). Before receiving its definitive form, however. this work was to be rewritten in two distinct intermediate versions in manuscript: *Novembre* (1842), and a preliminary draft entitled *L'Éducation sentimentale* (1843–45). Stage by stage, it was expanded into a vast panorama of France under the July monarchy — indispensable reading, according to Georges Sorel, for any historian studying the period that preceded the *coup d'dtat* of 1851.

At Trouville, where his family owned some property, the young Gustave Flaubert in 1835 had formed a sentimental friendship with one of his sister Caroline's friends, Gertrude Collier, a daughter of the British naval attaché in Paris. But in 1836 this was forgotten when he met Elisa Schlésinger (née Foucault; 1810–88), to whom he returned a coat that she had left on the beach. Eleven years older than he and married to a music publisher, this woman (the Marie Arnoux of *L'Éducation sentimentale)* inspired a devastating passion in Flaubert. She no doubt loved him too, but their love was never consummated. Readers of *L'Éducation sentimentale* may take the famous opening sentences of its last chapter but one as a true representation of Flaubert's feeling for her:

> He traveled.
>
> He came to know the melancholy of steamers, cold awakenings in the morning under canvas, the shock of landscapes and ruins, the bitterness of discontinued friendships.
>
> He came back.
>
> He associated with people and he had other love affairs. But the memory of the first one made them indifferent to him . . .

La Tentation de Saint Antohe. — The composition of *La Tentation de Saint Antoine* provides another example of that tenacity in the pursuit of perfection which made Flaubert go back constantly to work on subjects without ever being satisfied with the results. In 1839 he was writing *Smarh,* the first product of his bold ambition to give French literature its *Faust.* He resumed the task in 1846–49, in 1856 and in 1870 and finally published the book as *La Tentation de Saint Antoine* in 1874. The four versions show how the author's ideas changed in the course of time. The version of 1849 is influenced by Spinoza's philosophy and nihilistic in its conclusion. In the second version the writing is less diffuse, but the substance remains the same. The third version shows a respect for religious feeling that was not present in the earlier ones, since in the interval Flaubert had read Herbert Spencer and reconciled the Spencerian notion of the Unknown with his Spinozism. He had come to believe that science and religion, instead of conflicting, are rather the two poles of thought. The published version has the form of a catalogue of errors in the field of the Unknown (just as *Bouvard et Pécuchet* was to be a catalogue of errors in the field of science).

From Nov. 1849 to April 1851 Flaubert was traveling in Egypt, Palestine, Syria, Turkey, Greece and Italy with Du Camp. Before leaving, however, he wanted to finish *La Tentation* and to submit it to Du Camp and to his friend the poet Louis Bouilhet for their sincere opinion. For three days in Sept. 1849 he read his manuscript to them, and they then condemned it mercilessly: "Throw it all into the fire, and let's never mention it again." Bouilhet gave further advice: "Your Muse must be kept on bread and water or lyricism mill kill her Write a down-to-earth novel, like Balzac's *Parents Pauvres*. The Delamare story, for instance. . . ."

Madame **Bovary.**—Eugène Delamare mas a country doctor in Normandy who died of grief after being deceived and ruined by his wife, Delphine (née Couturier). The story is in fact that of *Madame Bovary* but it is not the only source of that novel. Another source is the manuscript *Mémoires de Mme Ludovica,* discovered by Gabrielle Leleu in the library of Rouen in 1946. This is an account of the adventures and misfortunes of Louise Pradier (née d'Arcet), the wife of the sculptor Fradier, as dictated by herself; and it bears a strong resemblance to the story of Emma Bovary. apart from the suicide. Flaubert, out of kindness as well as out of professional curiosity, had continued to see Louise Pradier when the "bourgeois" were ostracizing her as a fallen woman, and she must have given him her strange document. Even so, when inquisitive people asked him who served as model for his heroine, Flaubert replied. "Madame Bovary is myself." This was doubtless meant as a joke, but can be regarded as true if it is remembered that the idea nas already in his mind in 1837 when he was writing *Passion et vertu,* a short and pointed story with a heroine, Mazza. resembling Emma Bovary. For *Madame Bovary* he took a commonplace story of adultery and made of it a book that will always be read because of its profound humanity The Emmas of the 20th century do not take the stagecoach to rejoin their lovers but drive to them in their own cars, yet they pay the same price for their folly. While working on his novel Flaubert wrote: "My poor Bovary suffers and cries in more than a score of villages in France at this very moment."

Madame Bovary, with its unrelenting objectivity—by which Flaubert meant the dispassionate recording of every trait or incident that could illuminate the psychology of his characters and their role in the logical development of his story—marks the beginning of a new age in literature. It occupies the same position in the history of the novel as Claude Bernard's *Introduction à la médecine expérimentale* occupies in that of biology.

Madame Bovary cost the author five years of hard work. Du Camp, who had founded the periodical *Revue de Paris,* urged him to make haste, but he would not. The novel, nith the subtitle *Moeurs de province,* eventually appeared in instalments in the *Revue* irom Oct. 1 to Dec. 15, 1856 (new edition in book form, 1857). The French government then brought the author to trial on the ground of his novel's alleged immorality, and he narrowly escaped conviction (Jan.–Feb. 1857). The same tribunal found Baudelaire guilty six months later.

Salammbô.—To refresh himself after his long application to the dull world of the *bourgeoisie* in *Madame Bovary,* Flaubert immediately began work on *Salammbô,* a novel about ancient Carthage, in which he set his sombre story of Hamilcar's daughter Salammbô, an entirely fictitious character, against the authentic historical background of the revolt of the mercenaries against Carthage in 240–237 B.C. His transformation of the dry record of Polybius into richly poetic prose is comparable to Shakespeare's treatment of Plutarch's narrative in the lyrical descriptions in *Antony and Cleopatra.* The novel appeared in 1862 (dated 1863) and had a great and lasting success. A play, Le *Château des coeurs* (1863), was not printed until 1880.

Trois **Contes.**—The merits of *L'Éducation sentimentale,* which appeared a few months before the outbreak of the Franco-German War of 1870, were not appreciated, and Flaubert was much disappointed. Two more plays, *Le Sexe faible* and *Le Candidat* (both 1873), likewise had no success, though the latter was staged for four performances in March 1874. The last years of his life, moreover, were saddened by poverty. In 1875 his niece Caroline's husband Ernest Commanville, a timber importer, found himself heavily in debt. Flaubert sacrificed his own fortune to save him from bankruptcy. Flaubert found some consalation in his work and in the friendship of George Sand, Turgenev and his neighbour Edmond Laporte, and also in that of younger novelists—Émile Zola, Alphonse Daudet and, especially, Guy de Maupassant, who was the son of his friend Alfred Le Poittevin's sister Laure and regarded himself as Flaubert's disciple.

Flaubert temporarily abandoned work on a long novel, *Bouvard et Pécuchet,* in order to write *Trois Contes* (1877), which comprises the three short stories "Un Coeur simple," "La Légende de Saint Julien l'Hospitalier" and "Hérodias." This book, through the diversity of the stories' themes, shows Flaubert's talent in all its aspects and has often been held to be his masterpiece.

Bouvard et **Pécuchet.**—The heroes of *Bouvard et Pécuchet* are two clerks who receive a legacy and retire to the country together. Not knowing how to use their leisure, they busy themselves with one abortive experiment after another and plunge successively into scientific farming, archaeology, chemistry and historiography, as well as taking an abandoned child into their care. Everything goes wrong because their futile book learning cannot. compensate for their lack of judgment and because they have not had the general education that is a prerequisite of any intellectual activity. The profound meaning of this novel, which Flaubert left unfinished and which was published after his death (in the *Nouvelle Revue* from Dec. 15, 1880, to March 1, 1881; in book form. 1881), has been seriously misunderstood by critics who have regarded it as a denial of the value of science. In fact it is "scientism" that Flaubert is arraigning; *i.e.,* the practice of taking science out of its own domain, of confusing efficient and final causes and of convincing oneself that one understands fundamentals when one has not even grasped the superficial phenomena. Intoxicated with empty words, Bouvard and Pécuchet awake from their dream only when catastrophe overtakes their presumptuous efforts. Flaubert has been accused of presenting them as imbeciles, but in fact he expresses his compassion for them: "They acquire a faculty deserving of pity, they recognize stupidity and can no longer tolerate it. Through their inquisitiveness their understanding grows; having had more ideas, they suffered more." Flaubert's satire is thus to some extent the history of his own experience, told with a sad humour.

Flaubert died suddenly of an apoplectic stroke on May 8, 1880. He left on his table an unfinished page and notes for a second volume of his novel. Bouvard and Pécuchet, tired of experimenting, were to go back to the work of transcribing and copying that they had done as clerks. The matter that they chose to transcribe was the subject of the notes: it was to be a selection of quotations, a *sottisier,* or anthology of foolish remarks. There has been much controversy about this bitter conclusion, as the form that it was to take was leit undetermined.

Flaubert's Method of Composition.—Flaubert worked slowly and carefully, and as he worked, his idea of his art became gradually more exact. His letters to Louise Colet, written while he was working on *Madame Bovary,* show how his attitude changed. His ambition was to achieve a style "as rhythmical as verse and as precise as the language of science" (letter of April 24. 1852). In his view "the faster the word sticks to the thought, the more beautiful is the effect." He often repeated that there was no such thing as a synonym and that a writer had to track down *le seul mot juste,* "the unique right word," to convey his thought precisely. But at the same time he always wanted a cadence and a harmony of sounding syllables in his prose so that it would appeal not only to the reader's intelligence but also to his subconscious mind in the same way as music does and thus have a more penetrating effect than the mere sense of the words at their face value. Composition for him was a real anguish.

Flaubert sought objectivity above all else in his writing: "The author, in his work, must be like God in the Universe, present everywhere and visible nowhere." It is paradoxical, therefore, that his personality should be so clearly discernible in all his work, and that his letters, written casually to his intimates and full of disarming sincerity, delicate sensibility and even exquisite tenderness, should be considered by some critics as his masterpiece.

Editions and Translations.—The critical edition by René Dumesnil of Flaubert's novels, short stories and travel notes in 12 volumes (1938–46) provides a definitive text, with variant readings, as well as an introduction and annotations. For Flaubert's juvenile writings and for his plays, reference can be made to the 18-volume Conard edition (1910–28). This includes five volumes of *Correspondance,* but these were superseded by a new edition in nine volumes (1926–33), followed by the four-volume *Supplément à la correspondance générale,* edited by R. Dumesnil, Jean Pommier and Claude Digeon (1954).

Some of Flaubert's novels have been translated into English several times. The following versions may be cited: *November,* translated by F. Jellinek (1932); *Sentimental Education,* translated by Anthony Goldsmith (1941); *The First Temptation of Saint Anthony,* translated from the version of 1856 by René Francis, new ed. (1924); *The Temptation of Saint Anthony,* translated by Lafcadio Hearn, new ed. (1932); *Madame Bovary,* translated by Gerard Hopkins (1949); *Salambo,* translated by E. Powys Mathers, new ed. (1950); *Three Tales,* translated by Mervyn Savill (1950); *Bouvard and Pécuchet,* translated by T. W. Earp and G. W. Stonier (1936). There are selections of his letters in English translations by J. M. Cohen with an introduction by R. Rumbold (1950); and by F. Steegmuller (1954).

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(R. Dl.)

FLAVIAN, SAINT (d. 449), patriarch of Constantinople, was an adversary of the Monophysite heresy (*see* MONOPHYSITES). He became patriarch in 446 and in 448 presided at a Constantinopolitan synod which condemned Eutyches (*q.v.*). Flavian's announcement of this evoked from Pope Leo I the famous *Dogmatic Letter* of 449. The "robber synod" of Ephesus, contrived by court intrigue, deposed and excommunicated him in 449; his opponents so maltreated him that he died three days afterward in Lydia. The Council of Chalcedon (451) vindicated him, however, proclaiming him a martyr and saint; both the Latin and Greek churches commemorate him on Feb. 18.

Three letters of Flavian to Pope Leo I and one to Emperor Theodosius II are preserved; they may be found in J P. Migne (ed.), *Patrologia Latina,* vol. 54 and *Patrologia Graeca,* vol. 65.

(Jn. Sr)

FLAVIAN I OF ANTIOCH (c. 320–404), bishop of Antioch from 381, was born probably at Antioch. With Diodorus of Tarsus. Flavian defended the Nicene faith against the Arian bishop Leontius. In the religious meetings they conducted, Flavian popularized the form of the lesser doxology that is derived from the baptismal formula, and he is believed to have originated the practice of antiphonal singing in church services. In 360 Meletius (*see* MELETIUS OF ANTIOCH), whom the Arians had ordained bishop of Sebaste, became bishop of Antioch, where his unexpected profession of the Catholic faith earned him several exiles. During these absences Flavian and Diodorus resumed the care of the faithful. Meanwhile, the Eustathians — Antiochenes who had separated from the Arian bishop after the banishment of the orthodox bishop Eustathius (331)—rejected Meletius and made Paulinus their bishop (*see* EUSTATHIUS, SAINT). The schism thus set afoot continued after Meletius' death. Flavian succeeded him in 381, and Paulinus appointed as his own successor Evagrius, the last bishop of the Eustathians. Recognition of Flavian as legitimate bishop of Antioch was at first withheld by the bishop of Rome, but it was secured in 399 through the intervention of John Chrysostom (q *v.),* patriarch of Constantinople, and the influence of the emperor Theodosius.

Flavian died in 404. Some Eustathians continued in schism until 414.

See F. Cavallera, *Le schisme d'Antioche* (1905); Herzog-Haupt, *Realencyklopadie.*

(J. A. P. B.)

FLAVIAN II OF ANTIOCH (d. c. 518), patriarch of Antioch probably from 498 to 512, mas chosen patriarch by the monophysitic emperor Anastasius I after he accepted the evasive Henoticon, the decree of union between the Monophysites (*q.v.*) and the Orthodox. In deference to orthodoxy, however, Flavian would not expressly repudiate the Council of Chalcedon. This equivocal policy only antagonized both sides, particularly the Monophysites. At the synod of Sidon (511) Flavian maintained his position, but soon afterward, under constant harassment by his enemies, he yielded finally to their demand for a rejection of Chalcedon. It was too late. He was forced to abdicate and was banished to Petra in Arabia. There he died, probably in 518. (Jn. Sr.)

FLAVIGNY, VALÉRIEN (d. 1674), French philologist primarily interested in technical questions of textual meaning in the Bible, was born near Laon, France, at the beginning of the 17th century. In 1640 he became professor of Hebrew at the Collège de France. His best-known work, *Epistolae IV de ingenti Bibliorum opere septemlingui* (1646–48), concerned Le Jay's polyglot Bible, over which Flavigny was engaged in a controversy with Abraham Ecchellensis. Flavigny also edited and published (1632) the works of Guillaume de Saint-Amour, 13th century French theologian. He died in Paris on April 29, 1674.

FLAVIUS, BLONDUS (*c.* 1388–1463), Italian historian, was born at Forlì. After acting as ambassador to Milan, where he discovered the manuscript of Cicero's *Brutus,* he was exiled to Venice from 1423–32. In the latter year he became secretary to Pope Eugenius IV. During his lifetime he was also secretary to three other popes, Nicholas V, Calixtus III and Pius II. He died in Rome in 1463.

Flavius wrote three encyclopaedias, *Romae Instauratae Libri Tres* (1482), *Romae Triumphantis Libri Decem* (1482) and *Italia Illustrata* (1474). The three included valuable material on 15th century Rome and Italy as well as on the ancient city and its inhabitants. These books formed the pattern on which many later works on Rome were based, and they continued to be consulted for hundreds of years after their author's death.

His collected works, including *Decades* and *De origine et gestis Venetorum* in addition to those listed above, were often printed in the 16th century, notably at Basle in 1531. B. Nogara edited *Scritti inediti e rari di B. Flavio* in "Studi e Testi" series, no. 48 (1927).

FLAVIUS, GNAEUS, Roman writer of the 4th century B.C., on legal procedure, was the son of a freedman but had a distinguished career which began when he was made secretary to Appius Claudius Caecus. Before Flavius' time, the technical rules of procedure in Roman law were known only to the patricians and pontiffs, part of whose power derived from the fact that they had to be consulted frequently on legal questions. Flavius, either by copying from a law book owned by Appius Claudius or by questioning the latter's friends, was able to work out the procedural system and published his findings under the title of *Jus Flavianum.* Thereafter he was immensely popular with the Roman people and was selected for a number of public offices. including that of senator. In 303 B.C. Flavius was made curule aedile (magistrate of public buildings and works) over the bitter protests of the nobles, with whom he was unpopular both because he had taken from them one of the sources of their power and because of his lowly parentage.

FLAVOUR is the total of the sensations perceived when a food or beverage is consumed; these sensations not only help a person identify substances but also furnish sources of enjoyment when eating and drinking.

Taste **and** Aroma. — The sensory organs involved in flavour perception are those of taste, smell and touch, with the nerve endings located in the nose and mouth.

Tasting occurs in the mouth, chiefly on the tongue through the taste buds. There appear to be only four basic receptor types responsible for the tastes—sweet, salty, sour and bitter. Examples of substances that induce the four basic tastes are sugar (sweet), salt (salty), lemon juice (sour) and quinine (bitter). Substances can be tasted only when they are in water solutions, and if a substance is not in solution when taken into the mouth it must be dissolved in saliva before it can be detected by the taste buds.

Smelling involves the olfactory nerve endings in the upper part of the interior of the nose. Aromas can reach these nerves either directly through the nostrils as in breathing or indirectly up the back passageway from the mouth. Because of their remote location, the olfactory nerve endings are best stimulated by "sniffing" through the nose or swallowing if food is in the mouth. Odours are smelled only when the material is in gaseous form: *i.e.,* a dispersion of molecules in air. While taste types are limited to four, the number of odours that can be identified is in the thousands. The trained flavour chemist is normally capable of distinguishing 10,000 different odours. Further, the sense of smell is extremely sensitive, requiring only minute quantities for detection; a few parts per million in air is sufficient for detection of many odours. The smell of brewing coffee or the cooking of onions, for instance, can be recognized at considerable distances. The sense of taste requires considerably higher concentrations of substances for detection, as much as several tenths of a per cent often being necessary to elicit a response. (See also SMELL AND TASTE.)

Touch sensations that contribute to taste originate in the nose, lips and throughout the entire mouth and throat. The many kinds of touch sensations are based on either the physical or chemical properties of the substance, or a combination of them. Physical properties of foods that produce touch sensations are particle size, texture, consistency and temperature; reactions induced by chemical properties include the coolness of peppermint, the "bite" of mustard and pepper, the warmth of cloves and the astringency of spinach. (See also TOUCH, SENSE OF.)

When a human consumes food, the simultaneous stimulation of the senses of taste, smell and touch create an immediate impression that causes the eater to accept the food and continue eating or reject and discard it. Many foods such as bananas, berries and other fruits, nuts, milk and a few vegetables have flavours that make them highly acceptable in their natural, uncooked state. Other foods derive their flavour through cooking, seasoning and flavouring or combinations of these. (See also NERVOUS SYSTEM: Sensory Endings (Receptors); SENSATION: Senses; FEELING, PSYCHOLOGY OF: *Theory* of Feeling.)

Flavour Development.—Roesting.—One of the earliest known and most impressive means of developing flavour is the cooking of meats and poultry over a fire. The high temperature caramelizes meat sugars, chars proteins and decomposes fats, resulting in development of highly aromatic roasted meat flavour. Wood fires, such as those made with hickory wood. may impart distinctive smoke aroma. Roasted meat flavour can also be produced by heat sources that use coke, charcoal, gas, electricity or any high-temperature fuel. To a lesser extent pan roasting, searing and pan frying also develop roasted meat flavour.

Flavour development by roasting is not confined to meat; for example, the flavours of coffee, cocoa and nut meats are developed by roasting. In the cooking of breads, cakes, cookies and pies, the outer crusts are often browned and have slightly burned, caramel flavour that is attributed to the roasting action of heat.

Baking, Boiling, *Steaming.*—Perhaps the simplest and best-known method of food preparation consists of cooking foods by placing them in boiling water or by allowing the steam produced by the water to heat the food. Meats, fish, cereals and vegetables are frequently cooked in this manner. While not usually thought of as such, baking, which is similar to roasting, is also a form of water cooking, involving the driving off of water in the form of steam from the baking food. During baking. boiling and steaming, the water will extract the volatile flavours and can carry them off; this extraction, if prolonged, can result in insipid flavour, as occurs when onions, carrots or parsnips are cooked too long. The effects of water extraction are not entirely adverse, however, and the method is used to prepare coffee, tea and other beverages.

For optimum flavour, vegetables should be boiled just long enough to produce tenderness. The food should be served immediately and not allowed to stand in the hot water. Some situations require lengthy boiling to develop flavour. as in the preparation of soup stock by boiling bones and meat to produce new aroma and flavour factors; but such situations are the exception to the rule.

As mentioned above, the outer crusts of breads. cakes and pastries are heated during baking to browning temperatures that are above the boiling point of water. Although the interiors of baked foods never reach browning temperature, the flavour changes produced in the interiors by baking greatly increase palatability. The most important change is brought about by cooking or bursting the starch cells to eliminate the raw starch taste and produce the full, mouth-filling flavour of cooked doughs.

Presumably by accident, man long ago found that the predecessor of modem bread could be made if a yeast were allowed to grow in the dough with subsequent conversion of sugars to alcohol, release of carbon dioxide gas and creation of a unique flavour. The highly attractive flavour of bread comes not only from the inherent flavours in the grain but also from by-products of yeast fermentation, which are alcoholic in odour, followed by the aromatic materials produced by baking.

Aging.—Some foods and beverages highly prized for their flavours owe these flavours to the development process of aging for long periods of time. Such aged foods include brandies, cheeses and pickles, to mention only a few. Brandy, for example, is first distilled and then the distillate is stored in wooden barrels for years to develop desirable brandy flavour. During this aging process components of the wood are slowly extracted by the brandy, and at the same time components of the brandy are absorbed or adsorbed by the wood. This gradual change in the brandy's flavour-producing ingredients produces a so-called "mellowing" or blending of flavours. Cured cheeses depend on a slow fermentation or ripening process to develop distinctive flavour characteristics. With some pickles, the action of sugar, vinegar, herbs and spices is allowed to take place over a long period of time to develop optimum flavour.

Seasoning.—Salt, sugar, monosodium glutamate (MSG) and certain spices such as pepper are examples of seasonings that make outstanding improvements in flavour. Their mode of action is not clearly understood; however, enough is known to indicate that seasoning is a highly complex phenomenon.

It is learned from early writings that man has always sought salt to make his foods more palatable and to help preserve them when stored. The continents of North and South America were discovered because of man's quest for new routes to the spice treasures of the orient. The optimum flavour contribution of salt occurs most often at a concentration below that which would give a distinct salty taste; best seasoning results are obtained by adding salt to foods prior to cooking.

Sugar and other sweeteners such as honey, sirups and molasses are useful at the seasoning level in gravies, stews and vegetables.

Monosodium glutamate, used for centuries in the orient in the form of a vegetable sauce to improve the palatability of a predominantly rice diet, has in recent years been introduced in North America and many countries of Europe. Like salt, it has found important use as a seasoner for improvement of flavour. Although it adds no flavour or aroma of its own, it has the ability to blend and zccentuate many flavour factors and makes important flavour contributions in soups, stews, meats, fish, poultry and vegetable dishes.

The spice pepper also belongs in the seasoning category, for it is used more often as a seasoning than as a flavouring agent. The demand for pepper has not diminished since the early caravans and explorers sought routes for procuring this highly prized substance. In early times, pepper no doubt did a great deal to improve the palatability of the unrefrigerated foods of the world. As a seasoning it is a blending agent, increasing the body of flavour and providing pleasant taste and aroma sensations.

Flavouring.—While the flavours of all natural foods are quite complex. the foods themselves are often made more appealing to the human palate by using them in combination with other foods, or by adding small quantities of highly aromatic flavouring agents such as spices. herbs and essential oils. The essential oils are the flavouring oils extracted from any natural product. Soaps and stews in which meat and vegetables are cooked together are examples of foods combined to give optimum appeal. Spreads such as butter, oleomargarine, jams and jellies when eaten on breads make for more eating enjoyment. Much use of flavouring agents is now made by food processors and home use continues to flourish in many instances; cinnamon and nutmeg are used in pastries, vanilla in baked goods, clove in hams and celery seed in soups and stews. (For descriptions of the most common herbs, spices and other seasoning agents and their use in cooking, see FOOD PREPARATION : Herbs and Spices. Also see individual articles on each agent.)

History has demonstrated that man has continually sought compatible combinations of foods and flavourings to relieve the monotony of eating. While sources of available foods have always governed eating habits to some extent, man often seeks flavour in preference to good nutrition. Although there is no one flavour that is appealing to all, certain widely accepted foods all seem to possess the following characteristics: (1) an early initiation of appropriate flavour; (2) rapid development of a full body of blended flavour; (3) pleasant mouth sensations; (4) absence of unpleasant characteristics in either the initial impression or aftertaste; and (5) usually a quick disappearance of flavour on swallowing. Cooking, aging, seasoning and flavouring all contribute toward these five desirable features.

Flavour Testing.—The techniques used for judging the flavour of foods can be grouped into several major categories: (1) ranking and scoring; (2) difference testing; (3) the flavour profile method, an analytical descriptive method of characterizing flavour; and (4) consumer acceptance testing.

Early flavour testing was carried out by experts who because of training, experience and familiarity with foods were believed to make sound judgments. While many judgments on flavour are referred to teams of trained workers known as flavour panels, single experts are employed in the coffee, tea and wine industries. Here the expert rates his product against product standards known to be acceptable to the consumer.

Ranking and Scoring.—One of the simplest techniques of flavour judgment is ranking, which requires flavour panel members to arrange a series of samples in ascending or descending order of intensity based on a specific flavour characteristic. For instance, panel members might be asked to rank sweetness of sugar solutions so that a correlation might be made between sweetness and strength. Panel members are trained to recognize the flavour factor under study and relate it to reference intensity standards. Ranking methods are useful in the food industry chiefly in quality control in large-scale production; however, the method lacks precision when flavour differences are small, and the information developed is limited to one flavour factor.

The scoring method was originally developed by the dairy industry to rate products such as butter, by numerical grade according to some predetermined standard; it is now widely used in the flavour appraisal of fruits and vegetables, as well as dairy products. Scoring is performed by panels previously trained in the particular qualities under observation. Many numerical scales are used, depending on the number of points considered convenient.

Difference Tests.—Difference tests were developed just prior to World War II as a means of introducing more precise measurement in the field of flavour testing. Many forms of difference tests are utilized, but all are intended to establish whether there is a detectable difference between two samples. The numbers of tasters and flavour samples evaluated are carefully controlled to meet a statistical model having a known theoretical distribution of responses based on chance. In the best known difference test, known as the triangle test, two of the three samples employed are identical, although all three are coded differently. The taster is asked to pick the odd sample. The chance probability of a taster picking the correct sample would be one out of three. Triangle tests for flavour are useful in production quality control to make sure each lot is as good as a standard.

Flavour Profile Method.—In the flavour profile method, panels of trained tasters describe the aroma and flavour of a food product in everyday language. Persons who have normal abilities to taste and smell and who are trained in sensory techniques of tasting and smelling are selected to work on flavour profile panels. They are also exposed to a number of flavour and odour situations in order to provide background experience for odour and flavour description. At least six months are required to train a panel member.

Panels first observe the total aroma of the food under test and then give their impressions of each of the detectable aroma factors as they occur, describing these in associative terms. The panel then tastes the food and makes similar observations on the flavour-by-mouth and on the aftertaste. Each aroma and flavour factor is appraised on the basis of intensity, using the scale of threshold, slight, moderate and strong. Aroma factors are the sensations perceived on sniffing and include odours as well as touch factors. Flavour-by-mouth sensations are those perceived by all of the flavour senses. including the basic tastes, touch factors in the mouth and throat, and odour and touch factors in the nose.

Individual observations recorded in tabular form on a response sheet are interpreted by the panel leader. Flavour profiles have been found useful in quality control of flavour, in guiding product development and in flavour research.

Consumer Acceptance Testing.—To determine the flavour acceptability of a food, it is often necessary to obtain information direct from the consumer. A number of methods have been employed to accomplish this, with variations occurring in the size and composition of the panel of tasters, the method of presenting the samples, the means of gathering information and the method of interpreting the data. Flavour is best evaluated by consumers who are potential users of the food; for example, a ready-to-eat cereal should be judged by those who normally eat this type of breakfast food. In consumer testing, it is important to have a panel large enough to furnish statistically significant information. Although much consumer testing is done on a single exposure, best judgments are made in the home under normal use conditions and over a short period of time. Data are collected either by questionnaire or by interview. Great care is taken to obtain factual information with respect to flavour, since most consumers are incapable of describing their reactions adequately.

Consumer panel results are interpreted by workers who are experienced in consumer testing and attempt to project the findings in terms of proposed market sales.

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FLAVOURINGS. Flavouring agents with the exception of common salt, are mostly obtained from plants, but some are derived from synthetics which resemble the natural products. The latter may be from any part of the plant; that is, leaf, stem, root or fruit. Though useful in helping to make certain foods palatable and easier to digest, condiments have no food value. Flavourings should always be blended with food in cooking and not served with the food. This rule should apply to salt and pepper but cus-. tom has largely prevailed to the contrary in this case. All condiments ought to be used sparingly and in such proportions that they do not spoil the natural flavours of other ingredients.

Pot Herbs.—This expression is usually applied to a particular set of flavouring herbs (parsley, thyme, bay leaf and marjoram) which is used in the form of a bouquet for stews, sauces, etc. A complete bouquet has other flavourings added such as lemon, celery, mace, tarragon, etc.

The term pot herbs is also familiarly given to onion, carrot and turnip added to stock.

Essences. — These are made by immersing a flavouring agent (*e.g.,* celery seed) in spirits of wine for several days to form a tincture; or, an essential oil, obtainable at a pharmacy (*e.g.,* oil of bitter almonds) is added to spirits of wine when the natural volatile oil cannot be obtained by ordinary methods of immersion and soaking. Examples of essences are cinnamon, nutmeg, lemon, ginger, etc. Vinegars are made by soaking some strong flavouring agent (*e.g.,* chilli) in ordinary vinegar.

Other Condiments. — Fresh herbs or those dried in leaf or powdered are used in making sauces, stews, etc. It is usual to classify them according to the part of plant to which they belong: (1) Leaves and stems. Among these are sage (for flavouring forcemeats, etc.); spearmint, commonly called mint and used in making mint sauce for mutton; bay leaf (bouquets); marjoram, thyme and sweet basil (bouquets); parsley, used as garnish as well as a popular flavouring agent; peppermint, principally used in confectionery. (2) Flowers and buds. Cloves; saffron (used chiefly for colour); capers (pickles, sauces, etc.). (3) Barks. Cinnamon. (4) Roots. Horseradish (grated in sauce or eaten au *naturel* with beef); turmeric (chiefly for colour and as an ingredient in curry preparations); ginger (puddings, cordials and jams); garlic (stews and sauces); these are the best known. (5) Seeds. Aniseed (pastry, cakes, cordial); caraway (cakes); fennel (cakes and liqueurs); mustard; nutmeg and mace; dill; cumin; coriander and various seeds used in curry preparations. (6) Fruits. In this class are certain fruits, such as allspice, capsicum and vanilla pods, ett. See FOOD PREPARATION.

FLAX. Flax (*Linum usitatissimum*), a crop plant grown on nearly 20,000,000 ac. annually in many temperate and subtropical countries for the production of linseed oil and linen fibre. Flax is an annual in temperate and cool climates, and a winter annual in warm climates. The plants grow to a height of 12 to 40 in., with a distinct main stem and a short taproot. Two or more basal branches may arise from the lower part of the main stem, and these, like the main stem, produce branches that bear the flowers. The lance-shaped leaves are borne alternately on the stems and branches. Each flower has 5 petals that are blue, white or pale pink, and 10 anthers that are blue or yellow. The flowers open in early morning and shed their petals by early afternoon. Daily blooming may continue for several weeks. The floaers are self-pollinated. The boll or capsule has 5 double-celled carpels and contains 10 seeds when all of them develop. The shiny, flattened seeds are brown or yellow, and from $\frac{1}{7}$ to $\frac{1}{5}$ in. long. A pound of flaxseed contains from 65,000 to 120,000 seeds. Fibre type varieties have long stems with few branches and seeds. The linen or bast fibres occur in the bark of the stem. Seed flaxes have short, much-branched stems and many seeds.

Origin and History. — Cultivated flax probably originated in the Mediterranean region from the wild flax (Linum *angustifolium*), the only species of wild flax with which it crosses readily. Several other species of Linum are grown as ornamentals. Flax was cultivated in prehistoric times, possibly at first for food. It was found in the ruins of the Stone Age lake dwellings of Switzerland, and the ancient Egyptians made linen cloth from flax fibres. Later flax cultivation spread through Europe, parts of Asia, and North Africa. It reached the United States during the colo'nial period where it was widely grown for fibre before the invention of the cotton gin in 1792 made cotton a cheaper fabric. The manufacture of linseed oil in the United States began in 1805.

Fibre Flax. — The world produces about 700,000 to 1,000,000 tons of flax fibre on from 2,000,000–3,000,000 ac. annually. Fully three-quarters of this is produced in the U.S.S.R. Other leading countries include Poland, Germany, France, Northern Ireland, Ireland. Rumania, Belgium and Holland; some is also produced in New Zealand, Australia, Japan, Argentina and Egypt. In the United States fibre flax is grown only in Oregon. Production there increased from a few thousand acres up to 18,000 ac. during World War II but declined to 1,000 to 2,000 ac. annually after 1950. Yields of fibre range from 300 to 800 lb. per acre in most countries, with still lower yields in the U.S.S.R. and much higher yields in Northern Ireland. The yield in the United States averages about $1\frac{3}{4}$ tons of straw or 400 lb. of fibre per acre. Flax is best adapted to medium loam or clay soils. Flax grown on soils high in nitrogen often has a low fibre content. Clean land, well-tilled to destroy weeds, is essential, and a smooth firm seed bed is desirable.

The crop is sown in early spring in most countries at a rate of 80–140 Ib. of seed per acre. Some hand weeding of the flax field may be necessary. Flax is harvested for fibre when about one-half of the seeds are ripe and the leaves have fallen from the lower two-thirds of the stem, which stage usually is reached about 80 to 100 days after sowing. Most of the crop is harvested by pulling the plants from the ground by hand, but pulling machines are available and all of the United States crop is pulled and bound by machine. After pulling, the bound stalks usually are set in shocks in the field for curing (drying). The dried stalks are deseeded by threshing, combing or beating the tops of the bundles. The seed, a by-product, is saved for sowing purposes, oil extraction or feed.

BY PERMISSION OF DR EUGEN KOHLER, "MEDIZINAL PFLANZEN"
FLAX (LINUM USITATISSIMUM) FROM WHICH LINEN IS MADE.

The deseeded straw is then retted (partly rotted) to dissolve the gums that bind the fibres to the woody portion of the stem. Both dew retting and water retting processes are practised but the latter provides uniformly better fibre. In dew retting. the common method in the U.S S.R., the straw is spread out evenly and thinly on the ground, usually on grassland, where it is subjected to weathering and to the action of soil-borne bacteria that are present on the straw. Retting is completed after 7 to 21 days, or more, when the bark of the stems is loosened so that it can be readily peeled from the woody core. The straw is then gathered, bound and again set in shocks to dry. In water retting, the common method in most countries, the straw is immersed in ponds, sluggish streams or vats, and allowed to steep until the bark is loosened. In vats the water is circulated to provide uniform retting. Water retting requires 6 to 8 days at a water temperature of 80° F., and up to 20 days when the water is cooler. The retted straw bundles are set in the fields in open shocks (wigwams) to dry. Chemical retting is also possible, but was not yet economically feasible in the 1950s.

The fibre is separated from the woody core by breaking and scutching. Breaking is accomplished by passing the straw between fluted rolls or by crushing it between slatted hand-breaking frames. This breaks the brittle woody portions of the stem into short pieces called shives while leaving the flexible fibres largely intact. Scutching is accomplished by passing the broken straw through revolving beaters that free the fibres from the shives. Some machines do both breaking and scutching. The scutched fibre is baled and shipped to spinning mills. At the spinning mill the fibre is hackled by machines that comb out the short, tangled fibres and remaining shives. The resultant long straight fibre, called line fibre, is further combed and then twisted into yarn on a spinning machine. Coarse yarns may be 8 lea or 2,400 yd. per pound. while the finest yarns are 120 lea or 36,000 yd. per pound.

The short or tangled fibres called tow may be carded to produce strands of parallel fibres which are then spun into coarse yarns, or the tow may be used for upholstering or padding. Fine yams are used in weaving high quality linen fabrics, such as laces, household linens and dress goods. Coarse yarns are used for crash or other coarse fabrics, or for making twine, cord or rope.

Seed Flax.—The world production of flaxseed (linseed) is about 130,000,000 bu. from more than 19,000,000 ac. About an eighth of this is obtained as a by-product from fibre flax and the remainder is produced by seed flax varieties. Seed flax yields are about twice those of seed from fibre flax under similar conditions. The United States, Argentina, the U.S.S.R., India, Canada and Uruguay are the leading countries in linseed production, but appreciable quantities are produced in 25 other countries on all continents. Production in the United States ordinarily averages more than 38,000,000 bu. on more than 4,000,000 ac., with a yield of 9.3 bu. an acre. North Dakota, Minnesota and South Dakota usually lead in total production but the highest yields are obtained on irrigated lands in Arizona and California.

The crop is grown from fall or early winter seeding in California, Texas and Arizona and other warm climates where it ripens about five months later. It is sown in the spring in northern Europe and in the northern half of the United States where it matures in 80 to 120 days. Flaxseed usually is sown with a grain drill, about 1 in. deep, at the rate of 30 to 50 lb. per acre. Flax is an excellent companion crop with which to sow meadow grasses and legumes. A clean seedbed, which is desirable, is best obtained when flax is preceded by an intertilled crop or a sod crop and the land is worked frequently before sowing the flax. Certain weedy grasses as well as broadleaved weeds in flax fields can now be controlled with suitable chemical herbicides.

Seed flax is harvested and threshed with a combine in the more advanced agricultural countries but simple harvesting and threshing machines or hand methods are still used on numerous small farms in many countries.

Flax is attacked by several diseases including wilt, rust, pasmo and anthracnose. These diseases are kept under fair control by chemical seed treatment or by growing resistant varieties that were developed by flax breeders. Before wilt resistant varieties were developed, flax could be grown on the same land for only a few years before the crop failed because the soil became infested with the fungus causing the wilt disease. This fact led to the popular misconception that "flax is hard on land." From colonial times until about 1920 flax production shifted westward to new lands that were not infested with wilt. Later, resistant varieties became available for all parts of the United States.

Linseed Oil.—Flaxseed contains from 30% to 40% oil and about 8% moisture. Large seeds are highest in oil content. Drought or temperatures above 90° F. when the seed is developing reduces the seed size and the oil content. A bushel (56 lb.) of linseed yields about 2½ gal. of oil in commercial crushing. Linseed oil contains three unsaturated fatty acids (oleic, linoleic and linolenic) that absorb oxygen and thus when used in paint cause the oil to form a hard film when the paint dries. The quality of a drying oil is measured by the iodine number, the grams of iodine absorbed by 100 g. of oil in a chemical test. The iodine number of linseed oil ranges from 160 to 195. In linseed oil mills the flaxseed is ground, steamed and then pressed to extract the oil. The residue or oilcake contains about 35% protein and 6% oil. It is used as a concentrated or conditioning feed for livestock. Linseed oil is used chiefly in paints and varnishes but also in making linoleum, oilcloth, printer's ink and patent leather.

Tow extracted from seed flax straw in the United States is used in making the domestic requirements for cigarette paper and Bible paper.

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FLAXMAN, JOHN (1755–1826), English sculptor and draftsman, was born at York on July 6, 1755. His father was a modeler of plaster casts, and his early training was largely received at home. He was awarded a medal as a prize by the Society of Arts at the age of 12, and at 15 began to exhibit at the Royal Academy. At 20 he was working for Josiah Wedgwood as a modeler of medallions, portraits, vases, plaques, etc., and this activity accounted for much of his later fame. He continued to work for Wedgwood till 1787, developing into a sensitive neoclassicist with a manner of seeing which during his mature years was everywhere the fashion.

In 1782, Flaxman was married to Anne Denman. In 1787 they set out for Rome. Flaxman soon ceased modeling for Wedgwood himself, but continued to direct the work for other modelers employed for the manufacture at Rome. He had intended to return after a stay of a little more than two years, but was detained by a commission for a marble group of a "Fury of Athamas" from Frederick Hervey, earl of Bristol and bishop of Derry, and did not return until the summer of 1794, having in the meantime executed another commission (a "Cephalus and Aurora") for Thomas Hope, and having sent home models for several sepulchral monuments, including one in relief for the poet William Collins, in Chichester cathedral, and one in the round for Lord Mansfield in Westminster abbey.

But what gained for Flaxman in this interval a general and European fame were those outline designs to the poets, in which he showed his natural affinity to the ancients. The designs for the *Iliad* and Odyssey were commissioned by Mrs. Hare-Naylor; those for Dante by Hope; those for Aeschylus by Lady Spencer. All were engraved by Piroli, not without considerable loss of the finer and more sensitive qualities of Flaxman's own lines.

In 1797 Flaxman was made an associate of the Royal Academy. Every year he exhibited work of one class or another; occasionally a public monument in the round, more often memorials for churches, with symbolic acts of mercy or illustrations of Scripture texts, both commonly in low relief. In 1800 he was elected full academician. In 1810 he was appointed to a chair of sculpture specially created for him by the Royal Academy.

The most important works which occupied Flaxman in the following years were the monument to Mrs. Baring in Micheldever church, the richest of all his monuments in relief (1805–11); that for the Worsley family at Campsall church, Yorkshire, which is the next richest; those to Sir Joshua Reynolds for St. Paul's (1807); to Capt. Josiah Webbe for India (1810); to Captain Walker and Captain Beckett for Leeds (1811); to Lord Cornwallis for Prince of Wales's Island (1812); and to Sir John Moore for Glasgow (1813).

After his Roman period he produced for a good many years no outline designs for the engraver except three for William Cowper's translations of the Latin poems of Milton (1810). Other sets of outline illustrations drawn about the same time, but not published, were one to the ***Pilgrim's Progress,*** and one to a Chinese tale in verse, called "The Casket." In 1817 we find him returning to his old practice of classical outline illustrations and publishing the happiest of all his series in that kind, the designs to Hesiod, excellently engraved by the sympathetic hand of William Blake. Immediately afterward he was much engaged in designing for the goldsmiths—a testimonial cup in honour of John Kemble and following that, the great labour of the famous and beautiful though quite un-Homeric shield of Achilles. Almost at the same time he undertook a frieze of "Peace, Liberty and Plenty," for the duke of Bedford's sculpture gallery at Woburn, and a heroic group of Michael overthrowing Satan, for Lord Egremont's house at Petworth. He died on Dec. 3, 1826.

As a sculptor Flaxman was weakest when he was most ambitious and most inspired when he made the least effort. Of Flaxman's complicated monuments in the round, such as the three in Westminster abbey and the four in St. Paul's, there is scarcely one which has not something heavy and infelicitous in the arrangement. But when we come to his simple monuments in relief we find almost always a far finer quality. He did not thoroughly understand composition on the great scale and in the round, but he did thoroughly understand relief, and found scope in it for his remarkable gifts of harmonious design, and tender, grave and penetrating feeling.

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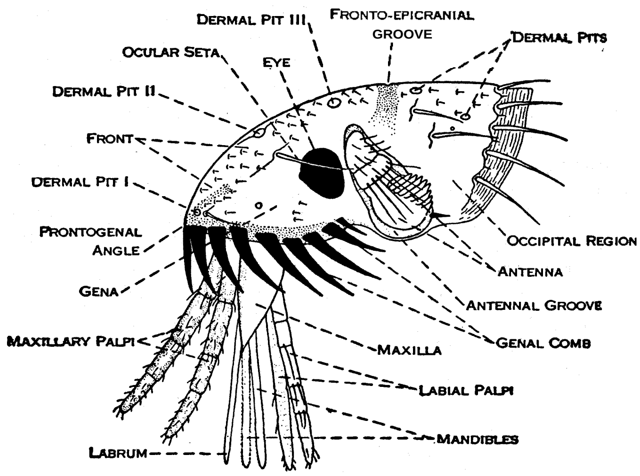
FLEA, the common name of a group of insects, known scientifically as the order Siphonaptera (or Aphaniptera), whose members are of economic importance because they are transmitters of human disease and because they are serious pests of man and animals. In the adult state they feed exclusively on the blood of birds and mammals, including man, but in the immature stages they are residents of the nest or habitation of the host and are not parasitic.

For the flea commonly known in the United States as "chigger," *see* JIGGER, CHIGGER or CHIGOE.

Structure and Life History.- leas are small insects, the largest ones being about one-fourth of an inch in length. They are wingless and have a greatly compressed body which is frequently provided with one or more combs of spines. Their well-developed legs give them remarkable powers of leaping, and they can jump a horizontal distance of about 13 inches—from 50 to 100 times their body length! As the adult subsists solely on blood, the mouthparts are adapted for piercing the skin of the host and sucking its blood. A penetrating beak is formed by the two mandibles and the labrum. From the accompanying illustration it will be seen that the mandibles are long, cutting blades with saw-toothed margins, while the labrum is flattened and needlelike. The drawing shows many other interesting features of the flea's head.



COURTESY OF U S. DEPARTMENT OF AGRICULTURE

HEAD OF A CAT FLEA *(Ctenocephalides felis)*, FEMALE. WITH THE DIFFERENT PARTS LABELED: DRAWING BY HENRY ELLSWORTH EWING

Among these are the simple eyes (degenerate or absent in some species), the short, stout antennae, and the genal comb of heavily pigmented spines, which is a conspicuous structure when it is present. The life history of the flea involves four distinct stages—the egg, the larva, the pupa and the adult. A number of eggs are laid by each adult female flea, commonly among the hairs or feathers of the host, from which they fall out into the nest or places where the animals roam or rest. The immature stages are therefore found in the situations frequented by animals. The cream coloured eggs hatch into small, yellowish, wormlike larvae which live in the organic debris of the resting place of the host. After a time, the larva transforms into the pupa which develops within a silken cocoon. ,The length of time necessary for completion of the entire life cycle is variable and depends upon the species concerned and upon various conditions; it may be from 17 days to more than a year.

Economic Importance and Control.—There are many known kinds of fleas. From North America and the West Indies, by the beginning of World War II, 209 species and 63 subspecies and varieties were recorded. How many occur in other parts of the world is difficult to ascertain, but certainly the number after World War II was in the vicinity of 500 known species. Only a few of these species affect man; the rest feed upon obscure wild birds and mammals, having strong preference for certain hosts. Nearly all species show this "host specificity." However, a few fleas are sufficiently versatile to feed upon man in the absence of their favoured hosts, and these are the ones of greatest importance, because they are capable of transmitting disease from animal to man.

Bubonic plague and murine typhus, a disease of increasing importance in the United States, are carried from rats to man by fleas. Two species are ordinarily involved in the transmission of these diseases, the oriental rat flea (*Xenopsylla cheopis*) and the European rat flea (*Nosopsyllus fasciatus*). The former is almost cosmopolitan in distribution but prefers particularly the warmer regions of the world. It is an efficient vector of disease because it bites humans freely. Plague is a disease which affects not only rats but also various wild rodents such as ground squirrels, chipmunks and even rabbits. Reservoirs of infection exist among these animals and are maintained by the fleas which carry the disease from one individual to another. Control of rodent fleas must be directed against the hosts, and this involves trapping, poisoning and fumigating as well as the ratproofing of buildings.

Fleas affect man not only as disease carriers but also as household pests. The principal ones which most frequently annoy man are: the dog flea *(Ctenocephalides canis)*, the cat flea (*Ctenocephalides felis)* and the human flea (*Pulex irritans)*. The United States department of agriculture recommends three steps in their control: (1) determine the source of the infestation. (2) treat or destroy the animal hosts, and (3) destroy the immature stages occurring in places where the hosts live. When fleas occur in human habitations they nearly always originate from animals which troop in and out or from the places where animals sleep or rest. To rid cats and dogs of fleas apply derris powder or pyrethrum powder to their skin and repeat the treatment every two weeks until the animal is free of the pest. When hogs are infested, their backs should be sprayed lightly with oil. If the fleas originate from cellars, outbuildings, porches, barns and beneath houses, spray the infested area with creosote oil. Should the use of creosote be objectionable, scatter flaked naphthalene over the floor, using enough to make the floor white in appearance.

The most injurious of the livestock-infesting species is the sticktight flea *(Echidnophaga gallinacea)* which causes damage to poultry. Its common name derives from the habit of attaching itself to the skin of the host. It attacks not only chickens but dogs, cats and man himself, as well as many other animals. Derris, powder or carbolated vaseline brought into contact with these fleas will control them.

The irritation caused by the bite of a flea in man is ordinarily not very serious. To assuage the pain a cooling lotion should be applied, such as mentholated ointments, carbolated vaseline, spirits of camphor, etc.

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FLÈCHE, an architectural term which, in France, signifies any spire, but in English usage is limited to those small, slender spires which are placed on the ridge of a roof of a church and not upon a tower. The flèche is usually built of a wood framework covered with lead or occasionally copper and is generally of rich, light, delicate design, in which tracery, miniature buttresses and crockets have an important part. They are frequently of great height, that of Notre Dame, Paris, being nearly 100 ft. and that of Amiens, 148 ft. The fleche is usually placed at the intersection of nave and transepts. Reims cathedral had, however, an additional flèche at the summit of the apse. *See* SPIRE.

FLÉCHIER, VALENTIN ESPRIT (1632–1710), bishop of Lavaur (1685) and Nîmes (1687), one of the celebrated court preachers under Louis XIV, was born at Pernes near Avignon, June 10, 1632. He was admired as a man of letters rather than as a devout preacher, and his sermons were particularly relished by women, He wrote *Mémoires sur les Grands Jours tenus à Clermont en 1665.* In dealing with the Huguenots, he proved himself a wise and humane bishop. He died at Montpellier, Feb. 16, 1710.

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FLECKEISEN, ALFRED (1820–1899), German philologist and critic, chiefly known for his work on Plautus and Terence, was born at Wolfenbuttel on Sept. 23, 1820. He was educated at the Helmstedt gymnasium and the University of Göttingen. After holding several educational posts he was appointed in 1861 to the vice-principalship of the Vitzthum'sches gymnasium at Dresden, which he held until his retirement in 1889. He died on Aug. 7, 1899. In the knowledge of Plautus and Terence he was unrivaled, except perhaps by F. W. Ritschl. his life-long friend. Fleckeisen's chief works are: *Exercitationes plautinae* (1842), one of the most masterly productions on the language of Plautus; *Plauti Comoediae,* i, ii (1850–51, unfinished); *P. Terenti Afri Comoediae* (new ed., 1898). His short treatise on orthography *Fünfzig Artikel* (1861) is considered most valuable. Fleckeisen was for many years editor of the *Jahrbücher fur classische Philologie.*

FLECKER, JAMES ELROY (1884–1915), English poet was born in London on Nov. 5, 1884. Desiring to enter the consular service, he went to Caius college, Cambridge. to learn oriental languages, and he was sent to Constantinople in June 1910. The same year his *Twenty-sin: Poems* was published. In September, having fallen ill, he returned to England and went to a sanatorium. He returned to his post. apparently cured, in March 1911, and was transferred to Smyrna in April. He fell ill again early in 1913, and went to Switzerland: *The Golden Journey to Sanzarkand* was published in this year. He died at Davos on Jan. 3, 1915. He belongs to no "school," though the Parnassians are known to have had some influence on him. Of his many themes the most recurrent are Greece, the east and England, and he has best portrayed himself in *Oak and Olive.* But at least it seems safe to conjecture that some of his lyrics, between the sculptured stillness of *A Ship, an Isle* and the movement, so expressive in utterly different ways, of *Saadilbad* and the *Dying Patriot* will not be forgotten. He left behind him at his death two unpublished plays, *Hassan* (Haymarket. 1923) and *Don Juan. Don Juan* is perhaps too slight and unequal to support a claim to dramatic genius. *Hassan* is rather a different matter. No one would call it faultless, but as a play to read. with its colour and its wit and its passion, its alternation of merriment and tragedy, and the strange beauty of its rhythms it is entirely fascinating. Flecker also wrote *The Grecians* (1910) and a novel, *The Kzng of Alsander* (1914).

Editions of his work are *Collected Poems,* with an introduction by J. C. Squire (1916); *Hassan* (1922); *Don Juan* (1925); *Collected Prose* (1920 and 1922); *Letters to Frank Savery* (1926).

See D Goldring, *J. E. Flecker* (1922); and the *Life* by Geraldine Hodgson (1925).

FLECKNOE, RICHARD (*c.* 1600–*c.* 1678), English poet, dramatist and traveler, whose writings evoked both praise and ridicule, was possibly a Jesuit of Irish extraction. The most authentic information about him is *A Relation of Ten Years' Travels in Europe, Asia, Affrique, and America* (1654?), a collection of letters to distinguished persons in England and abroad. He went to Flanders in 1640, attempted in 1645 to negotiate in Rome the marriage of Béatrix de Cusance to Charles IV of Lorraine, traveled in the Levant, visited Portugal, and in 1648 "merely on curiosity" went to Brazil. Although he appears vain and cocksure, his letters are interesting, particularly his account of Brazil.

Flecknoe's picture of himself as a popular ladies' man contrasts sharply with Andrew Marvell's account in his poem, "Fleckno, an English Priest at Rome," which ridicules his threadbare asceticism and bad verses. The unpopularity which greeted his return to England may have resulted from his disapproval of the licence of the stage, implicit in his *Short Discourse of the English Stage* (1664; reprinted in J. E. Spingarn's *Critical Essays of the 17th Century,* 1908), which he prefixed to the revised version of *Love's Dominion* (1654) the only one of his five plays to be publicly performed. This may also account for the hostility of Dryden, who lampooned him in *MacFlecknoe* (1682) as being "Throughout the realms of Nonsense, absolute." Neither his poems in *Epigrams of all sorts . . .* (1670) nor his prose sketches in *Enignzatical characters . . .* (1658) warrant such an attack and both Lamb and Southey attempted to restore his reputation; Lamb prefixed some of Flecknoe's lines to his essay, "A Quakers' Meeting." Flecknoe remains a contradictory personality who praised Cromwell in *The Idea of his Highness Oliver* (1659) and the Stuarts in *Heroick Portraits* (1660).

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FLEET, NAVAL. The word fleet is used with several meanings, logically related but differing in their precise connotation. It is sometimes defined as the collective naval force of a country, and naval men frequently use it in this sense. For example, the first lord of the admiralty, in a statement to parliament in Feb. 1958 used a subtitle, "The Strength of the Fleet," followed by this explanation: "During the coming year the ships of the Fleet will be deployed as follows: (A.) Ships in the Operational Fleet. or preparing for service with it. (B.) Ships engaged on Trials and Training (C.) Fleet Support and Auxiliaries. (D.) Ships in all classes of Reserve or undergoing extended refit, modernization, conversion, etc.. during the course of the year." During and since World War II the Royal Navy has had a home fleet and a Mediterranean fleet, each with a commander in chief, besides a number of commands, forces, stations and flotillas responsible to the admiralty and not to either fleet commander. Thus the word fleet means a large group of naval vessels of many types under a single commander in chief, and usually assigned to one geographical area. In a loose sense, fleet is applied to a large number of ships, as a fishing fleet, the Cunard fleet or a fleet of oil tankers.

The U.S. navy did not employ the word fleet officially until 1907 when the Atlantic fleet, Pacific fleet and Asiatic fleet were established. Previously there had been a home squadron, a Pacific squadron and so on. After temporary disruption of this arrangement during World War I, it was restored in 1922. During the years that followed. the U.S. fleet consisted of a battle force, scouting force. submarine force and base force. Since World War II there have been Atlantic and Pacific fleets, each with an admiral as commander in chief; Atlantic and Pacific reserve fleets, under the commanders of the Eastern and Western Sea Frontiers; and four numbered fleets, 1st in the Pacific, 7th in the far east, both a part of the Pacific fleet; 2nd in the Atlantic and 6th in the Mediterranean, both belonging to the Atlantic fleet. Each of the six subordinate fleets had a vice-admiral as commander.

Administrative and Tactical **Groupings.**—In the U.S. navy each of the two major fleets had commanders in charge of the air force, cruiser force, destroyer force, submarine force, amphibious force and service force. These officers were called type commanders or administrative commanders; some were vice-admirals, others rear admirals. Three to six vessels constituted a "division" of aircraft carriers, cruisers, destroyers, submarines, transports, mine sweepers and other types. The division commanders were considered to be tactical commanders primarily. Frequently a force commander would also command a division of his own force. Two divisions of destroyers or of submarines constituted a squadron, and the squadron commander commanded one of the divisions. Three destroyer squadrons made a flotilla. Rear admirals usually commanded aircraft and cruiser divisions and destroyer flotillas. Service force and amphibious force squadrons, destroyer and submarine squadrons were commanded by captains. Divisions of destroyers, submarines, and mine craft were commanded by captains or commanders.

Fleet Tactical Training. — Although a fleet comprises ships of various types it will not be an effective fighting unit unless the ships are capable of working together as a team and can be controlled by the commander. This necessitates continuous tactical training and study. A new naval vessel, or one which has undergone an extensive reconstruction, runs a series of trials over a measured-mile course, or over a range which can be measured accurately by means of positions on a chart. By means of such trials, calibration scales are developed and the ship's engineer officer knows how many revolutions of his propellers normally produce a given speed. By further trials, in an area where precise positions can be fixed by cross bearings, the new ship determines the necessary rudder angle to turn through 90° or 180° at usual speeds. These two processes are necessary steps in preparing the ship to steam in formation with other vessels and to make turns while in formation. When a new ship has "standardized" her own steaming and her own turning she is ready to steam with others, beginning with vessels of her own type.

Fleet Tactical Formations. — There are three elemental formations involving a single line of ships. If all ships present steamed in single file, all on the same course, one astern of the other, they would form a straight line. The Royal Navy called this formation "line ahead." while the U.S. navy called it "column." If the ships were abreast of each other, the Royal Navy called it "line abreast" and the U.S. navy simply "line." Any other form of line was called "line of bearing," with the bearing designated by signal.

A large fleet would usually form a more complicated formation. For example. three squadrons of eight ships each might steam with each squadron in column or line ahead, while the three flagships leading their respective squadrons might be abreast of each other. In the U.S. navy this formation would be line of squadron columns; in the Royal Navy it mould be squadrons in line ahead. disposed abeam. More complicated formations presented no problems to ships accustomed to maintain position and distance in the elemental formations and to turn in standard turning circles on signal. Type commanders had the responsibility for developing tactical instructions for their own vessels so that these ships would conform to the standards of the fleet as a whole. Tactical commanders had the responsibility for insuring that their own ships could maneuver with the fleet without becoming a menace to their neighbours in formation. Proficiency in fleet maneuvers was possible only if the fleet systematically and regularly steamed together at sea, in bad weather as well as in good. The study of fleet tactical manuals helped to expedite the attainment of high standards, but practice at sea was indispensable. When a fleet was well trained it could pass from one formation to another without confusion or delay.

Battle Formations. — In the days of sail, the great sailing ships of the line-of-battle formed in a single line to fight the enemy with broadsides, keeping their frigates on the unengaged side of their line for the protection of these vessels and to use them for repeating signals. In World War I and earlier the battleships formed the battle line, and kept their cruisers and destroyers ahead and astern of this battle line.

In World War II the presence of the aircraft carrier completely changed fleet dispositions. All formations were circular, with the carriers in the centre, battleships and cruisers deployed in a circle outside the carriers, and destroyers on an outer circle. One large ship was designated as guide and all others kept their bearing and distance on the guide. The carrier task force in the Pacific in 1944–45 usually consisted of 4 carrier groups, each in its own circular formation with 3 to 5 carriers. 2 or 3 battleships. 4 to 8 cruisers, 10 to 18 destroyers. When the carriers of a group launched or recovered planes, the entire circular formation of that group headed into the wind by simultaneous ship turns. In these formations the carriers were allowed slightly more leeway than the other ships in their station keeping, but they had to remain close to their designated positions.

NATO Tactical Formations. — After the establishment of the North Atlantic Treaty organization (NATO) all of the participating navies combined to devise uniform tactical instructions, doctrine and formations for cruising and battle. All formations became circular. Thus the tactical practices of the Royal Navy and the U.S. navy merged in the common instructions governing the NATO navies.

TYPES OF VESSELS

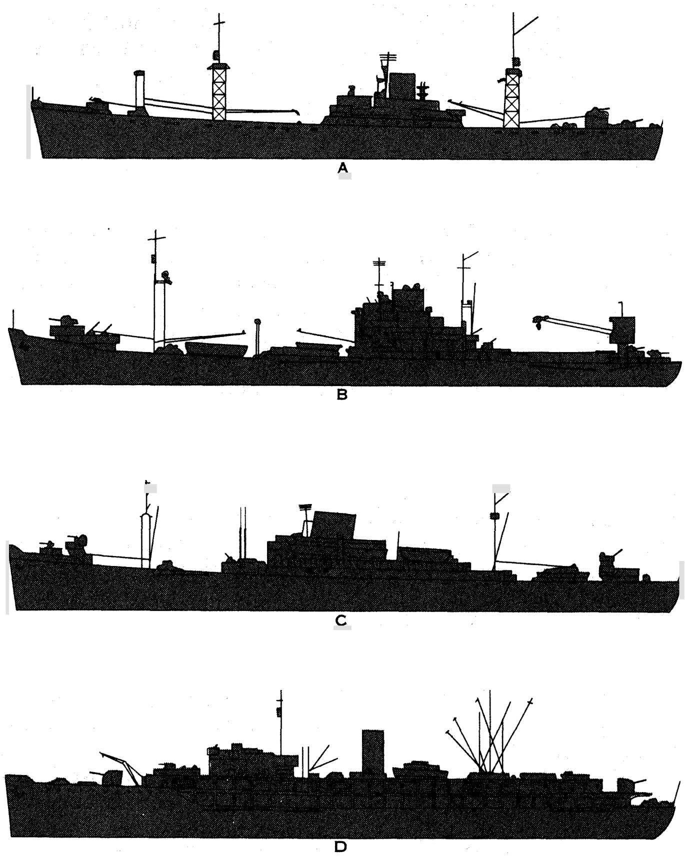
Combatant vessels include the aircraft carrier; battleship; cruiser; submarine; frigate and other destroyer (*qq.v.*) types, including corvette and sloop; and escort and patrol vessels. All of these types are men-of-war. Gunboats. which vary considerably in size. armament and speed, submarine chasers and motor torpedo boats also belong to the combatant vessels classification, although their effectiveness is much limited in bad weather.

Mine craft and amphibious types are in a slightly different category. Mine layers and mine sweepers frequently enter enemy waters in wartime and have little or no defense against enemy attack. Vessels of the various amphibious types, including attack transports, attack cargo vessels. landing ships or fast transports, as well as the smaller landing craft and rocket launchers are all designed to enter enemy territory under fire and sustain enemy attacks, although they are extremely vulnerable. Command ships are subject to the same hazards.

During and since World War II, mine craft and amphibious craft have been considered combatant ships because of the nature of their normal employment in wartime, although they are obviously not fighting ships in the same sense as the types listed in the preceding paragraph.

Fleet auxiliary vessels are manned by officers and men of the navy and are built for the service of the fleet. The U.S. navy is proud of the fact that it pioneered in the development of destroyer and submarine tenders, fleet repair ships and fleet oil tankers. The tenders for destroyers and submarines were developed when vessels of these two types were much smaller than they were after World War II They supplied food, clothing, miscellaneous stores and repair facilities nhich were beyond the capacity of the destroyers and submarines themselves. Fleet repair ships were capable of many kinds of repair work which were impossible for the largest men-of-xar to execute with their own facilities. and they undertook jobs for which the tenders lacked equipment.

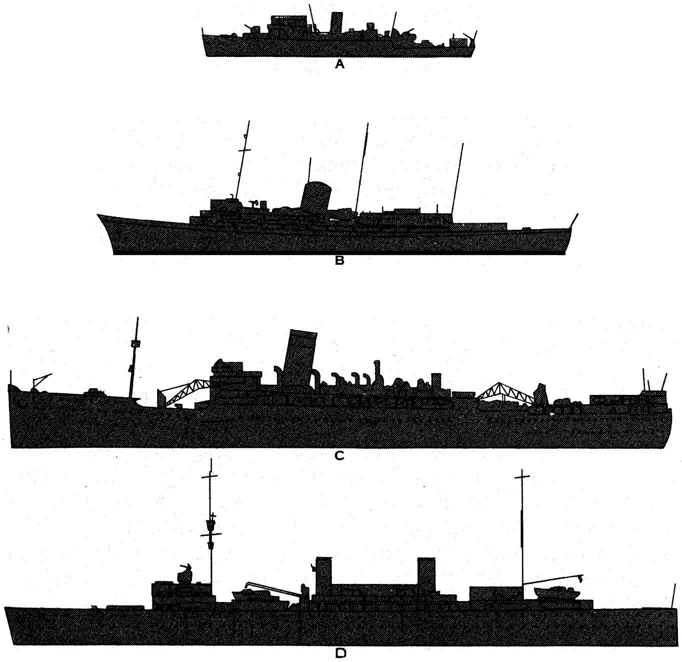
During World War II many repair ships were commissioned to specialize in particular types of repair work, such as the overhaul



ADAPTED FROM "JANE'S FIGHTING SHIPS," 1957–58

SILHOUETTES OF U.S. AUXILIARY SHIPS

(A) Attack cargo ship U.S.S. "Bellatrix"; (B) seaplane tender U.S.S. "Pokomoke"; (C) attack transport ship, President class; (D) destroyer tender ship U.S.S. "Cascade"



ADAPTED FROM "JANE'S FIGHTING SHIPS," 1957–58

SILHOUETTES OF BRITISH AUXILIARY SHIPS

(A) Ocean minesweeper, Algerine class; (B) royal yacht (hospital ship) H.M.S. "Britannia"; (C) heavy repair ship H.M.S. "Ranpura"; (D) destroyer depot ship H.M.S. "Woolwich"

of diesel engines, etc. Seaplane tenders served the large long-range patrol planes and furnished living quarters for their men, as well as repair facilities for the planes. Ammunition ships were partly improvised in World War II, but the U.S navy had a few that were designed for this duty; they were able to control temperatures and humidity in their ammunition and powder storage spaces to avoid any possibility of deterioration. The fleet oil tankers were equipped for fueling ships at sea while under way, and they had facilities for passing supplies across to the ships receiving fuel oil while the fueling was in progress.

Fleet supply ships were equipped to carry fresh meat and other refrigerated items, as well as what the navy calls dry provisions, meaning food in cans, barrels, sacks or packages; they also had stowage for potatoes and for miscellaneous ships' stores, including stationery, cleaning materiels, paints, etc. Fleet stores ships were fitted for carrying miscellaneous fleet supplies, including dry provisions, so arranged that particular items could be supplied to tenders and other ships which requested them. Submarine rescue vessels usually were seagoing fleet tugs fitted with some special equipment which would be especially useful in helping damaged vessels. including submarines. Salvage vessels varied in their facilities and equipment, but some of them were employed in the extensive work of clearing harbours after many ships had been sunk by gunfire or aerial bombs or both.

Service Squadrons in Advanced Areas.—Before World War II the fleet organization of the U.S. navy included a fleet base force. sometimes called the "fleet train," which became the service force during that war. A few squadrons of this force, notably service squadron ten, became especially well known for their effective and immediate service to vessels of the fleet in the forward areas in the Pacific. This squadron began operating in Majuro atoll in Feb. 1944, and afterward moved to Eniwetok, thence to Ulithi. The squadron had one or more of each of the types of fleet auxiliary vessels described in the preceding paragraph, plus many others.

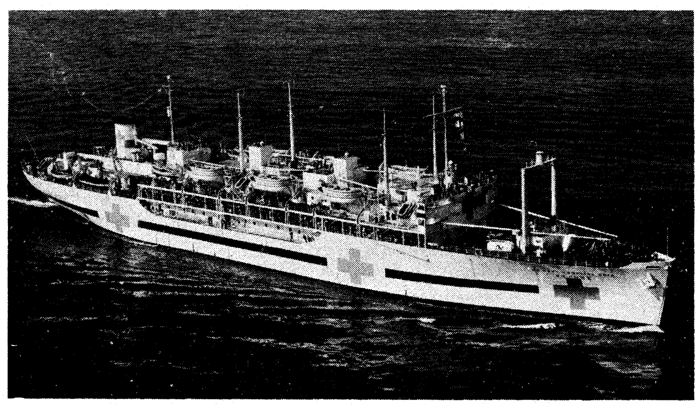
Perhaps even more important than the ships available, the squadron equipment included three floating drydocks: one small one capable of lifting 1,000 tons, a medium dock to lift 3.000 tons and a gigantic sectional floating dock able to lift 80,000 tons, and thus able to take any ship of the fleet. A barracks vessel had quarters for 60 officers and 1,000 men. There were four repair barges besides the repair ships, four ocean-going fleet tugs, four harbour tugs, four rescue tugs and one salvage barge in addition to two salvage ships. There were also net tenders, net layers and a net cargo ship to keep the lagoon entrance closed to enemy submarines. Two floating cranes, a degaussing barge, water barges, picket boats and patrol boats completed the aggregation afloat in the lagoon. Later a dozen large concrete stores barges were brought to the atoll and these were used as floating storage. Some of them had refrigeration in some storerooms. Supply and stores ships discharged their cargoes into these barges and returned to the mainland for reloading.

Other service squadrons were established and located at other islands or atolls in the Pacific. It would be difficult to exaggerate the value of these service squadrons because they made it possible for a number of seriously damaged ships to be patched up sufficiently to return to the mainland for major repairs. The repair ships and tenders demonstrated that they could accomplish almost anything in the form of repairs, but there was so much to be done that it was necessary to send to the mainland for the big jobs rather than tie up all the repair facilities of the squadron.

The Royal Navy's fleet support and auxiliaries listed by the first lord in his report to parliament (mentioned above) included: destroyer depot ships, submarine depot and support ships, repair ships, deep diving vessels, mine layers, a coastal mine-sweeping headquarters ship, a survey ship, boom defense vessels and harbour accommodation ships.

The only noncombatant ships in the U.S. navy were hospital ships; the Royal Navy had none in commission. Under international law these vessels carry no arms of any kind. When they cruise at sea in wartime they show lights and keep the red cross on the funnel and on the ship's side illuminated at night. Hospital ships joined each of the service squadrons in the Pacific during World War II and while there, in anchorages where men-of-war were present, they showed no lights at night.

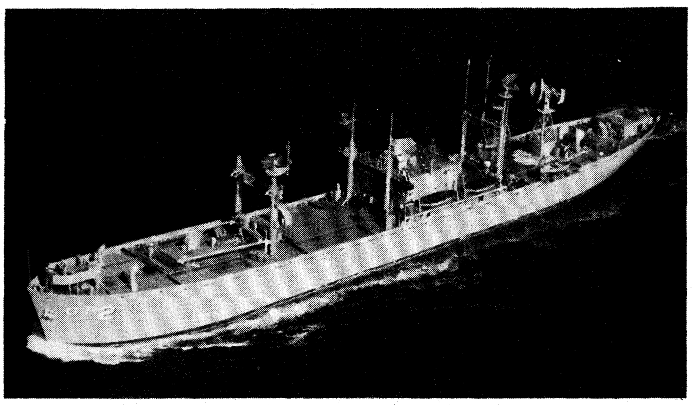
The U.S. navy had a few special types of vessels in operation in 1958, including surveying ships, icebreakers and ocean radar station ships. These latter remained on fixed cruising stations well off the coast and were in a position to report by radio concerning anything to be seen on their powerful radars.



BY COURTESY OF U.S. DEPARTMENT OF THE NAVY

NAVY HOSPITAL **SHIP U.S.S.** "REPOSE"

Reserve Fleets.—Ships of the Royal Navy in reserve consisted of three groups. The operational reserve included ships in commission with reduced complements on board, which could put to sea fully manned and equipped within a very short period of time. It was a substantial force and included a number of escort vessels. The second part was called the supplementary reserve. It consisted of ships in very good condition. in a state of preservation called "moth-balling." Such ships would require a certain amount of time before they could be restored to active service. The number of destroyers and frigates in these first two reserve groups in 1958 was stated to be about the same as the number in the seagoing fleet. The vessels in this maintained reserve would be kept in that status until their useful lives had ended, unless their services were found to be required sooner.



BY COURTESY OF U.S. DEPARTMENT OF THE NAVY

OCEAN RADAR WARNING SHIP U.S.S. "LOOKOUT"

The third class was called the extended reserve. It consisted of ships of wartime design and construction which had not been modernized. The majority of the vessels had not had a refit for five years or longer These ships were tied up in an unattended condition; their maintenance cost was almost nothing, but under these circumstances they were deteriorating. They were cruisers 18 to 20 yr. old. destroyers 14 to 17 yr. old, ocean mine sueepers built in nartime and frigates 14 to 17 yr. old It mas stated explicitly that the five carriers in reserve could not be modernized; that even if they mere cut down to the waterline their hulls would not be satisfactory for modernization.

The reserve fleets of the U S. navy in the late 1950s were located on the two coasts. About 28 destroyers were in commission in reserve with partial crews and did some operating. About 34 destroyer escorts were assigned to naval reserve training and had full creus of reservists assigned on a mobilization basis. These vessels regularly made one week-end cruise per month and one annual cruise of 14 days, with their assigned complement of reserve officers and men.

A small number of reservists serving on active duty were the instructors for their shipmates, and these men were the shipkeepers between cruises. A number of submarines were assigned for reserve training, but these ships were partially moth-balled with their propellers removed. The reservists assigned to them made their training cruises in regularly commissioned submarines.

All other ships of the Atlantic and Pacific reserve fleets were in "moth balls," with the ships dehumidified and all their equipment and machinery in a state of preservation. Groups of ships in this status were berthed at piers on both the east and west coasts. The navy department planned to scrap some older battleships, aircraft carriers, cruisers and submarines but not destroyers or destroyer-type vessels from the reserve fleets.

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(J. B. HN.)

FLEETWOOD, CHARLES (d. 1692), English soldier and politician, was admitted into Gray's Inn on Nov. 30, 1638. At the beginning of the Great Rebellion, he joined Essex's lifeguard. was wounded at the first battle of Newbury, obtained a regiment in 1644 and fought at Naseby. He had already been appointed receiver of the court of wards and in 1646 became member of parliament for Marlborough. He was said to have been the principal author of the plot to seize King Charles at Holmby, but he did not participate in the king's trial. In 1649 he was appointed a governor of the isle of Wight, and in 1650, as lieutenant general of the horse, took part in Cromwell's campaign in Scotland and assisted in the victory of Dunbar. Next year he was elected a member of the council of state, was entrusted with the command of the forces in England, and shared in the final triumph at Worcester. In 16jz he married Cromwell's daughter and was made commander in chief in Ireland, to which title that of lord deputy was added. During his administration (1652–55) he carried out ruthlessly the settlement of the soldiers on the confiscated estates. He showed great severity in the prosecution of the Roman Catholic priests, and favoured the Anabaptists and the extreme Puritan sects.

Fleetwood was a strong and unswerving follower of Cromwell's policy. In Dec. 1654 he became a member of the council, and after his return to England in 1655 was appoii red one of the major generals. On Cromwell's death, he was regarded as a likely successor. and it is said that Cromwell had in fact so nominated him. He, however, supported Richard Cromwell, but allowed subsequently, if he did not instigate, petitions from the army demanding its independence, and finally compelled Richard by force to dissolve parliament. His project of re-establishing Richard in close dependence upon the army met with failure and the Long Parliament was recalled. Fleetwood became a member of the committee of safety and of the council of state, and one of the seven commissioners for the armv: on Tune 4 he was nominated commander in chief. But on Oct. 11 parliament declared his commission void. The next day he assisted Lambert in his expulsion of the parliament and mas reappointed commander in chief. On Monk's approach from the north, he stayed in London and maintained order. The army on Dec. 24 restored the Rump, when he was deprived of his command and ordered to appear before parliament to answer for his conduct. At the Restoration he was included among the 18 who were punished only by perpetual exclusion from public office, and his public career therefore closed, though he survived until Oct. 4, 1692.

FLEETWOOD, WILLIAM (1656–1723), English divine, was born in the Tower of London on New Year's day, 1656. He was educated at Eton and King's college, Cambridge. About the time of the Revolution he took orders, and became bishop of St. Asaph (1708), then of Ely (1714). He died at Tottenham on Aug. 4, 1723. Fleetwood's opposition to the doctrine of nonresistance brought him into conflict with the Tory ministry of 1712 and with Swift, but he never entered into personal controversy.

His principal writings are: *An Essay on Miracles* (1701); *Chronicum preciosum* (an account of the English coinage, 1707); and *Free Sermons* (1712), containing discourses on the death of Queen Mary, the duke of Gloucester and King William. The preface to this last was condemned to public burning by parliament, but, as no. 384 of *The Spectator,* circulated more widely than ever. A collected edition of his works, with a biographical preface, was published in 1737.

FLEETWOOD, a municipal borough, seaport and holiday town in the North Fylde parliamentary division of Lancashire, Eng., at the mouth of the Wyre, 9 mi. N.N.E. of Blackpool. Pop. (1951) 27,537. It dates its rise from 1836 and takes its name from Sir Peter Hesketh Fleetwood (1801–66), who laid it out.

Fleetwood looks northward over Morecambe bay to the Lake district and has large sandy beaches. A market is held Tuesdays and Fridays. A ferry crosses the Wyre to Knott End-on-Sea. Rossall school, formerly Rossall hall and the seat of Sir Peter Hesketh Fleetwood, was founded in 1844 and incorporated by royal charter in 1890. It is a large fishing port, with extensive docks and fish docks and ancillary industries. Coastal and Irish trade shipping is carried on.

FLEGEL, EDWARD ROBERT (1855–1886), German traveler, who attempted to open up West Africa for the Germans, was born on Oct. 13, 1855 at Vilna, Russia. He was appointed to a post in Lagos, West Africa, in 1875 and in 1879 traveled up the Benue river about 125 mi. farther than the point previously attained by European travelers and was commissioned by the German-African society to explore the whole of the Benue country. In 1880 he went by way of the Niger to Sokoto and there obtained permission from the sultan for an expedition to Adamawa. This was undertaken in 1882 and on Aug. 18 he discovered the source of the Benue near Ngaundere. In 1883–84 he again explored on the Benue. After a short stay in Europe, Flegel returned to Africa in April 1885 with a commission to open up the Niger-Benue basins to German influence and so prevent the British from establishing themselves in that part of West Africa. He was unsuccessful and died at Brass (Guinea) in the Niger delta on

Sept. 11, 1886.

Flegel wrote Lose Blatter *aus* dem Tagebuch meiner *Haussa*-freunde (1885); Vom *Niger-Benuë;* Briefe aus Afrika, edited by K. Flegel (1890). (R. M. P.)

FLÉMAL (FLEMAEL), **BERTHOLET** (1614–1675), Flemish painter, a pioneer of the classicist movement in his country, was born at Liège, Belg.. on May 23, 1614. He studied under Henri Trippez and Gerard Douffet. He went to Italy in 1638, returning via Paris, where he decorated the churches of the Grands Augustines and the Carmes Déchaussés. He returned to Liège in 1663. In 1670 he was elected member of the Paris academy. and he painted the ceiling of the audience chamber in the Tuileries (destroyed in 1871). He is one of the most important masters of the later Flemish school. His style is modeled on that of Poussin. Most of his numerous religious pictures in the churches of Liège were destroyed and lost during the French Revolution. However, there are several works still extant in the cathedral and in the churches of St. Jean, St. Barthelemy and Ste. Croix. Others are in the museums of Likge, Bamberg, Brussels, Dresden, Fontainebleau, Cassel, Stockholm, Niort and in the Louvre, Paris. Flémal was also a distinguished portrait painter. His self-portrait was engraved by Jean Duvivier.

Flémal died at Likge on July 10, 1675.

FLÉMALLE, LE MAÎTRE DE: see CAMPIN, ROBERT.

FLEMING, SIR ALEXANDER (1881–1955), British bacteriologist and discoverer of penicillin and 1945 Nobel laureate in medicine! was born at Lochfield, Ayrshire, Scot. on Aug. 16, 1881. He was educated at Kilmarnock academy and St. hlary's Hospital medical school, University of London, winning academic distinction at both institutions. Following his graduation he did research work at St. Mary's under Sir Almroth Wright, pioneer in vaccine therapy, and became interested in bacterial action and antiseptics. During World War I Fleming served as a captain in the army medical corps (1914–18) and was mentioned in dispatches.

After military service?during which he was able to make further studies of the problems of infection and use of antiseptics, Fleming returned to laboratory work and teaching bacteriology at St. Mary's. In 1919 he was appointed Hunterian professor and in 1928 Xrris and Gale lecturer at the Royal College of Surgeons. In the laboratory Fleming's interest continued in antibacterial substances which would be nontoxic to animal tissues. The first fruit of his search was the discovery of the antibiotic lysozyme. His epochal discovery in 1928 of the antibacterial powers of the mold from which penicillin is derived was a "triumph of accident and shrewd observation." While he was engaged in research on influenza, mold had developed accidentally on a staphylococcus culture plate, and Fleming discovered that the mold had created a bacteria-free circle around itself. Experimenting further, he found that a liquid mold culture, which he named penicillin, prevented growth of staphylococci, even when diluted 800 times. He published his results in the Journal of *Experimental* Pathology in 1929.

Fleming was made fellow of the Royal society in 1943, was knighted and given the John Scott medal in 1944, and awarded the Nobel prize, with Sir Howard Walter Florey and Ernst Boris Chain (*qq.v.*) in 1945. He died March 11, 1955, in London. See also PENICILLIN.

FLEMING, PAUL (1609–1640), German poet, was born at Hartenstein in the Saxon Erzgebirge, on Oct. 5, 1609, the son of the village pastor. He studied at Leipzig until driven away by the troubles of the Thirty Years' War. He was attached by Duke Frederick of Holstein-Gottorp to an embassy (1634–39) to Russia and Persia, to which the famous traveler Adam Olearius was secretary. Fleming died at Hamburg on April 2, 1640.

Fleming's *Teutsche Poëmata* (pr. 1642) mere edited by J. M. Lappenberg, in the Bibliothek des litterarischen Vereins. 2 vol. (1863). a third volume (1866) contains Fleming's Latin poems. Selections by J. Tittmann are in Deutsche Dichter des siebzehnten *Jahrhunderts,* vol. ii (1870) and by H. Österley (1885).

See Rost, *Paul Fleming* (1909).

FLEMING, RICHARD. (c. 1360–1431), bishop of Lincoln, and founder of Lincoln college, Oxford, was born in Yorkshire and educated at University college, Oxford. He was made prebendary of York in 1406. Becoming an ardent Wycliffite, he incurred the censure of Archbishop Arundel. He afterward became one of Wycliffe's most determined opponents, and to him was entrusted the execution of the decree of the council for the exhumation and burning of Wycliffe's remains. Before 1415 he was rector of Boston, Lincolnshire, and in 1420 became bishop of Lincoln. In 1423 he attended the councils of Pavia and Siena, and on his return. the see of York being vacant, the pope conferred it on Fleming; but Henry V refused to confirm the appointment. In 1427 Fleming obtained the royal licence empowering him to found a college at Oxford for the training of disputants against Wycliffe's heresy.

Fleming died at Sleaford on Jan. 26, 1431.

FLEMING, SIR SANDFORD (1827–1915), Canadian engineer and publicist, was born at Kirkcaldy, Scot., on Jan. 7, 1827, but in 1845 emigrated to Canada, where he was from 1867 to 1880 chief engineer of the Dominion government. Under his control were constructed the Intercolonial railway and much of the Canadian Pacific. After his retirement in 1880, when the Canadian government handed over the construction of the latter to the Canadian Pacific Railway company, he devoted himself to the study of Canadian and imperial problems, such as the unification of time reckoning throughout the world. and the construction of a state-owned system of telegraphs throughout the British empire. He saw the first link forged in the chain. in the opening in 1902 of the Pacific cable between Canada and Australia. He advocated federation in 1864–67, and in 1891 attacked the Liberal policy of unrestricted reciprocity with the United States.

He received the C.M.G. in 1877 and the K.C.M G. in 1897. He died on July 22, 1915, at Halifax. Nova Scotia.

He published The Intercolonial: a historical sketch *1832–76* (1876); England and Canada (1884); numerous *brochures* and magazine articles.

See L J. Burpee, *Sandford Fleming, Empire-Builder,* with bibliography (1915).

FLEMISH LANGUAGE. In a narrow sense. Flemish (Vlaams) refers to the local dialects of the provinces of East and West Flanders (Oost- en *West-Vlaanderen*) in western Belgium and of the adjoining section of France to the west. In a broader sense. Flemish refers to the standard language and the various dialects of northern Belgium. This broader use of the term often leads to the belief that Flemish is a separate language, though this is not the case. Just as the standard language of southern Belgium is identical with that of France, so the standard language of northern Belgium is identical with that of the Netherlands. In place of Flemish (for northern Belgium) and Dutch (for the Netherlands). the single term Netherlandish (*Nederlands*) is generally used in scientific writings. At the level of local dialects, northern Belgium and the Netherlands (except the Frisian speaking province of Friesland) are part of the Netherlandish-German dialect area which stretches from the North sea to the Alps.

See NETHERLANDISH LANGUAGE; GERMANIC LANGUAGES.

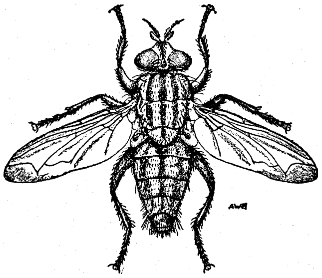
(W. G. Ms.)

FLENSBURG (Danish, Flensborg), a seaport in the Land of Schleswig-Holstein, Germany, at the head of the Flensburg fjord, 20 mi. N.W. from Schleswig. Pop. (1959 est.) 97,055.

Flensburg was probably founded in the 12th century. It attained municipal privileges in 1284, was frequently pillaged by the Swedes after 1643 and in 1848 became the capital. under Danish rule, of Schleswig. In the plebiscite after World War I it voted itself in Germany. The principal public buildings are the Nikolaikirche (built 1390, restored 1894). uith a spire 295 ft. high and the Marienkirche. also a medieval church, with a lofty tower. Flensburg is the most important town in nhat was formerly the duchy of Schleswig. It possesses excellent wharves, does a large trade in coal, is famous for fish curing; it has shipbuilding yards. sugar, paper, glass, copper, soap factories and iron foundries. It engaged in the Greenland whale and the oyster fisheries,.

FLESH FLY, the name applied to any member of the family Metopiidae (or Sarcophagidae) of the order Diptera (*q.v.*), but more specifically to the genus *Sarcophaga*. The flies are usually blackish with a checkered abdomen and gray and black striped thorax. They deposit living maggots on carcasses, and often on fresh meat. Others are parasites of snails, grasshoppers, caterpillars, etc. *S. cistudinis* is a parasite of turtles in North America.

For North American Species *see* J. M. Aldrich, *Sarcophaga and Allies* (1916), for British species *see* C. J. Wainwright, "The British Tachinidae," in *Trans. Entomological Soc. London,* pp. 139–254, (1928). (C. H. CN.)



FROM C. H. CURRAN, "INSECTS OF THE PACIFIC WORLD" (THE MACMILLAN COMPANY)
A TYPICAL FLESH FLY, SARCOPHAGA: THE FEMALES DEPOSIT LIVING LARVAE ON MEAT

FLETA, a treatise on the common law of England written about the year 1290. It is little better than an ill-arranged epitome of Bracton. The author also borrowed some information on husbandry from Walter of Henley. He is supposed to have written it during his confinement in the Fleet prison, hence the name. *Fleta* was first printed by Selden in 1647.

FLETCHER, ALICE CUNNINGHAM (1838–1923), U.S. ethnologist, a distinguished early student of American Indian life, was a pioneer in the study of Indian music and devoted much of her life to the improvement of Indian uelfare. She was born in Cuba (where her Bostonian parents were visiting) on March 15, 1838, and was privately educated. With the encouragement of F. W. Putnam of the Peabody museum at Harvard, Miss Fletcher studied the Plains and Prairie Indians, among whom she lived for a number of years. Together with her adopted Omaha son she wrote her major work, an ethnography of the Omaha tribe, which remains one of the best anthropological studies of its kind. Her description of a Pawnee ritual is equally outstanding as an intimate description and interpretation of a primitive ceremony. She was the first anthropologist to undertake a systematic study of American Indian music, for which she devised a system of notation.

Miss Fletcher served as special agent on problems of land allotment to the Omaha (1883–84), Winnebago (1887–89) and Nez Percé (1890–93) tribes, and initiated a system whereby the Indians secured loans for buying land and building houses. She was largely responsible for preventing the deportation of the Omaha from their Nebraska settlement to Indian territory in Oklahoma. In the early 1880s Miss Fletcher became associated with the Peabody museum, where she became an assistant in 1886 and held a fellowship from 1891 until her death in Washington, D.C., on April 6, 1923. She was elected vice-president of the American Association for the Advancement of Science (1896) and president of the Anthropological Society of Washington (1903) and of the American Folk-Lore society (190j).

Alice Fletcher's outstanding works are *The Omaha Tribe,* with Francis La Flesche, published as the 27th annual report of the Bureau of American Ethnology (1911); *The Hako: a Pawnee Ceremony,* 22nd annual report of the Bureau of American Ethnology (1904); *Indian Story and Song from North America* (1900). For a complete bibliography *see* W. Hough, "Alice Cunningham Fletcher" in *American Anthropologist* (April–June 1923).

FLETCHER, ANDREW, of Saltoun (1655–1716), Scottish politician. was the son and heir of Sir Robert Fletcher (1625–1664), and was born at Saltoun (Salton), East Lothian. He was a member of the Scottish parliament which met in 1681. Fletcher was a fearless and active opponent of the duke of Lauderdale's administration. He left Scotland about 1682. subsequently spending some time in Holland as an associate of the duke of Monmouth and other malcontents. He accompanied Monmouth to the west of England, but left the army after killing one of the duke's trusted advisers.

During the next few years he is said to have traveled in Spain, and he fought against the Turks in Hungary. Having in his absence from Scotland lost his estates and been sentenced to death, he joined William of Orange at The Hague. On William's accession his estates were restored to him; he soon became a leading member of the "club," an organization which aimed at reducing the power of the crown in Scotland, and an active opponent of the English government. In 1703, at a critical stage in the history of Scotland, Fletcher again became a member of the Scottish parliament.

The failure of the Darien expedition had aroused a strong feeling of resentment against England, and Fletcher and the national party seized the opportunity to obtain a greater degree of independence for their country. In the negotiations for the union of the two kingdoms Fletcher performed essential service. He got the act of security passed, which declared that the two crowns should not pass to the same head until Scotland was secured in its civil and religious liberties. Therefore Lord Godolphin was forced into the Union, to avoid a civil mar after the queen's demise.

After the passing of the Act of the Union, Fletcher retired from public life. He did a real, if homely, service to his country by introducing from Holland machinery for sifting grain. He died in London in Sept. 1716.

Fletcher was a fine scholar and a graceful writer. His chief works are: *A Discourse of Government relating to Militias* (1698); *Two Discourses concerning the Affairs of Scotland* (1698); and *An Account of a Conversation concerning a right regulation of Governments for the common good of Mankind* (1704), which contained his well-known remark, "I knew a very wise man so much of Sir Christopher's (Sir C. Musgrave) sentiment, that he believed if a man were permitted to make all the ballads, he need not care who should make the laws of a nation."

See *The Political Works of Andrew Fletcher* (1737); D. S. Erskine, 11th earl of Buchan, *Essay on the Lives of Fletcher of Saltoun and the Poet Thomson* (1792).

FLETCHER, GILES (*c.* 1548–1611), English poet and author and father of the poets Phineas and Giles Fletcher, who published an interesting account of his visit to Russia in *Of the Russe Common Wealth* (1591). The son of Richard Fletcher, the vicar of Cranbrook, Kent, he was born in 1548 or 1549 at Watford, Hertfordshire, and educated at Eton and at King's college. Cambridge. He was employed on diplomatic service in Scotland, Germany and Holland; and in 1588 was sent to Russia to the court of the tsar Theodore I, with instructions to conclude an alliance between England and Russia, to restore English trade and to obtain better conditions for the English Muscovy company. He returned to England in 1589, and in 1591 published *Of the Russe Common Wealth,* a comprehensive account of Russian geography, government, law, methods of warfare, church and manners. The Russian government was alarmed at the book's freedom and had it suppressed. In 1610 Fletcher was employed to negotiate with Denmark on behalf of the merchants of the Eastland company; he died in London in the following year and was buried on March 11, 1611.

Of the Russe Common Wealth was issued in an abridged form in Richard Hakluyt's *Principal Navigations, Voyages, Traffiques and Discoveries* (2nd ed., 1598); in *Purchas his Pilgrimes* (1625); and also as *History of Russia* in 1643. Fletcher also wrote *De Literis antiqzrae Britanniae* (1633); a treatise on "The Tartars," to prove that they were the ten lost tribes of Israel; Latin poems published in various miscellanies; and *Licia, or poems of love . . . Whereunto is added the Rising to the Crowne of Richard the Third* (1593). This series of love sonnets, followed by some other poems, was published anonymously. Most critics have accepted it as the work of Giles Fletcher on the evidence afforded in the first of the *Piscatorie Eclogs* (1633) of his son Phineas, who represents his father (Thelgon) as having "raised his rime to sing of Richard's climbing."

FLETCHER, GILES (*c.* 1584–1623), English poet principally knonn for his great baroque devotional poem. *Christs Victorie, and Triumph in Heaven, and Earth, over, and after death,* was the younger son of Giles Fletcher (c. 1548–1611; *q.v.*). He was born in London about 1584, and was educated at Westminster school and at Trinity college, Cambridge. After taking orders, he held a college living, and his sermons at St. Mary's were famous. Thomas Fuller states in his *Worthies* (1662) that Fletcher's prayer before his sermon was a continuous allegory. He left Cambridge about 1618, and soon after received the rectory of Alderton, Suffolk. He died in 1623.

The theme of Fletcher's masterpiece, *Christs Victorie* (1610), owes something to the *Semaines* of Du Bartas, but the devotion, the passionate lyricism and the exquisite vision of paradise are Fletcher's own. The poem is written in eight-line stanzas owing something to Edmund Spenser of whom, like his brother Phineas, Giles was a disciple. The first five lines rhyme a, b, a, b, b. and the stanza concludes with a rhyming triplet, resuming the conceit which nearly every verse embodies. Like most amateurs of the conceit, he is sometimes grotesque, but uhen he forgets his ingenuity he attains a depth of melody that delighted Milton, who followed him to some extent in *Paradise Regained* (1671).

Fletcher contributed a poem on the death of Queen Elizabeth I to *Sorrowes Joy* (1603), and in 1612 he edited *The Young Divines Apologie for his Continuance in the Universitie* of his cousin Nathaniel Pownoll. His last work was the prose *Reward of the Faithfull* (1623).

There is an unpublished manuscript by him in the library of King's college, Cambridge, *Aegidii Fletcherii versio poetica Lamentationum Jeremiae.*

Bibliography.—*The Poetical Works of Giles and Phineas Fletcher* were ed. by F. S. Boas, 2 vol. (1908–09). *See* also *H*. E. Cory, *Spenser, the School of the Fletchers, and Milton* (1912) and *A*. Esch, *Giles Fletchers "Christs Victorie and Triumph": Eine Studie zum Epenstil des englischen Barock* (1937).

FLETCHER, HARVEY (1884–), U.S. physicist who made notable contributions to the science of acoustics, was born in Provo, Utah, Sept. 11, 1884. He graduated from Brigham Young university in 1907 and received a Ph.D. *summa cum laude* in 1911 from The University of Chicago. He taught physics at Brigham Young until joining Bell Telephone Laboratories, Inc., in 1916, where he remained for 33 years, working primarily in the fields of speech, music and hearing. Fletcher appreciated the importance of precise measurement and the value of organizing fundamental information into useful relationships. Throughout the period, new instrumentation and techniques of measurement were under continuous development. The basic knowledge so obtained was fundamental to the rapid growth of the science of psycho-acoustics and its application to communications. Much of the work is described in Fletcher's book *Speech and Hearing in Communications* (1929).

On retirement as physical research director in 1949, Fletcher joined the staff of Columbia university and established a new department of acoustical engineering. In 1952 he returned to Brigham Young university as director of research and in 1954 became dean of the college of physical and engineering sciences.

(J. C. Sg.)

FLETCHER, JOHN WILLIAM (1729–1785), English divine, was born at Nyon, Switzerland, on Sept. 12. 1729, his original name being de la Flechere. He was educated at Geneva for the church, but went to Lisbon and enlisted. An accident prevented his sailing with his regiment to Brazil, and he went to England, picked up the language, and in 1752 became tutor in a Shropshire family. Here he came under the influence of the new Methodist preachers, and in 1757 took orders, being ordained by the bishop of Bangor. He often preached with John Wesley and for him. Refusing the wealthy living of Dunham, he accepted the humble one of Madeley, where for 25 years (1760–85) he lived and worked with unique devotion and zeal. Fletcher was one of the few parish clergy who understood Wesley and his work, yet he never wrote or said anything inconsistent with his own Anglican position. In theology he upheld the Arminian against the Calvinist position, but always with courtesy and fairness; his resignation on doctrinal grounds of the superintendency (1768–71) of the countess of Huntingdon's college at Trevecca left no unpleasantness. The outstanding feature of his life was a transparent simplicity and saintliness of spirit. Wesley preached his funeral sermon from the words "Mark the perfect man." Southey said that "no age ever provided a man of more fervent piety or more perfect charity, and no church ever possessed a more apostolic minister." It is said that Voltaire, when challenged to produce a character as perfect as that of Christ, at once mentioned Fletcher of Madeley. He died on Aug. 14. 1785.

Complete editions of his works were published in *1803* and *1836*. The chief of them, written against Calvinism, are *Five Checks to Antinomianism, Scripture Scales to weigh the Gold of Gospel Truth,* and the *Portrait of St. Paul. See* lives by J. Wesley (1786); L. Tyerman *(1882)*; F. *W*. Macdonald *(1885)*; J. Maratt (1902); also C. J. Ryle, *Christian Leaders of the 18th Century (1869).*

FLETCHER, PHINEAS (1582–1650), English poet best known for his religious and scientific poem *The Purple Island*, elder son of Giles Fletcher *(c.* 1548–1611; *q.v.)* and brother of Giles the younger *(c.* 1584–1623), was born at Cranbrook, Kent, and baptized on April 8, 1582. He was educated at Eton and at King's college. Cambridge. His pastoral drama, *Sicelides A Piscatory* (1631) was written in 1615 for performance before James I at King's college but only produced after the king's departure. Fletcher became chaplain to Sir Henry Willoughby, who presented him in 1621 to the rectory of Hilgay, Norfolk, where he spent the rest of his life. He had married Elizabeth Vincent of Risley, Derbyshire, in Aug. 1615. In 1627 he published *Locustae, vel pietas Jesuitica (The Locusts or Apollyonists*), two parallel poems in Latin and English attacking the Jesuits. An erotic poem, *Brittain's Ida* (1628), though bearing Spenser's name, is to be included in the Fletcher canon, since it appears in the unique manuscript preserved at Sion college, London, of his *Piscatorie Eclogs.* Entitled there *Venus and Anchises,* it bears additional stanzas which prove his authorship. In 1632 appeared two theological prose treatises, *The Way to Blessedness* and *Joy in Tribulation,* and in 1633 his magnum opus, *The Purple Island.* It included his *Piscatorie Eclogs and other Poetical Miscellanies.* He died in 1650, his will being proved on Dec. 13.

The Purple Island, or the Isle of Man, is a poem in 12 cantos describing in cumbrous allegory the physiological structure of the human body and the mind of man. The manner of Spenser is preserved throughout, and the chief charm of the poem lies in its descriptions of rural scenery. Some critics see in the allegorist of *The Purple Island* a link between Spenser and Bunyan. The *Piscatorie Eclogs* are pastorals, the characters of which are represented as fisherboys on the banks of the Cam, and are interesting for the light they cast on the biography of the poet himself (Thyrsil) and his father (Thelgon), and on Phineas' friendship with Cambridge men, such as the musician Thomas Tomkins (Thomalin). Phineas Fletcher's poetry has not the sublimity sometimes reached by his brother Giles. The mannerisms are more pronounced, the conceits more farfetched, but the verse is fluent and musical; his lyric poetry lacks neither colour nor ardour, as is seen in the "Epithalamium" of the Sion college manuscript.

Bibliography.—*Poems,* ed. by A. B. Grosart, 4 vol. *(1869)*; *Poetical Works of Giles and Phineas Fletcher,* ed. by F. S. Boas, 2 vol. (1908–09); *Venus and Anchises . . . ,* ed. by E. Seaton for the Royal Society of Literature *(1926). See* also *H. E.* Cory, *Spenser, the School of the Fletchers, and Milton* (1912), and *A.* B. Langdale, *Phineas Fletcher* (1937).

(M. *E.* Sn.)

FLEURANGES, ROBERT III DE LA MARCK, Seigneur de (1491–1537), marshal of France and historian, was the son of Robert II de la Marck, duke of Bouillon, seigneur of Sedan and Fleuranges, whose uncle was William de la Marck, "the Wild Boar of the Ardennes." At the age of ten he was sent to the court of Louis XII, and placed in charge of the count of Angoulême, afterwards King Francis I. He served in Francis' Italian campaigns; and in 1512, the French being driven from Italy, Fleuranges was sent into Flanders to levy a body of 10,000 men, in command of which. under his father, he returned to Italy in 1513, seized Alessandria, but failed to take Novara. In 1515 he distinguished himself at Marignano, where the king knighted him with his own hand. He next took Cremona, and was there called home by the news of his father's illness. In 1519 he was sent into Germany to canvass the electors in favour of Francis I. Fleuranges fought at Pavia (1525), and was taken prisoner with Francis. The emperor, irritated by the defection of his father, Robert II de la Marck, kept him in prison in Flanders for some years. During this imprisonment he was created marshal of France. In his *Histoire des choses mkmorables advenues au règne de Louis XII et de François I, depuis 1499 jusqu'en l'an* **1521,** written in prison (ed. Lambert, 1735), also in the *Nouvelle collection des mkmoires pour servir à l'histoire de France* (edited by J. F. Michaud and

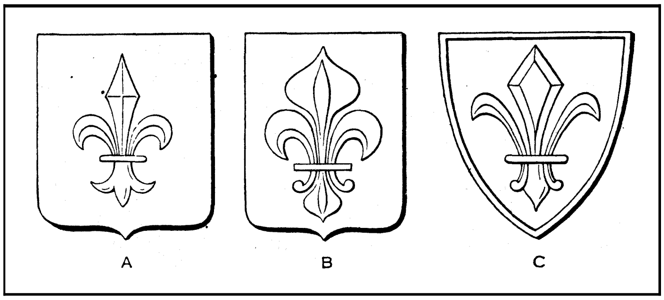
J. J. F. Poujoulat, series i, vol. v, 1836 *et* seq.), he gives many curious and interesting details of the events he had witnessed. He died at Longjumeau in Dec. 1537.

FLEUR-DE-LIS (Fr. "lilyflower"), a heraldic device, very widespread in the armorial bearings of all countries, but more particularly associated with the royal house of France. The conventional fleur-de-lis, as Littre says, represents very imperfectly three flowers of the white lily (Lilium) joined together, the central one erect, and each of the other two curving outwards. The fleur-de-lis is common in ancient decoration, notably in India and in Egypt, where it was the symbol of life and resurrection, the attribute of the god Horus. It is common also in Etruscan bronzes. It is uncertain whether the conventional fleur-de-lis was originally meant to represent the lily or white iris — the flower-de-luce of Shakespeare — or an arrow-head, a spear-head, an amulet fastened on date-palms to ward off the evil eye, etc. In Roman and early Gothic architecture the fleur-de-lis is a frequent sculptured ornament. As early as 1120 three fleurs-de-lis were sculptured on the capitals of the Chapelle Saint-Aignan at Paris.

The fleur-de-Iis was first definitely connected with the French monarchy in an ordonnance of Louis le Jeune (c. 1147), and was first figured on a seal of Philip Augustus in 1180. The use of the fleur-de-lis in heraldry dates from the 12th century, soon after which period it became a very common charge in France, England and Germany, where many a gentleman of coat-armour desired to adorn his shield with a loan from the shield of France, which was at first *d'azur, semé* de *fleurs* de *lis* d'or (blue, interspersed with gold lilies). In Feb. 1376 Charles V of France reduced the number of fleurs-de-lis to three — in honour of the Trinity — and the kings of France thereafter bore *d'azur, à trois fleurs* de *lis* d'or (blue, with three gold lilies).

Tradition soon attributed the origin of the fleur-de-lis to Clovis, the founder of the Frankish monarchy, and explained that it represented the lily given to him by an angel at his baptism. According to a more rationalistic explanation, it was a figure used instead of a sceptre at the proclamation of the Frankish kings.

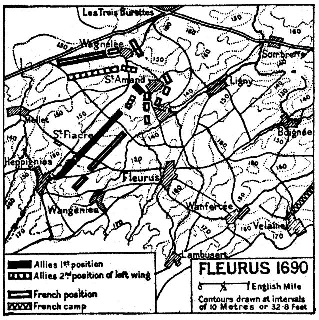
An order of the Lily, with a fleur-de-lis for badge, was established in the Roman states by Pope Paul III in 1546; its members were pledged to defend the patrimony of St. Peter against the enemies of the church. Another order of the Lily was founded by Louis XVIII in 1816, in memory of the silver fleurs-de-lis which the comte d'Artois had given to the troops in 1814 as decorations; it was abolished by the revolution of 1830.



THREE MODIFICATIONS OF THE FLEUR-DE-LIS
A. Middle Aaes B. 17th Century C. 18th and 19th Centuries

FLEURUS, a village of Belgium, in the province of Hainaut, 5 mi. N.E. of Charleroi, pop. (1955 est.) 7,206; scene of several battles. The first of these was fought on Aug. 19–29, 1622, between the forces of Count Mansfeld and Christian of Brunswick and the Spaniards under Cordovas, the latter being defeated. The second is described below, and the third. and fourth, incidents of Jourdan's campaign of 1794, under FRENCH REVOLUTIONARY WARS. The ground immediately north-east of Fleurus forms the battlefield of Ligny (June 16, 1815), for which see WATERLOO CAMPAIGN, 1815.

The second battle (for its strategic prologue see GRAND ALLIANCE, WAR OF THE) was fought on July 1, 1690, between 45,000 French under duke of Luxemburg, and 37,000 allied Dutch, Spaniards and Imperialists under George Frederick, prince of Waldeck. The latter had formed up his army between Heppignies and St. Amand in what was then considered an ideal position; a double barrier of marshy brooks was in front, each flank rested on a village, and the space between, open upland, fitted his army exactly. But Luxemburg, riding up with his advanced guard from Velaine, decided, after a brief survey of the ground, simultaneously to attack the front of the Allies' position, envelop their right flank and turn their left flank by a wide manoeuvre on to their rear, a boldness and breadth of tactical conception which was rare for the age, indeed for any age. The left wing of cavalry was to move under cover of woods, houses and hollows to gain Wangenies, where it was to connect with the frontal attack of the French centre from Fleurus and to envelop Waldeck's right. Luxemburg himself with the right wing of cavalry and some infantry and artillery made a wide sweep round the enemy's left by way of Ligny and Les Trois Burettes, concealed by the high-standing corn. At 8 o'clock the frontal attack began by a vigorous artillery engagement, in which the French, though greatly outnumbered in guns, held their own, and three hours later Waldeck, whose attention had been absorbed by events on the front, found a long line of the enemy already formed up in his rear. He at once brought his second line back to oppose them, but while he was doing so the French leader filled up the gap between himself and the frontal assailants by posting infantry around Wagnelée, and also guns on the neighbouring hill whence their fire enfiladed both halves of the enemy's army up to the limit of their ranging power. At 1 P.M. Luxemburg ordered a general attack of his whole line. He himself scattered the cavalry opposed to him and hustled the Dutch infantry into St. Amand, where they wera promptly surrounded. The left and centre of the French army were less fortunate, and in their first charge lost their leader, de Gournay, one of the best cavalry officers in the service. But Waldeck, hoping to profit by this momentary success, sent a portion of his right wing towards St. Amand, where it merely shared the fate of his Ieft, and the day was decided. Only a quarter of the cavalry and 14 battalions of infantry (English and Dutch) remained intact, and Waldeck could do no more, but with these he emulated the last stand of the Spaniards at Rocroi 50 years before. A great square was formed of the infantry, and a handful of cavalry joined them — the French cavalry, eager to avenge de Gournay, had swept away the rest. Then slowly and in perfect order, they retired into the broken ground above Mellet, where they were in safety. The French slept on the battlefield, and then returned to camp with their trophies and 8,000 prisoners. They had lost some 2,500 killed, the Allies twice as many, as well as 48 guns, and Luxemburg was able to send 150 colours and standards to decorate Notre-Dame. But the victory was not followed up, for Louis XIV. ordered Luxemburg to keep in line with other French armies which were carrying on more or less desultory wars of manoeuvre on the Meuse and Moselle.



PLAN OF THE SECOND BATTLE OF FLEURUS, JULY 1, 1690

FLEURY (ABRAHAM JOSEPH BÉNARD) (1750–1822), French actor, noted as a comedian, was born at Chartres on Oct. 26, 1750. He began his stage apprenticeship at Nancy, where his father was an actor at the court of King Stanislaus I. He went to Paris in 1778 and almost immediately was made a full member of the Comédie Franqaise, although the public was slow to recognize him as thegreatest comedian of his time. In 1793 Fleury was arrested in consequence of the presentation of the politically controversial play *L'Ami des Lois* by Jean Laya. When liberated, Fleury appeared at various theatres until, in 1799, he rejoined the rehabilitated Comédie Franqaise.

Fleury retired in 1818 and died on March 3, 1822.

FLEURY, ANDRÉ HERCULE DE (1653–1743), French cardinal and statesman, was born at Lodbve (Hérault) on June

22, 1653, the son of a collector of taxes. Educated by the Jesuits in Paris, he entered the priesthood, and became in 1679, through the influence of Cardinal Bonzi, almoner to Maria Theresa, queen of Louis XIV., and in 1698 bishop of Fréjus. Seventeen years later he became tutor to the king's great-grandson and heir, and in spite of an apparent lack of ambition, he acquired over the child's mind an influence which proved to be indestructible. On the death of the regent Orleans in 1723 Fleury, already 70 years of age, deferred his own supremacy by suggesting the appointment of Louis Henri, duke of Bourbon, as first minister. Fleury was present at all interviews between Louis XV. and his first minister, and on Bourbon's attempt to break through this rule Fleury retired from court. Louis made Bourbon recall the tutor, who on July 11, 1726, took affairs into his own hands, and secured the exile from court of Bourbon and of his mistress Madame de Prie. He refused the title of first minister, but his elevation to the cardinalate in that year secured his precedence over the other ministers. He was naturally frugal and prudent, and carried these qualities into the administration, with the result that in 1738–1739 there was a surplus of 15,000,000 livres instead of the usual deficit. In 1726 he fixed the standard of the currency and secured the credit of the government by the regular payment thenceforward of the interest on the debt. By exacting forced labour from the peasants he gave France admirable roads, though at the cost of rousing angry discontent. During the 17 years of his orderly government the country found time to recuperate its forces after the exhaustion caused by the extravagances of Louis XIV. and of the regent, and the general prosperity rapidly increased. Internal peace was only seriously disturbed by the severities which Fleury exercised against the Jansenists. He imprisoned priests who refused to accept the bull *Unigenitus,* and he met the opposition of the parlement of Paris by exiling 40 of its members.

In foreign affairs his chief preoccupation was the maintenance of peace, which was shared by Sir Robert Walpole, and therefore led to a continuance of the good understanding between France and England. But he reluctantly supported the ambitious projects of Elizabeth Farnese, queen of Spain, in Italy by guaranteeing in 1729 the succession of Don Carlos to the duchies of Parma and Tuscany. Fleury had economized in the army and navy, as elsewhere, and when in 1733 war was forced upon him he was hardly prepared. He was compelled by public opinion to support the claims of Louis XV.'s father-in-law Stanislaus Leszczynski, ex-king of Poland, to the Polish crown on the death of Frederick Augustus I., against the Russo-Austrian candidate; but the despatch of a French expedition of 1,500 men to Danzig only served to humiliate France. Fleury was driven by Chauvelin to more energetic measures; he concluded a close alliance with the Spanish Bourbons and sent two armies against the Austrians. Military successes on the Rhine and in Italy secured the favourable terms of the treaty of Vienna (1735–1738). France had joined with the other powers in guaranteeing the succession of Maria Theresa under the Pragmatic Sanction, but on the death of Charles VI. in 1740 Fleury by a diplomatic quibble found an excuse for repudiating his engagements, when he found the party of war supreme in the king's counsels. After the disasters of the Bohemian campaign he wrote in confidence a humble letter to the Austrian general Königsegg, who immediately published it. Fleury disavowed his own letter, and died a few days after the French evacuation of Prague on Jan. 29, 1743. He had enriched the royal library by many valuable oriental mss., and was a member of the French Academy, of the Academy of Science, and the Academy of Inscriptions.

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FLEURY, CLAUDE (1640–1723), French ecclesiastical historian, was born at Paris on Dec. 6, 1640. Educated at the aristocratic college of Clermont (now that of Louis-le-Grand), he was nominated an advocate to the parlement of Paris in 1658, but nine years later, he turned to theology and by 1672 was in orders. The king entrusted to him the education of the princes of Conti and of the count of Vermandois, one of his natural sons, on whose death in 1683 Fleury received for his services the Cistercian abbey of Loc-Dieu, in Rhodez. In 1689 he was appointed sub-preceptor of the dukes of Burgundy, of Anjou and of Berry, and thus became intimately associated with Fénelon, their chief tutor. On the completion of the education of the young princes the king appointed him prior of Argenteuil, near Paris (1706), and he resigned that of the abbey of Loc-Dieu. Fleury, who had been made confessor to the young king Louis XV. in 1716, because, as the duke of Orleans said, he was neither Jansenist nor Molinist, nor Ultramontanist, but Catholic, died on July 14, 1723. His great learning was equalled by the modest simplicity of his life and the uprightness of his conduct.

His chief work, the *Histoire ecclésiastique,* which comes down to 1414 and was completed by others dcwn to 1684, has passed through many editions, the first being that of Paris, 20 vols., 1691, Partial Eng. trs., 1842 ff. His other works *include:* — *Histoire du droit françois* (1674, Eng. trs., 1724), *Moeurs des Israélites* (1681, Eng. trs., 1805); *Moeurs des Chrétiens* (1682, Eng. trs., 1698); *Traité du choix et de la me'thode des e'tudes* (1686, 2 vols.); *Les Devoirs des maîtres et des domestiques* (1688); his *Cate'chisme historique* (1679, Eng. trs., 1726) and the *Institution du droit ecclésiastique* (1687) were put on the Index. *See* C. E. Simonetti, *Der Character eines Geschichtsschreibers in dem Leben und aus den Schriften des Abts C. Fleury* (Gottingen, 1746); C. F. P. Jaeger, *Notice sur C. Fleury, considéré comme historien* (Strasbourg, 1847); Reichlin-Meldegg, *Geschichte des Christentums,* i.

FLEXNER, SIMON (1863–1946), U.S. pathologist, was born at Louisville, Ky., on March 25, 1863. After receiving his medical degree from the University of Louisville in 1889, he studied at Johns Hopkins university, Baltimore, Md., and at the universities of Strasbourg, Berlin and Prague and the Pasteur institute, Paris. He was associate professor of pathology (1895–98) and professor of pathological anatomy (1898–99) at Johns Hopkins and professor of pathology at the University of Pennsylvania, 1899–1903. Director of the laboratories of the Rockefeller Institute for Medical Research, New York, 1903–35, he was also director of the institute, 1920–35.

Flexner became widely known for his treatment of spinal meningitis (*see* MENINGITIS) with a curative serum. He published numerous monographs, including *Serum Treatment of Epidemic Meningitis* (1917); *Epidemic Poliomyelitis;* and *Epidemiology.* With James Thomas Flexner he wrote *William Henry Welch and the Heroic Age of American Medicine* (1941). He died in New York city on May 2, 1946.

His brother ABRAHAM FLEXNER (1866–) was secretary of the general education board, 1917–25, and director of the Institute for Advanced Study, 1930–39. He wrote *A Modern School* (1916); *A Modern College* (1923); *I Remember: An Autobiography* (1940); and works on medical education.

FLICKER, one of more than 100 names for ground-loving, ant-eating, North American woodpeckers *(Colaptes auratus),* 12 in. long, brownish-gray above barred black, brownish-white below washed yellow, black spots and crescent on breast, and black moustaches in the male. White rump and yellow under wings and tail are conspicuous in flight. A 13-18 in, nest is dug high in dead limb or stub where 5-9 white eggs incubate two weeks. The flicker ranges from the Atlantic to the Rockies and limit of trees to the Gulf coast. Red-shafted flickers (C. *cafer),* Rockies to Pacific and Alaska into Mexico, have brown crown, red under wings and tail, black moustaches in male. Gilded flickers (C. *chrysoïdes*) occur on Arizona-California-Mexican borders, other species in Cuba and southern Mexico. (G. F. Ss.)

FLIEDNER, THEODOR (1800–1864), German Protestant divine and philanthropist, was born on Jan. 21, 1800, at Epstein (near Wiesbaden), and studied at Giessen, Gottingen and Herborn. In 1821 he became pastor of the Protestant church at Kaiserswerth, on the Rhine. During a visit to England in 1823 he made the acquaintance of Elizabeth Fry. The German prisons were then in a very bad state. The prisoners were huddled together in dirty rooms, badly fed, and left in complete idleness. Fliedner applied for permission to be imprisoned for some time, in order to see prison life from the inside. This petition was refused, but he was allowed to hold fortnightly services in the Düsseldorf prison, and to visit the inmates individually. On June 18, 1826, the first Prison Society of Germany (Rheinisch-Westfälischer *Gefängnisverein*) was founded. In 1833 Fliedner opened in his own parsonage garden at Kaiserswerth a refuge for discharged female convicts. He then turned to the care of the sick poor, and he began a scheme for securing proper training for nurses. In 1836 he began the first deaconess house, and the hospital at Kaiserswerth, the institution which gave Florence Nightingale fruitful ideas on the provision of nursing. By their ordination vows the deaconesses devoted themselves to the care of the poor, the sick and the young; but their engagements were not final—they might leave their work and return to ordinary life if they chose. Fliedner also founded (1835) an infant school, then a normal school for infant school mistresses (1836), an orphanage for orphan girls of the middle class (1842), and an asylum for female lunatics (1847). He assisted at the foundation and in the management of similar institutions, not only in Germany, but in various parts of Europe.

In 1849 he resigned his pastoral charge, and until 1851 travelled over a large part of Europe, America and the east—the object of his journeys being to found "mother houses," which were to be not merely training schools for deaconesses, but also centres from which other training establishments might arise. He established a deaconess house in Jerusalem, and after his return assisted by counsel and money in the erection of establishments at Constantinople, Smyrna, Alexandria and Bucharest. He founded the Christian house of refuge for female servants in Berlin (connected with which other institutions soon arose) and the "house of evening rest" for retired deaconesses at Kaiserswerth. Fliedner died on Oct. 4, 1864, leaving behind him more than 100 stations.

His son FRITZ FLIEDNER (1845–1901), after studying in Halle and Tübingen, became in 1870 chaplain to the embassy in Madrid and founded several philanthropic institutions in Spain. He was also the author of a number of books, among which was an autobiography, *Aus meinem Leben, Erinnerungen und Erfahrungen* (1901).

See G. Fliedner, *Theodor Fliedner, kurzer Abriss seines Lebens und Wirkens*, 3rd ed. (1892). *See* also on Fliedner and his work *Kaiserswerth Deaconesses* (1857); J. S. Howson, *Deaconesses* (1862); E. C. Stephen, *The Service of the Poor* (1871); W. F. Stevenson, *Praying and Working* (1865).

a purchase of stock that is known by the buyer to be of a highly speculative nature, and by which he hopes to make a quick turnover at a profit, though realizing that there is also a great possibility of loss. *Taking a flier* is essentially a gamble and is so recognized.

(NATURAL). The flight of birds has been from time immemorial a riddle as well as a source of inspiration. In the Proverbs of Solomon it says "the way of an eagle in the air" is "too wonderful" for him; and for many centuries the paradox that a bird could for hours together maintain its motion without a flap of the wing or any appreciable expenditure of energy seemed hopeless of explanation. But though the upward gliding of a vulture until it is almost invisible, or the effortless sailing of an albatross for hundreds of miles over the ocean are obviously marvellous, the ordinary flapping flight of a swift or a pigeon is in reality almost as wonderful. For flapping flight involves a combination of a highly perfected mechanical design of the wings with a motive power of remarkable lightness; and, though men have carried on sailing flight in a motorless aeroplane for hours, a motor-driven flapping aeroplane has not been prodhced.

Gliding, Soaring or Sailing Flight.— For comprehension of the fundamental principles underlying nonflapping flight, we are indebted to the late Lord Rayleigh who in 1883 remarked that "wherever . . . a bird pursues his course for some time without working his wings we must conclude either (1) that the course is not horizontal, (2) that the wind is not horizontal, or (3) that the wind is not uniform." As we shall see these suggestions lead to the solution of the problem, which, as far as flight inland is concerned, may be exemplified by the behaviour of an ordinary vulture. He weighs about 10 lb., has wings each about 3 ft. long and 1 ft. wide, and, about an hour after sunrise, when he throws himself off the bough on which he has roosted, he gives the impression of being too heavily loaded for any but the clumsiest of flying. He flaps laboriously uphill, usually in a spiral path, until he has reached a height of 50 or 100 ft. and then a mysterious change begins to show itself; he flaps less and less hard and after a short time starts gliding steadily and majestically upward in his spiral. After reaching a considerable height, which may be between 500 and 2,000 ft., he has no need of further effort, and seems able to float at will in any direction and at any pace that he likes until he descends for food or because sunset is approaching.

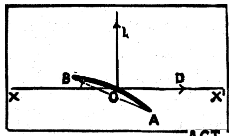


FIG. 1.—AIR FORCES ACTING ON 7 WING SHOWING HOW, WHEN MOVING HORIZONTALLY, THE WING EXPERIENCES A VERTICAL * BACK-

The details of his flight do not diminish our surprise; for the air in the plains is often so still that there is no suggestion of an upcurrent sufficient to support a 10 lb. weight, and with the plane of his wings inclined upward (the forward edge being higher than that in the rear) a vertical upcurrent would seem to drive him backward, not forward. His continued advance seems inexplicable.

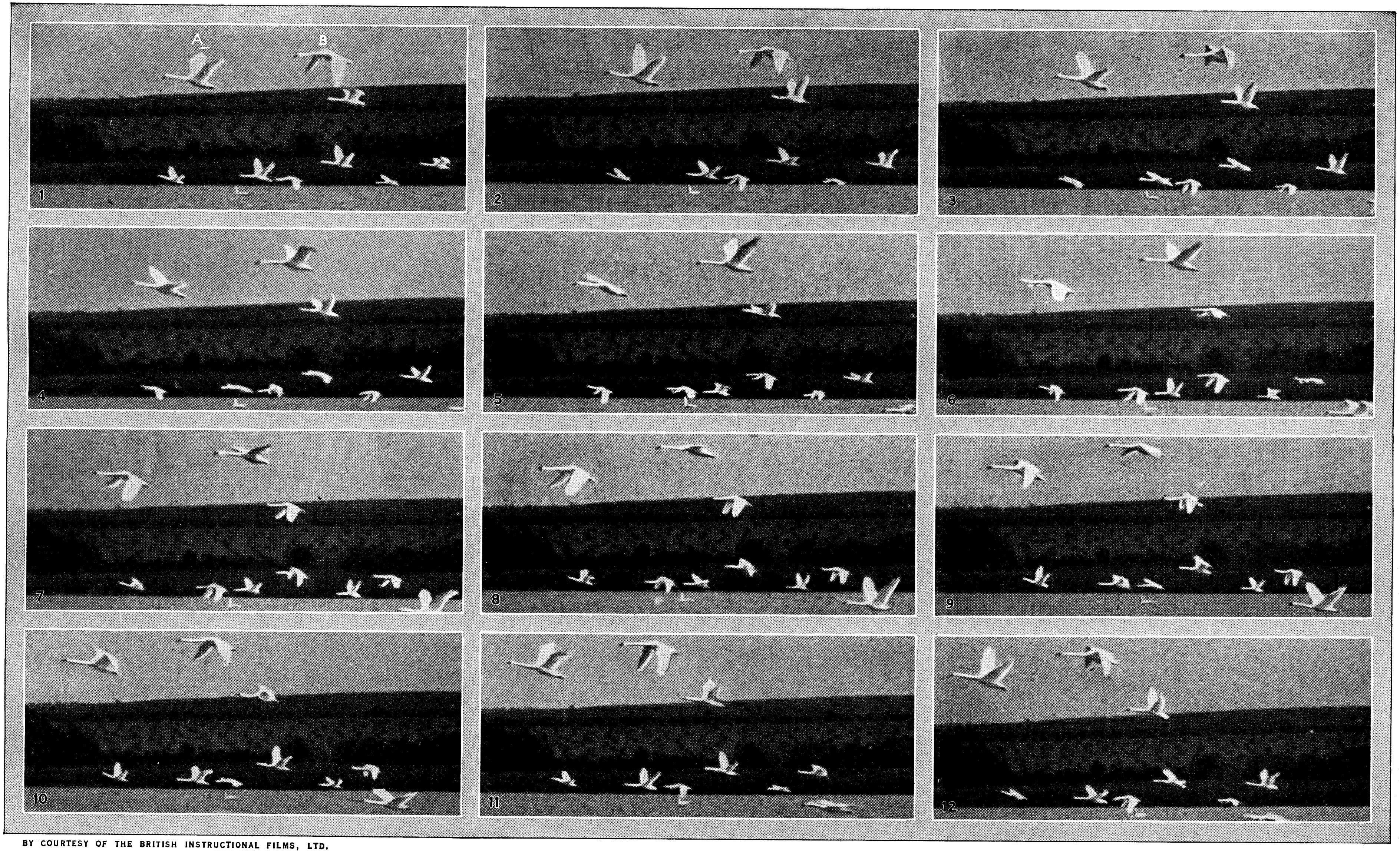
Downhill Gliding Through Still Air.—If a bird is gliding horizontally through still air the resistance of the air must lessen his speed, and on the other hand if he glides steeply downhill he will gain in speed. There must be some slope for which he will neither gain nor lose speed and its inclination is called the "angle of descent." Much detailed information has been accumulated regarding the forces which act on wings of various cross sections and on elongated bodies when travelling at different speeds through the air (*see* AERONAUTICS); and if we have a wing of cross section AB (*see* fig. 1) travelling in the direction X′OX the air forces acting on it are equivalent to (1) a resistance or "drag" D backward in the reversed direction of motion. (2) a lifting force L at right angles to the direction of motion. For a "high velocity" section, the ratio of L : D may reach 17. So when our bird is gliding steadily downhill along a line inclined and to the horizon it is acted on by D, L and its weight W, and we must have

$$\frac{\quad}{\cos a} = \frac{\quad}{\sin \alpha} = W$$

Now it may easily be calculated from well-known data that if we construct an artificial bird with rectangular wings of standard section and a torpedo-shaped body all of approximately the actual dimensions, the total weight being that of the bird, its angle of descent will be about 4° or 5°. Further, we habitually see birds in the tropics gliding at a considerable height in all directions without any obvious descent; but we should not observe an angle of descent of 5° under these conditions, and for one who has been able to watch the gliding of kites from a hill it is impossible to believe that their angle of descent is as great as this. Hence, although past measurements of the forces acting upon stuffed birds in wind tunnels have indicated great inferiority by parison with aerofoils fitted to torpedo-shaped bodies, the ratio of lift/drag in the stuffed birds not exceeding 5, the failure must be explained by the difficulty of preserving the true shape of the wing. Preliminary experiments made at S. Kensington have confirmed this view and from measurements made on living birds in 1920 in Africa, P. Idrac found a lift/drag ratio of about 18.

Gliding When There Is an Upward Current of Air.—If a bird whose angle of descent is 1 in 12 is gliding through still air at 18 m.p.h. he will be descending at the rate of $\frac{18}{12}$ or $1\frac{1}{2}$ m.p.h.; and if there were a column of air ascending at more than $1\frac{1}{2}$ m.p.h. the bird would climb as long as he kept within it in a spiral path.

Now an ordinary observer has no evidence of such vertical air motion, for near the ground that motion must be negligible; but there is complete proof, both meteorologically and by direct measurement, of its existence. We know that in sunny weather. owing to the overheating of air near the ground, conditions in continental regions in summer in medium latitudes and in the tropics for much of the year are unstable; so that a mass of



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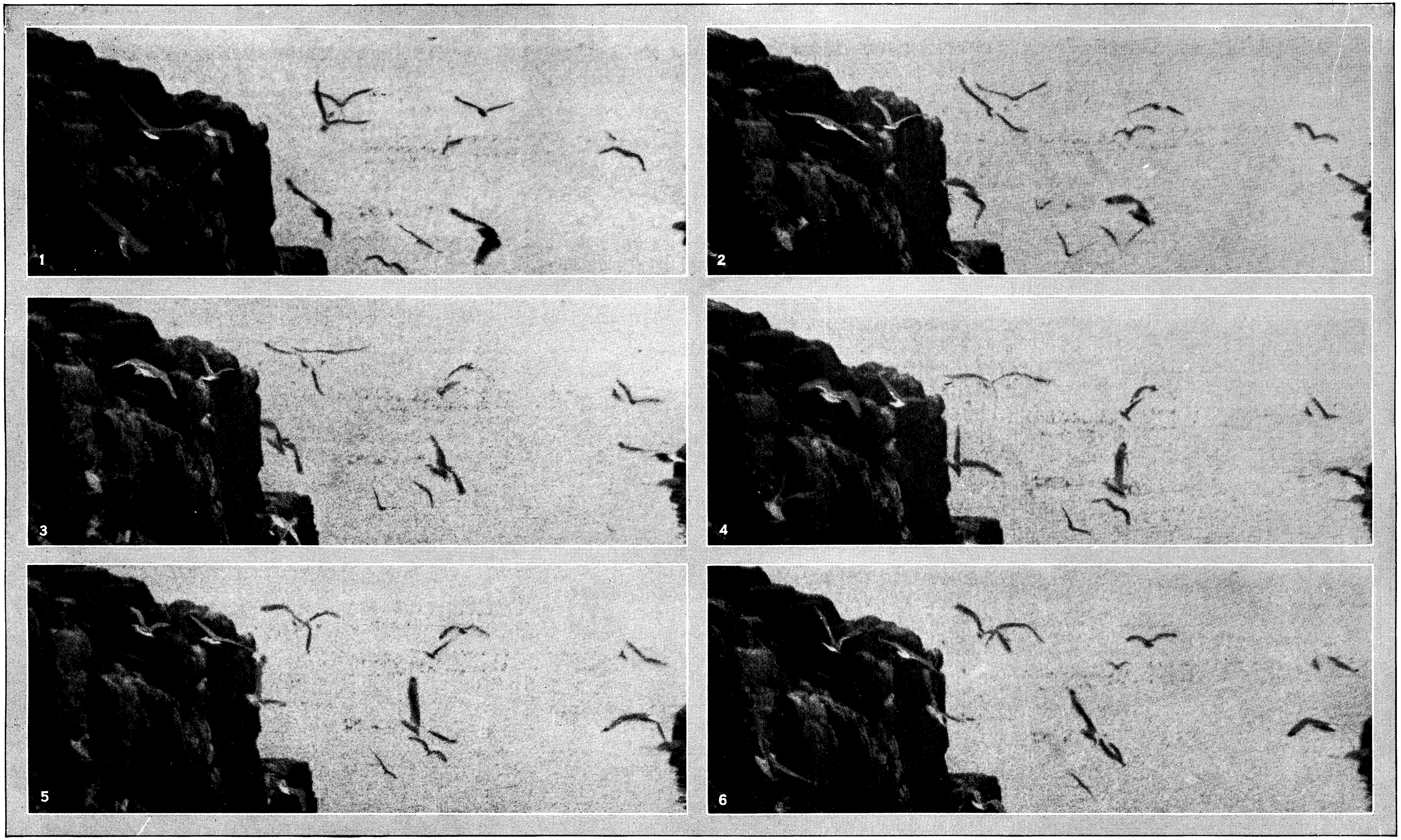
WILD SWANS IN STEADY FLIGHT

Series of cinema photographs, showing wing movements of birds in course of flight. The changes can best be observed by following the movements of the two birds at the top of the pictures. The wings are straightened at the end of the upward beat, curved at the end of the downward beat. At the beginning of the upward beat the wings are bent to avoid air resistance; at the beginning of the downward beat the wings are straightened to give maximum driving surface



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KITTIWAKE GULLS IN FLIGHT

The pictures in the series are timed at equal intervals. By observing the top gull against the dark cliff throughout the series a cycle or flap of the wings can be followed, ending in the rapid upward flick of the wings. 1, beginning of downbeat; 2, 3 & 4, movements in downbeat, showing twist or bend of wings; 5, 6, upbeat, wings raised in preparation for downbeat tips steeply inclined upward air rising above a heated rock will climb to a considerable height before it cools to the same temperature as the surrounding air and comes to rest. These local upward currents are experienced by meteorological kites and balloons, and their effects are described by aviators as "bumps"; in Egypt, for instance, they extend to heights of 4,000 to 10,000 feet. In addition to large currents there are "small vertical currents" whose bottoms can in many cases be detected "in the vicinity of a town by kites or hawks soaring," and whose vertical speed over hilly country is probably as much as 16ft. a second. The dependence of soaring flight on vertical currents is also completely confirmed by the observations of Idrac in Senegal.

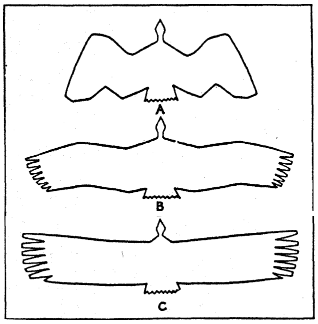


FIG. 2.—A VULTURE GLIDING ILLUSTRATING THE SHAPE OF WINGS WHEN (A) DESCENDING STEEPLY, (B) GLIDING EASILY AND (C) CLIMBING AS FAST AS POSSIBLE

When a bird of prey is "stooping" at a great speed he bends his wing considerably at the elbow and wrist joints as shown at (a) in fig. 2; when he is gliding and not troubling about climbing the bending is slight as at (b); but when he is trying to ascend all he can he straightens his wings and spreads out the primary quills (the pinions at the ends of his wings) so that they are separate from each other over a length of about a fifth of the wing, as at (c). Nature obviously attaches some importance to this feature for she employs a special device to increase the separation beyond that due to the mere fan-like spreading of the feathers; she deliberately leaves the primary quills of full width for about half their length and then steps down the width almost to half the previous amount for the outer half of the length of the quill. This feature, sometimes called the "notch" is apparently universal in birds of prey and the device, as a whole, strongly recalls the Handley-Page slotted wing which enables an aeroplane to climb at a much bigger angle of incidence. Thus G. T. Walker reports having seen vultures climbing on an upward current of about 12ft. a sec., their speed being about 25ft. a sec. up a slope of about 20°, the inclination of the wings also being 20°. If in fig. 3 OP=25 represents the velocity of the bird in space, PN the vertical rate of climb is about 8·5 f.s., so that if QP=12 represents the upward velocity of the air, the rate of climb through the ascending air is NQ=3·5 f.s. and OQ, the bird's path relation to the air, descends at about 8·5°, so that the real angle of incidence POQ is about 28.5°. At first sight it would seem as if the bird could not possibly maintain its forward motion against the resistance of the air. But if we consider the forces acting—the "lift" L (at right angles to the relative motion and so inclined forwards at 8·5° to the vertical) and the "drag" D—it is clear that the condition for maintenance of the forward motion is that the resultant of L and D shall be forward of the vertical, or that (since 8·5°=7·7) the lift shall exceed 7·7 times the drag; this condition is satisfied with a Handley-Page wing.

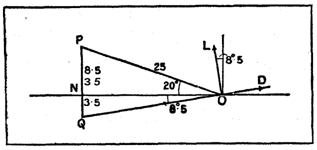


FIG. 3.—FORCES ON A BIRD GLIDING ON AN ASCENDING CURRENT SHOWING HOW THE BIRD IS DRIVEN FORWARD BY AN ASCENDING CURRENT ALTHOUGH THE UPWARD SLOPE OF ITS WINGS SUGGESTS A BACKWARD FORCE

When an aeroplane is losing pace the pilot is tempted to raise the nose of his machine so as to increase the angle of incidence of the wings and get an adequate lift; but this process checks his pace, and if he is still losing height, it may be that no further increase of the angle of incidence will support the aeroplane. The machine is thus said to "stall," control may be lost and a crash occur. Now at such times a Handley-Page slot is of great value in enabling control to be kept; and as a bird trying to climb fast is probably near the stalling angle very often, the slotted ends of its wings have probably the great advantage of enabling it to maintain control. Vultures when climbing may occasionally be seen to make sudden movement of the wings which ends in a short downhill path and probably indicates recovery from a difficult situation of this kind.

Gliding (or Sailing) When the Wind Is Not Uniform.—Lord Rayleigh indicated in general terms the mechanism by which the energy necessary to maintain flight could be derived from the variability of the wind. He pointed out that it is the velocity of the bird relative to the air, not its velocity relative to the ground, which determines the forces acting on it; and the bird can at any time by climbing upwards turn some of the energy of that relative velocity, with comparatively slight loss owing to air resistance, into energy of position; conversely he can with little loss by gliding downhill turn energy of position into velocity relative to the air.

Now if the bird is flying horizontally with relative velocity U, the potential height to which he could climb is $U^2/2g$, where g is the acceleration due to gravity; and if relative to the air he has an acceleration f in the direction of U, U^2 will after an extremely short interval τ become $(U \text{ and } f\tau)^2$ and will so increase at a rate 2Uf; hence the potential height will grow at a rate Uf/g. Also as the bird is moving horizontally L the "lift" must be equal to his weight; and if the ratio L/D is k, D will be the weight divided by k; so as the weight would produce a downward acceleration g, the backward acceleration due to the drag is g/k. Now if the wind is changing in any continuous manner it will have some acceleration where the bird is, which we can call f′, and by steering always so as to meet that acceleration he will secure an acceleration $(f'-g/k)$ through the air and will gain potential height at a rate $U(f'-g/k)/g$ or $U(f'/g-1/k)$. If the bird does not fly directly against the direction of f′ so that there is only a component —f″ along his path, f″ must replace f′ in this formula.

Now it has long been known that the velocity of the wind is in general far from steady and much light has been gained regarding the gustiness due to eddymotion of the air under various conditions. It has been estimated by Walker that in an ordinarily gusty wind of 22m. an hour the acceleration due to turbulence is in excess of 2fss. and for stronger winds proportionally higher. So for a bird with k=12, whose angle of descent would be 5°, we must have f/g not less than $\frac{1}{12}$ or f not less than $\frac{32}{12}$, *i.e.*, 25. Thus a wind averaging $22\times2\frac{2}{3}\div2$, or, say, 30m. an hour would enable a bird to keep up its velocity without flapping.

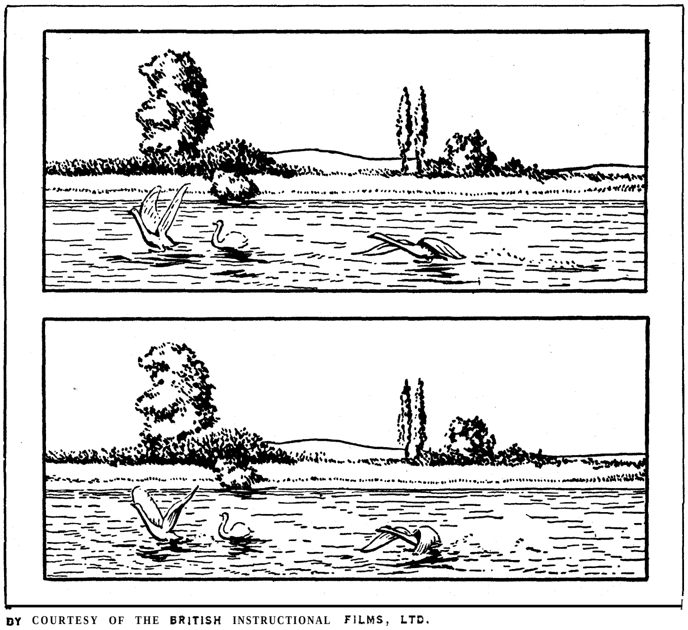
It may be noted that not only do some inland birds of temperate regions, such as rooks, and many sea-birds avail themselves of turbulence for sailing flight, but also tropical birds of prey who usually depend on convection currents. Thus on overcast days when there are not enough upward currents for kites and scavenger vultures to glide they usually remain in their trees; but occasionally a sudden change in the weather will start them gliding in all directions as if aimlessly, or for pleasure; and it would appear that turbulence afforded the explanation. Nonflapping flight is also possible when the wind, though steady, varies from place to place, as when a gull uses the screening of the wind by a vessel to describe circles near its stern.

The principle also has an important application to the gliding or sailing flight of albatrosses and other large sea birds in windy weather away from the influence of ships. It is known that the velocity of the wind must diminish down to the surface of the water owing to the influence of friction at the surface and of eddy-motion in the air; so by rising or falling a bird can get into a stronger or weaker current of air. If then he sails uphill against the wind, the air that he meets will be at increasing heights and will have an increasing velocity in the direction opposite to his motion, so that his rate of travel through it will not diminish as it would if the air were stationary; *i.e.*, he will gain potential height. Exactly the same happens if he sails downhill with the wind, which is then decreasing in speed and has an acceleration in the direction opposite to his velocity. The natural way to combine these effects is to describe circles in an inclined plane, always descending when moving to leeward and ascending when moving to windward. It is accordingly interesting that the results of a mission of Idrac to the south seas to study the problem entirely confirmed Rayleigh's ideas. He found (a) that such flight was only possible for very swift birds, the average speed of the albatross being 72 f.s. or 49 miles an hour; and (b) it needs a minimum wind of 17 f.s. close to the water.

Now the rate of increase of wind with height varies greatly with the conditions; and in the absence of detailed observations close to the surface of the sea we must utilize those over land made by the London Meteorological Office which agree with those at Nauen in giving an excess of 47% in the wind at 50 feet (5 metres) compared with that at $6\frac{1}{2}$ feet (2 metres) above ground. So corresponding to a speed of 24 f.s. at 7ft. we can deduce r, the velocity increase for 1ft. of height, as ·26 f.s. Further, it seems that over the sea in high latitudes the reduction of the velocity will not extend so high as over land, and r will be greater. We shall not be very far wrong in taking it as ·3 though Idrac's formula leads to only ·2.

If the albatross climbs a slope of 1 in 3 at 72 f.s. against the wind his rate of ascent is 24 f.s., so that the increase of the wind in a second is 7.2 f.s. If for simplicity's sake we may treat U as constant in the computation, the rate of gain of potential height $U\,(f/g - l/k)$ is 1·6ft. if $k=15$; so he would in 2 seconds of either climb against, or descend with, the wind gain enough energy to take him 116 yards before further thought was necessary. Of course, a greater rate of increase of wind with height, or a greater efficiency of design, would enlarge his powers, but a moderate rate would seem to give an albatross the ability to roam apparently at will. If he describes a circle inclined at 20° with the lowest point to leeward and say 5ft. above the sea, while the highest point is 50ft. above sea, Walker's approximate formula gives a gain of potential height of 13ft. on describing the circle. Reference may also be made to a letter to Nature by S. L. Walkden.

Flapping Flight.—Birds differ materially in the details of their flapping, the contrasts between the deliberate beat of a heron, the smooth silent flight of an owl, and the hurried whirr



BY COURTESY OF THE BRITISH INSTRUCTIONAL FILMS, LTD.

FIG. 4–5.— WILDSWANS RISING FROM THE WATER

In this series the swans are seen taking off from the lake. As greater driving power is needed than for steady flight, the wings are more rotated on the up beat and brought more forward on the down beat

of a partridge being conspicuous enough. But the general character of the wing movements is the same; and as there have been differences of opinion, mainly owing to the difficulties of observation, regarding the fundamental facts, it will be useful to refer to the twelve reproductions in Plate I. of wild swans derived from a "slow-motion" cinema film made by British Instructional Films, Ltd. In Plate I., fig. 1, the two top birds are marked (a) and (b), and in fig. 6 will be found diagrams (1) to (12) showing approximately the positions of the wings of bird (a) at instants corresponding with the figures of the plate. In them two features stand out prominently; (a) the time interval between successive pictures being constant, the time of a down beat is half as long again as that of an upbeat; and (b) though the wings are kept straight during positions 2–6 of a down beat, they are bent during 8–11 of the up-beat, the outer portions remaining almost at the same angle with the horizontal for the time 7–9, and being then lifted with a flick in the second half of the upbeat, 9–11. As may be readily seen in Plate I., the motion of the wings relative to the body consists of an up and down beat roughly in a vertical plane when the bird is in horizontal steady flight. The rotation, or twisting of the wing about its own long axis also is of importance as it affects the angle of incidence, *i.e.*, the angle between the direction of motion and the plane of the wing (between X'X and AB in fig. 1). It will be seen from Pl. I., fig. 3 that while the wings of b, during an upbeat, are inclined decidedly uphill, those of a, in a downbeat, are less clearly downhill; the same is true in figs. 6, 7 with a and b interchanged. If now the bird's body is describing from right to left an approximately straight line OQSU (fig. 7) a point in the outer portion of the wing will describe an undulating line OPQRSTU, with the upbeats steeper than the downbeats. So if we indicate the plane of the wing as shown in the film, clearly uphill at O and slightly downhill at Q, it will be seen that on the downbeat, as at Q, the angle of incidence is positive and the lift L is upwards at right angles to the path; while on the upbeat, as at S, the angle of incidence is negative, so that L is downwards and forwards. The drag D is always backwards along the path.

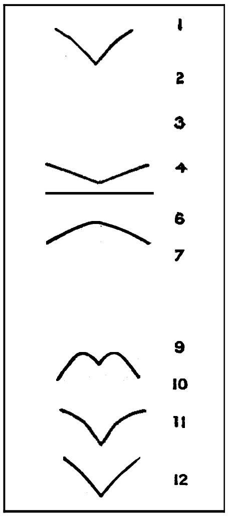


FIG. 6.—PROFILES OF WINGS DURING A DOWNBEAT AND AN UPBEAT MADE AT EQUAL INTERVALS SHOW THAT THE UPBEAT TAKES PLACE MORE THAN THE DOWNBEAT, THE OUTER PORTION OF THE WINGS BEING RAISED WITH A FLICK

It will be seen that the force L always tends to drive the bird forwards; and as it is much greater than D which tends to retard the forward motion, the outer portion of the wing contributes propulsion. Also both L and D have a downward tendency during the upbeat, though the tendency is upward during the downbeat; so this portion of the wing is of little avail for support. With the inner portion, however, the situation is quite different. Here the slight up-and-down motion is almost cancelled by the slight down-and-up motion of the bird's body, so that the flight is essentially non-flapping; the section of the wing must be adapted for high lift and the angle of incidence is positive so that there is lift all the time.

Reference to fig. 7 will show that the plane of the wing is twisted. Near the top of the upbeat, when the upward flick of the outer portion occurs, the plane of the outer portion at B will be inclined more uphill than of the inner portion at B_1, but this is not so in the early portion of the upbeat at A and A_1. And during the downbeat the outer portions of the wing will be inclined downwards but not the inner portion. These inferences may be verified in the illustration of Plate II. of Kittiwake gulls. In figs. 1, 2 of Pl. II., we have the downbeat of the marked bird with the downward inclined tips seen almost edge on. At the beginning of the upbeat in 15, the inner portions are inclined uphill more than the tips; but in 5, during the flick, the tips are inclined uphill more steeply than the inner portions.

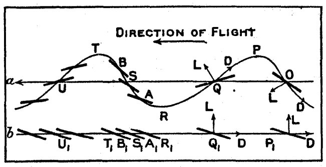


FIG. 7.— THE ROTATION OF THE WING: (A) OUTER THIRD, (B) INNER THIRD, ILLUSTRATING WHY THE INCLINATION OF THE INNER AND OUTER PORTIONS OF A WING IS DIFFERENT DURING THE FLAPPING FLIGHT

As will be seen from the reproductions, the swans (a) and (b) are ascending, so that their beats must be stronger than if they were flying horizontally; and it is worth while to see what modifications occur when a bird has to exert all his force. In the figures 4–6 we have some wild swans flapping hard to get into the air, that to left in 4 beginning his downbeat; that to right is beginning his upbeat. They have not yet acquired much pace, and are using their feet as well as their wings. It will be seen in 5, that, as far as rotation is concerned, the plane of the wings of one is inclined downhill, while that of the other is uphill, and the reason is that, with a speed insufficient for the inner portion to support the weight by mere gliding, the bird has to adopt an uphill path and aim at more propulsion; so he uses most of the wing as he previously used only the outer portion, and with marked rotation of the type indicated in fig. 8. At the lowest point (*see* fig. 5) the wings are rather forward, partly in order to avoid the water. but also in order to secure propulsion along a more upward direction.

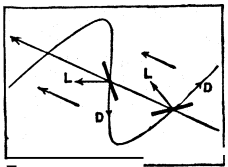


FIG. 8.—BIRD CLIMBING STEEPLY, SHOWING HOW THE WHOLE WING IS EMPLOYED IN PRODUCING FORWARD DRIVE

The question naturally arises whether a machine fitted with aerofoils of known properties as wings attached to a torpedo-shaped body would support and propel itself in the air if its dimensions and weight were those of a typical bird such as a rook; and the wings were flapped in approximately the same manner. To this Walker, as the result of an approximate computation with a "high lift" inner third of the wings for support and a flat outer third for propulsion, replies "Yes." He also finds that the power requisite compares not unfavourably with that necessary for a screw propeller driving a gliding bird with fixed wings.

Flight by Creatures Other Than Birds.—There is no evidence of the use by these of principles other than those described; and it will therefore suffice to indicate the chief types:—Bats, Flying Lemurs, Flying Squirrels, Flying Phalangers; Pterodactyles (extinct), Flying Lizards (or Dragons), the Flying Snake of Borneo; Flying-fishes, Flying-gurnards, American and African Fresh-water Flying-fishes; Insects.

See also AERONAUTICS and the long series of articles described under AERONAUTICAL ARTICLES.

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See also the following works of general reference:—O. Lilienthal, *Bird flight as the basis of aviation* (tran. A. W. Isenthal, 1911), and the *First Report* of the Bird Construction Committee of the Aeronautical Society of Great Britain. (G. T. W.)

FLINCK, GOVAERT (1615–1660), Dutch painter, was born at Cleves on Jan. 25, 1615. He first studied under L. Jacobszon in Leeuwarden and later entered Rembrandt's studio, becoming one of the master's most accomplished followers. As a painter of Biblical and allegorical subjects he at first modeled himself very closely on Rembrandt's style, as, for example, in his "Crucifixion" (1643?) in Basel, but later he developed a more florid and oratorical manner, in which he appears to have been influenced by Rubens, as in the allegory of 1654, "Amalia van Solms Mourning the Death of Her Husband. Prince Frederick Henry of Orange," in the Rijksmuseum, Amsterdam. Flinck's most successful genre was portraiture. In this, too, his earlier works are extremely close to his master, for instance the "Portrait of Rembrandt," signed and dated 1639, in the National gallery, London. which had passed (with the aid of a forged signature) as a self-portrait by Rembrandt himself. In later portraits his own individuality is more apparent, and he is especially successful in his groups, among which one may single out the portrait of "A Goldsmith and his Family" in Brussels, and the splendid large groups of "Civic Guards" in the Rijksmuseum. Flinck died at Amsterdam on Feb. 2, 1660. (R. E. W. J.)

FLINDERS, MATTHEW (1774–1814), English navigator, was born at Donington in Lincolnshire on Mar. 16, 1774, and entered the navy in 1789. He served in the "Bellerophon" at Ushant in 1794, and from 1795 to 1799 was engaged in exploration on the Australian coast, including the circumnavigation of Tasmania in 1798. On his return to England he was appointed to the command of an expedition for the thorough exploration of the Australian coasts. The sloop "Investigator" left Spithead on July 18, 1801, and reached Cape Leeuwin on Nov. 6. On his way round the coast he met the French exploring ship "Le Géographe" on Apr. 8, 1802, in what is now Encounter Bay. The narrative of the French expedition claimed discovery of most of the land west of the point of meeting, and the matter was not cleared up till the publication of Flinders' book in 1814.

Flinders reached Port Jackson on May 9, 1802. On July 22 he set out again to complete the circumnavigation of Australia. He examined the Great Barrier Reef and surveyed the gulf of Carpentaria, and then, finding the "Investigator" to be in a leaky state, sailed round the west and south of Australia back to Port Jackson, which he reached on June 9, 1803, after a voyage in which much suffering had been endured by everyone, particularly from scurvy. He left Port Jackson for England in the "Porpoise" which, together with the "Cato," was wrecked on a coral reef, about 800 miles out, on Aug. 17. The officers and men camped on a small sandbank, while Flinders returned to Port Jackson in a six-oared cutter to obtain relief. He got back and took them off on Oct. 8, and on the 11th sailed again in the "Cumberland." Putting in at Mauritius on Dec. 15, he found England and France at war, and his passport from the French government did not cover the "Cumberland." He was detained until June 1810, and reached England in October. His narrative, *A Voyage to Terra Australis*, was published on July 19, 1814, on which day Flinders died. This work contains very valuable scientific observations, especially with regard to magnetism, meteorology, hydrography and navigation. He seems to have been the first to discover, and correct for, the errors of the compass caused by iron in ships. He also wrote *Observations on the coast of Van Diemen's Land*, etc., and two papers in the *Phil. Trans.* in 1805 and 1806.

FLINDERS BARS, vertical bars of soft iron placed in front of or behind a ship's compass to compensate the disturbing magnetic effects due to the vertical soft iron parts of the ship. Other effects due to soft and hard iron in horizontal and vertical directions are also eliminated by bars or by spheres appropriately placed. *See* COMPASS.

FLINDERS RANGE: *see* AUSTRALIA.

FLINSBERG or SWIERADOW ZDROJ. a village in Lower Silesia region, Wroclaw province, southwestern Poland. It lies near the Czechoslovakian border at the foot of the Isergebirge on the Kwisa river about 18 mi. W. of Hirschberg (Jelenia Gora). Pop. (1946) 2,994. Flinsberg is a noted health and winter sports resort.

FLINT, AUSTIN (1812–1886), U.S. physician, was born at Petersham, Mass., on Oct. 20, 1812, and graduated in medicine at Harvard university in 1833. From 1847 to 1852 he was professor of medicine in Buffalo Medical college, of which he was one of the founders, and in 1852–56 he filled the same chair in the University of Louisville. From 1861 to 1886 he was professor of medicine in Bellevue Hospital Medical college, New York. He wrote many textbooks on medical subjects. among these are *Diseases of the Heart* (1859–70); *Principles and Practice of Medicine* (1866); *Clinical Medicine* (1879); and *Physical Exploration of the Lungs* (1882). He died in New York on March 13, 1886.

His son, AUSTIN FLINT (1836–1915), who was born at Northampton, Mass., on March 28, 1836, after studying at Harvard and at the University of Louisville, graduated at the Jefferson Medical college, Philadelphia, in 1857. He then became professor of physiology at the University of Buffalo (1858) and subsequently at other centres, his last connection being with the Cornell University Medical college (1898–1906). His *Text-book of Human Physiology* (1876) was for many years a standard book in U.S. medical colleges. He also published an extensive *Physiology of Man*, 5 vol. (1866–1874) and other valuable medical works. He died in New York city on Sept. 23, 1915.

FLINT, TIMOTHY (1780–1840), **U.S.** clergyman and writer, an important social historian of the early Ohio valley, was born near North Reading, Mass.. July 23, 1780. After graduation from Harvard in 1800 he served as a Congregational minister at Lunenburg, Mass., 1802–14. In 1815 he left for the Ohio valley, engaging in missionary work for a time and farming at St. Charles, Mo. Subsequently he visited Louisiana and was principal of a seminary at Alexandria. Plagued by ill health, he moved to Cincinnati, O., where he edited the *Western Monthly Review* (1827–30) and devoted himself to literary work. He served briefly as editor of the New York *Knickerbocker Magazine* (1833). Besides editorial work. Flint wrote history, biography and four novels. His *Recollections of the Last Ten Years* (1826) is a valuable account of early western life and manners. In 1826 he also published his best novel, *Francis Berrian: or the Mexican Patriot,* in which he utilized some of his own experiences. *A Condensed Geography and History of the Western States* appeared in 1828 (rev. ed., 1832), his edition of the *Personal Narrative* of the adventurer James O. Pattie in 1831 and his biography of Daniel Boone in 1833. *George Mason, the Young Backwoodsman* (1829) is a novel of Mississippi river life, and *The Shoshonee Valley* (1830) is a far western romance notable for its fantastic plot and lush description. He died at Reading, Mass., on Aug. 16. 1840.

See J. E. Kirkpatrick, Timothy *Flint* (1911), which contains a bibliography. (J. T. Fn.)

FLINT or FLINTSHIRE (*Sir-y-Fflint*), a county of north Wales, bounded north by the Irish sea and the Dee estuary, east by Cheshire, and south and west by Denbighshire. Pop. (1951) 145,279. Area 255.8 sq.mi. Included in Flint are the detached parish of Marford and Hoseley, lying 2½ mi. southeast of the main part of the county, and the hundred of Maelor, a separate rural district, lying 8 mi. southeast of the main part. Maelor is bounded by Cheshire, Shropshire and Denbighshire.

Physical Features. — The county is dominated by the Clwydian hills running south-southeast to north-northwest. Their western slope to the Vale of Clwyd is steep but the eastern slope over much of the county to the Vale of Dee is more gentle. The Clwydian hills are entirely of Silurian age; their highest point is Moel Fammau (1,820 ft.) on the Flint-Denbighshire boundary. The Silurian strata of the hills, all of Ludlow age, are faulted against the Triassic (Bunter) Red Beds in the Vale of Clwyd. On the eastern flank of the range the Silurian is overlaid by Carboniferous rocks which, for their economic value, are the most important rocks in the county. A band of Carboniferous Limestone passes from Prestatyn on the coast, forms the Halkyn mountain (943 ft.) and continues west of Mold to beyond the county boundary. Above these beds come the Holywell Shales while upon them lies the Gwespyr Sandstone. Farther to the east the Coal Measures extend from Talacre through Flint and Mold to Hope. A purple sandstone succeeds the Carboniferous Limestone in the neighbourhood of St. Asaph.

The Alyn enters the county near Moel Fammau and passes Cilcen and Mold with a section of underground drainage in the Carboniferous Limestone near Hesb-Alyn ("the drying up of Alyn") and bends south to Caergwrle, re-enters Denbighshire and joins the Dee. The Dee enters Flintshire near Overton and divides Maelor from Denbigh on the west, then passes Chester and forms the eastern boundary of the county on the northeast. It enters the Irish sea by means of a wide but shallow estuary. The northeastern part of Flintshire is a low-lying country bordering the Dee estuary which extends westward to the mouth of the Clwyd valley. This has been one of the great "ways" into Wales for many centuries. Short stretches of blown sand occur between Rhyl and Talacre.

History **and** Architecture. — The post-Roman centuries saw Flintshire under the influence of the Celtic saints, the Saxons and the Northmen. St. Beuno, who has been called the St. David of the north, is commemorated by legends in Flintshire. The lives of St. Kentigern ascribe to that long-lived Glasgow saint the foundation of the monastery of St. Asaph, later the cathedral city of the diocese. One of the few relics of ancient Christianity in the county is a late sculptured cross, Maen Achwyfan, in Whitford parish. The Anglo-Saxon occupation of the more fertile low-lying part of the county left its mark on place names as far north as Prestatyn. The famous earthwork, Offa's dyke, a poor defensive work with a gap of over 20 mi. between Pantasaph and Treuddyn, is backed by the shorter and better preserved Watt's dyke, which begins near Holywell and runs out of the county beyond Hope. Sir Cyril Fox in his standard work (*Offa's Dyke*, London, 1955) shows that the dykes start 12 mi. apart at Prestatyn and Holywell and that the lines almost converge at a point outside the county.

The Normans at first found north Wales an easy prey. A great castle and a borough were built at Rhuddlan. The twin lordship of Mold and Hawarden became the prize of the Montalt family, who had castles at both places. Flintshire was the easy road into north Wales and for 200 years. as Welsh resistance stiffened, nar in the county was almost unceasing. The earls palatine of Chester fought many of the early battles. Henry II suffered a decisive check (1156) in the forest of Ewloe. Henry III relied greatly on his favourite castle at Dyserth and struggled to defend it in a long war and through many truces. Edward I finally built a great castle and a borough at Rhuddlan on a new site, and a castle and bastide at Flint, and achieved a final conquest in 1284. The Welsh had revived notably under Owain Gwynedd and the two Llewelyns, and the result of this roo years' fighting was that Welsh influence penetrated almost to the walls of Chester.

Edward I in 1284 formed the county of Flint out of the northern cantred of Tegeingl, taken from the Welsh principality of Gwynedd; the hundred of Maelor, taken from the dowager of the Welsh princely line of Powys Fadog; and Hope and Hopedale, anciently part of Powys and taken immediately from the last Welsh prince, David. The county was in three detached portions. When Henry VIII suppressed the lordships of the march, in the Acts of Union (1536–42), he gave Moldsdale and Hawarden to Flintshire and so joined the cantred of Tegeingl to the land of Hopedale, leaving the county in two main portions, as it is still.

In the civil war of the 17th century, Flintshire was solidly royalist, and the castles. Hawarden, Flint and Rhuddlan, were garrisoned again to protect the communications between Chester and north Wales and Ireland. After the fall of Chester, the castles surrendered slowly and were slighted (dismantled) by order of parliament.

The county contains two mediaeval religious houses — Basingwerk abbey, near Holywell, a Cistercian house founded about 1131 and patronized alike by Welsh princes and Norman counts, and Rhuddlan priory (*c.* 1258), a house of Dominicans; its ruins were later incorporated in a farmhouse. The rise of the great Welsh religious denominations in the 18th and 19th centuries caused a profound change in the social life of Wales. Flintshire, especially on the English border in the Maelor district, had early associations with Puritanism. But the Calvinistic Methodism of the highlands of Denbighshire was not so marked in Flintshire, though the western section of the county was much affected. Holywell has always been a Roman Catholic centre.

In the second half of the 19th century. Daniel Owen (1836–95) of Mold, wrote a number of Welsh novels depicting the life of his times, and earned a permanent place in Welsh letters. The county has been influenced in its architecture as in its life as much from England as from Wales. In addition to the notable Edwardian castles — Flint, with an unusual plan, and Rhuddlan — there is the interesting castle of Ewloe, built by Welsh princes in imitation of Norman work. The prosperity of the county in the 16th and 17th centuries is shown by a large number of country houses of that period. such as Fferm, Gwysaney, Rhual, Golden Grove, Plas Teg, Vaenol. In the 18th century Leeswood hall was built from the profits of lead mining. The most elaborate church is perhaps the old Perpendicular church of St. Mary in Mold, built by the Stanleys in Cheshire style.

Archaeology. — Caves in the Lower Carboniferous rocks bordering the Vale of Clwyd have yielded plentiful remains of Pleistocene mammals, particularly Cae Gwyn and Ffynnon Beuno near Tremeirchion and the Gop cave, Newmarket, or Trelawnyd. Microliths found in the Gop cave suggest Mesolithic occupation and a Mesolithic site has also been recorded near the coast at Prestatyn. Few traces of Megalithic influence survive in the county, Neolithic occupation has been proved at Dyserth and Gwaenysgor in the north near the coast, and the Gop cave was used in Neolithic times for burial and shelter. The later Bronze Age was obviously an important time in the county's prehistory. Barrows are numerous especially on the Halkyn-Brynford plateau. Sir Cyril Fox's excavation of the earth circle and barrow at Lower Stables farm in a distant part of Ysceifiog parish is a notable piece of work. A gold ceremonial cope or tippet, now in the British Museum, London. was found at Mold in 1823. About the same time a gold torque was found somewhere in the large parishes of Caerwys or Ysceifiog, and a gold hoard just over the county boundary at Maesmaenan. The Caergwrle cup, in the National Museum of Wales at Cardiff, is probably of this period. A jet necklace of unusual type appeared in a barrow at Llong, which was under excavation in 1956. The impressive hill forts on the Clwyd range have yielded finds of Roman coins. A tribe known as the Deceangli held what is modern Flintshire as their territory. They were overrun by the Romans in an early campaign and the great legionary fortress at Chester must have kept them in subjection. Considering the nearness of Chester, the scarcity of Roman remains in Flintshire is a mystery. Some of the land may have been densely forested and uninhabitable. There were Roman smelting-works at Flint and pigs of lead have been found marked DECEANGL, the name of the Celtic tribe occupying what was later called Tegeingl in Welsh. A Roman bathhouse of legionary type has been found at Prestatyn and the important and ancient Talargoch lead mines are nearby.

Agriculture and Industries. — The Vale of Clwyd is well known for its pasture lands. Out of the 163,712 ac. of land in the county, 117,58j were, in the mid-1950s, under crops and grass, of which 21,704 ac. were in tillage crops. Oats, mixed corn and wheat are the chief crops. Milk production is the main enterprise, while pigs and poultry contribute materially to the farming economy. There is a high stock density, Friesians being a leading breed followed by Ayrshires and Shorthorns. Early lamb production was increasing in the mid-1950s, Welsh ewes being crossed with Border Leicester and Down rams.

Flintshire is, from an industrial point of view, one of the most important of the Welsh counties. It has been known from early times that the county was rich in mineral deposits as the Romans mined lead there, later copper and lead were worked and throughout the 19th and early 20th centuries a considerable quantity of coal was mined and there are still coal mines in the county. Copper and lead are no longer worked.

In the first half of the 19th century large industries sprang up with consequent substantial increase in the county's population and prosperity. The principal manufacturing industries include iron and steel, rayon, aircraft manufacture, chemicals, paper making, woollen textiles, cement, brick-making and quarrying in its various forms. Steel is manufactured on a large scale on Deeside. The principal product is steel sheet. There are large iron works producing mainly a manganese alloy of iron. In the Flint area are some of the largest rayon plants in Europe manufacturing rayon staple fibre by the viscose process, with distribution to Lancashire, Yorkshire and abroad. Rhyl and Prestatyn are attractive seaside resorts on the north coast.

Administration and Communications. — Flintshire is divided into 4 rural districts, 6 urban districts and the municipal borough of Flint (pop., 1951, 14,267). Between the census of 1931 and that of 1951 the population of the county increased by 32,219 chiefly because of industrial development. Flintshire is within the Wales and Chester circuit and the assizes are held at Mold; there is one commission of the peace. Considerable interest is taken in technical and agricultural education, the county council having provided a modern and extensive technical college and a horticultural college. The main part of the county is in the diocese of St. Asaph, but there is a small portion in that of Chester. The county returns two members to parliament, for East and West Flint.

The Chester-Holyhead main railway line runs along the east and north coasts of the county and a branch line from Chester to Mold and Denbigh serves the central area.

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(W. H. Js.)

FLINT, a city of southeastern hfichigan, U.S., 62 mi. N.W. of Detroit; county seat of Genesee county. Pop. (1960) city, 196,940; standard metropolitan statistical area (Genesee county), 374,313. The city was named for the Flint river. The first settlement occurred at the Grande Traverse, where the Mackinaw trail crossed the river; there Jacob Smith, a Detroit fur trader, established an outpost in 1819, soon after the land passed from Indian control. The emigration of settlers from western New York led to the organization of the county, with Flint as the county seat, in 1836. Flint became the trading centre of the Saginaw valley farming area and was incorporated as a city in 1855.

For the next 30 years, Flint was one of Michigan's lumbering centres, but with the depletion of the pine stands in the 1880s, Flint's importance declined. The success of the two-wheeled road carts manufactured by the Durant-Dort Carriage company in 1886 opened its manufacturing era. By 1900 Flint was widely known as the "Vehicle city," with a population of more than 13,000 and a production of more than 100,000 horse-drawn wagons and carriages annually. The body, spring and wheel companies of the carriage industry became the suppliers for the rapidly expanding Buick Motor company, organized in 1903. Thereafter, the city's growth paralleled the business successes of William C. Durant and other former carriage makers. In 1908 Flint's major manufacturing resources were consolidated into the General Motors company. Flint's continued growth reflected the success of the automotive industry, and in the second half of the century it was the site of the largest single manufacturing operation of the General Motors corporation. Supplying the needs of that industry and other commercial activities are two railroads, the Grand Trunk Western and the Chesapeake and Ohio, and many trucking lines. Flint's retail trade area has a radius of 25 mi.

At mid-century, more than 90% of the total manufacturing labour force was engaged in some phase of the automotive industry. According to the 1950 federal census, more than 85% of Flint's population was native-born. By 1958, however, it was estimated that less than 20% of its population was born in Genesee county. The continued migration to the automobile factories, begun in 1904, had considerable influence on Flint's metropolitan population.

Flint adopted the commission-manager form of municipal government in 1929. A 1933 amendment established a nine-ward division of the city with a commissioner elected from each ward. The rapid growth of the metropolitan fringe area after World War II encouraged efforts to bring the whole area of 162 sq.mi. under a single government.

A new municipal centre, including a city hall, municipal court building, police department headquarters and health department building and auditorium, was completed in 1958 at a cost of more than $7,000,000.

In addition to its public school system. Flint's educational institutions include a publicly supported junior college; the General Motors institute, a private technical school; the Mott foundation (which offers a program in co-operation with the community schools); and the Flint college of the University of Michigan.

As part of Flint's $25,000.000 college and cultural development project, a combined campus for the city's two colleges was dedicated in 1954, and four years later a natatorium, art centre, planetarium and theatre were completed. A new public library was also opened in 1958. The city park system included three golf courses, four swimming pools, and over 1,750 ac. of parks.

(R. H. V. B.)

FLINT, a municipal borough in the East Flint parliamentary division of Flintshire. Wales, on the Dee estuary, 12 mi. W N.W of Chester by road. Pop. (1951) 14,267. Area 10.6 sqmi. At Pentre, along the coast, was a Roman settlement. Flint castle was built on an isolated rock by the river side by Edward I, whose architects laid out the town, geometrically, beneath the castle and who granted it the first charter in 1284. The castle held out against Owen Glendower; it was held for the king during the Civil War but taken, after siege, by the parliament, and finally dismantled in 1647.

First a market town and seaport, Flint became, in the 19th century, a coal-mining and lead-smelting town. The introduction of rayon manufacture, still the chief industry, brought it prosperity in the 20th century and other industries include paper mills at Oakenholt, iron and steel works at Shotton and aircraft manufacture at Broughton.

FLINT: see CHERT AND FLINT.

FLINT-LOCK: see SMALL ARMS, MILITARY.

FLINT RIDGE CAVE SYSTEM, in Mammoth Cave National park (*q.v.*) in Kentucky, is an integrated complex of caves and underground rivers. Thirty-five miles of passages are known. The integration of the system has been established by surveys and exploration and by an extensive series of dye tests conducted on the underground drainage. Flint Ridge is an erosional plateau of ten square miles, capped by layers of resistant sandstone and impervious shale and underlain by 275 ft. of relatively pure limestones, all bedrock being of Middle Mississippian (Carboniferous) Age. This unique stratigraphic sequence in a karst (*q.v.*) area is responsible for the unusual characteristics of this cave system.

Especially prominent, in addition to its great length, are the localized abundance of distinctive vertical shafts, many of which exceed 150 ft. in height; fantastic and extensive sulfate mineral decorations; sparse but attractive stalacto-stalagmite displays; the magnificent size of many of the cave passages; and archaeologic artifacts.

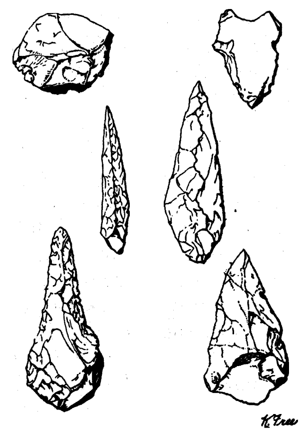
Individual caves which have played a part in the region's colourful history include Salts, Colossal, Unknown, Floyd's, Potato, Logsdon, Great Onyx and Blair. The hub and gateway of the system is Floyd Collins' Crystal cave, named after its discoverer (1917) nho also lost his life there (1925) trying to find a new entrance, and its Blind Fish river which issues as Pike spring on Green river (the base-leveling surface stream of the region), where all of the affected drainage converges. Much of the knowledge of this system is due to the efforts of attack teams of the National Speleological society and the Cave Research foundation.

(E. R. P.)

FLINTS. The term flints is popularly used to denote implements made by men of the Stone Age, since in Europe flint and flinty materials were frequently used for that purpose.

Flint is a hydrated silica containing a varying amount of water loosely held in combination. When pure it is translucent, but impurities render it opaque and coloured, commonly either black or brown. Irregular flint nodules occur native in horizontal bands in chalk. Their origin is not clearly understood. In some cases it is undoubtedly due to marine organisms, such as sponges which, requiring silica for their growth, secrete it from the water.

Under certain imperfectly understood conditions the water in the flint seems to dry out, leaving on the exposed surface a thin film of white silica; this is known as the patina. When thick it gives a quite white appearance; when very thin the colour of the unchanged flint underneath shows through, so that a black flint will have a blue appearance. Flint itself is impervious to moisture, but the patina is porous. Thus when patinated flint occurs in gravels containing iron salts a yellow staining, producing the well-known ochreous patina, results. Patinated flint embedded in peats also gets stained in a characteristic manner. Other varieties of staining called by fanciful descriptive names are often due to the patina occurring in patches; thus we have the "toad-belly" patina found in certain gravel pits in East Anglia. Originally the patinated surface is matt, but where the object has been rolled to some extent in soft sands or loams it becomes polished and lustrous. The thickness of the patina skin is partly a question of the length of time during which the weathering process has operated but it naturally depends on local conditions.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

FLINT IMPLEMENTS OF THE OLD STONE AGE

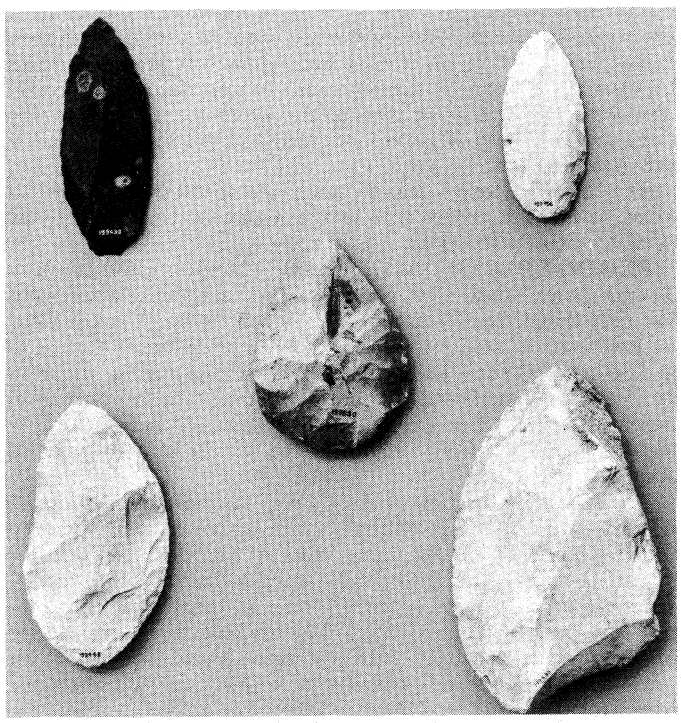
The discovery of artificially chipped flint in soii belonging to the Palaeolithic epoch has enabled science to trace, with firmer conviction, the history of man back to that period

Flints are fractured easily and evenly in three ways, by percussion, by pressure, and by temperature changes.

Percussion Flaking. — If a lump of flint is struck with a sharp blow concentrated at a point it breaks in such a way that a sort of cap can be lifted off, exposing a double cone consisting of a broad angled cone resting on the truncated apex of another with steeper sides, there being a more or less sharply defined shoulder at the junction of the two. The cap which comes off naturally shows a hollow corresponding to these cones; this is known as the negative cone. If the blow is delivered on the margin of the block a flake comes off showing a swelling near the point of impact. This is the so-called bulb of percussion; it is a partially formed cone. Around this bulb curved lines often appear on the flake, the concavity being always toward the apex of the bulb. This is important. as it sometimes happens in the case of an implement that the bulb has been removed subsequently; but it is still possible to tell from these curved lines the direction from which the blow originally came. When the blow has been particularly intense, lines of fracture radiating from the point of impact also appear on the surface of the flake. They form radii to the curved lines. A small flake scar known as an *éraillure* is often seen on the surface of the bulb. This is not due to an attempt by prehistoric man to get rid of the bulb, but appears under certain conditions when a flake is struck off.

When a piece of flint is struck the force of the blow rapidly diminishes as it penetrates the dense medium. Should there be sufficient energy the fracture set up by the blow, especially if it is struck diagonally outward near the edge, will go right through the flint. a flake being removed. In this case the new flake-scar forms a clean angle where it meets the original surface of the flint. Should the blow be directed inward, however, and only penetrate a short way into the flint the shattering will cause a fragment to break off which leaves ridges where the two surfaces meet. The first method is known as "feather-edge" flaking, the second as "resolved" or "step" flaking. Both were used as secondary working to toughen an edge and it is important to differentiate between the two, as resolved flaking is especially common in certain prehistoric cultures. In nature percussion flaking takes place by torrent action, where materials are hurled together, the result being chipping in all directions (flint thus knocked about shows innumerable minute incipient cones of percussion); by sea action, where not only is beach material hurled by the waves against larger fixed rocks and so chipped indiscriminately, but also is sucked back by the waves, so that any chance lump of flint embedded in the beach becomes in time much chipped in one direction by the passing pebbles; by ice action in glaciated regions.

Pressure Flaking. — This method of flaking flint was employed by prehistoric man and is still used by many primitive peoples, such as the aborigines of Australia. The aborigine takes a flake and, using the sole of his foot as a tough anvil, presses off little flakes along the margin, wherever he requires a sharp edge or desires to remove material. When a large flake is thus removed a bulb of pressu-e corresponding to the bulb of percussion appears, but it is, as a rule, considerably flatter. Usually flakes removed by pressure are small and scalelike. The resulting flake scar shows a large number of curved lines like those round a bulb of percussion but generally rather flatter and closer together; the consequent reflection and refraction of light give a characteristic glassy or waxy appearance to an unpatinated pressure-flaked surface. In nature pressure-flaking results from the differential movement of gravels containing a large number of pebbles, such movement being often due to the slipping of a gravel bed down the side of a valley or the caving-in of a gravel bed owing to the solution of some underlying limestone deposit by underground streams. Thus pebbles get forced against one another; and in the latter case especially the pressure tends to come all from one direction, and so definite trimmed edges are produced.



BY COURTESY OF CHICAGO NATURAL HISTORY MUSEUM

OLD STONE AGE FLINTS FOUND AT LE MOUSTIER, FRANCE

Upper row: points, used for spears or arrows; centre: a hand ax; bottom row: side-scrapers

Temperature Changes.—Flint is a very poor conductor of heat but it expands with a rise of temperature. If then the exterior is rapidly heated accommodation with the interior has to take place and there results a series of fractures. In this case no bulb of any sort occurs, but the fractured surface is covered with irregular closed rings. This method has been rarely used by man; but thermal fractures. as they are often called. naturally caused by daily and seasonal changes in temperature, are of common occurrence. Frost action is especially characteristic. As a rule the surface of the flint becomes pitted and covered, as it were, with small hemispherical depressions. Under certain circumstances, too, prismatic bars of flint are found, the formation of these being analogous to that of the prismatic columns occurring in basalt. This is commonly known as "starch" fracture. At first sight these prismatic bars of flint might be taken for cores from which long narrow flakes had been removed. The complete absence of any bulb, coupled with an appearance characteristic of a thermally fractured surface but difficult to describe, at once distinguishes the two.

Mr. Reid Moir has attempted, by studying microscopically fractured surfaces of the flint, to distinguish between the various methods just described. With regard to the appearance of percussion and pressure-flaked surfaces, a rough analogy may be made respectively with the surface of an apple cut by a knife, which is smooth, and that of an apple broken between the two hands, which is rougher and more hackly. No results, of course, can be obtained where the surfaces have been subsequently patinated.

It has become desirable to find criteria which will demonstrate whether a chipped object has been fashioned by man or by nature. As noted previously, when nature chips flint, whether by percussion or pressure, the direction of the blow or pressure comes either from one or an infinite number of directions. What nature cannot do is to apply blows or pressure in two or three definite directions more or less at right angles to one another. Thus it is difficult for nature to knock off a flake and then trim one of the edges, an action involving two directions of blows; and it is almost impossible to invoke nature as the agent if we find a specimen showing also a "prepared" platform on which the blow making the original flake had been struck, thus involving blows from yet a third definite direction. Nor would it have been more possible for nature to achieve this result did we postulate, as might more probably be the case, that the direction of the blows remained constant and that the object itself was revolved once or twice through go° while receiving the blows.

Of course prehistoric man did not only make his tools of flint, chalcedony, chert, and other flintlike materials which furnish a sharp but brittle working-edge; any kind of fine-grained rock was utilized. In these latter materials the fracture phenomena are similar to those of flint but are far less in evidence and much more difficult to identify. Such rocks, too, fracture irregularly, and it was not till Neolithic man adopted a grinding and polishing technique that a sharp regular edge was obtainable which had the added virtue of being tough.

Typology (*q.v.*) enables the prehistorian to group the various tools of the Stone Age into families according to their purposes or significant characteristics. The following is a summary of the more important of these tool families.

Coups de **poing** (sometimes called hand-axes or bouchers).—Originally pear-shaped, boldly flaked, and with irregular edges; later they become flatter and finer. An oval form also develops. In the latter case the edge shows the "S" twist characteristic of the Acheulean culture, where the top part of the tool is, as it were, slightly rotated upon the bottom half. The coup de poing family is especially characteristic of Lower Palaeolithic cultures.

Scrapers.—The essential feature of the scraper is its sharp, convex edge. The chief varieties are side-scrapers, end-scrapers on blades or flakes, round-scrapers and core-scrapers. Side-scrapers generally show the characteristic "resolved" flaking and belong to the Mousterian culture: the other varieties are post-Mousterian. A special kind of core-scraper, in which the flakes removed are narrow and flat and rise fanwise to a well defined keel, is known as the keeled or tarti-scraper. It is a characteristic tool of the Middle Aurignacian culture, when such a fluting technique was common.

Awls.—A true awl has a point prepared by careful trimming all round. Pseudo-awls which have the point trimmed only halfway round, the under surface remaining a part of the general flake surface, are, however, common.

Points.—These form a varied family comprising a number of related types and others the connection of which is more obscure. Some types were doubtless used as lance-heads, *e.g.,* the Mousterian Point and the Solutrean Laurel and Willow leaves, others, such as an important series which grade from what are known as Xudi Points to Gravette Points were probably pointed knife blades. They have the side of the blade opposite the working edge blunted. This series enables us to subdivide the Aurignacian period into a number of stages.

Pigmy Tools.—The pigmy family includes several distinct types which are named, according to their shape, lunates, crescents, triangles, trapezes, and pigmy scrapers. They are linked together by the fact that they formed the sharp working edges of finished tools, being hafted in various ways into handles made from some other material. The chipping seen on them is generally intended to blunt the edge which is actually to be hafted lest it should cut into or split the haft. Pigmies are found all over the world during widely different periods; they do not necessarily all belong to the same culture.

Celts.—The Celt family is characteristic of Neolithic times, and a grinding and polishing technique is often employed in their manufacture. The original type when chipped only is not unlike the coup de poing at first view. But the carefully prepared sharp, convex working edge is at the broad end of the tool. Two evolutionary series can be determined—one North European, the other West European. In the former the sides of the tool become squared and finally the upper and under surfaces become flat, a section through the tool being rectangular. In the latter the round squat original type becomes flatter and more chisel-like.

Arrow-heads.—Many varieties of arrow-heads are known, some with wings and a central tang, others with wings or tang only; some again are lozenge or leaf shaped. Not only can an evolutionary series be to some extent determined, but certain types only occur commonly in definite areas.

Bone tools, found associated with stone tools during certain periods, can also be classed into families. Harpoons for example form an important evolutionary series, starting with a primitive form where the barbs are hardly detached from the stem and developing through the detached single-barbed varieties to the double-barbed specimens. This series is important for subdividing the Magdalenian culture. Other important bone families are lance-heads, needles, and polishers.

See W. J. Sollas, *Ancient Hunters* (3rd ed., 1924), pp. 78 *et seq.* M. C. Burkitt, *Prehistory* (2nd ed., 1925), chap. iv. (M. C. B.)

FLOATING BATTERY: *see* MONITOR, NAVAL.

FLOATING DEBT: see DEBT, PUBLIC.

FLOATING DOCK: see DOCK.

FLOCK. 1. A word found in O.E. and O.Norw., from which come the Danish and Swedish words, and not in other Teutonic languages; originally a company of people, now mainly, except in figurative usages. of certain animals when gathered together for feeding or moving from place to place. For birds it is chiefly used of geese, and for other animals most generally of sheep and goats. It is from the particular application of the word to sheep that "flock" is used of the Christian Church in its relation to the "Good Shepherd," and also of a congregation of worshippers in its relation to its spiritual head.

2. Probably from the Lat. *floccus*, but many Teutonic languages have the same word in various forms; a tuft of wool, cotton or similar substance. The name "flock" is given to a material formed of wool or cotton refuse, or of shreds of old woollen or cotton rags, torn by a machine known as a devil, This material is used for stuffing mattresses or pillows and also in upholstery. The name is also applied to a special kind of wallpaper, which has an appearance almost like cloth or, in the more expensive kinds, of velvet. It is made by dusting on a specially prepared adhesive surface finely powdered fibres of cotton or silk. The word "flocculent" is used of many substances which have a fleecy or flocklike appearance, such as a precipitate of ferric hydrate.

FLODDEN or FLODDEN FIELD, near the village of Branxton, in Northumberland, Eng. (10 mi. N.W. of Wooler), the scene of a famous battle fought on Sept. 9, 1513, between the English and the Scots. On Aug. 22 a great Scottish army under King James IV had crossed the border. For the moment the earl of Surrey (who in King Henry VIII's absence was charged with the defense of the realm) had no organized force in the north of England. King James wasted much precious time among the border castles, and when Surrey appeared at Wooler, with an army equal in strength to his own, which was now greatly weakened by privations and desertion, he had not advanced beyond Ford castle. The English commander promptly sent in a challenge to a pitched battle, which the king, in spite of the advice of his most trusted counselors, accepted. On Sept. 6, however, he left Ford and took up a strong position facing south, on Flodden Edge. Surrey's reproaches for the alleged breach of faith and a second challenge to fight on Millfield plain were this time disregarded. The English commander, thus foiled, executed a daring and skillful march around the enemy's flank, and on Sept, 9 drew up for battle in the rear of the hostile army. It is evident that Surrey was confident of victory, for he placed his own army. not less than the enemy, in a position where defeat would involve utter ruin. On his appearance the Scots hastily changed front and took post on Branxton hill. facing north. The battle began at 4 P.M. Surrey's archers and cannon soon gained the upper hand, and the Scots, unable quietly to endure their losses, rushed to close quarters. Their left wing drove the English back, but Lord Dacre's reserve corps restored the fight on that side. In all other parts of the field, save where James and Surrey were personally opposed, the English gradually gained ground. The king's corps was then attacked by Surrey in front, and by Sir Edward Stanley in flank. As the Scots were forced back, a part of Dacre's force closed upon the other flank. and finally Dacre himself. boldly neglecting an almost intact Scottish division in front of him, charged in upon the rear of King James's corps. Surrounded and attacked on all sides. this, the remnant of the invading army, was doomed. The circle of spearmen around the king grew less and less: and in the end James and a few of his nobles were alone left standing. Soon they too died, fighting to the last man. Among the 10,000 Scottish dead were all the leading men in the kingdom of Scotland. and there was no family of importance that had not lost a member in this great disaster.

The "King's Stone," said to mark the spot where James was killed, is at some distance from the actual battlefield. "Sybil's Well," in Scott's *Marmion,* is imaginary.

FLODOARD (894–966). French chronicler. was born at Epernay. and educated at Reims in the cathedral school which had been established by Archbishop Fulcon (822–900). As canon of Reims, and favourite of the archbishops Herivaeus (d. 922) and Seulfus (d. 925), he occupied while still young an important position at the archiepiscopal court! but was twice deprived of his benefices by Heribert, count of Vermandois, because of his steady opposition to the election of the count's infant son to the archbishopric.

Upon the final triumph of Archbishop Xrtold in 947, Flodoard became for a time his chief adviser, but withdrew to a monastery in 952, and spent the remaining years of his life in literary and devotional work. His history of the cathedral church at Reims *(Histovia Remensis Ecclesiae)* is one of the most remarkable productions of the 10th century. Flodoard had been given charge of the episcopal archives, and constructed his history out of the original texts, which he generally reproduces in full: the documents for the period of Hincmar being especially valuable. The *Annales* which Flodoard wrote year by year from 919 to 966 are doubly important, by reason of the author's honesty and the central position of Reims in European affairs in his time.

Flodoard's poetical works are of hardly less historical interest. The long poem celebrating the triumph of Christ and His saints was called forth by the favour shown him by Pope Leo VII, during whose pontificate he visited Rome, and he devotes 14 books to the history of the popes.

Flodoard's works were published in full by J. P. Migne in *Patrologia Latina*, vol. CXXXV; a modern edition of the *Annales* is the one edited by P. Lauer (Paris, 1906). For bibliography *see* A. Molinier, *Sources de l'histoire de France,* no. 932.

FLOE, a sheet of floating ice detached from the main body of polar ice and of less extent than the field of pack ice; the latter is a compacted mass of greater depth, drifting frequently under the influence of deep currents, while the floe is driven by the wind.

FLOGGING was for a long time one of the most common methods of punishing criminals and of preserving discipline in the home, school, armed forces and prisons. In the Mosaic code flogging was a punishment for crime. Slaves were frequently flogged to death when they were sufficiently numerous to be of little value, but the flogging of Negro slaves in the southern states before the American Civil War was exaggerated in abolitionist literature: the fact was that these slaves were too valuable to have their efficiency reduced by severe punishment. Both soldiers and sailors received many lashes for their offenses, the latter being flogged at the mast or through the fleet, receiving a stipulated number of lashes on each ship. During the 19th century imprisonment gradually took the place of corporal penalties as a punishment for crime. The courts, however, retained the power of sentencing a prisoner to be whipped when convicted of crimes of violence. The situation was greatly changed in England, Scotland and Wales by the Criminal Justice act of 1948, by which the courts were deprived of the power to sentence a person to a whipping in many cases. However, except in Scotland, the power to inflict corporal punishment was retained in cases of mutiny, incitement to mutiny and gross personal violence to an officer of a prison when committed by a male person.

In the second half of the 20th century the flogging of certain criminals was still prescribed by law in Great Britain, Canada, some continental and Asiatic countries and in the state of Delaware in the United States, where public whippings might be administered at the discretion of the court for 25 different crimes. In 1953 Maryland repealed its law which had prescribed corporal punishment for wife beaters (*see* Robert G. Caldwell, *Red Hannah: Delaware's Whipping Post,* 1947).

The instruments and methods of flogging have varied. In maintaining discipline in the home and school, sticks, rods, straps, whips and other objects are used. Elsewhere the lash has been widely used, usually with ingenious refinements and elaborations. One of the most brutal of these is the cat-o'-nine-tails. This is constructed of nine knotted cords or thongs of rawhide attached to a handle. Even more effective in producing pain and ultimately death is the Russian knout. This is an instrument consisting of a number of dried and hardened thongs of rawhide interwoven with wire, the wires often being hooked and sharpened so that they tear the flesh.

A particularly painful, though not so deadly, type of flogging is the oriental bastinado, or blows delivered on the soles of the feet with a light rod or knotted cord or lash. Flogging was formerly executed with great brutality. The backs of the condemned were frequently lacerated and salt was poured into the wounds to increase the pain. (H. E. BAR.; P. E. L.; R. G. CL.)

FLOOD, HENRY (1732–1791), Irish statesman, son of Warden Flood. chief justice of the king's bench in Ireland. was educated at Trinity college. Dublin. and at Christ Church. Oxford. He entered the Irish parliament for Kilkenny in 1759, and immediately began the creation of an opposition in that corrupt body and the education of public opinion in the country. The English government was driven by his efforts to pass the Octennial bill! limiting the duration of parliament to eight years. and, during the viceroyalty of Lord Townshend. to mitigate the practice of allowing crown patronage to be dispensed by the owners of parliamentary boroughs. The growth of an independent spirit in the Irish house was shown in 1769. when a money bill was sent over by the privy council in London for acceptance by the Irish house of commons. It was rejected on the ground that the bill had not originated in the Irish house. Parliament was peremptorily prorogucd. and a recess of 14 months was employed by the government in securing a majority by the most extensive corruption. Nevertheless when parliament met in Feb. 1771 another money bill was thrown out on the motion of Flood; and the next year Lord Ton-nshend, the lord-lieutenant whose policy had provoked this conflict, was recalled. The struggle was the occasion of a publication, famous in its day, called *Baratariana,* to which Flood contributed a series of powerful letters after the manner of Junius. one of his collaborators being Henry Grattan.

Flood was now in a position such as no Irish politician had previously attained. Under parliamentary conditions that were exceedingly uniavourable and in an atmosphere charged with corruption. venality and subservience. he had created a party before which ministers had begun to quail and had inoculated the Protestant constituencies with a genuine spirit of liberty and self-reliance. Lord Harcourt. who succeeded Townshend as viceroy, saw that Flood must be conciliated at any price: accordingly, in 1775, he received a seat in the privy council and the office of vice-treasurer with a salary of £3.500 a year. The result was that the leadership of the national party passed from Flood to Grattan, who entered the Irish parliament in the same session that Flood became a minister. Flood continued in office for nearly seven years. During this period he necessarily remained silent on the subject of the independence of the Irish parliament. But in 1778 the creation of a volunteer force to defend Ireland against a possible invasion by France. which had become the ally of the revolted American colonies. changed the Irish situation. A volunteer convention, formed with all the regular organization of a representative assembly but wielding the power of an army, began menacingly to demand the removal of the commercial restrictions which were destroying Irish prosperity. The government gave way: the whole colonial trade was in 1779 thrown open to Ireland for the first time, and other concessions were also extorted. Flood now resigned his office to rejoin his old party. He found to his chagrin that he was eclipsed by Grattan. But though Flood had lost control of the movement for independence of the Irish parliament. the agitation. backed as it now was by the volunteer convention and by increasing signs of popular disaffection. led at last in 1782 to the concession of the demand. together with a number of other important reforms (*see* GRATTAN, HENRY). A question then arose—known as the Simple Repeal controversy — as to whether England. in addition to the repeal of the acts on which the subordination of the Irish parliament bad been based, should not be required expressly to renounce for the future all claim to control Irish legislation. This dispute led to the rupture of friendship between Flood and Grattan, each of whom assailed the other with unmeasured but eloquent invective in the house of commons. Flood's view prevailed — for a Renunciation act such as he advocated was ungrudgingly passed by the English parliament in 1783—and for a time he regained popularity at the expense of his rival. Flood next (Nov. 28, 1783) introduced a reform bill, after first submitting it to the volunteer convention." The bill, which contained no provision for giving the franchise to Roman Catholics — a proposal which Flood always opposed — was rejected. ostensibly on the ground that the attitude of the volunteers threatened the freedom of parliament.

In 1783 Flood purchased a seat for Winchester in the English house of commons from the duke of Chandos, and for the next seven years he was a member at the same time of both the English and Irish parliaments. He remained a firm opponent of Roman Catholic emancipation, even defending the penal laws on the ground that after the revolution they "were not laws of persecution but of political necessity": but after 1786 he does not appear to have attended the parliament in Dublin. In the house at Westminster. where he refused to enroll himself as a member of either political party, he disappointed the expectations aroused by his achievements in Dublin. At the dissolution in 1790 he lost his seat in both parliaments, and he then retired to Farmley, his residence in County Kilkenny. where he died on Dec. 2, 1791.

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FLOOD, the rise of the waters of a natural stream above a level associated with the beginning of damage. Damage stage is usually reached when the stream is bank full; that is, when the channel is completely occupied. Beyond this, the flood plain is overflow. Flood plains range from a narrow marginal width in the confined, steeply sloped valley of mountainous country to one extending many miles from the river channel.

Four thousand years of recorded history tell of man's repeated failure to evade the destructiveness of floods. The fertile valleys of the Yangtze and Hwang-ho rivers in China have lured him back after each disastrous flood, only to drive him forth again as these rivers rechart their courses in unstable alluvial plains which to this day have defied man-made controls. In striking contrast, the floods of the Nile have been turned to a decided advantage, For thousands of years its orderly and controlled rise and fall have provided fertility and moisture for the fields within its flood plain. (*See* also NILE: Hydrology.)

Excessive rains caused floods of great damage in Paris in 1658 and 1910, Warsaw in 1861 and 1934, Frankfurt am Main in 1854 and 1930, and Rome in 1530 and 1557. The Darling river in Australia was reported to have flooded extensive areas in 1864 and 1886. In 1927 monsoon rains swelled the rivers throughout India to such extent that enormous property damage resulted. In 1099 a storm tide flooded the coasts of England and the Netherlands causing 100,000 deaths. In early 1953 disastrous storm tides flooded the coasts of England, the Netherlands and Belgium resulting in the loss of nearly 2,000 lives.

Records for the Danube, dating back to the 11th century, tell of serious floods in 1342, 1402, 1501 and 1830, resulting from ice jams during the spring rise. In 1824 St. Petersburg (Leningrad) and Kronstadt suffered an ice jam flood in the Neva in which 10,000 persons were drowned.

Lisbon in 1755 and Hilo, Haw., in 1946 experienced floods caused by sea waves of earthquake origin. Johnstown, Pa., was practically destroyed in 1889 by a flood following the failure of a dam behind which runoff from a moderate storm had been allowed to concentrate.

Maximum Flood of Record at Selected River Cities in the United States

River	City	Years recorded	Flood* stage (ft.)	Maximum crest stage: Height (ft.)	Maximum crest stage: Date of maximum flood
North Atlantic drainage					
Merrimac	Lawrence, Mass.	75		39.3	21,
Hudson	Albany, N.Y.	52		21.5	28,
Delaware	Trenton, N.J.	51	12	16.6	March 19,1936
Susquehanna	Wilkes-Barre, Pa.	62	22	33.1	March 20, 1936
South Atlantic drainage					
Potomac	Harpers Ferry, W.Va.	64	18	36.5	March 19,1936
James	Lynchburg, Va.	62	18	24.7	March 18, 1936
Savannah	Augusta, Ga.	79	32	46.3	Sept. 27, 1929
East Gulf drainage					
Flint	Albany, Ga.	62	20	36.6	Jan. 21, 1925
Alabama	Montgomery, Ala.	63	35	57.[illegible]	Dec. [illegible], [illegible]
Black Warrior	Tuscaloosa, Ala.	63	47	68.6	April 18, 1900
West Gulf drainage					
Trinity	Riverside, Tex.	52	40	52.7	May 6, 1942
Brazos	Waco, Tex.	56	27	40.9	Sept. 27, 1936
Colorado	Austin, Tex.	57	29	45.0	June 15, 1935
Guadalupe	Gonzales, Tex.	51	20	38.3	May 29, 1929
Interior					
Ohio	Pittsburgh, Pa.	83	25	46.0	March 18, 1936
Ohio	Cincinnati, O.			80.0	
Kanawha	Charleston, W.Va.	81		46.6	
Cumberland	Nashville, Tenn.		40	56.2	Jan. 1, 1927
Wisconsin	Portage, Wis.	82	17	20 5	Sept. 14, 1938
Mississippi	St. Paul, Minn.	88	14	22.0	April 16, 1952
Mississippi	La Crosse, Wis.	80		16.5	June 19, 1880
Mississippi	Davenport, Ia.	85		20.9	March 1868
Mississippi	Vicksburg, Miss.	84	43	58.6	May 4, 1927
Missouri	Kansas City, Mo.	82	22	36.2	July 14, 1951
Ouachita	Camden, Ark.	69	26	44.8	April 3, 1945
Red	Fulton, Ark.	70	27	37.4	April 3, 1945
Pacific coast drainage					
Columbia	Vancouver, Wash.	52	15	30.2	June 1, 13–14, 1948
Willamette	Albany, Ore.	75	20	31.3	Jan. 26, 1903
Sacramento	Sacramento, Calif.	74	29	30.2	Nov. 21, 1950
San Joaquin	Lathrop, Calif.	51	17	22.5	Dec. 10, 1950
Colorado	Yuma, Ariz.	77	25	34.8	Jan. 22, 1916

*Beginning of flood damage.

Lying athwart a zone in which dry, cold air masses from the arctic meet warm, moist air originating in the Caribbean and South Atlantic, the United States east of the 90th meridian is subject to storms and floods which extreme contrasts in temperature and moisture invariably bring about. Among the results are the spectacular floods of the Connecticut, Susquehanna and Potomac rivers in 1936, the Ohio in 1936 and 1937, and the Mississippi in 1884, 1927, 1937, 1943, 1947, 1951 and 1952.

The encroachment of industrial and community development on the natural channels of nearly all the larger rivers has contributed substantially to the extent of flood damage. Unless such encroachment is halted by some form of flood plain zoning, flood damage can become staggering. In certain eastern and western states flood danger is increased by the possibility that seasonal rains may combine with thawing of major snow accumulations.

Flood-producing storms of limited areal extent occur throughout the whole of humid United States. These storms are of the thunderstorm type, occurring as single or multiple convective "cells," and are capable of producing phenomenal downpours. Property damage and loss of life from floods created by this type of storm constitute an appreciable percentage of the total loss. The storm of July 1942 in Pennsylvania afforded an outstanding example of this type, more than 30 in. of rain in 12 hours having been observed at the storm centre.

With the exception of the arid southwest and the Great basin, no region of the United States is immune from floods in any month of the year. The primary cause of flood is rain concentrated within relatively short storm periods. However, protracted storms, such as that of January 1937, blanketed the whole of the Ohio basin and caused the greatest flood of record on that river. The great flood of 1937 took 137 lives and caused an estimated property damage of $417,700,000 in the Ohio and lower Mississippi basins.

Following a two-month period of above-normal precipitation, rains of unprecedented intensity over much of the state of Kansas in July 1951 resulted in the greatest flood in more than a century in the Kansas river basin and adjoining areas. Twenty-eight lives were lost and property damage amounted to nearly $1,000,000,000.

Hurricane rains of 1955 caused floods of record or near-record proportions in many streams in southern New England, southeastern New York, eastern Pennsylvania and New Jersey which took 180 lives and caused an estimated damage of $686,000,000.

Monetary loss from floods averages $300,000,000 annually in the United States. This figure would be much higher were it not for various means of flood control, such as protective levees, channel improvement, storage reservoirs and flood warnings.

Early precedent in protecting the fertile alluvial plains of the lower Mississippi valley at government expense established the policy of flood control under and by federal agencies, the principal one of which is the corps of engineers, United States army. The department of agriculture, with its soil conservation and forest services, carries out programs of soil and forest conservation that are in many cases the indirect means of retarding and absorbing storm runoff, thus reducing the height to which floods would otherwise rise.

The weather bureau, through its flood forecasting service, reduces flood damage by providing opportunity to remove goods and evacuate populations. Losses are still further reduced by the efforts of the American Red Cross, the army engineers and the coast guard in caring ior persons driven from their homes by floods.

Many sections of Asia and the far east frequently suffer severe floods. In India, for example, some parts are flooded every year with considerable damage. Floods of major importance occurred in many parts of India during 1952 to 1956. These started with the Brahmaputra and tributaries doing extensive damage with large loss of dwellings and cattle. Heavy southwest monsoon rain (June–September) caused the Godavari floods of 1953 which were unprecedented in 50 years. Southwest monsoon rain caused severe floods in all the south Indian states again in 1954 although less severe than those of 1953. Floods also occurred during this period in Assam, Bihar and West Bengal. Some of India's rivers reached the highest flood of record in 1955. The Mahanadi, Orissa's largest river, reached a record level and marooned 300,000 people. Severe floods also developed in the Jumna, the Beas, the Ravi and the Sutlej rivers in the northwest of India. The Ravi completely changed its course during this flood, swamping hundreds of villages on both sides of the Pakistan-India border. Floods continued in 1956 with the Jumna river reaching the highest level on record at Delhi, and with the Ganges river seriously affecting the states of Bihar, Uttar Pradesh and West Bengal. India's floods result primarily from rain, however snow melt makes a contribution from those rivers arising in the Himalayas. Nearly half the total population of (half a billion people) continually face the danger of floods.

Australia's largest rivers are the Murray, Darling, Fitzroy and

Burdekin which together comprise a drainage area of approximately 740,000 square miles or about one quarter of the continent. Flooding occurs periodically in these major rivers but even more frequently in the smaller eastern and southeastern streams.

Major floods occurred in New South Wales in 1955 on the Macquarie, Castlereagh. Namoi, Hunter and Gwydir rivers taking 50 lives and leaving nearly 40,000 homeless in 40 towns.

Some of the heaviest rains of history occurred in 1956 in southeastern Australia, flooding rivers, and forming a sea 40 miles wide between the towns of Hay and Balranald.

The British Isles occasionally are subjected to flooding irom abnormally heavy storms. Outstanding recent events were the Lymouth flood, causing 28 deaths, the Korth Devon, North Somerset and Sussex floods, all in 1952, the northern England and southwest Scotland floods of 1953, and the Weymouth flood of 195j which resulted from 11 inches of rain in less than 24 hours at Martinstown, Dorset. See also RIVER AND RIVER ENGINEERING.

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FLOOD (IN RELIGION AND MYTH) is the name given to the cataclysm that was said to have covered most of the earth with an immense inundation and to have caused the death of all but a few of the human race. Most civilizations record a tradition about this event, which is best known from the account in the Old Testament and in the Gilgamesh myth.

Biblical Accounts.— The story of the flood in Gen. vi–ix is, as biblical criticism has shown, a fusion of two closely interwoven versions. one based on the 8th-century B.C. tradition known as "J" (Yahweh), the other on the 6th-century B.C. priestly tradition called "P," which represents a less primitive and more theological attitude (see GENESIS).

The J *Source.*—Yahweh has decided to destroy the human race, which is basically evil. save for one just man, named Koah. Yahweh warns Noah of the coming cataclysm. and commands him to go into the ark with his household and pairs of animals, seven of the clean and one of the unclean. in order to preserve the species. The waters cover the earth, and every living thing is destroyed except for those in the ark. Xfter the rain has ceased, Noah releases a raven. which returns to the ark because it can find nowhere else to rest. and a dove. which does the same. Seven days later the dove is released again. and returns with an olive branch in her beak. After a further seven days the dove does not return after her release. Noah then leaves the ark and makes a thank offering to Yahweh. who in his turn is reconciled with mankind. promising never again to smite every living thing.

The P *Source.*—Noah is an upright man in the midst of a perverse generation which God has decided to obliterate. He is commanded to make an ark of certain precise measurements which is to shelter him and his, together with two of each species of living things and provisions for them all. Noah is 600 years old when the flood begins: "all the fountains of the great deep burst forth, and the windows of the heavens were opened" (Gen. vii. 11). The ark carries its load while the waters rise for 150 days. Then comes a wind which brings calm, and the waters begin to sink. In the seventh month, on the 17th day of the month, the ark comes to rest "upon the mountains of Ararat." A further period of time. carefully measured, has to pass before Noah with his family and animals can leave the ark. God then blesses Noah and his sons. and makes a covenant that he will never send another flood on the earth.

Mesopotamian Accounts.— The Assyrian text of the epic of Gilgamech on cuneiform tablets discovered at Nineveh comes from the library of Ashurbanipal (7th century B.C.), but undoubtedly repeats an earlier original. (A fragment of a Babylonian version found at Nippur goes back to the 19th century B.C.)

Assyrian *Version in Cuneiform* Script.— Gilgamesh, king of Erech (Uruk), much distressed by the death of his friend Enkidu, realizes that his own life too must one day end. He remembers that only one human being, Ut-Napishtim ("Uta is my life"), has received eternal life. after surviving a flood which he has described in all its episodes. When the gods decided to destroy the city of Shuruppak, Ea advised his protégé Ut-Napishtim to build a vessel according to a specified plan and to bring into it his family. craftsmen. animals. gold and silver. Flood and storm are then unloosed. to the great dismay of the gods who have commanded them. The earth is submerged, and "mankind is turned into clay," Seven days later there is a lull, and the vessel comes to rest on Mt. Nisir. After another seven days a dove, a swallow and a raven are sent out. Only the last finds a place to alight. so does not return. The survivors come out of the ark and make a sacrifice upon which the gods descend. The wrath of Enlil is appeased, and after blessing Ut-Napishtim and his wife he grants them immortality.

There is also another cycle. parallel to the epic of Gilgamesh, in which the hero's name is Atrahasis ("the most wise"). The tablets on which it is found were excavated at Nineveh and at Sippar. These documents in Akkadian, like Hebrew a Semitic language. had been preceded by others written in Sumerian, which is not Semitic.

Sumerian Version From *Nippur.*—The gods, except for Inanna and Enki, have decided to send a flood "to destroy the seed of the human race." The king Ziusudra is saved in a giant ship which he has built in accordance with instructions from a god who takes pity on him. He makes a thank offering for his escape and ultimately receives an "eternal inspiration" and goes to live in the country of Dilmun.

Late Babylonian Version.—The latest Babylonian version of the flood story was written about 275 B.C. by Berossus. priest of Marduk (Bel) at Babylon. Xisuthros is commanded by Cronus to build a ship for his family, friends and animals. and load it with food. as a flood is imminent. The cataclysm is then unleashed. When it is over, Xisuthros releases birds in order to find out how far the water has sunk, and it is only after this has been done three times that they do not return. Xisuthros then leaves the ship with his wife. his daughter and the pilot, and makes a sacrifice to the gods. These four become invisible. and those left in the ship are begged to become virtuous and to return to Babylon, then to Sippar, where Xisuthros buried all existing writings before the flood. This is a long journey for them, as the ship has come to rest on the Corydaean mountains of Armenia.

Evidence for *the* Flood in *Historical* Sources.— Besides these more. or less legendary narratives. there are brief references to the flood as a historic fact. For instance. Weld-Blundel's prism (W.B. 444) mentions Ubar-Tutu, father of Ut-Napishtim according to the Gilgamesh epic. and then. after enumerating five cities and eight kings, it continues, "the flood came. Xfter the flood had come. kingship descended from heaven. The kingship was at Kish." A tablet (W.B. 62) mentions two kings of Shuruppak (the city of the flood) including Ziusudra (as in the Sumerian version of the story). For ancient historiographers, therefore, the flood marks a distinct break in the train of events.

Archaeological Evidence in Mesopotamia.— Excavations in Mesopotamia have revealed conflicting evidence about the flood. In strata dating from before 2000 B.C., when the first Sumerian narrative was probably written, flood layers have been found at levels which do not correspond stratigraphically. At Ur a deposit of clean water-laid clay whose depth varies from 3.7 to 2.7 m. appears to go back to between 3000 and 4000 B.C., whereas at Kish a similar deposit, only 0.3 m. deep, dates from about 2800 B.C. In Erech and Shuruppak the flood layers date from the same period

(c. 2800 B.C.), but differ in depth (1.55 m. and 0.6 m. respectively). Further, at Nineveh excavators found at a depth of between 21.1 and 21.3 m. a series of 13 alternate strata of mud and riverine sand, which show an important climatic change (c. 3000–4000 B.C.).

The conclusion to be drawn from these excavations seems to be that there was not merely a single flood but many. Probably one of these cataclysms brought such destruction in its train and made such a great impression that it became a theme of cuneiform literature. It was known as *the* flood, caused first by an unusually violent rising of the Tigris and the Euphrates (Iraq still suffers from such disasters, as witness the flood in the spring of 1954), augmented perhaps by torrential rain (cf. Gen. vii, 4, 12) if not also by a tidal bore (cf. Gen. vii, 11). Such violent upheavals of water could not fail to bring about almost total destruction of life in the area save for a few privileged exceptions.

Relationship Between the Biblical and the Mesopotamian Floods. — That the various accounts of the flood given above are connected is beyond all doubt, and it is equally clear that the biblical narrative enshrines the Israelite version of an earlier Mesopotamian tradition (extant in cuneiform texts) which was reshaped by the Hebrew writers of the 8th and 6th centuries B.C. This Babylonian tradition must have been brought from Mesopotamia by the patriarchs and later transferred to Canaan where there was no memory of such a flood, which is a specifically Mesopotamian disaster.

Religious Meaning of the **Biblical Flood.**—Into this story drawn from earlier sources the biblical narrative introduces new elements which reveal teaching about God and his purposes for mankind. The flood in Genesis is understood as an instrument of God's justice, which because of man's wickedness dealt out destruction on all save the righteous Noah and his family. The flood story also marks an important stage in the relationship of man to God, for God in his mercy then promised that such a cataclysm would never happen again and made the first of the covenants recorded in the Bible, that made with every living creature, whereby the earth should continue, with its ceaseless cycle of the seasons and the harvest.

In the New Testament the flood story is used as a "type" of the last judgment. Jesus Christ compared the unexpected coming of the last judgment to the flood, making the comparison a warning of the necessity for watchfulness (Matt. xxiv, 37 ff.; Luke xvii, 26 ff.). The story is used in II Pet. ii, 5 as a reminder that God punishes the ungodly while delivering the righteous. A further interpretation is found in I Pet. iii, 20, where the floodwaters are said to prefigure the saving waters of Christian baptism.

The Flood in Greek Mythology. — The story of the flood is first explicitly mentioned in Greek literature by Pindar (5th century B.c.). A full version is to be found in the mythological compendium called *Bibliotheca* wrongly ascribed to Apollodorus (2nd century B.C.). Zeus has decided to destroy the human race, but King Deucalion, advised by his father Prometheus, builds an ark in which he and his wife Pyrrha take refuge with a store of provisions. Zeus submerges Greece in torrential rain. so that only a few others are able to escape by climbing up into the mountains. The ark of Deucalion floats for nine days, after which it comes to rest on Mt. Parnassus. When the rain ceases Deucalion comes out of the ark and makes a sacrifice. Zeus, thus appeased. then sends Hermes to offer Deucalion anything he wants. Deucalion chooses to increase the human race; he throws over his shoulder stones which turn into men while those thrown by Pyrrha become women.

This legend about Deucalion was not the only flood story current in the Greco-Latin world. Dionysius of Halicarnassus (1st century B.c.) in his work on Roman antiquities refers to a flood in the reign of King Dardanus of Arcadia, and the church historian Julius Africaaus (c. A.D. 200) speaks of a flood in the time of Ogyges, king of Thebes in Boeotia. References to these floods are found in other sources, and by the 5th century A.D. the poet Nonnus in his *Dionysiaca* counts three floods, first Ogyges', then Deucalion's, then Dardanus'.

J. G. Frazer suggested that these various narratives are not based on actual events but were invented to account for certain obvious physical features of the Greek landscape: the formation of Lake Copais from overflow (flood of Ogyges), the rising in the valley of the Pheneus (flood of Dardanus) and the split in the mountains of Thessaly (flood of Deucalion).

The story of the flood of Deucalion was popular at Hierapolis on the Euphrates. A version in the De *dea Syria* wrongly ascribed to Lucian (2nd century A.D.) relates that after the flood all the waters disappeared into a cleft in the earth at Hierapolis, beside which Deucalion built a sanctuary to Hera. Twice a year thereafter, in memory of this miracle, worshipers brought sea water to the sanctuary and poured it into the cleft. Similarly, Pausanias (2nd century A.D) was informed that an offering of honey cakes was made annually at Athens at the cleft in the ground near the temple of Olympian Zeus where the floodwaters had drained away. It is worth adding that coins of the 3rd century A.D. from Apamea Cibotus in Phrygia (Asia Minor) show the ark, with the name Noah written on it. This is the first known instance of the iconography of the flood which later becomes so familiar, especially in Romanesque paintings and sculptured capitals.

Legends of the Flood in Other Traditions. — The flood is not mentioned in the Vedic hymns of ancient India (1500–1000 B C.), but in the Sanskrit Satapatha-Brahmana (6th century B C.) there is the story of Manu, who was informed by a small fish that a flood was to take place and advised to build a ship. Manu reared the fish until it grew big, and when the flood began it pulled him in the ship to a mountain, thus saving him alone from death. When the waters sank. Manu came out of the ship and offered a sacrifice of butter and milk, from which sprang a woman, to be the mother of the race of Manu; *i.e.,* mankind. Later variations of this legend are also known.

Legends of a flood are also found in southern Asia, the Indian archipelago (Sumatra, Borneo, Celebes). New Guinea, Australia, Melanesia, Polynesia and the American continents from Alaska to Cape Horn, as well as in the folklore of certain European countries—Wales, Lithuania and Rumania—and in eastern Russia. But in Africa, including Egypt. there is scarcely a trace of it. In most of these stories constant features are the saving in a vessel of a remnant (whether a single person, man and wife, brother and sister or a larger group), often with the help of a god, and the subsequent repeopling of the earth by natural or miraculous means.

Origins of the Legends. — It seems that the traditions of the flood fall into two groups, to one of which belong the cuneiform (both Sumerian and Akkadian) and Hebrew narratives. These may to some extent have inspired the Greek story of Deucalion, and just possibly that of Manu in Sanskrit literature Behind them would lie a historical flood of catastrophic proportions which inundated the Tigris-Euphrates basin. To the other group belong the rest of the legends nhich, having no necessarily factual basis, are to varying degrees mythical or legendary and are not connected with the first group

BIBLIOGRAPHY.—The most convenient collection of flood stories from all parts of the world in J. G. Frazer, *Folklore in the Old Testament,* vol. 1, pp. 104–361 (1918). *See* also A. Jeremias, *Das alte Testament im Lichte des alten Orients,* 4th ed., pp. 128–160 (1930). For monograph on the Mesopotamian and biblical flood stories with archaeological evidence *see* A. Parrot, *Déluge et arche de Noe* (1953; Eng. trans., 1955). For Greek flood stories *see* H. Usener, *Die Sintflutsagen* (1899). (A. Pa.)

FLOOD CONTROL: *see* RIVER AND RIVER ENGINEERING; DAM; RESERVOIRS; LAND RECLAMATION.

FLOOD PLAIN, a plain made of sediment deposited by a river. When the gradient of a river becomes very slight, it is unable to carry all the material brought downstream. and consequently the lower valley becomes filled with alluvial deposits. In times of flood the river torrent tears off and transports an unusually large quantity of sediment; in the flooded lower valley the rush of water is checked. and the stream in consequence drops its extra load. Flood plains are sometimes of great extent. In the United States, that of the Mississippi below its confluence with the Ohio has an occasional width of 80 mi. with a total area estimated at 50,000 sq.mi.

Flood plains may be caused by a graded river's meandering from side to side and thus widening its valley and ultimately covering the nidened valley mith sediment. Any sudden increase in a river's velocity and volume or obstruction across its course may result in a flood plain, but flood plains are most commonly found in the lower reaches of such large rivers as the Rhine, Nile or Mississippi. The flood plain is usually bounded by levees (*q v*).

Sections of the Missouri river flood plain show a great variety of material of varying depth and of coarseness ranging from heavy gravel through fine sand to fine silt. It is probable that any section of such a plain would shou similar deposits.

The flood plain during its formation is characterized by marshes, meandering or anastomosing streams, oxbow lakes and bayous (*q.v*), and is occasionally completely drowned. When the drainage system is entirely diverted for any cause, the flood plain may become a smooth area of great fertility, similar in appearance to the floor of an old lake. from which it differs, however. in that it is not quite flat. It has a gentle slope along the original downstream course and also usually from the edges toward the centre. See also PLAIN.

FLOOR, the lower horizontal surface of an enclosure; used, also, almost interchangeably with "story," to designate different levels or planes of rooms, one above the other. The floor may be a prepared surface of the ground or an elevated area. In primitive buildings the leveled surface of the ground was covered with matting as a protection against dampness; in regions of heavy rainfall, a platform or floor set above the ground and supported on posts provided a protection from surface water.

In modern buildings the floor areas resting on the ground are insulated from moisture by replacing the top soil with coarse gravel or crushed rock, which leaves large volumes of voids to permit free drainage and cut off the capillary action which might otherwise penetrate the floor slab.

A floor area free of the ground is both a structure and a finished surface. The structure must have sufficient strength to carry loads. The upper surface should be protected by a covering or wearing surface capable of withstanding traffic. The underside may be exposed or covered, depending upon the aesthetic requirements or the need for protection against fire. The upper, or wearing surface is called the finished floor; the underside, either exposed or finished: is the ceiling.

Wood, steel, concrete or a combination of these materials may be used in the construction of the floor. The structure is similar to that of flat roofs of the same materials, except that the distances between supports are usually less to accommodate heavier loads.

For light wood construction in dwellings, the joists are supported by bearing partitions in the first and upper stories, or by beams and posts where the supporting partitions would not coincide with the locations of the walls of the rooms. In the basement story the bearing partitions and the first floor joists are usually carried on wood or steel girders supported on posts and the basement walls.

The finished floors are usually hardwood strips (oak or maple) having a $2\frac{1}{4}''$ face width! and tongue and grooved at the edges and ends. The strips are blind nailed through the tongue to the under floor using cut nails. The strips are laid at an angle with the under floor and parallel to the partitions or outer walls. The flooring strips are sanded when laid to remove any inequalities at the edges and to provide a smooth clean surface for the finish. The finish consists of a filler, followed by a built-up surfacing of wax properly polished.

The floors of multistoried industrial buildings carrying heavy loads (as well as those of commercial buildings and schools carrying relatively light loads) may be constructed of reinforced concrete slabs supported directly on columns or carried on concrete or steel beams attached to supporting columns. For lighter constructions steel panels or light steel joists supporting a light concrete slab or fill may be used.

For the finished floor wood, cork, linoleum, tiles, and masonry (*e.g.,* flagstone, marble, brick slate, granolith, terrazzo) have practical and aesthetic qualities. See ROOF; CARPENTRY.

(E. N. G.)

FLOOR COVERINGS.' Many materials are used as floor coverings; those considered in this article have been classed as smooth-surface floor coverings and include linoleum, rubber floor coverings. cork tile, asphalt tile, printed felt base and the many varieties derived from vinyl chloride resins. The use of these materials increased greatly after 1920; in the 1960s the extensive use of concrete flooring in homes and commercial buildings had further expanded the market.

Linoleum, the first smooth-surface floor covering to be used widely. was introduced about 1860. Frederick Walton invented the linoleum-making process, in which linseed oil is oxidized to produce the binder for cork and other fillers. He built the first linoleum factory at Staines. Eng.. and in about 1900 developed the straight-line inlaying machine, which greatly increased the variety of patterns that could be produced. Production of linoleum increased steadily until about 1950, after which it decreased, mainly because of competition from newer materials.

Printed felt base mas first manufactured in Erie. Pa.. about 1910. Production gradually increased until yardage became much greater than that of linoleum. But, like the output of linoleum. the production of this material is now decreasing although large volumes are still manufactured.

Cork tile has been made for many years and continues to be produced in large volume, although not in the volume of linoleum or the newer materials. Rubber flooring has been produced for many years, and the volume has shown a gradual increase. However, it is a relatively expensive material and the yardage produced is not a major portion of the total floor covering manufactured.

Asphalt tile was first produced about 1930. The volume of production has increased rapidly and in the 1960s it exceeded the yardage for linoleum. Vinyl floor coverings were first produced in the United States about 1945 and their use has expanded greatly. Vinyl coverings are made in a wide variety of types, and the total vinyl usage is about the same as that of linoleum.

Floor coverings are offered in a variety of forms. The flexible materials are available in roll form; the trend, however, is toward tile. and nine-inch square tile is most widely employed. The tiles are offered in a variety of thicknesses from $\frac{1}{16}$ to $\frac{3}{16}$ in., and in some cases the tile is even thicker. A backing of felt may be used.

These floor coverings, except those in which thin films are employed. are manufactured by mixing the plastic material with fillers and pigments to create a plastic mix that is rolled into sheets and then calendered to the desired thickness. If a backing is used the plastic sheet is calendered onto the backing.

A variety of decorative effects; including mottles, *jaspé* and spatter patterns, are obtained by blending in one or more other mixes of the same general composition as the base in sheet or chip or granule form. By controlling the extent of mixing a wide variety of these effects may be achieved. In some cases the added colour is mixed little, if at all, and it may be compressed rather than rolled into the sheet.

Linoleum.—In the original process for manufacturing linoleum. a thin film of linseed oil was allowed to oxidize. Since oxidation proceeds principally on the surface, fresh oil was continually applied to the surface of the oxidized film. The film was started on a light cotton scrim, and linseed oil was poured over the film while it was festooned in tall stoves or sheds. After weeks of exposure. during which the thickness of the oil film reached several inches, the oxidized oil was fluxed with a natural resin, such as rosin or kauri gum. Cork and other fillers, such as wood flour (pulverized dried wood) and whiting, were mixed with the blend of resin and oxidized oil.

The shed process was cumbersome and slow, and it was replaced by a faster method in which linseed oil is oxidized in large cylindrical kettles where the oil is stirred at elevated temperatures. The oxidization is continued until the oil barely flows at reaction temperature; then the oil is blended mith rosin in heated kettles equipped with agitators. Often the rosin is added to the oxidizing kettles while the air is blown into the mixture at elevated temperatures; a plastic material of high viscosity is then formed.

The mixture of oxidized oil and rosin is blended with wood flour and whiting. In modern practice cork is no longer widely employed as a filler. The use of cork declined largely because of both the trend to brighter colours and the scarcity and relatively high cost of cork.

The binder. fillers and pigments are mixed, then calendered in sheet form and applied to a backing. Burlap mas the principal material used for backing until World War II, but it became scarce during the war and was replaced by felt saturated with asphalt. Burlap is still used, however, for heavier gauges of linoleum Saturants of light colour are often used in place of asphalt to waterproof the felt.

The backed linoleum is hung in tall buildings or stoves, which are heated to harden the linoleum. The hardening process may take weeks. Linoleum tile is made by prolonging the heating until a much harder material is formed.

While the modern process described can be used to produce plain or solid patterns, many decorative effects are obtained by blending mixes of various colours. Marble effects are achieved by mixing blends of two or more colours. The degree of mixing must be controlled carefully to obtain the desired effect. Geometric patterns are produced by granulating mixes of various colours and applying the granules through stencils. Tile and textured effects are obtained in this same manner. The granules are integrated under pressure and then stoved. Spatter patterns are produced by adding granulated mixes in various colours and granule sizes to the surface of a calendered sheet and again calendering. At one time a printed surface was applied to linoleum, but this practice has long been abandoned.

Most linoleum is made in rolls 6 ft. wide, $\frac{3}{32}$ in. thick and with a felt backing. Some grades are offered in a thickness of $\frac{1}{8}$ in. and with burlap backing.

Felt Base.—This low-cost floor covering, often referred to as printed felt base, is produced by printing a heavy film of paint on felt that has been saturated with asphalt. Before the paint is applied, the felt is sealed nith one or two layers of coating to keep the asphalt from discolouring the paint and to level the surface; a backing coat also is applied at this time. A variety of paint vehicles have been employed; usually oleoresinous varnishes form the paint base, although alkyd resins have been used. The requirements for a satisfactory paint are rather severe since the paint must (1) have a low volatility when applied; (2) exhibit little tendency to flow; (3) dry readily in thick films much heavier than the usual paint film; and (4) produce a durable wearing surface with high gloss.

The paint is printed on the felt base from wooden blocks that are coated with paint and then applied to the surface of the felt. Many colours are applied in the usual printed pattern, and each colour is printed separately. The printed felt is then dried by heating in ovens, either in horizontal racks or in festoons. The paint must not flow if the festoon system is used. Maturing is finished in a few days. Printed felt base is available either in roll form or in rugs of various sizes and in several thicknesses.

Asphalt Tile.—Linoleum does not give good service when subjected to dampness or alkaline conditions, and a need arose for a floor covering that would perform well under these conditions. Asphalt tile met these requirements. It is comparatively low in cost and is available in tile form so that it can be installed easily by the homeowner.

The name "asphalt tile" is essentially a misnomer, since asphalt is used only in the very darkest shades of tile; lighter-coloured resins are used for most of the asphalt tile now on the market. The first tiles made from asphalt were quite dark in colour and were used mostly in industry. The name, however, has persisted.

The manufacture of asphalt tile is somewhat simpler than the manufacture of linoleum since the binder is thermoplastic and is not cured. Scraps, cuttings and trimmings can be reworked, and the tile can be packaged as soon as the calendered sheet has been cut and the tile has cooled.

Asphalt tile is made by mixing about 25 parts by weight of a resin and plasticizer with about 75 parts by weight of fillers and pigments. The filler consists of about 35% of asbestos fibres, 60% of ground limestone and up to 5% of pigments. The fillers and binder are premixed in some cases to shorten the mixing cycle.

Asphalt, gilsonite, dark-coloured coal tar and petroleum resins are used for dark-coloured asphalt tile while limed tall oil pitch is often used as the plasticizer for the darkest shades. For the lighter colours, coumarone-indene (coal-tar) resins were the first resins used. With the rapid increase in consumption of asphalt tile. however, petroleum resins came to be used, but the addition of polystyrene was required to make a suitable resin. Much of the tile on the market in the early 1960s contained some polystyrene, although the amounts used by various manufacturers varied considerably. Plasticizers for light-coloured tile also must be light in colour; limed tall oil is usually employed in combination with mineral oils or synthetic alkylated aromatic hydrocarbons. Since tall oil is saponifiable. the amounts in which it is used must be kept to a minimum in order to preserve the alkali resistance of the tile.

After the resin, plasticizer and fillers have been thoroughly mixed they are sheeted on mixing rolls and finally calendered to the thickness of the final tile, either $\frac{1}{8}$ or $\frac{3}{16}$ in. Mottle colours are usually added on mixing rolls, and the spatter colours are added in granular form just prior to calendering.

The sheet is then cut into nine-inch square tiles, cooled and packed. Originally the tile was offered in a wide variety of marbleized effects, but the spatter patterns have become more popular. In some cases the colour granules cover most of the surface of the tile; simulated cork surfaces are made in this way.

Vinyl Asbestos Tile.—Vinyl asbestos tiles are formed from vinyl chloride polymers or vinyl chloride-vinyl acetate copolymers. Copolymers are used more frequently than polymers because they are softer and more readily plasticized. (See also PLASTICS: Polyvinyl Chloride Resins)

Vinyl asbestos tile is made by mixing about 25 parts of a binder with about 75 parts of filler consisting of ground limestone, asbestos fibres and pigments. The binder consists of a vinyl chloride polymer or vinyl chloride-acetate copolymer, phthalate ester plasticizers and materials that stabilize the vinyl resin in heat and light. The asbestos content is usually lower than in asphalt tile, Mixing procedures are similar to those for asphalt tile although working temperatures may be somewhat higher. Mottle colours are added on the mixing rolls after the mix is blended and sheeted or just before it is calendered, depending on the type of decoration desired. The most popular thickness for vinyl asbestos tile is $\frac{1}{16}$ in.. although heavier gauges are offered. The material is offered usually as nine-inch square tiles, although other sizes are available. In addition to mottles, terrazzo and spatter patterns. tile is also decorated with bronze and aluminum flakes. Vinyl asbestos tile is somewhat more flexible than asphalt tile but often cracks on repeated flexing.

Vinyl Floor Coverings.—Rug-size floor coverings made from vinyl resins have proved popular and are now offered in a wide variety of forms. One variety is similar to printed felt; the paint coat consists of a vinyl chloride resin and a plasticizer. This is usually printed as a plastisol coating consisting of very finely divided vinyl chloride resin suspended in a plasticizer and pigmented. When heated, the resin dissolves in the plasticizer; no further curing is required.

Calendered vinyl floor coverings are also produced from calendered sheets on felt backing. These are offered in several different forms but usually in rolls or as tiles =&in, thick. Calendered vinyl sheets on felt backing are also offered in an alkali-resistant variety.

Homogeneous vinyl tile is made from vinyl chloride polymers plasticized with a phthalate ester. Fillers are employed but asbestos is not used in these flexible tiles. Pigments and stabilizers for the vinyl resin are used in the blend. The tile is produced in thicknesses of 0.08 to 0.125 in. and in 9-in. squares and in other tile sizes.

Some varieties are offered in translucent form. In this type little or no filler is used and the decoration consists of geometric shapes or metallic flecks throughout the tile. Many of these simulate the appearance of marble.

Rubber Flooring. — Rubber flooring for many years was made of natural rubber, but in recent years synthetic rubber, particularly the styrene-butadiene copolymer, has been employed in most rubber flooring. The rubber is mixed with resins to improve processing; fillers, pigments and curing agents are mixed, and the mix is then sheeted and cured in heated presses. Rubber tile is usually offered in plain or mottle patterns, in thicknesses of $\frac{1}{8}$ in. and $\frac{3}{16}$ in., in squares of 6 in., 9 in. and 12 in., and in rolls.

Cork Tile. — Ground cork has long been used to make floor coverings. When cork is heated at high temperatures the particles knit and form a resilient composition. Heating takes hours by conventional methods since heat is transferred through the cork very slowly. High-frequency heating (*q.v.*) reduces the heating time to minutes. Cork tile is offered in tan and dark brown colours, thicknesses of $\frac{1}{8}$ in., $\frac{3}{16}$ in. and $\frac{5}{16}$ in., squares of 6 in. and 9 in. and also in rectangular shapes.

Properties of Floor Coverings. — All of the floor coverings described in this article have found their own fields of application and each has properties that make it suitable or unsuitable for particular applications. Asphalt tile is lowest in cost, the dark shades of asphalt being the least expensive. Linoleum is next lowest in cost, followed by vinyl asbestos, cork and rubber. Homogeneous vinyl tile is the most expensive of all those described.

When comfort and quiet are essential, cork tile is superior; appearance and maintenance, however, are not strong points of cork. Linoleum has had a long history of successful performance, but it cannot be used below grade, as in basements, or in areas where high moisture or alkaline conditions prevail. Asphalt tile has been widely adopted under these conditions because it is resistant to water and alkali. Rubber flooring is used mostly in public buildings and has many excellent properties; it is not too easy to maintain, however, nor is it particularly resistant to grease. Vinyl flooring is offered in so many forms that generalizations are difficult. Homogeneous vinyl tile, however, offers good resistance to water and alkali, is grease resistant and has good colour stability.

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FLOOR TRADERS, members of a (especially the New York) stock exchange who buy and sell securities for their own account and who do not conduct transactions for clients. They are to be distinguished from the commission brokers whose exclusive function is to trade for the accounts of clients. Floor traders are often known as room traders.

FLOQUET, CHARLES THOMAS (1828–1896), French statesman, was born at St. Jean-Pied-de-Port (Basses Pyrénées) on Oct. 2, 1828. He studied law in Paris, and was called to the bar in 1851. The coup *d'état* by Napoleon III in that year aroused the strenuous opposition of Floquet, who had, while yet a student, given proof of his republican sympathies by taking part in the fighting of 1848. He made his name by his brilliant and fearless attacks on the government in a series of political trials, and at the same time contributed to the *Temps* and other influential journals.

When the tsar Alexander II visited the Palais de Justice in 1867, Floquet was said to have confronted him nith the cry "Vive la Pologne. monsieur!" He delivered a scathing indictment of the empire at the trial of Pierre Bonaparte for killing Victor Noir in 1870, and took part in the revolution of Sept. 4 as well as in the subsequent defense of Paris. In 1871 he was elected to the national assembly by the *département* of the Seine.

During the Commune he formed the Ligue d'union républicaine des droits de Paris to attempt a reconciliation with the government of Versailles. He was imprisoned for a short time after the fall of the Commune. Floquet edited the *République française,* was president of the municipal council, and entered the chamber of deputies in 1876. He took a prominent place among the extreme radicals, and became president of the group of the "Union républicaine." In 1882 he held for a short time the post of prefect of the Seine. In 1885 he succeeded Henri Brisson as president of the chamber. This difficult position he filled with such tact and impartiality that he mas re-elected the following two years. Having approached the Russian ambassador in such a way as to remove the prejudice existing against him in Russia since the incident involving tsar Alexander II in 1867, he rendered himself available for office. On the fall of the Tirard cabinet in 1888 he became president of the council and minister of the interior in a radical ministry pledged to secure the revision of the constitution. Heated debates in the chamber during the Boulangist agitation culminated on July 13 in a duel between Floquet and Boulanger in which the latter was wounded.

In Feb. 1889 the government fell on the question of revision, and in the new chamber of November Floquet was re-elected to the presidential chair. Implicated in the Panamá scandals he lost the presidency of the chamber in 1892, and his seat in the house in 1893, but in 1894 was elected to the senate.

Floquet died in Paris on Jan. 18, 1896.

See *Discours et opinions de M. Charles Floquet,* ed. by A. Faivre (1885).

FLOR, ROGER DI, a military adventurer of the 13th–14th century, was the second son of a falconer in the service of the emperor Frederick II, who fell at Tagliacozzo (1268). When Roger was eight years old he was sent to sea in a galley belonging to the Knights Templars. He entered the order and became commander of a galley. At the siege of Acre by the Saracens in 1291 he was accused and denounced to the pope as a thief and an apostate, was degraded from his rank, and fled to Genoa, where he began to play the pirate.

The struggle between the kings of Aragon and the French kings of Naples for the possession of Sicily was at this time going on and Roger entered the service of Frederick, king of Sicily, who gave him the rank of vice-admiral. At the close of the war, in 1302, as Frederick was anxious to free the island from his mercenary troops (called *Almogávares*), whom he had no longer the means of paying, Roger induced them under his leadership to seek new adventures in the east, in fighting against the Turks, who were ravaging the empire. The emperor Andronicus II accepted his offer of service; and in Sept. 1303 Roger with his fleet and army arrived at Constantinople. He was adopted into the imperial family, was married to a granddaughter of the emperor, and was made grand duke and commander in chief of the army and the fleet.

After several weeks lost in dissipation, intrigues and bloody quarrels, Roger and his men were sent into Asia. and after some successful encounters with the Turks they went into minter quarters at Cyzicus.

In May 1304 they again took the field, and relieved Philadelphia, then invested and reduced to extremities by the Turks. But Roger determined to found in the east a principality for himself. He sent his treasures to Magnesia, but the people slew his Catalans and seized the treasures. He besieged the town, but was repulsed. Being recalled to Europe, he settled his troops in Gallipoli and other towns, and visited Constantinople to demand pay for the *Almogávares.* Dissatisfied with the small sum granted by the emperor, he plundered the country and carried on intrigues both with and against the emperor, receiving reinforcements all the while from all parts of southern Europe. Roger was now created Caesar, but shortly afterward the young emperor Michael Palaeologus, not daring to attack the fierce and now augmented bands of adventurers, invited Roger to Adrianople, and there contrived his assassination and the massacre of his Catalan cavalry (April 4, 1306).

His death was avenged by his men in a fierce and prolonged war against the Greeks.

See Moncada, *Expedicidn de los Catalanes* y *Aragones contra Turcos y Griegos* (1840).

FLORA, Italian goddess of the flowering of plants. Her worship at Rome, where she had her own priest (flamen), goes back to very early times. Her festival (*Floralia:* April 28–May 3) was instituted in 238 B.C. on the advice of the Sibylline books, and at the same time a temple was dedicated on the slopes of the Aventine near the Circus Maximus. The *Floralia* was accompanied by much indecency. Harlots considered this their special season, and the games included lewd mimes. Flora's head, distinguished only by a floral crown. appears on coins of the republic.

The term flora is used in botany collectively for the plant growth of a district.

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FLORAL PARK, a residential village of Nassau county in southeastern New York, U.S., on Long Island, immediately east of the borough of Queens (New York city) and 4 mi. W. by N. of Hempstead. Although most residents of the village work in New York city, there are light manufactures which include the making of slippers, photographic equipment and aircraft parts. Flower cultivation, from which the village takes its name, is also carried on. Floral Park was incorporated in 1908. For comparative population figures see table in NEW YORK: *Population.*

FLOREAL. The name given to the eighth month of the year introduced into the French Republican calendar in 1793. It extended from April 20 to May 19.

FLORE AND BLANCHEFLEUR: see AUCASSIN AND NICOLETTE.

FLORENCE, WILLIAM JERMYN (BERNARD CONLIN) (1831–1891), U.S actor. whose greatest success was in Benjamin Woolf's *The Mighty Dollar,* which he is said to have performed over 2,500 times. He was born in Albany, N.Y., July 26, 1831, of Irish parents. Reared in New York city, he became a call bov at the Old Bowery theatre under F. S. Chanfrau. While working to support his mother and her seven younger children, he rehearsed plays at night. and in 1850 began to do dialect impersonations. In 1851 he married Malvina Pray, and thereafter the two generally appeared together on the stage.

Florence's first success was in *A Row at the Lyceum* (1851); following this. he established his reputation as Captain Cuttle in *Dombey and Son,* Bob Brierly in *Ticket-of-Leave Man* and Sir Lucius O'Trigger in *The Rivals.* His last appearance was with Joseph Jefferson, with whom he had maintained a successful partnership. He died in Philadelphia, Nov. 18, 1891. Florence was one of a select number of Americans to win the ribbon of the Société Histoire Dramatique. (S. W. H.)

FLORENCE (Ital. FIRENZE, Lat. FLORENTIA), capital of Tuscany, and the capital of the province of the same name, lies 145 mi. N.N.W. of Rome, Italy. Pop. (1957 est.) 411,962 (commune). Florence is very favourably situated where the Arno river, after leaving the undulating spurs of the Apennines and before flowing inta the level fertile plain, is at its narrowest and therefore easiest to ford and to bridge. Because of its position near the three Apennine passes, of which two lead to Bologna and one farther south to Faenza, Florence became one of the foremost centres of communication of central Italy. It has equally easy access to the Tyrrhenian seaboard since the embarking and draining operations have averted the danger of flooding from the intervening lower ranges of the river.

ancient times Tuscany stood out among the regions of peninsular Italy as the one endowed with the most varied natural resources and containing almost the entire mineral wealth of Italy. The surrounding hills and plain produce wheat, maize, olives, vines, fruit trees, etc. The chief nonfruit-bearing trees are the pine, cypress, ilex and poplar. Gardens and fields produce such an abundance of blossoms that Florence is known as *la cittb del fiore* ("the city of the flower"); the city's emblem is a flower which also was struck on the obverse of the Florentine gold coins (hence called *florins*).

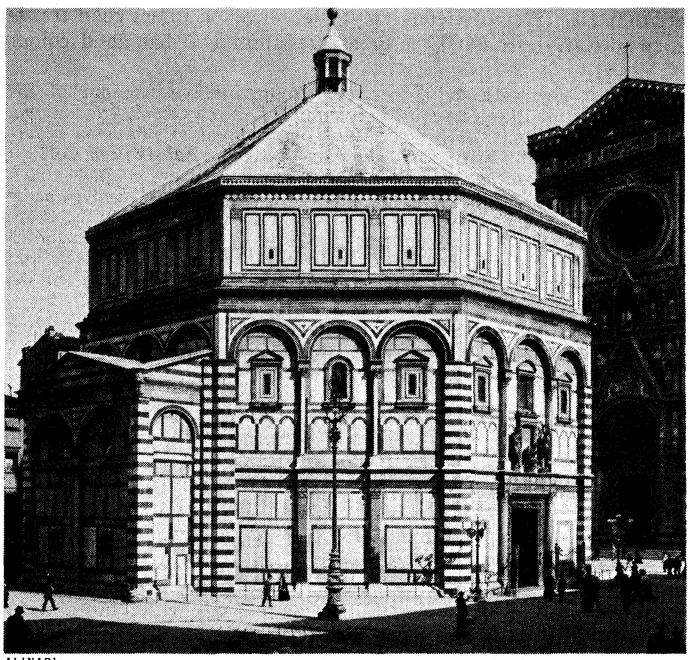
The soft yet precise outlines of the surrounding hills are one among the many attractions of the Florentine landscape. The rigour of the winter (minimum temperature 23° F.) and the heat of the summer (maximum 96.3" F. in July) do not last long: between the seasons the temperature is delightful.

Known as "the Athens of Italy," Florence is one of the foremost art centres of the world, second only to Rome for the wealth of monuments and art treasures; it equally used to be the seat of the oldest learned societies and academies. The Florentines have never lost their inborn sensitiveness for the fine arts nor their natural good taste; lively, quick in repartee, with a sharp, sometimes cynical sarcasm, they nevertheless cling to their traditional festive occasions and their charitable customs.

The artistic temperament of the Florentines accounts for their highly developed handicrafts, the best-known being statuettes (in marble and alabaster), gold and silver wares, the so-called Florentine "mosaic" (really *intarsio* of hard stones), cabinetmaking, artistic ceramic and terra-cotta wares, glass. wrought iron, embroidery, lace, tooled leather and the typical Florentine plaited straw goods. Later crafts have been added such as photographic reproduction of works of art. The latest manifestation of Florentine artistry is the fashion shows which. under the auspices of the Ente della Moda. take place periodically in the Palazzo Pitti: these occasions have grown into international exhibitions and attract people from the rest of Europe and from North America.

Florence has been spared the mechanization attending mass production. Except for a few flour mills, some glassworks. a nonferrous metal factory, a motor factory and an oil drilling equipment factory, there are hardly any large industries, though Florence is the centre of one of Italy's foremost firms producing precision instruments. There are porcelain works in the outskirts. (O. D. S.)

Architecture and Art.—The oldest surviving building in Florence is almost certainly the Baptistery, but it has never been satisfactorily dated. In the 14th and 15th centuries it was regarded as having been built by the Romans as a temple of Mars: modern guesses range from the 5th (or even 4th) century to the 11th or 12th. The present building is probably of the 11th or 12th centuries and very probably replaces a much earlier one. There are other churches of the Romanesque period in Florence, and



ALINARI

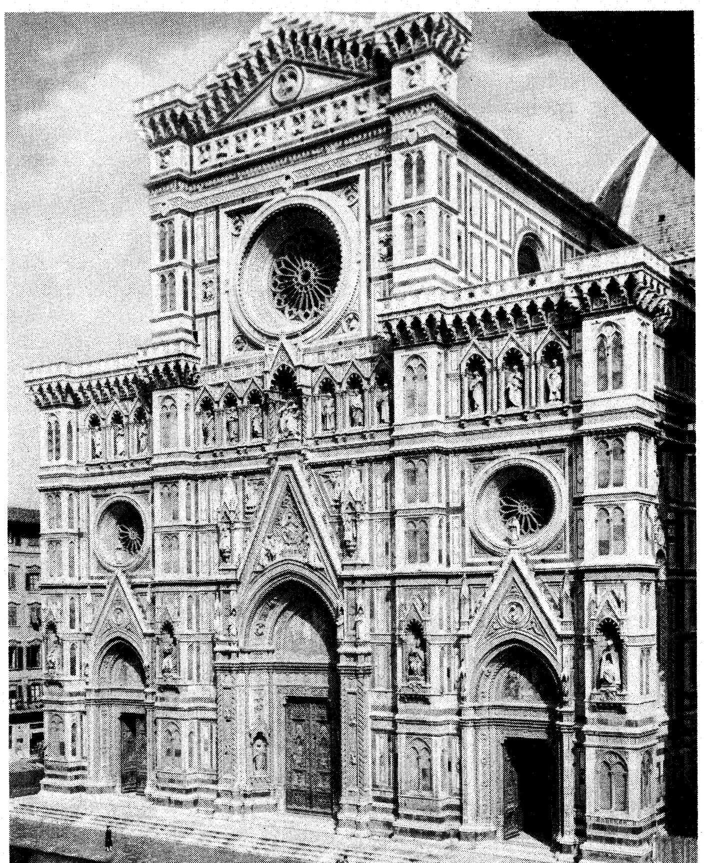
BAPTISTERY OF S GIOVANNI. PROBABLY THE OLDEST SURVIVING BUILDING IN FLORENCE, DATING IN ITS PRESENT FORM FROM THE 11TH OR 12TH one of the finest is S. Miniato al Monte, just outside the city, which goes back to 1018 or 1062, although most of it is somewhat later. These very classical buildings, with their peculiar striped appearance due to the decorative use of bands of ahite and dark grey-green marble, were one of the formative influences on the great outburst of architectural activity in Florence in the 13th, 14th and 15th centuries.

After the governmental reorganization of 1250 there was a wave of church-building, partly due to the great influence of the new mendicant orders of friars (Dominicans and Franciscans) and, at the same time, the strong civic sense of the Florentines asserted itself in several large public buildings and in the subsidizing of new churches, especially the great cathedral (begun in 1294 and not consecrated until 1436) which was regarded as a state enterprise. In the 14th century. there grew up two nuclei of building activity in Florence, one centred on the new cathedral and campanile just opposite the old Baptistery and the other nearer the river and centred on the Palazzo della Signoria (Palazzo Vecchio), or town hall, the great square in front of it, and the Loggia dei Lanzi, with the Bargello, the residence of the *podestà* or chief magistrate, a little way off.

The first great church to be built for one of the new orders was Sta. Maria Novella, the main Florentine church of the Order of S. Dominic, or Friars Preachers. This church is the one that shows the strongest influence of an entirely new style, conditioned by French Gothic (and particularly by the Cistercian forms of it), but with far less verticality and with a calm spaciousness due to the remembered forms of the classical and Romanesque churches. Some of the spacious effect is probably also due to the fact that churches for the new orders were designed to hold huge congregations who came to hear the preachers. The first plan of Sta. Maria Novella was made by 1246, but it is not certain how much (if any) of the existing church is of that date; and it has been argued that parts of Sta. Trinità antedate Sta. Maria Novella: whether or not this is so. it remains true that Sta. Maria was a new kind of church designed for a new religious purpose in a new, Italian, Gothic style. Sta. Croce, at the opposite end of the city. was the corresponding headquarters of the rival Franciscan order and, according to tradition, was designed by Arnolfo di Cambio from 1294–95. It is less ambitious architecturally than Sta. Maria Novella for it retains the traditional flat, openwork, timber roof where Sta. Maria has stone vaults. Sta. Croce is perhaps best known for the wealth of Trecento frescoes. including those by Giotto (*q.v.*) decorating two chapels, and for the Quattrocento and later tombs. Arnolio di Cambio is also credited with the Badia. a reworking of an older church. but his principal work was Sta. Maria del Fiore, the cathedral of Florence. where he is recorded as having worked in 1300 and consequently being exempt from taxation. He died soon afterward. and the plans he had established were much enlarged, though relatively little changed, by Francesco Talenti (1355–65).

Between the times when Arnolfo and Talenti held the surveyorship it passed to Giotto (1334–37) on the grounds of his fame as a painter rather than his architectural skill. He did not alter Arnolfo's plans hut instead began to erect the campanile, or bell tower, which stands at the side of the west front. The crowning feature of the cathedral, and the great landmark for miles around. is the huge ribbed dome which was added by Brunelleschi (*q.v.*) between 1420 and 1436—the lantern mas added later—and which was constructed entirely without centring. The opening is about $138\frac{1}{2}$ ft. across (slightly larger than St. Peter's. Rome, and much larger than St. Paul's. London). The engineering feat performed by Brunelleschi ensured his fame, quite apart from his other works in Florence, some of which are of greater aesthetic importance. The decoration of the cathedral occupied much of the 15th century and many of the finest sculptors worked on it, in particular. Donatello and Luca della Robbia who both worked there at the time when Ghiberti was occupied with his first and second bronze doors for the Baptistery (1403–52). The main front of the cathedral remained incomplete until 1875 when the present neo-Gothic design was made by E. de Fabris.

The major public buildings erected in the 14th century were the Bargello (now the National Museum of Sculpture) and the Palazzo della Signoria, which was the seat of government and was sufficiently fortified to withstand rioting and other disorders. The great bell tower, built out over the façade, carries the bell used



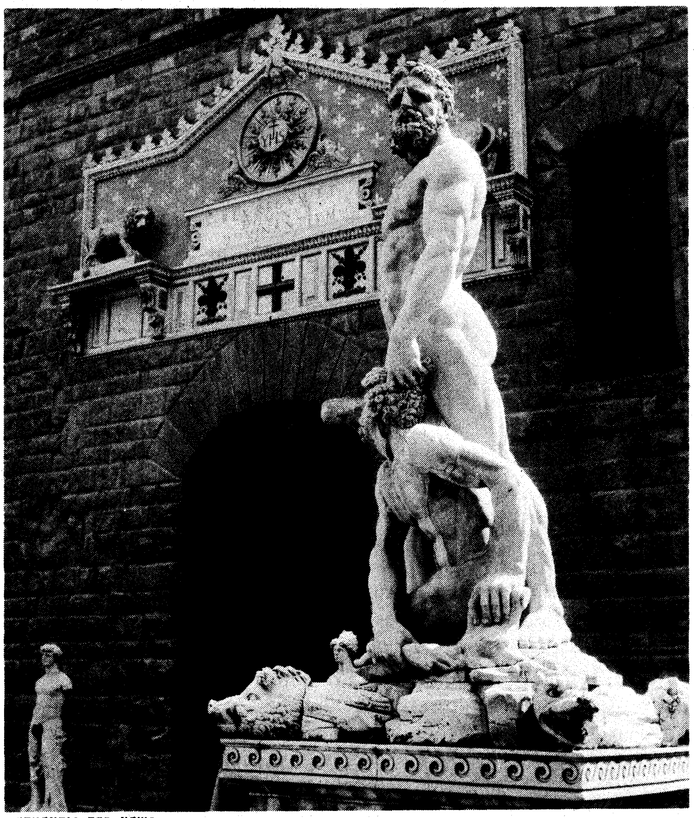
EWING GALLOWAY

FACADE OF STA. MARIA DEL FIORE. THE CATHEDRAL OF FLORENCE. BEGUN IN THE 13TH CENTURY, COMPLETED LATE 19TH CENTURY

as a city alarm. The Palazzo della Signoria is attributed to Arnolfo di Cambio, but there is no evidence for this although the dates, 1298 to 1314, would fit. Opposite the palace, the Signoria built an open loggia, generally known as the Loggia dei Lanzi, as a public meeting place. This was begun in 1376. Other more ar less public buildings include the church of Or San Michele, which was originally a grain store but became the church of the guilds, which formed the political centre of Florence. On the façades of Or San Michele are several niches holding statues of the patron saints of the various guilds; many of these figures are among the most important examples of early 15th-century Florentine sculpture, including Ghiberti's "St. John," "St. Matthew" and "St. Stephen," Donatello's "St. George" (now represented by a copy), Nanni di Banco's "Quattro Santi Coronati," and, among the later works, Verrocchio's "Incredulity of St. Thomas."

Perhaps the most important semipublic building in Florence is the loggia of the Spedale degli Innocenti (the Foundling hospital). Not only was this the first hospital of its kind but it is also an architectural landmark, since it was designed by Brunelleschi about 1419 and it, rather than the cathedral, is the first Renaissance building. It was finished by Brunelleschi's pupils and he himself turned his attention to church-building, his two main works being S. Lorenzo and Sto. Spirito. Both are Latin cross designs (derived from traditional models such as Sta. Croce), subjected to the rigorous classical discipline of mathematical proportion which was Brunelleschi's major contribution to Renaissance architecture. S. Lorenzo was the parish church of the Medici, and it was for one of this family that he first built the old sacristy at S. Lorenzo before working on the church proper. The old sacristy is the burial place of several Medici and is one of the first modern buildings to be constructed on the central plan system. It is built as a cube with a dome over it; the hemispherical dome is half the height of the cube. The decorations—which did not please Brunelleschi—were by his friend Donatello. A century later, beginning in 1520, Michelangelo built the new sacristy as another Medici chapel in a style which is clearly based on Brunelleschi's old sacristy opposite. Finally, the later Medici caused a still larger funerary chapel to be added behind the church choir and between the other two chapels: this is by Matteo Nigetti and was begun in 1605. It is one of the least successful of the few Baroque buildings in Florence. The cloister of S. Lorenzo contains the Biblioteca Laurenziana, also by Michelangelo and one of his most important works in architecture as well as one of the first Mannerist buildings.

On the other side of the Arno, in the poorer quarter Oltr' Arno Brunelleschi built Sto. Spirito, his last church design, which is



AUTHENTICATED NEWS

MARBLE STATUE OF HERCULES AND CACUS BY BACCIO BANDINELLI (1493–1560), OUTSIDE THE PALAZZO DELLA SIGNORIA (PALAZZO VECCHIO). FLORENCE

a revised edition of the ideas in S. Lorenzo. Additions were made later in the century by Giuliano da Sangallo and Il Cronaca, but the influence of Brunelleschi is paramount. The only other important church in this quarter is Sta. Maria del Carmine, which is of interest less because of its architecture than because it contains Masaccio's Brancacci chapel frescoes, the foundation of Quattrocento painting and the most important fresco cycle painted in Florence since Giotto's in the chapels of Sta. Croce a century earlier.

The only other major building on the south side of the Arno is the huge Pitti palace. begun in the mid-15th century by an unknown architect, traditionally, but improbably, said to be Brunelleschi. It was enormously enlarged by Ammanati (1558–70) as a residence for the Medici; various later grand dukes had further alterations and additions made. It became the usual residence after Cosimo I gave up living in the Palazzo della Signoria and for this reason it was connected with the Palazzo degli Uffizi (Vasari and others, 1560 onward), which housed the government offices, by a long corridor carried over the Arno on top of the Ponte Vecchio. The corridor was badly damaged during World War II, when the Germans destroyed all the old bridges save the Ponte Vecchio and also blew up much of the Por Santa Maria quarter at the approaches to the Ponte Vecchio. Two bridges have been built since the war: Ponte Santa Trinità, reconstructed according to the original plans, and Ponte Amerigo Vespucci, built of prestressed concrete. Behind the Pitti palace lie the Boboli gardens, smong the largest and most splendid of Italian formal gardens, sloping steeply up the hillside. At the top is the Fortezza di Belvedere, first opened to the public in 1957, from which a breathtaking panorama of Florence may be obtained.

The Pitti and Uffizi are now the two principal art galleries of Florence, containing an unsurpassed representation of Tuscan painting from the 13th to the 17th centuries and a fair representation of other Italian and foreign schools. Some early and less important works are also to be found in the Academy of Fine Arts, the chief treasure of which is Michelangelo's "David." The main collection of Tuscan sculpture is, however, housed in the Bargello. Most of the numerous churches of Florence contain interesting paintings, but two must be mentioned specifically: S. Marco and the SS. Annunziata. Both contain important frescoes; the convent of S. Marco is now a museum dedicated to its two most famous inhabitants, Savonarola and Fra Angelico, the latter of whom painted the splendid series of frescoes which adorn it, as well as the altarpieces now preserved there.

No account of the art history of Florence, however brief, could conclude without mention of the palaces which have formed many of our ideas of city living. The Florentines were among the first people to revive the classical idea of great houses which combined warehouses and shops on the ground floor with apartments on the upper ones. In most cases the palace was built by a wealthy merchant (not noble) family, which had offices on the ground floor and lived on the cool, spacious first floor (piano *nobile*); the upper floors, smaller and hotter, being let off or used for the accommodation of employees and relatives. Many such palaces are still in the possession of the families that built them and are still used for the same purposes. The Palazzo Davanzati, now a museum, is a splendid example, built at the end of the 14th century. The finest examples are from the 15th century: the Palazzo Medici, by Michelozzo (*q.v.*); the Rucellai, by Alberti (*q.v.*), which first used the classical orders on a house façade; later 15th-century ones like the Pazzi-Quaratesi and Strozzi; and, in the 16th century, one by Raphael himself, the Palazzo Pandolfini. This, though now within the northern boundary of the city, was then a suburban villa, and, as such, can perhaps hardly count in the evolution of what has always been a very urban city.

(P. J. MY.)

Libraries.—The Biblioteca Nazionale Centrale (Central National library) has the right to receive a copy of every publication issued in Italy and contains some 4,000,000 pieces divided into manuscripts, rare first editions, pamphlets, maps, engravings and autographs. The Biblioteca Marucelliana, founded in 1703, is chiefly remarkable for its collection of illustrated works and art publications. The Laurentian library was opened to the public by Grand Duke Cosimo I in 1571; it contains first editions and a collection of manuscripts, including richly ornamented missals, bibles and codices of great beauty. A famous international library is the Gabinetto Viesseux which now belongs to the commune of Florence and is on the ground floor of the Strozzi palace. (See LIBRARIES: Italy.)

University and Institutes.—The University of Florence is descended from "Studio Fiorentino" (later called *universitas scholarium*) founded in 1349, which Lorenzo de' Medici transferred to Pisa in 1472; there still remained in Florence the important study of medicine which was at the head of the scientific movement of the age, though the university was not legally constituted until 1923. There are numerous specialized and foreign academies.

(X.)

HISTORY

Florentia was founded considerably later than Faesulae (Fiesole), which lies on the hill above it. Tacitus mentions it, and

Florus describes it as one of the *municipia splendidissima.* A bishop of Florence is mentioned in A.D. 313. The first event of importance recorded is the siege of the city by the Goths. A.D. 405, and its deliverance by the Roman general Stilicho. We find the Longobards in Tuscany in 570, and mention is made of one *Gudibrandus Dux'civitatis Florentinorum,* which suggests that Florence mas then the capital of a duchy.

Guelphs and **Ghibellines.**—Under the Carolingian emperors, Tuscany was a march or margraviate, which, in 1054, passed to the famous countess Matilda, daughter of Boniface of Canossa. In the Wars of the Investitures Matilda was on the papal (Guelph) side against the emperor and the faction afterward known as Ghibelline *(see* GUELPHS AND GHIBELLINES), and she herself often led armies to battle. While she presided at the courts of justice in the name of the empire, she was assisted by a group of great feudal nobles, judges, lawyers, etc., who formed. as elsewhere in Tuscany, the *boni homines* or *sapientes.* The citizens found themselves in opposition to the nobility of the hills around the city, Teutonic feudatories of Ghibelline sympathies, who interfered with their commerce, and they began to form themselves into groups and associations, which were the germs of the *arti* or guilds.

After the death of Countess Matilda in 111; the *grandi* or *boni homines* continued to rule, but in the name of the people—a change which marks the foundation of the commune. After 1138 the *boni homines* began to be called *consules,* while the population was divided into the *grandi* or *delle torri; i.e.,* the noble families possessing towers, and the *arti* or industrial and merchant guilds. At first the *consules* were chosen by the *grandi* and assisted by a council of 100, in which the *arti* were predominant. In 112j Fiesole was sacked and destroyed, but the feudal nobles of the *contado* (surrounding country), protected by the imperial margraves, were still powerful.

The Florentines waged war against the Alberti family, whose castles they destroyed, and fought successfully against the powerful Counts Guidi. Frederick Barbaroisa. honever, elected emperor in 1152, made his authority felt in Tuscany, and appointed one Welf of Bavaria as margrave, and a *potestas* or *podestci* who resided at San Miniato was appointed to represent the emperor and exercise authority in the *contado.* From the end of the 12th century the *podestà* was always a foreigner. In the meantime Florence had already become an important industrial and banking centre.

The work of crushing the nobles of the *contado* and of asserting the city's position among rival communes continued. The tumults against the Paterine heretics (1244–45), among whom were many Ghibelline nobles, indicate a successful Guelphic reaction; but, when civil war broke out. Frederick of Antioch, imperial vicar in Tuscany, and natural son of Frederick II. entered the city with 1,600 German knights, the Ghibellines triumphed again, and in 1249 the Guelph leaders were driven into exile—the first of many instances in Florentine history of exile en masse of a defeated party.

Comune and **Popolo.**—The Ghibellines being unable to maintain their supremacy, the city came to be divided into two almost autonomous republics, the *comune* headed by the *podestci,* and the *popolo* headed by the *capitano* and militarily organized into 20 companies; the central power was represented by 12 elders. At this time the *podestci's* palace (the Bargello) was built, and the gold florin was first coined and soon came to be accepted as the standard gold piece throughout Europe. But, although greatly strengthened. the Guelphs were not wholly victorious, and in 1251 they had to defend themselves against a league of Ghibelline cities (Siena, Pisa and Pistoia) aided by Florentine Ghibellines. A Florentine army assisted by Guelphs of other towns was met by a Sienese army reinforced by Florentine exiles, and by the cavalry of Manfred of Sicily *(q.v.),* with the result that the Florentines were totally routed at Montaperti on Sept. 4, 1260. Count Giordano, acting for Manfred, entered Florence, appointed Count Guido Novello *podestà,* and began a series of persecutions against the Guelphs. The Ghibellines even proposed to raze the walls of the city. Their triumph, however. was short-lived: Charles I of Anjou *(q.v.),* descended into Italy as the champion of the papacy; Manfred was defeated and killed (1266), and Guido Novello and the Ghibellines were expelled and their property confiscated. But it was not the *popolo* who triumphed; the pope and Charles were the real masters of the situation. Nevertheless much of the old order was restored; the *podestci* who represented King Charles was assisted by 12 *buoni uomini,* and by the council of the 100 *buoni uomini del popolo,* but the constitution of the republic, although of very democratic tendencies, seemed designed to promote civil strife and weaken the central pouer.

While the constitution was evolving in a manner which seemed to argue small political ability and no stability in the Florentines, the people had built up a wonderful commercial organization. Each of the seven *arti maggiori* or greater guilds was organized like a small state with its councils, statutes, assemblies, magistrates, etc., and in times of trouble constituted a citizen militia. Florentine cloth especially was known and sold all over Europe, and the Florentines were regarded as the first merchants of the age. In 1279 Pope Nicholas sent his nephew, Cardinal Latino Frangipani Malabranca, to reconcile the parties in Florence once more. He succeeded to some extent, and was granted a kind of temporary dictatorship. He raised the 12 *buoni uomini* to 14 (eight Guelphs and six Ghibellines), to be changed every two months; and they were assisted by a council of 100. A force of 1,000 men was placed at the disposal of the *podestci* and *capitano* (now both elected by the people) to keep order and oblige the Guelph nobles to respect the law. After 1282 the signory was composed of the three (afterward six) *priori* of the guilds, who ended by ousting the *buoni uomini,* while a *defensor artificum et artium* replaced the *capitano;* thus the republic became an essentially trading community, governed by the *popolani grassi* or rich merchants.

The republic now turned to the task of breaking the power of the Ghibelline cities of Pisa and Arezzo. In 1289 the Aretini were completely defeated by the Florentines at Campaldino, a battle made famous by Dante's presence. Peace was made in 1293.

The Ordinamenti Della **Giustizia.**—The nobles, who had largely contributed to the victory, especially men like Corso Donati and Vieri de' Cerchi. were becoming more powerful, but new laws were passed to reduce their influence. These were reinforced by the *Ordinamenti della Giustizia* of 1293, by which all nho were not of the *arti* were definitely excluded from the signory. The leading spirit of this reform was Giano della Bella, a noble who by engaging in trade had become a *popolano;* the nobles strenuously opposed the new measures, and in 1295 a signory favourable to them enacted a law attenuating the *Ordinamenti.*

Charles of Valois and Henry of Luxembourg. — The nobles, however, had split into two factions, the *Neri* (Blacks), headed by the Donati, and the *Bianchi* (Whites) led by the Cerchi. The pope's attempt to unite them having failed, he summoned Charles of Valois to come to his assistance, promising him the imperial crown, and in 1301 Charles entered Italy with instructions from the pope to crush the Bianchi and the *popolo* and exalt the Neri. On Nov. 1 Charles reached Florence. He promised to respect the laws, but the new *podestci,* Cante dei Gabrielli of Gubbio, who had accompanied Charles, punished many of the Bianchi; among those whom he exiled mas the poet Dante (1302).

Corso Donati, who for some time mas the most powerful man in Florence, made himself many enemies by his arrogance, and the irritation against him resulted in a rising in which he was killed (1308). In the same year Henry of Luxembourg was elected king of the Romans, and with the pope's favour he came to Italy in 1310; the Florentine exiles and all the Ghibellines of Italy regarded him as a saviour and regenerator of the country, while the Guelphs of Florence regarded both him and the pope as dangerous to their liberties. In 1312 Henry was crowned emperor as Henry VII in Rome, but circumstances made him merely a German kaiser who tried to subjugate free Italian communes. He besieged Florence without success, and died in 1313.

The 14th Century. — In 1325 further constitutional reforms were enacted. The former councils were replaced by the *consiglio del popolo,* consisting of 300 *popolani* and presided over by the *capitano*, and the *consiglio del comune* of 250 members, half of them nobles and half *popolani,* presided over by the *podestà.* The *priori* and other officers were drawn by lot from among the Guelphs over 30 years old who were declared fit for public office by a special board of 98 citizens (1329).

From 1313 to 1338. the Florentines waged war with varying success against Pisa and Lucca. Finally. by the peace of 1339 they obtained a part of Lucchese territory. At the same time they purchased from the Tarlati the protectorate over Arezzo for ten years. But misfortunes fell on the city: Edward III of England repudiated the heavy debts contracted for his wars in France with the Florentine banking houses of Bardi and Peruzzi (1339), and this eventually led to their bankruptcy, shaking Florentine credit all over the world; Philip VI of France extorted large sums from the Florentine merchants and bankers in his dominions by accusing them of usury; in 1340 plague and famine wrought terrible havoc in Florence, and riots again broke out between the nobles and the *popolo.* To put an end to these disorders, Walter of Brienne, duke of Athens. was elected "conservator" and captain of the guard in 1342. An astute, dissolute and ambitious man, half French and half Levantine, he succeeded in getting himself acclaimed by the populace lord of Florence for life. But by his oppressive taxes; and his ferocious cruelty. he accumulated bitter hatred against his rule. On July 26, 1343, the citizens rose in arms, demanded the duke's abdication, and besieged him in the palace. Finally on hug. 1 he had to resign his lordship.

A *balia,* or provisional government. was appointed to institute reforms; new constitutional changes were introduced; the *Ordinamenti* were maintained, but in a somewhat attenuated form, and certain nobles as a favour were declared to be of the *popolo.* Florence became a thoroughly democratic and commercial republic, but Florentine democracy was limited to the walls of the city, for no one of the *contado* nor any citizen of the subject towns enjoyed political rights. which were reserved for the inhabitants of Florence alone, and not by any means for all of them.

Florence was, in the 14th century. a city of about 100,000 inhabitants. of whom 25,000 could bear arms; there were 110 churches. 39 religious houses; the shops of the *arte della lana* numbered over 200, producing cloth worth 1,200,000 florins. and Florentine bankers and merchants were found all over the world, often occupying responsible positions .in the service of foreign governments. It was already a centre of art and letters and full of fine buildings, pictures and libraries. But since the nobles had been suppressed politically, the lowest class of adventurer had come into prominence. thus paving the way for tyranny.

In 1347 the city was again stricken with famine, and in 1348 by a terrible plague. which carried off three-fifths of the population (according to Yillani). Yet in spite of these disasters the republic was not vanquished; it soon regained the suzerainty over many cities which had broken off all connection with it and purchased the overlordship of Prato. Giovanni Visconti, lord and archbishop of Milan, having purchased Bologna and allied himself with sundry Ghibelline houses of Tuscany with a view to dominating Florence. aroused Florentine anger and the city made war on him in 1351, and placed itself under the protection of the emperor Charles IV (13jj). This enabled the nobles who dominated the *Parte Guelfa* to enact stringent measures, punishing with death or heavy fines all who, being Ghibellines, held office, and to exercise a veritable reign of terror.

Italy at this time began to be overrun by bands of soldiers of fortune. The first of these bands with whom Florence came into contact was the Great Company. commanded by the count of Lando, which twice entered Tuscany but was expelled both times by the Florentine troops (1358–59). From 1362–64 Florence was again at war with Pisa and the latter called Sir John Hawkwood's English company to their aid. Peace was finally made with no advantage gained on either side.

The Parte **Guelfa.**—The tyranny of the *Parte Guelfa* continued unabated, and the *capitani* carried an enactment by which no measure affecting the *Parte* should be even discussed by the signory unless previously approved by them. This law. however, aroused so much opposition that some of the very men who had proposed it assembled in secret to discuss its abolition, and a quarrel between the Albizzi and the Ricci having weakened the *parte*, a *balìa* of j6 was agreed upon. Several of the Xlbizzi and the Ricci were excluded from office for five years. and a council called the Ten of Liberty was created to defend the laws and protect the weak against the strong.

In 1375 Florence became involved in a war which showed how the old party divisions of Italy had been obliterated. The papal legate at Bologna, Cardinal Guillaume de Noellet (d. 1394), although the Church was then allied to Florence. was meditating the annexation of the city to the Holy See; he refused a request of the Florentines for grain from Romagna, and authorized Hawkwood to devastate their territory. An alliance with Bernabò Visconti was thereupon concluded. war declared, and a *balia* of eight, the *Otto della guerra* (afterward called the "Eight Saints" on account of their good management) was created to carry on the campaign. Pope Gregory XI placed Florence under an interdict. but by 1378 peace was made, partly through the mediation of St. Catherine of Siena, and the interdict was removed in. consideration of the republic's paying a fine of 200.000 florins to the pope.

During the war the eight had been practically rulers of the city, but now the *Parte Guelfa,* led by Lapo da Castiglionchio and Piero degli Albizzi, attempted to reassert itself. Salvestro de' Medici, however, who had always opposed the *parte,* was elected *gonfaloniere* in spite of its intrigues (1378), and the people were anxious to break the power of the *parte* for good. *A* large body of wool carders gathered outside the city and conspired to subvert the signory and establish a popular government. Although the plot, in n-hich Salvestro does not seem to have played a part. was discovered. a good deal of mob violence occurred. and on July 21 the populace seized the *podestà*'s palace, which they made their headquarters. Once the people were in possession of the palace. a carder named Michele di Lando took the lead. Master of Florence for one day, he quelled disorder and pillage, and reformed the constitution. But to satisfy the people several of the nobies, including Piero degli Albizzi, were put to death on charges of conspiracy, and many others were exiled. Perpetual rioting and anarchy succeeded. until at last, in 1382, a reaction set in, and order was restored by the guild companies. Again a new constitution was decreed by which the *gonfaloniere* and half the *priori* were to be chosen from the greater guilds and the other half from the lesser. The demagogues were executed or forced to fly, Michele di Lando was exiled, and the Guelph families gradually regained much of their lost power.

Pisa.—In 1393 Maso degli Albizzi was made *gonfaloniere,* and for many years remained almost master of Florence. A severe persecution was initiated against the Alberti and other families, who were disfranchised and exiled. Disorders and conspiracies against the merchant oligarchy continued. and the exiles caused the republic much trouble by intriguing against it in foreign States. In 1397–98 Florence was at war with Gian Galeazzo Visconti, who, aspiring to the conquest of Tuscany. acquired the lordship of Pisa, Siena and Perugia; but just as the Milanese were about to march on Florence, Visconti died. His territories were divided between his sons and his *condottieri.* In 1404 the Florentines' attempt to capture Pisa single-handed failed, and Gabriele Maria Visconti. lord of Pisa, placed himself under the protection of the French king. The Florentines then made overtures to France, who had supported the antipopes all through the Great Schism, and suggested that they too would support the then antipope, Benedict XIII, in exchange for the sale of Pisa. With French support they purchased the city in 1405, but a few days later the citizens rose in arms and recaptured it from the mercenaries. There was great consternation in Florence at the news, and the Florentines attacked Pisa once more. After a six months' siege it surrendered on terms (Oct. 9, 1406), and Florence acquired a great seaport and was at last able to develop a direct maritime trade.

Except in connection with the Pisan question, the republic had taken no definite side in the Great Schism which had divided the church since 1378, but in 1408 it appealed both to Pope Gregory XII and the antipope, Benedict XIII, and suggested a council nithin its own territory. Gregory refused, but after consulting a committee of theologians who declared him to be a heretic, the council promoted by Cardinal Cossa and other independent prelates met at Pisa. The council deposed both popes and elected Pietro Filargi as Alexander V (June 26). But Ladislas of Naples still occupied the Papal States, and Florence. alarmed at his growing power and ambition, formed a league with Siena, Bologna and Louis of Anjou who laid claim to the Neapolitan throne, to drive Ladislas from Rome. Cortona, Orvieto, Viterbo and other cities were recovered for Alexander, and in Jan. 1410 Rome itself mas captured by the Florentines under Malatesta dei Malatesti. Alexander having died in May. Cardinal Cossa was elected as John XXIII, and Florence purchased Cortona from the pope.

Ascendency of the De' Medici

Giovanni de' **Medici.**—In 1421 Giovanni de' Medici was elected *gonfaloniere* of justice, an event which marks the beginning of that family's power. The same year the republic purchased Leghorn from the Genoese for 100,000 florins, and established a body of "consuls of the sea" to superintend maritime trade. Filippo Maria Visconti, who had succeeded in reconquering most of Lombardy, seized Forlì. The Florentines declared war on him. and through Venetian intervention, Visconti was finally defeated and forced to accept peace on onerous terms (1427).

The old systems of raising revenue no longer corresponded to the needs of the republic, and as early as 1336 the various loans made to the state were consolidated into one national debt (*monte*). Subsequently all extraordinary expenditure was met by forced loans (*prestanze*), but because of the general discontent a *catasto* or assessment of all the wealth of the citizens was made in 1427, and measures were devised to distribute the obligations according to each man's capacity, so as to avoid pressing too severely on the poor. The *catasto* was largely the work of Giovanni de' Medici, who greatly increased his popularity thereby. He died in 1429.

Cosimo de' Medid — An attempt to capture Lucca led Florence, in alliance with Venice: into another costly war with Milan (1432–33). The mismanagement of the campaign brought about a quarrel between the aristocratic party. led by Rinaldo degli Albizzi, and the popular party led by Giovanni de' Medici's son Cosimo (1389–1464). Rinaldo succeeded in getting Cosimo exiled, but his proposal for a coup d'état met with no response from his own party. and he failed to prevent the election of a pro-Medici signory in 1434. A revolution was only averted through the intervention of Pope Eugene IV. A *parlamento* was summoned, and the *balìa* appointed decreed the return of Cosimo and the exile of Rinaldo degli Albizzi and others. On Oct. 6, 1434, Cosimo returned to Florence, and for the next three centuries the history of the city is identified with that of the house of Medici.

Cosimo succeeded in dominating the republic while remaining nominally a private citizen. He exiled those who opposed him, and governed by means of the *balìa*, which, re-elected every five years. appointed all the magistrates and acted according to his orders. In 1437 Florence and Venice were again at war with the Visconti, whose chief captain, Niccolò Piccinino (*q.v.*), on entering Tuscany with many Florentine exiles in his train. was signally defeated at Anghiari by the Florentines under Francesco Sforza (1440); peace was made the following year. The system of the *catasto,* which led to abuses, was abolished, and a progressive income tax (*decima scalata*) was introduced with the object of lightening the burdens of the poor, who were as a rule Medicean, at the expense of the rich.

Lorenzo the Magnificent. — In 1464 Cosimo died and was succeeded, not without some opposition, by his son, Piero. who was very infirm. Various plots against him were hatched, but Piero's unexpected energy upset the schemes of his enemies. He died in 1469, leaving two sons, Lorenzo (1449–92) and Giuliano (1453–78). The former at once assumed the reins of government and established his domination by means of provisional governments consisting entirely of Mediceans, to be renewed every five years (1471). In 1472 a quarrel having arisen with Volterra, Lorenzo sent an expedition against the city. which was sacked, and many of the inhabitants massacred. As a result of a variety of causes an enmity arose between Lorenzo and Pope Sixtus IV, and the latter, if not an accomplice, at all events had cognizance of the Pazzi conspiracy against the Medici (1478). The result of the plot was that Lorenzo strengthened his position, and put to death or exiled numbers of his enemies. He was excommunicated by Sixtus, who, together with King Ferdinand of Naples, waged war against him.

Eventually the Florentines were defeated at Poggio Imperiale and the city itself was in danger. Lorenzo by his boldness in going to Naples succeeded in concluding a peace with the king, which led to a reconciliation with the pope (1479–80). He was received with enthusiasm on returning to Florence and became absolute master of the city. From that time until his death the city was free from party strife under a *de facto* despotism. Because of his .political activity Lorenzo had neglected the business interests of his firm, and in order to make good certain heavy losses he seems to have appropriated public funds. His foreign policy, which was magnificent but expensive, rendered further forced loans necessary.

An attempt by the Venetians to seize Ferrara led to a general Italian war. in ahich Florence also took part on the side hostile to Venice, and when peace was made in 1484, the republic gained some advantages. The following year a revolt of the Neapolitan barons against Ring Ferdinand broke out actively supported by Pope Innocent VIII; Lorenzo remained neutral at first. but he ended by giving Ferdinand assistance in spite of the king's unpopularity in Florence. Peace was made in 1486, and in 1487 Lorenzo regained Sarzana. which Genoa had taken from Florence nine years previously. The general disorders and ceaseless intrigues all over Italy required Lorenzo's constant attention. and he succeeded in making Florence "the needle of the balance of poner in Italy." At this time the Dominican friar, Girolamo Savonarola (*q.v.*), was in Florence, and aroused the whole city by his denunciations of ecclesiastical corruption and also of that of the Florentines. He opposed Lorenzo's government as the source of the immorality of the people, and to some extent influenced public opinion against him. Ill health now gained on Lorenzo. and Savonarola, whom he had summoned to his bedside, refused to give absolution to the destroyer of Florentine liberties. Lorenzo died in 1492.

Expulsion of the Medici, 1494.—He was succeeded by his son Piero, who had none of his father's capacity and made many blunders. When Charles VIII of France came to Italy to conquer Naples, Piero decided to assist the latter, but as soon as Charles had entered Florentine territory and captured Sarzana, Piero went to his camp and asked pardon for opposing him. The king demanded the cession of Pisa. Leghorn and other towns, which Piero granted, but on returning to Florence on Kov. 8. 1494, he was refused admittance to the palace, and the people began to shout "Popolo e liberta!" in opposition to the Medicean cry of "Palle, Palle!" (from the Medici arms). With a small escort he fled from the city, followed soon after by his brother Giovanni. That same day Pisa rose in revolt against the Florentines and was occupied by Charles.

The expulsion of the Medici produced some disorder, but Piero Capponi (*q.v.*) and other prominent citizens succeeded in keeping the peace. Charles entered Florence on Nov. 1 j at the head of 12.000 men. He was impressed with the wealth and refinement of the citizens, and above all with the solid fortresslike appearance of their palaces. But his demands by no means pleased the Florentines, and when the king began to hint at the recall of Piero de' Medici. whose envoys had gained his ear, the signory ordered the citizens to be ready to resort to arms. The proposal was dropped, but Charles demanded an immense sum of money before he would leave the city. The syndics refused to accept his insolent ultimatum, and the king said in a threatening tone, "Then we shall sound our trumpets," whereupon Capponi tore up the document in his face and replied, "And we shall ring our bells." The king. realizing what street fighting in Florence would mean, at once came to terms; he contented himself with 120,000 florins, agreeing to give up the fortresses he had taken and to keep the Medici in exile. But it was not until Nov. 28, after an exhortation by Savonarola, whom he greatly respected, that he left Florence.

Savonarola.—It was intended to re-establish the government on the basis of the old republican institutions, but it was found that 60 years of Medici rule had reduced them to mere shadows, and the condition of the government was utterly chaotic. Consequently men talked of nothing save of changing the constitution, but. unfortunately. there was no longer an upper class accustomed to public affairs. while the lower class was thoroughly demoralized. Savonarola. who had already made a reputation as a moral reformer. began his famous series of political sermons, and gradually a new government was evolved. each law being enacted as the result of his exhortations. A greater council empowered to appoint magistrates and pass laws was formed, to which all citizens who had paid their taxes, and *beneficiati* (*i.e.,* who had sat in one of the higher magistracies, or whose fathers, grandfathers or great-grandfathers had done so) were eligible. There were 3,200 such citizens. and they sat one-third at a time for six months. The greater council was to elect another council of 80 citizens over 40 years old; this body was to appoint ambassadors and commissaries of war, and deal with other confidential matters. The system of forced loans was abolished and a 10% tax. on real property introduced in its stead, and a law of amnesty for political offenders enacted. Savonarola also proposed a court of appeal for criminal and political offenses tried by the *Otto di guardia e balìa;* this too was agreed to, but the right of appeal was to be, not to a court, as Savonarola suggested, but to the greater council, a fact which led to grave abuses, as judicial appeals became subject to party passions. But in spite of Savonarola's popularity. there was a party called the *Bigi* (grays) who intrigued secretly in favour of the return of the Medici, while the men of wealth, called the *Arrabbiati*, although they hated the Medici. were even more openly opposed to the actual regime. The adherents of Savonarola were called the *Piagnoni,* or snivellers, while the *Neutrali* changed sides frequently.

A league between the pope. the emperor. Venice and Spain having been made against Charles VIII. the French king was forced to return to France. On his return journey he violated his promise by giving aid to the Pisans in their revolt against Florence, and did not restore the other fortresses. Piero de' Medici's attempt to seize Florence failed, but the conditions of the city were not prosperous; its resources were strained by the sums paid to Charles and by the war, its credit was shaken, its trade paralyzed; famine and plague visited the city, and the war to subjugate Pisa was proceeding unsatisfactorily. Worse still was the death, in 1496, of one of its ablest and most disinterested statesmen. Piero Capponi. The league now attacked Florence, for Pope Alexander VI hated Savonarola and was determined to destroy the republic, so as to reinstate the Medici temporarily, and prepare the way for his own sons; Venetians and Imperialists besieged Leghorn, and there was great misery in Florence.

All this decreased Savonarola's popularity to some extent. but the enemy having been beaten at Leghorn and the league being apparently on the point of breaking up, the Florentines took courage and the friar's party was once more in the ascendant. Numerous processions were held, Savonarola's sermons against corruption and vice seemed to have temporarily transformed the citizens, and the carnival of 1497 remained famous for the burning of the "vanities" (*i.e.,* indecent books and pictures and carnival masks and costumes). The friar's sermons against ecclesiastical corruption, and especially against the pope, resulted in Savonarola's excommunication. The party hostile to him gained ground with the support of the Franciscans, who disliked the Dominican order. The pope again and again demanded that the friar be surrendered to him, but, in spite of his threats of an interdict against the city, without success. In 1498, however, a signory of *Arrabbiati* having been elected, Savonarola was arrested and imprisoned. The commission appointed to try him on charges of heresy and treason was composed of his enemies; many irregularities were committed during the three trials. and the prisoner was repeatedly tortured. The outgoihg signory secured the election of another which mas of their way of thinking, and on May 22, 1498, Savonarola was condemned to death and executed the following day.

Piero **Soderini.**—The pope having been satisfied, the situation in Florence was less critical for the moment. But Cesare Borgia suddenly demanded the reinstatement of the Medici in Florence, and the danger was only warded off by appointing him captain-general of the Florentine forces at a large salary (1501). The weakness of the government became every day more apparent. In 1502, in order to give more stability to the government. the office of *gonfaloniere,* with the right of proposing laws to the signory, was made a life appointment. The election fell on Piero Soderini (1448–1522), an honest public-spirited man of no particular party, but lacking in strength of character. One useful measure which he took was the institution of, a national militia, at the suggestion of Niccolò Machiavelli (1505). Meanwhile the Pisan war dragged on until in 1509 the city was driven by famine to surrender and again became a dependency of Florence.

The Schismatic Council of **Pisa.**—In 1510 Pope Julius II, having seceded from the league of Cambrai, in which he had joined France and Spain against Venice, raised the cry of "Fuori i Barbari" ("out with the barbarians"), with a view to expelling the French from Italy. King Louis thereupori proposed an ecumenical council and demanded that it be held in Florentine territory. The republic agreed to the demand. and the council was opened at Pisa. whereupon the pope immediately placed Florence under an interdict. A Spanish army under Raymundo de Cardona entered the republic's territory and demanded 100.000 florins, the dismissal of Soderini, and the readmission of the Medici. Soderini offered to resign, but the greater council supported him and preparations for defense were made. In August the Spaniards took Prato by storm and committed hideous atrocities on the inhabitants; Florence was in a panic, a group of the nobles forced Soderini to resign and leave the city, and Cardona's new terms were accepted, viz., the readmission of the Medici, a fine of 150,000 florins and an alliance with Spain.

Return of the Medici, 1512.—On Sept. 1, 1512, Giuliano and Giovanni de' Medici. and their nephew. Lorenzo. entered Florence with the Spanish troops, and a constitution similar to that of Lorenzo the Magnificent was created. Giuliano became *de facto* head of the government, but he did not pursue the usual vindictive policy of his house. In 1513, on the death of Julius II. Giovanni de' Medici was elected pope as Leo X. In March 1514 Giuliano died. and was succeeded by Lorenzo. who was also created duke of Urbino. At his death, in 1519, Cardinal Giulio de' Medici took charge of the government. He did not rule badly and maintained at all events the outward forms of freedom. In 1523 he was elected pope, as Clement VII. and sent his relatives. Ippolito and Alessandro. both minors and bastards. to Florence under the tutorship of Silvio Cardinal Passerini.

Second Expulsion of the Medici, 1527.—Cardinal Passerini's regency proved most unpopular, and the city was soon seething with discontent. Revolts broke out and Passerini showed himself quite unequal to the situation. The nobles were mostly anti-Medicean. and when Filippo Strozzi. and above all his wife, threw their influence in the scales against the Medici, and the magistrates declared for their expulsion from power, Passerini. Ippolito and Alessandro left Florence (May 17, 1527). *A Consiglio degli Scelti* was summoned and a constitution similar to that of Savonarola's time was established.

The greater council was revived and Niccolò Capponi created *gonfaloniere* for a year. Rut Florence was torn by factions. Having been re-elected *gonfaloniere* in spite of much opposition in 1528, Capponi tried to make peace with the pope but his correspondence nith the Vatican resulted in a quite unjustified chargr of high treason, and although acquitted he had to resign office and leave the city for six months. Francesco Carducci was elected *gonfaloniere* in his place. and on June 29, 1529, the pope and the emperor concluded a treaty by which the latter agreed to reestablish the Medici in Florence.

Siege of Florence and Restoration of the **Medici.**—Carducci made preparations for a siege, but the majority of the people were against him, either from Medicean sympathies or fear, although the *Frateschi*, as the believers in Savonarola's views were called, supported him strongly. A body called the *Nove della Milizia*, of whom Michelangelo (*q.v.*) Buonarroti was a member, was charged with the defense of the city, and Michelangelo himself superintended the strengthening of the fortifications. A most unfortunate choice for the chief command of the army was the appointment of Malatesta Baglioni. In August an imperial army under Philibert, prince of Orange, advanced on the city. In September Malatesta surrendered Perugia, and other cities fell before the imperialists. All attempts to come to terms with the pope were unsuccessful, and by October the siege had begun. Although alone against papacy and empire, the citizens showed the greatest spirit and devotion, and were successful in many sorties. The finest figure produced by these events was Francesco Ferruccio (*q.v.*); by his defense of Empoli he showed himself a first-class soldier, and was appointed commissioner-general. But Malatesta was a traitor at heart and hindered the defense of the city. Ferruccio, who had recaptured Volterra, marched to Gavinana above Pistoia, to attack the imperialists in the rear; but in spite of his heroism he was defeated and killed (Aug. 3); the prince of Orange also fell in that desperate engagement. The signory, at last realizing that Malatesta was a traitor, dismissed him; but it was too late, and he now behaved as though he were governor of Florence; when the troops attempted to enforce the dismissal he turned his guns on them. On Aug. 9 the signory saw that all hope was lost and entered into negotiations with Don Ferrante Gonzaga, the new imperial commander. On the 12th the capitulation was signed; Florence was to pay an indemnity of 80,000 florins, the Medici were to be recalled, the emperor was to establish the new government, "it being understood that liberty is to be preserved." Baccio Valori. a Medicean who had been in the imperialist camp, took charge, and the city was occupied by foreign troops. A *parlamento* was summoned, the usual packed *balìa* created, and all opposition silenced. The city was given over to Pope Clement. who, disregarding the terms of the capitulation. had Carducci and Girolami (the last *gonfaloniere)* hanged, and established Alessandro de' Medici, the natural son of Lorenzo, duke of Urbino, as head of the republic on July 5. 1531. The next year the signory was abolished, Alessandro created *gonfaloniere* for life, and his lordship made hereditary in his family by imperial patent. Thus Florence lost its liberty. and came to be the capital of the duchy (afterward grand duchy) of Tuscany. (P. V.; L. V.)

The **Medici's** Grand Dukes.—Cosimo I, who succeeded Alessandro when he was slain by his brother Lorenzino. laid the foundations of the regional state. which took the place of the small Florentine republic. He established a strong centralized government and started a policy of territorial expansion which led to the conquest of Siena and its surrounding area. The loss of old civic liberties was the price that Florence paid for the political unification of Tuscany under the Medicean rule. Solemn recognition of the new princedom came when Pope Pius V conferred on Cosimo the title of hereditary grand duke in 1567, which in 1576 was confirmed by Emperor Maximilian II. Cosimo's successor, Francis I. is chiefly remembered for the establishment of Leghorn as the great modern port of Tuscany. The policy of the next grand duke, Ferdinand I, former cardinal and brother of Francis, was far more ambitious in scope, if not in achievement. With him Tuscany entered the arena of international politics, shaking off the traditional Spanish influence for a fresh alliance with France. This was sealed by the marriage of Maria, daughter of Francesco di Medici. with King Henry IV, newly converted to Catholicism. Special attention was given to maritime development, and even attempts at colonial conquests were made by sending an expedition to Brazil. The progress of agriculture was furthered by important works of land reclamation in the marshes of Valdichiana. Maremma and Pisa. But the Tuscan grand duchy soon degenerated after Ferdinand's death. The inefficient rule of the weak Cosimo II was followed by the regency period when the mother and grandmother of young Ferdinand II directed the home and foreign affairs of the state with worse results. The decline of the Medici family reached its nadir with the sickly and inept Cosimo III, who let foreign powers decide the fate of Tuscany. It was decreed at the treaty of London in 1718 that Don Carlos of Spain, upon the extinction of the native dynasty, should receive Tuscany. But, in fact, because of intervening changes in the international scene, upon the death of the last Medici—the childless Gian Gastone—the grand duchy was assigned in 1737 to Francis, duke of Lorraine, who became Francis II of Tuscany and, in 1745, the emperor Francis I.

The 18th Century.—As Francis, who was the husband of Maria Teresa of Austria. resided abroad, Tuscany was governed for almost 30 years by a series of foreign regents. The first duke of Lorraine to settle in Florence was Francis' son, Leopold I. who remained from 1765 to 1790, and proved one of the most capable and remarkable of the enlightened princes of the 18th century. He improved the administration of justice, suppressed torture and capital punishment. reduced mortmain, and introduced a system of free trade. Taxation was also reorganized on a basis of equality for all citizens. and the system of *mezzadria* (crop sharing) between landowners and tenant farmers was introduced in agriculture. Leopold's intervention in religious matters, inspired by the most progressive ideas of the "enlightened age," was equally effective in curbing the excessive power of the clergy and in rejecting its interference in economic and political affairs; but his attempt to modify internal ecclesiastical discipline, although supported by the bishop of Pistoia, Scipione de' Ricci, failed because of the condemnation of the pope. The appointment of Ferdinand III as duke of Tuscany when his father Leopold became emperor and removed to Vienna was followed in 1799 by a brief revival of republican government in Florence during the wars of the French Revolution. After the peace of Lunéville in 1801, Tuscany became the kingdom of Etruria under Louis, duke of Parma. *(See* also MEDICI, and for further history, TUSCANY and ITALY: *History.)*

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FLORENCE, a city of northwestern Alabama, U.S., on the north bank of the Tennessee river, in the fertile Muscle shoals district; seat of Lauderdale county. Just upriver is the Wilson dam; across the river are important chemical and metallurgical plants and the Tennessee Valley authority's fertilizer-munitions centre. The city has several manufacturing industries. It is the seat of Florence State college, established in 1872, the oldest state teachers college in the south.

Florence was founded in 1818 by the Cypress Land company and chartered in 1826. It was named for Florence. Italy. An early property holder was Andrew Jackson. Among the distinguished ante-bellum homes are the Forks of Cypress, Mapleton, the Simpson-Irvine home and Rogers Hall. During the American Civil War the town was raided several times by the Federal forces. For comparative population figures *see* table in ALABAMA: *Population.* (B. CR.)

FLORENCE, a city of northeastern South Carolina, U.S., about 80 mi. E. of Columbia; the seat of Florence county. It is an important sales, distribution and manufacturing centre for the tobacco-rich Pee Dee section of the coastal plain. The Clemson college experimental station, a University of South Carolina extension centre and the state industrial school for boys are located there.

Sites of interest include a museum and library, the latter having extensive state historical material. There is a national cemetery and nearby is a Confederate prison stockade. Timrod park and the Henry Timrod School shrine display indigenous trees and flowers, and the Womack gardens and nursery are noted for azaleas and camellias. Florence was founded about 1856, chartered in 1871, incorporated in 1890. The city adopted the council-manager form of government in 1921. For comparative population figures *see* table in SOUTH CAROLINA: *Population.* (A. L. D.)

FLORENCE OF WORCESTER (d. 1118), English monk, usually accepted as the author of *Chronicon ex chronicis,* which is valuable for late Anglo-Saxon and early post-Conquest history. Its basis is the universal history (from the creation to 1082) compiled by Marianus Scotus, an Irish recluse at Mainz. The author of the *Chronicon,* like Marianus, was a careful annalist with a marked interest in chronology. He supplements Marianus' scanty treatment of English affairs by drawing on Bede. Asser, lives of English saints, laws, the Anglo-Saxon Chronicles and also on local records and traditions.

Under the year 1118 the *Chronicon* records the death of Florence (July 7), but it is continued without break to 1131 by a John of Worcester, who. later, added material up to 1140. On the interpretation of the notice under 1118 depends Florence's claim to authorship, but what Orderic Vitalis has to say of John's historical work at Worcester suggests that John's part in the whole *Chronicon* is more substantial than has been traditionally allowed. After 1131, the *Chronicon* was copied at other monasteries, in several cases continued and frequently used by chroniclers.

The standard edition is *Florentii Wigorniensis monachi Chronicon ex chronicis,* ed. by Benjamin Thorpe, English Historical Society, 2 vol. (1848–49), which excludes Marianus' text where possible and follows the *editio princeps* of 1592 by William Howard in printing the continuation to 1141. and adds a second continuation to 1295; translation of English material to 1295 by R. Forester in Bohn's *Antiquarian Library* (1854).

See *The Chronicle of John of Worcester,* 1118–1140, ed. *by* J. *R. H.* Weaver, *Anecdota Oxoniensia* (1908) ; *D.* Whitelock, *English Historical Documents,* vol. *1,* pp 113 ff, 121 (1955). (G. SD.)

FLORES, JUAN JOSÉ (1800–1864), autocratic first president and long-time dictator of Ecuador, was born in Venezuela on July 19, 1800. At 15 he enlisted in the forces fighting the Spaniards and fought practically continuously for the next ten years, becoming one of Simón Bolivar's trusted senior officers. In 1826 he became commanding general of the southern region of the federation of Gran Colombia. He fought brilliantly at the battle of Tarqui, where the Peruvian attempt to wrest territory from Colombia was thwarted. In 1830 he took the lead in establishing Ecuador as a separate country and became its first president. He held office from 1830 to 1834, crushing several revolutionary attemps to unseat him. Following four years as army commander he regained the presidency in 1839, relinquishing it in 1845 after a liberal revolution. Exiled first to Europe and later to Argentina and Chile, Flores spent the next 15 years plotting to return to Ecuador. He finally accomplished this through Gabriel Garcia Moreno. his son-in-law. who became president in 1861. Flores aided Garcia Moreno militarily during the latter's term, beating off Peruvian attempts to seize Guayaquil. Flores died on Oct. 1, 1864, while engaged in putting down a revolt against Garcia Moreno. His death closed a turbulent career, marked by revolution, invasion, corruption and oppression, characteristic of Ecuador's early years as an independent nation.

FLORES, a department in south-central Uruguay, named for Gen. Venancio Flores. leader of the Colorado party and president of Uruguay (1865–1868). Pop. (1954 est.) 41,081; area 1,982 sq.mi. Flores, like its neighbouring departments, is a great rolling pasture supporting concentrations of livestock—in the 1950s about 1,000.000 sheep and 250,000 cattle. Industrial crops, principally sunfloner seeds and flax, are grown. as well as cereals and forage. The departmental capital, Trinidad (est. pop. 24,000) is connected by railroad and highway to Durazno 29 mi. S.W. (M. I. V.)

FLORES, an island forming part of the Azores archipelago. Pop. (1950) 7,850; area. 55 sq.mi. Flores and the adjacent island of Corvo (pop. 731; area, 7 sq.mi.) constitute the westernmost group of the Azores, from the rest of which they are widely severed. It derives its name from the abundance of the flowers that find shelter in its deep ravines. Its capital is Santa Cruz das Flores. In 1591 Flores was the station of the English fleet before the famous sea fight between Sir R. Grenville's ship "Revenge" and a Spanish fleet of 15 vessels. *See* AZORES.

FLORES, one of the Lesser Sunda (Nusa Tenggara) islands, Indonesia, the last large island of the chain which extends eastward from Java, and lies between Celebes and Timor. Flores has an area of 6.622 sq.mi., is 224 mi. in length and 44 mi. in width.

Flores is a long narrow island extending from east to west, with several deep inlets, the chief being Maumere bay on the north coast, in the east, in which is Poelau Besar or Mangkure. On the north coast, too, are Terang bay, Sindeh bay and Hading bay; on the south coast, Aimere bay and the Gulf of Endeh; and on the east coast, Okka and Konga bays, tmo deep inlets, the former cutting through high mountains. The island is very mountainous, with the greatest heights in the western part where the peaks of the Mandasawu range reach more than 7,000 ft. There are ten active volcanoes in the central and eastern parts of the island, although the western section has a few which are in the fumarole stage. The interior, which is heavily forested, has been but little explored, but the existence of slates, chalk and sandstones, with eruptive rocks and volcanoes, indicates that geologically the island is similar in structure to others of the Lesser Sunda chain. The few rivers known run either northward or southward, and do not seem to be navigable, with the exception of the Reo river. for about a mile. In northern Manggarai, in the northwest where there is a considerable area of limestone. the rivers sometimes run underground. Little is known of the flora and fauna. but the former includes, in the forests, coconut palms. and the sapan, cinnamon and sandal tree. Most of the vegetation consists of either tropical deciduous forest or savanna. The population of Flores in 1956 was estimated at 894,826; mainly of a mixed Malay-Papuan type, the so-called Alfur type. In the west the Manggarese have more of the Malayan characteristics, while in the central and eastern parts the people are more Papuan in appearance. In addition to these there are settlers all round the coast from Macassar, Sumba, Sumbawa and the Solor isles; in Todo, Manggarai, are colonists said to be descended from Menangkabau Malays; and on the Endeh coast are descendants of shipwrecked Chinese. The indigenous population long remained heathen, but Christianity spread rapidly in modern times; almost all of the Christian population became Roman Catholic. The remainder is either Mohammedan, in the coastal areas, or still pagan. The people of Endeh and Manggarai are the most developed, those of Central Flores the most savage and warlike, but industry everywhere is at a low stage of development, and the people make their living mostly by fishing, hunting and simple agriculture. Maize is the chief food, though rice is also grown and coconuts are cultivated. copra forming the chief article of export. Other items are small amounts of coffee, sandalwood, cinnamon, tobacco, mother-of-pearl and trepang. Coffee is grown in the districts of Manggarai and Ngada, in the west, while cotton was for a time cultivated under Dutch supervision. Iron, sulfur, pumice stone and saltpetre are found. Horses, buffaloes, pigs. dogs and fowls are kept, but meat is little eaten except at festivals. *Baju* and *sarong,* or even trousers, are worn generally in the east and south, and often *sarong* only in the west; ceremonial garments are very elaborate, and many ornaments are worn. The form of house varies greatly. In Ngada houses are built on terraces. often on piles, and they are neat and regular in arrangement and are surrounded by a hedge of bamboo. In Manggarai they are conical in form, with a roof reaching to the floor; they are divided into separate rooms for different families. and a passage where unmarried men and strangers sleep. In the east the houses are smaller and inhabited by one family only, while in Endeh they are square, roomy and well-built. Each village has its barns and, generally, a *pemali* house. The ground is usually owned communally by the tribe, and the head man, *tuan tanah,* has great power. But hereditary tenure of the individual prevails in Ngada, and here a stranger may own the uncultivated land he breaks up, whereas in the remainder of the island he has no rights.

Dutch rule reached the people through their chiefs and weaned them gradually from a state of primitive culture to one of semi-civilization. which became apparent in most of the coastal districts. Endeh. Aimere, Reo and Labuan are ports of call for vessels. A fair-weather motor road traverses the entire island from west to east. There is an airfield at Reo on the northwest coast. Flores originally was tributary to princes of Celebes. including Macassar. and nhen their power was broken by the Dutch in 1667 the island became open to Dutch influence, though Larantuka, in the east, together with some of the neighbouring islands, was claimed by Portugal, and in 1818 a commission confirmed Portugal's right. In that year the Dutch stationed an official at Endeh bay to suppress piracy, but no impression mas made until 1838, when the place was bombarded and seven chiefs journeyed to Kupang, in Timor, to apologize for their piratical activities. A treaty was then made with these and other chiefs of Endeh. Trouble aith the Portuguese authorities in Larantuka and the island of Solor in 1848 led to negotiations with Portugal when, in return for the remission of certain debts, the Portuguese government renounced all claims to Larantuka and the neighbouring islands, and though the treaty embodying this was not ratified until 1859, Dutch troops were sent to garrison the ceded districts in 1851. Later the troops were withdrawn and a civil official appointed to reside at Larantuka; for many years afterward there was considerable trouble here and at Endeh. on account of slave raids and piracy. The rajah of Larantuka, a Christian, was the principal cause of annoyance, and his arrest and banishment in 1905 led to a peaceful state of affairs. A treaty was concluded in 1874 with one of the principal chiefs of central Flores, but attempts made in 1887, 1888 and 1889 to penetrate into the interior failed, and in 1890 two large military expeditions were compelled to withdraw, because of the hostility of the natives. Eventually, from Endeh as a base, a body of mounted police succeeded in penetrating and pacifying the whole of the inland region (1907), and civil government was established. Manggarai has always been associated with the Sultan of Bima, in Sumbawa. The Dutch only once interfered—to suppress a small rising in 1909. The other states of Flores all came under the "short declaration," which allowed them some measure of self-government under Dutch supervision. Flores was occupied by Japanese troops during World War II.

(E. E. L.; X.)

FLOREY, SIR HOWARD WALTER (1898–), Australian pathologist, born at Adelaide, South Australia, Sept. 24, 1898, was awarded the Nobel prize for physiology and medicine in 1945, together with Ernst Chain and Sir Alexander Fleming, "for the discovery of penicillin and its curative effects in various infectious diseases." He studied medicine at Adelaide and Oxford universities until 1924 and then undertook research work in Great Britain and the United States. After holding a fellowship and a lectureship at Cambridge (1927–31) and the professorship of pathology at Sheffield (1931–35), he became professor of pathology at Oxford from 1935 onward.

Florey's contributions to experimental pathology were mainly concerned with fundamental phenomena of inflammation and later also with secretion of mucus by mucous membranes. The study of mucus roused his interest in lysozyme, a bacteriolytic enzyme, and work on this was continued with his colleagues until the enzyme was purified and its substrate characterized. This led to plans for a wide survey of naturally occurring antibacterial substances, of which many were known.

In this survey, which started in 1939, penicillin soon showed so much promise that other studies were dropped and research was concentrated on investigating and producing penicillin and eventually on bringing it into clinical use.

In 1943 Florey went with a research team to north Africa to investigate the possibility of using the penicillin then available on the wounded. In 1943–44 he visited Moscow with an Anglo-American scientific mission. In 1944 he visited Australia and New Guinea at the invitation of the Australian army. Later he mas an adviser to the Australian National university in Canberra.

Florey was elected a fellow of the Royal society in 1941, and received many honours. He was knighted in 1944.

FLÓREZ, ENRIQUE (1702–1773), Spanish Augustinian monk, an outstanding historian and scholar, was born at Villadiego, July 21, 1702. A notable example of 18th-century erudition, his *España sagrada,* 29 vol. (1747–55; continued by others to 51 vol; index by A. González Palencia, 1918), embodies the results of tireless research in many archives on the origins and growth of religious foundations in Spain; for transcriptions of documents and study of secondary materials (coins, medals. inscriptions, legends) it is an essential sourcebook for the history of Spain. His biographical *Memorias de las reinas católicas* (1761) has charm. Flórez died at Madrid on May 5, 1773. (R. F. B.)

FLORIAN (FLORIANUS), **SAINT** (d. 304), a Roman army officer and martyr. He occupied an administrative post in Noricum. now part of Austria, and was martyred under Diocletian. His *Acta,* with little historical value. date from the end of the 8th century.

Florian is regarded as one of the patron saints of Poland, Linz and Upper Austria. His protection is often sought against fire, and his feast is kept on May 4.

See H. Thurston and D. Attwater (eds.), *Butler's Lives of the Saints,* vol. ii, pp. 230–231 (1956).

FLORIAN, JEAN PIERRE CLARIS DE (1755–1794), French poet and romance writer, was born at the château of Florian, near Sauve, in the department of Gard. His uncle and guardian. the marquis of Florian, who had married a niece of Voltaire, introduced him at Ferney and in 1768 he became page at Anet in the household of the duke of Penthièvre, who remained his friend throughout his life. He then studied at the artillery school at Bapaume and became a captain of dragoons. On the outbreak of the French Revolution he retired to Sceaux, but he was soon discovered and imprisoned; and though his imprisonment was short he survived his release only a few months, dying on Sept. 13, 1794.

Florian's first literary efforts were comedies; his verse epistle *Voltaire et le serf du Mont Jura* and an eclogue *Ruth* were crowned by the French academy in 1782 and 1784 respectively.. In 1782 he also produced a one-act prose comedy, *Le Bon Ménage,* and in the next year *Galatée,* a romantic tale in imitation of the *Galatea* of Cervantes. Other short tales and comedies followed, and in 1786 appeared *Numa Pompilius,* an undisguised imitation of Fenelon's *Télémaque.*

In 1788 he became a member of the French academy, and published *Estelle,* a pastoral of the same class as *Galatée.* Another romance, *Gonzalve de Cordoue,* preceded by a historical notice of the Moors, appeared in 1791 and his famous collection of *Fables* in 1792.

Among his posthumous works are *La Jcunesse de Flovian, ou Mémoires d'une jeune Espagnol* (1807) and an abridgment (1799) of *Don Quixote,* which, though far from being a correct representation of the original, had great and merited success.

Florian imitated Salomon Gessner, the Swiss idyllist, and his style has all the artificial delicacy and sentimentality of the Gessnerian school. Perhaps the nearest example of the class in English literature was afforded by John Wilson's (Christopher North s) *Lights and Shadows of Scottish Life.* Among the best of his fables are "The Monkey Showing the Magic Lantern," "The Blind Man and the Paralytic" and "The Monkeys and the Leopard."

An edition of Florian's *Oeuvres complètes* appeared in Paris in 16 vol. (1820); his *Oeuvres inédites* in 4 vol. (1824).

See "Vie de Florian" by L. F. Jauffret, prefixed to his *Oeuvres posthumes* (1802); A. J. N. de Rosny, *Vie de Florian* (Paris, year V); Sainte-Beuve, *Causeries du lundi,* t. iii; *A.* de Montvaillant, *Florian, sa vie, ses oeuvres* (1879); *Lettres de Florian à Mme. de la Briche,* published, with a notice by the baron de Barante, in *Mélanges,* published (1903) by the Société des bibliophiles français; G. Gaillard, *Florian, sa vie, son oeuvre* (1912).

FLORIANÓPOLIS, a city and port of southern Brazil, and capital of the state of Santa Catarina (*q.v.*), is located some 450 mi. S.W. of Rio de Janeiro, on the western side of Santa Catarina Island (Ilha de Santa Catarina) which is connected to the mainland by a steel bridge 2,788 ft. long. Pop. (1950) 48,264. This island city serves as the state administrative and commercial centre in spite of the difficulties involved in reaching the inland parts of the state from the coast. The Great Escarpment which marks the edge of the Paraná plateau is especially steep in Santa Catarina and the interior of the state is more closely connected to Pôrto Alegre and Curitiba than to the state capital. Florianópolis is linked with other coastal towns, such as Blumenau and Joinville, by all-weather gravel highways. There are air services to the interior.

The central part of Florianópolis consists mainly of wharves, warehouses and business establishments. This older harbour district is encircled by a modern residential garden section known as Praia de Fora built on the surrounding hill slopes.

The first European settlement on Santa Catarina Island was made in 1 j42 by the Spaniards under Alvar Núñez Cabeza de Vaca, n-ho proceeded to march inland over rugged terrain to Asunción in Paraguay. The Portuguese established their control of this southern part of the coast when they sent an espedition from São \-icente to occupy the island in 1675. The present city was established in 1700 as Desterro. In 1777 the island was occupied by a Spanish expedition, but it was returned in the same year to Portugal by treaty.

In 1893 the island was captured by revolutionists who opposed the government of Pres. Floriano Peixoto. When the revolution collapsed the city was named Florianopolis in honour of the president. (P E. J.)

FLORIANOPOLIS SUSPENSION BRIDGE, an eyebar suspension type with a main span of 1.113 It. 9 in.. was constructed (1923–261 for the state of Santa Catarina. Braz.. to carry a highway. electric railway and water supply to the capital city Florianópolis situated on an island off the Atlantic coast.

The structure, designed by Robinson and Steinman, consulting engineers. is the first example of a new form of suspension bridge whereby greatly increased economy and rigidity are secured simultaneously. Its distinctive ieature is the utilization of the cable to replace the middle half of the top chord of the stiffening truss and the consequent change from the conventional parallel chord truss to a stiffening truss of more effective outline, namely, with maximum depth near the quarter points of the span. These features combined yielded a structure four times as rigid as the previous conventional design! together with a saving of one-third of the steelwork.

Another departure from conventional practice was the adoption of rocker towers. which. eliminating the customary bending stresses. contributed a saving of 20% of the steelwork in the towers and permitted the main piers to be reduced to concrete cylinders. 16 ft. in diameter. The steel towers are 22 j ft. high. Instead of wire for the cables. eyebars were adopted. these were made of the newly developed. high-tension. heat-treated carbon steel. having a yield point exceeding 75,000 lb. per square inch and used with a working stress of 50,000 lb. per square inch.

In the foundation work for the main piers, novel construction methods had to be devised. By excavating and concreting successive test pits, the entire foundation area of one pier was carried down 20 ft. below the bottom of the cofferdam to bedrock at elevation —60. The concrete anchorages are of novel design. U-form in plan, for maximum efficiency. The island anchorage is on rock. the continent anchorage on piles. An entirely new method was developed for the erection of the eyebar cables and the suspended stiffening trusses, using overhead trolley, thus eliminating wooden falsework and working platforms. The bridge. nhich was more than three years in building. provided a 28-ft. roadn-ay. a metre-gauge electric railway, a 24-in. water main and a 9-ft. sidewalk. Its over-all length is 2.788 ft. (D. B.S.)

FLORIDA, officially the "Sunshine state" and often referred to as the "Peninsula state." lies at the extreme southeastern corner of. and is the most southern state of. continental United States. The peninsula is the visible part of the Floridian plateau that separates the depths of the Atlantic ocean from those oi the Gulf of Mexico; the submerged area is as large as the part above sea level. It is bounded on the north by Alabama and Georgia, on the east by the Atlantic ocean, on the south by the strait of Florida. n-hich separates it from Cuba. and by the Gulf of Mexico. and on the west by the Gulf and by Alabama. The total area of the state is 58.560 sq.mi., of which 4,308 sq.mi. are water surface; it ranks 22nd in size among the states. Florida was admitted to the union on March 3, 1845. as the 27th state. The state capital is Tallahassee. The state tree is the palmetto, or sabal, palm; the state flower, the orange blossom; the state bird, the mockingbird.

PHYSICAL GEOGRAPHY

Physical Features.— Florida is situated between 24° 30' and 31" N. and 80° and 87° 38' W. The topographical regions of the state include the coastal lowlands. which are generally less than 100 ft. above sea level; the higher, hilly western highlands; the Marianna lowlands; the Tallahassee hills: and the central highlands or the "ridge" of the peninsula proper. Islands, the Florida keys. stretch southward. like a string of beads. from Biscayne bay to Key West. The last group of keys. the Dry Tortugas Islands (*q.v.*), lie west of Key West. The state is 447 mi. long and 361 mi. wide at its northern boundary, but never more than 145 mi. wide below the panhandle.

The general coast line. which does not recognize all the details of indentations, is 1.197 mi. in length (Atlantic. 399 mi., Gulf of Mexico. 798 mi.). The shore line when all details of indentations —bays. sounds and other bodies of water to the head of tidewater—are included measures 8.426 mi. (Atlantic. 3.035 mi.; Gulf of Mexico. 5.301 mi.). No point in the state is more than 70 mi. from either the Atlantic ocean or the Gulf of Mexico. The coast lines are bisected by many rivers, some of which are navigable for long distances. The St. Johns on the east coast is one of the few rivers in North America that flows northward; it enters the Atlantic at Mayport, above Jacksonville. The large rivers in western Florida rise in Georgia and Alabama: the Perdido, Escambia. Choctawhatchee and Apalachicola were the chief arteries of trade in the steamboat era. The Suwannee rises in the Okefenokee swamp on the border of Georgia and Florida.

Water is one of Florida's major resources: the underground and surface supplies are exceeded by no other area of similar size on the continent. There are more than 30.000 natural lakes in the state and more than 1.400 in one county (Lake) alone; the largest is Lake Okeechobee, covering 700 sq.mi., the second largest (after Lake Michigan) body of fresh water in the U.S. The overflow of this lake every year spilled into the long inundated plain of the Everglades (*q.v.*) and gradually made its way 100 mi. southward to Florida bay. The overflow is now controlled (see OKEECHOBEE, LAKE). and the lake forms a part of the Intracoastal waterway and cross-state canal, connected on the eastern side by the St. Lucie canal and river and on the western side by the Caloosahatchee canal and river. Of the 75 largest artesian springs in the United States. 17 are located in Florida; among the best knon-n are Silver springs. Rainbow springs and Salt springs near Ocala and Wakulla springs near Tallahassee.

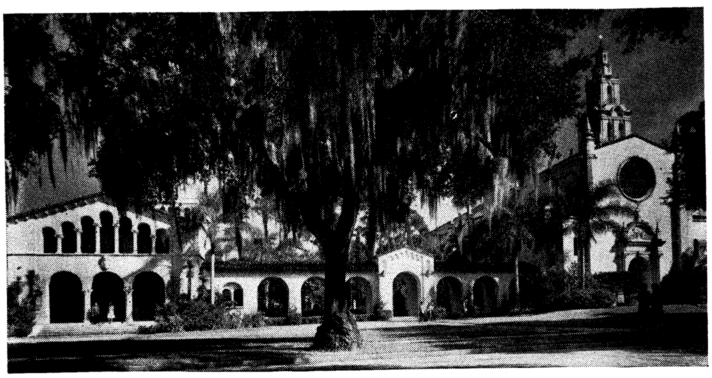
Climate.— A mild climate is one of the state's greatest assets; in winter there is more sunshine than in any other state east of the Mississippi. The annual rainfall of about 53 in., most of which falls from April to November, tempers the warm temperatures of the summer season. Although the average temperature is near 70° F.. the state is subject to damaging cold waves. Hurricanes that form in the Caribbean sea frequently strike the state and cause great destruction of property and often loss of life.

Soil.—The soils of Florida vary from the highly fertile organic muck and peat of the Everglades to the poorest of sandy soils along the coastal dunes and beaches. The soils of the coastal lowlands and the western highlands are generally composed of sands of low fertility, except in the river bottoms and marshy areas where organic materials have been deposited. Much of the area of the Marianna lowlands and of the central highlands is underlain by Ocala limestone formations which, when mixed with the overlying sands, make fertile soils. The soils of the Tallahassee hills are generally the most fertile in the state and contain large amounts of red clay and organic matter.

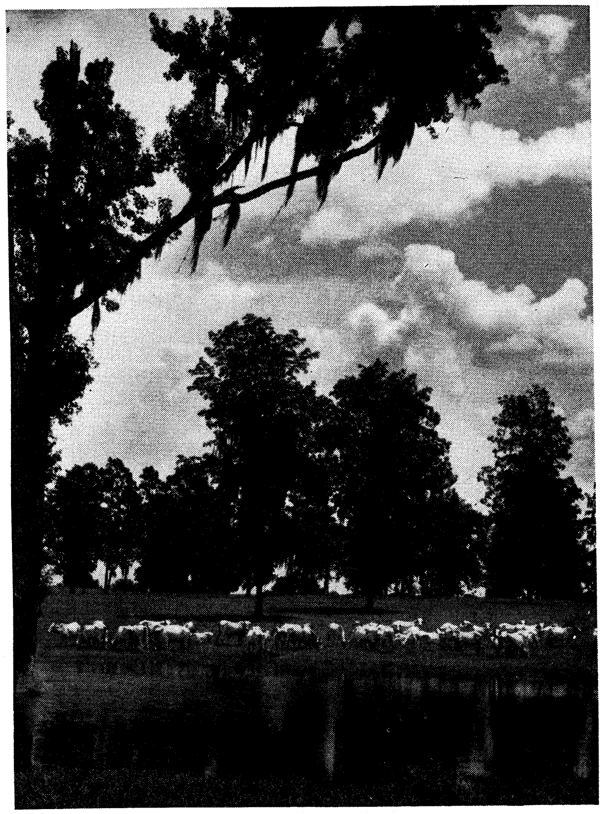
Plant Life.—The high and low hammocks, sand and clay hills, beds of organic soils and salt- and fresh-water marshes of Florida provide excellent habitats for native and imported plants, from

FLORIDA

Miami beach and Miami separated by Biscayne bay, southeastern Florida

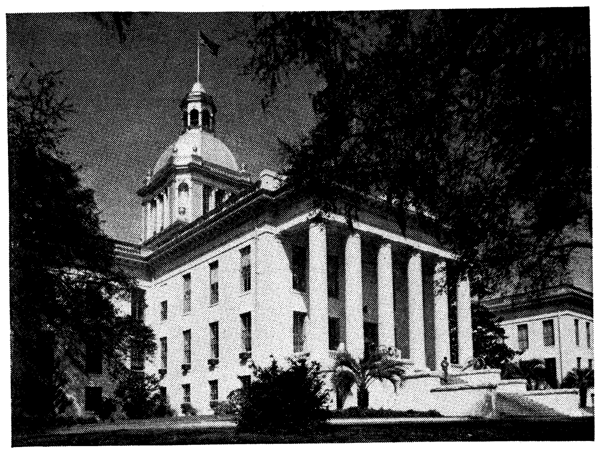


Annie Russell theatre (left) and Knowles Memorial chapel (right), Rollins college, Winter Park; founded in 1885

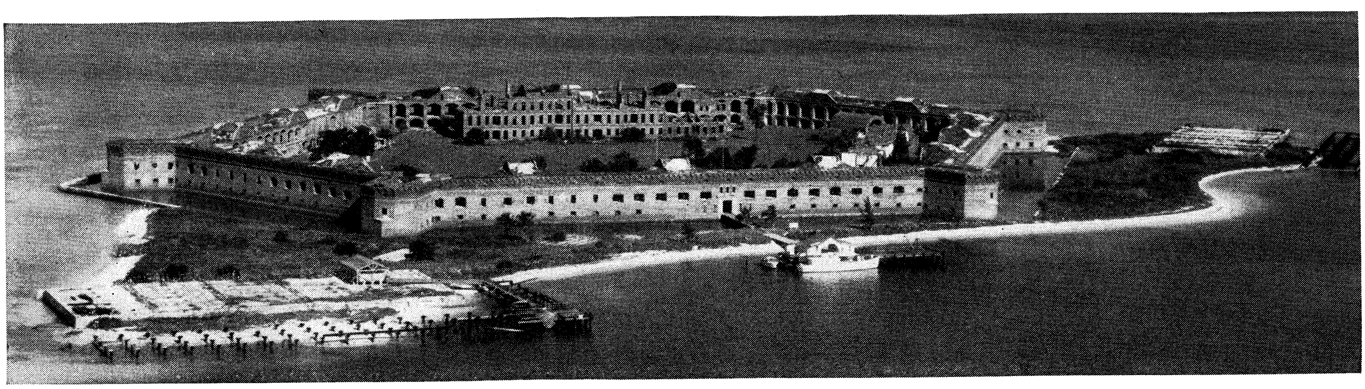


Brahman cattle on a farm near Ocaia. Stock raising has become a leading industry in Florida

The Everglades, largest subtropical wilderness in the U.S.; about 2,1560,000 ac. in area



The state capitol building at Tallahassee, capital of Florida since 1824



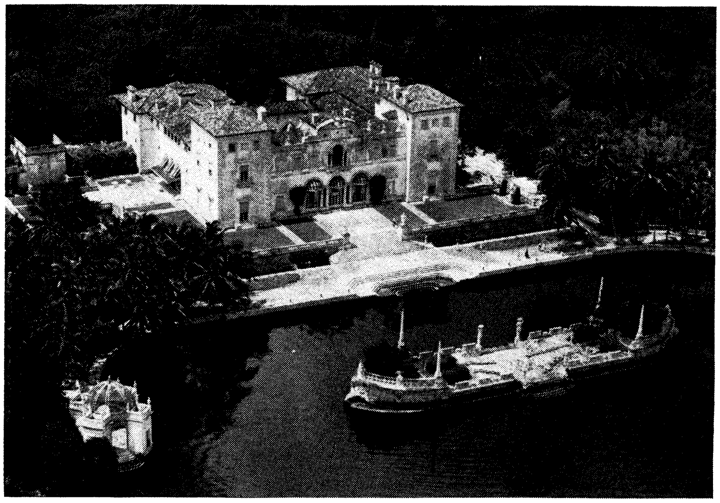
Fort Jefferson National monument (1846), on Garden Key of the Dry Tortugas. A military prison during the Civil War, it is now a bird refuge

SCENES IN FLORIDA

BY COURTESY OF (TOP LEFT) MIAMI BEACH NEWS BUREAU (TOP CENTRE LEFT) ROLLINS COLLEGE, PHOTOGRAPHS. (TOP RIGHT) CHARLES J BELDEN, (BOTTOM CENTRE LEFT. BOTTOM) H. ARMSTRONG ROBERTS (CENTRE RIGHT) AUTHENTICATED NEWS

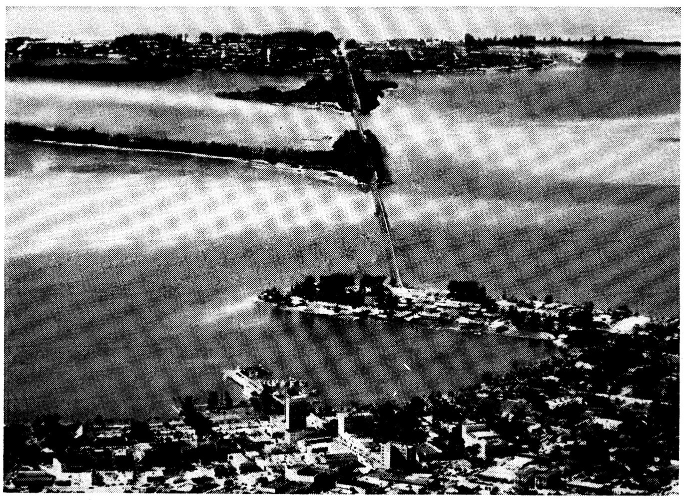
FLORIDA

Wind-bent coconut palm trees, Miami beach

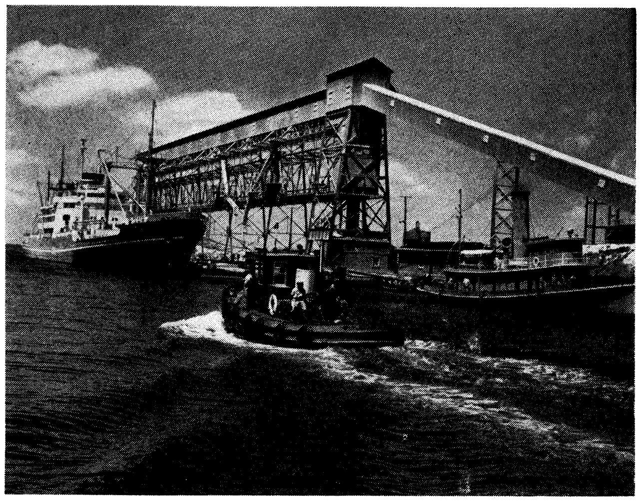


Vizcaya, James Deering estate resembling an Italian villa, on Biscayne bay, south of Miami

Bok Singing tower, in the Iron mountain bird sanctuary, near Lake Wales. Built by Edward William Bok (1863–1930), it has a carillon of 71 bells



Sarasota bay looking west across the John Ringling causeway toward the keys, offshore islands separating the bay from the Gulf of Mexico



Freighter in Port Tampa loading phosphate, one of Florida's principal mineral resources

VIEWS OF FLORIDA

BY COURTESY OF (BOTTOM LEFT) SARASOTA COUNTY CHAMBER OF COMMERCE. (BOTTOM RIGHT) FLORIDA STATE NEWS BUREAU; PHOTOGRAPHS, (TOP LEFT) EWING GALLOWAY, (TOP RIGHT) BUAGERT BROTHERS (CENTRE LEFT AUTHENTICATED NEWS large flowering trees to delicate orchids. Of the palms found in the U.S., 15 varieties are native to Florida, and they range in size from the small saw palmettos to the tall royal palms, the coconut palms and the sabal palmettos. There are more than 300 varieties of trees: pines. oaks, cypresses. palms and mangroves are the predominant native trees; magnolias, yews, hollies, and hickories are also native. The royal and coconut palms, mahogany and gumbo limbo trees are tropical; northern species that thrive in the state include the red maple, the sweet gum and the tulip tree.

The woods. prairies and marshes support more than 3,500 species of plants. Bladderwort, duckmeed, hyacinths and water lettuce grow in the marshes; pitcher plants, lilies, milkwort and cactus in the sandy soils: and coontie (comfortroot, from which the Indians made flour) flourishes in the rocky pinelands of the southeastern section of the state. Spanish moss streams from the trees: and more than 80 other air plants (epiphytes). 25 of which are orchids, have been identified in south Florida. Many plants and trees have been imported — more than 400 varieties of bougainvillaea. hibiscus. oleander: and croton for ornamental plantings and poinciana, poinsettia. jacaranda and mountain ebony.

Animal Life. — Eighty-four species of land mammals are found in Florida, including wildcat, gray fox, deer, panther and all of the smaller animals that are native to the southern states. Commercial trapping has reduced the number of otter and mink, and the tiny Key deer of the keys is almost extinct. The manatee or sea cow is occasionally found in coastal waters and in the rivers of the far southern part of the state. More than 400 species and subspecies of birds have been recorded, and the natural rookeries around Lake Okeechobee, in the Big Cypress swamp and in the Everglades are world famous. The first, national bird sanctuary, Pelican Island in the Indian river. was established by Pres. Theodore Roosevelt; since then 18 additional national sanctuaries have been created in the state. Among the water birds are gulls, pelicans. cormorants. ospreys and sandpipers found along the seacoasts; ibises, herons, egrets and gallinules (water hens) in the fresh-water marshes and surface waters. The snowy egret. roseate spoonbill and flamingo have become relatively rare. Land birds include almost all of the birds common to the southern states. Turkey, quail, dove and duck are the game birds protected by law except during the short hunting season in the fall of the year.

The alligator, long associated with Florida's lakes and rivers and hunted for sport and hide, is now protected from hunting by law. The crocodile is still found from time to time along the east coast from Biscayne bay to Cape Sable. Of the 40 species of snakes native to the state four are poisonous: the diamondback and ground rattlers: the coral snake and the moccasin. Lizards, land turtles, water turtles and frogs are plentiful. ;\lore than 700 species of fish have been identified: 300 species along the Gulf coast. 174 along the Atlantic and 290 around the Keys. The edible and commercially salable sea fish include mullet: drumfish, trout. mackerel, snapper, grouper and pompano; fresh-water fish that are edible include bass. bream, perch and catfish. For sport fishing the tarpon, sailfish and marlin of the deep waters and the bonefish of the shallows are eagerly sought.

Parks and Forests. — Florida was the first of the eastern states in which a national forest was created, the Ocala in 1908. The Osceola National forest was created in 1931 and the Apalachicola in 1936. The three national forests have a combined area of 1,100,000 ac. There are four state forests: Blackwater River near Milton, Myakka River near Sarasota. Pine Log near Panama City and Austin Cary near Gainesville. The Everglades National park in extreme south Florida attracts thousands of visitors as do the national monuments: Castillo de San Marcos at St. Augustine. Ft. Matanzas south of St. Augustine, Ft. Jefferson in the Dry Tortugas Islands. Ft. Caroline at Jacksonville and the De Soto memorial near Tampa. The Everglades National park contains the only tropical wilderness in the U.S., and is one of the few parks in the national park system established for the conservation of exotic plant, animal and marine life. A number of state parks and historical memorials protect plant and animal life, geological formations and historical landmarks. Pennekamp Coral Reef preserve, the world's first underwater park, is a state-controlled area of 75 sq.mi. (nautical) established (1960) in the Atlantic ocean off Key Largo by the federal and state governments to preserve a portion of the beautiful multihued coral formations of the area. There are also more than 20 public and private gardens and more than 200 public and private scenic attractions that are open to visitors.

HISTORY

The romance and the tragedies of the early history of Florida give it a unique place in the annals of the American states. Within 20 years after the first voyage of Columbus to the new world in 1492, an expedition was being organized to seek for a fabulous fountain of youth and for riches in the new and inviting land. This expedition was followed by others seeking wealth or seeking to establish the Christian faith among the savages. In turn these were followed by French Huguenots who sought a place of religious freedom. but the zeal of the Spaniards soon brought an unhappy end to their search. Florida also has the honour of containing the oldest European settlement within the bounds of the United States, as St. Augustine was founded in 1565, 42 years before the English were successful at Jamestown. The Spanish Council of Indies claimed that after 1510 fleets and ships had gone to Florida. and Florida is shown on the earliest known map of the new world, the Cantino map of 1502.

Spanish Exploration. — In 1513 Juan Ponce de León (c. 1460–1521), who had been with Columbus on his second voyage and who had later been governor of Puerto Rico, obtained a royal grant authorizing him to discover and settle "Bimini"—a fabulous island believed to contain a marvelous fountain or spring whose waters would restore to old men their youth or, at least. had wonderful curative powers. Soon after Easter day he came in sight of the coast of Florida, probably near the mouth of the St. Johns river. From the name of the day in the calendar. *Pascua* Florida, the country was named Florida. Ponce de León seems to have explored the coast, to some degree. on both sides of the peninsula, and to have turned homeward fully convinced that he had discovered an immense island. He returned to Spain in 1514 and obtained from the king a grant to colonize "the island of Bimini and the island of Florida." of which he was appointed *adelantado* (civil and military governor); in 1521 he made another expedition, this one for colonization as well as for discovery. He seems to have touched at the Dry Tortugas Islands, so named because of the large number of turtles found there, and to have landed at several other places, but many of his men succumbed to disease and he was wounded in an Indian attack, dying soon afterward in Cuba. Meanwhile, in 1516, another Spaniard, Diego Miruelo, seems to have sailed for some distance along the west coast of the peninsula. The next important exploration was that of Pánfilo de Narváez. In 1528 he sailed from Cuba with about 600 men (soon reduced to less than 400); he landed early in 1528, probably near the present site of Tampa. and for six months remained in the country, he and his men suffering terribly from exposure, hunger and fierce Indian attacks. In September, his ships being lost and his force greatly reduced in number; he hastily constructed a fleet of five boats, re-embarked, probably at Apalachee bay, and lost his life when his boat was blown out to sea while off the coast of Texas. Only four of his men. including Alvar Núñez Cabeza de Vaca, succeeded, after eight years of Indian captivity and of long and weary wanderings, in finding their way to Spanish settlements in Mexico. Florida was also partially explored by Hernando de Soto (*q.v.*) in 1539–40. In the summer of 1559 another attempt at colonization was made by Tristan de Luna. who sailed from Veracruz, landed at Pensacola bay and explored a part of Florida and (possibly) southern Alabama. Somenhere in that region he desired to make a permanent settlement, but he was abandoned by most of his followers and gave up his attempt in 1561.

French Huguenot Settlers. — In 1562, Jean Ribaut (c. 1520–65). with a band of French Huguenots, landed first near St. Augustine and then at the mouth of the St. Johns river, which he called the River of May, and on behalf of the king of France claimed the country. which he described as "the fairest, fruitfullest and pleasantest of all the world"; but he made his settlement on an island near what is now Beaufort, S.C. In 1564 René de Laudonnière (d. *c.* 1586), with another party of Huguenots, established Ft. Caroline at the mouth of the St. Johns, but the colony did not prosper and in 1565 Laudonnibre was about to return to France when (on Aug. 28) he was reinforced by Ribaut and about 300 men from France. On the same day that Ribaut landed, a Spanish expedition arrived in the Bay of St. Augustine. It was commanded by Pedro Menéndez de Avilés (1519–74), one of whose aims was to destroy the Huguenot settlement. This he did, putting to death almost the entire garrison at Ft. Caroline "not as Frenchmen but as Lutherans," on Sept. 20, 1565. The ships of Ribaut were soon afterward wrecked near Matanzas inlet; he and most of his followers surrendered to Menéndez and were executed. Menéndez then turned his attention to founding a settlement which he named St. Augustine (*q.v.*); he also explored the Atlantic coast from Cape Florida to St. Helena and established forts at San Mateo (Ft. Caroline), Avista, Guale and St. Helena. In 1567 he returned to Spain in the interest of his colony.

The news of the destruction of Ft. Caroline and the execution of Ribaut and his followers was received with indifference at the French court; but, according to a widely accepted story, Dominique de Gourgues (c. 1530–93), a friend of Ribaut but probably a Catholic, organized an expedition of vengeance, not informing his men of his destination until his three ships were near the Florida coast. With the co-operation of the Indians under their chief, Saturiba, he captured Ft. San Mateo in the spring of 1568 and on the spot where the Huguenots of Ft. Caroline had been executed, he hanged his Spanish prisoners and inscribed on a pine tablet the words: "I do this not as unto Spaniards but as to traitors, robbers and murderers." Feeling unable to attack St. Augustine, De Gourgues returned to France.

Spanish Settlements.— The Spanish settlements experienced many vicissitudes. The Indians were hostile and the missionary efforts among them failed. In 1586 St. Augustine was almost destroyed by Sir Francis Drake, and it also suffered severely by an attack of Capt. John Davis in 1665. Not until the last decade of the 17th century did the Spanish authorities attempt to extend the settlements beyond the east coast. Then, jealous of the French explorations along the Gulf of Mexico, they turned their attention to the west coast, and in 1696 founded Pensacola. When the English colonies of the Carolinas and Georgia were founded, there was constant friction with Florida. The Spanish were accused of inciting the Indians to make depredations on the English settlements and of interfering nith English commerce, and the Spanish were in constant fear of the encroachments of the English. In 1702, when Great Britain and Spain were contending in Europe, on opposite sides, in the War of the Spanish Succession (1701–14), a force from South Carolina captured St. Augustine and laid siege to the fort but, being unable to reduce it for lack of necessary artillery, burned the town and withdrew at the approach of Spanish reinforcements. In 1706 a Spanish and French expedition against Charleston, S.C., failed, and the Carolinians retaliated by invading middle Florida in various raids between 1702 and 1728. In 1740 Gen. James Edward Oglethorpe, governor of Georgia. supported by a naval force, made an unsuccessful attack upon St. Augustine; two years later a Spanish expedition against Savannah by way of St. Simon's Island failed, and in 1745 Oglethorpe again appeared before the walls of St. Augustine; but the treaty of Aix-la-Chapelle in 1748 prevented further hostilities. Pensacola, the other centre of Spanish settlement, though captured and occupied (1719–23) by the French from Louisiana, had a more peaceful history.

The Establishment of the Florida Provinces.— By the treaty of Paris in 1763 Florida was ceded to England in return for Havana. The provinces of East Florida and West Florida were now formed, the boundary of West Florida being 31° N. (when civil government was organized in 1767, the northern line was made 32" 28' N.), and the western boundary the Chattahoochee and the Apalachicola rivers, the Gulf of Mexico, Mississippi sound, Lakes Borgne. Pontchartrain and Maurepas, and the hlississippi river, A period of prosperity began. Civil in place of military government was instituted; immigration began; and Andrew Turnbull, an Englishman. brought over a band of about 1.500 Minorcans (1767), whom he engaged in the cultivation of indigo at New Smyrna. Roads were laid out, some of which yet remain; in the last three years of British occupation the government spent $580.000 on the two provinces. Consequently, the people of Florida were for the most part loyal to Great Britain during the American Revolution. In 1776, the Minorcans of New Smyrna refused to work any longer on the indigo plantations; many of them removed to St. Augustine, nhere they were protected by the authorities. Several plans were made to invade South Carolina and Georgia, but none matured until 1778, when an expedition was organized which co-operated with British forces from New York in the siege of Savannah, Ga. In the following year, Spain having declared war against Great Britain, Bernardo de Gálvez (1746–86), the Spanish governor at New Orleans, seized most of the English forts in West Florida and in 1781 captured Pensacola.

By the treaty of Paris in 1783 Florida reverted to Spain and, no religious liberty being promised, many of the British inhabitants left East and West Florida. A dispute with the United States concerning the northern boundary was settled by the treaty of 1795, the line 31° N. being established.

Acquisition by the **U.S.**—The westward expansion of the United States made it highly desirable to have American ports on the Gulf of Mexico: consequently, the acquisition of A'est Florida as nell as of New Orleans was one of the aims of the negotiations which resulted in the purchase of Louisiana in 1803. After the cession of Louisiana to the U.S., the people of West Florida feared that that province would be seized by Napoleon. They, therefore, through a convention at Buhler's plains (July 17, 1810), formulated plans for a more effective government. When it was found that the Spanish governor did not accept these plans in good faith, another convention was held on Sept. 26 which declared West Florida to be an independent state, and organized a government and petitioned for admission to the union. On Oct. 27, Pres. James Madison, acting on a theory of Robert R. Livingston that West Florida was ceded by Spain to France in 1800 along with Louisiana and was therefore included by France in the sale of Louisiana to the U.S. in 1803, declared West Florida to be under the jurisdiction of the United States. Two years later the U.S. congress annexed the portion of West Florida between the Pearl and hlississippi rivers to Louisiana (hence the so-called Florida parishes of Louisiana), and that between the Pearl and the Perdido to the hfississippi territory.

In the meantime war between Great Britain and the U S. was imminent. The U.S. government asked the Spanish authorities of East Florida to permit an American occupation of the country in order that it might not be seized by Great Britain and made a base of military operations. When the request was refused, American forces seized Fernandina in the spring of 1812, an action that was repudiated by the U.S. government after protest from Spain, although it was authorized in official instructions. About the same time an attempt to organize a government at St Mary's was made by U.S. sympathizers and a petty civil war began betneen the Americans. who called themselves "patriots," and the Indians, who were encouraged by the Spanish. In 1813 British troops landed at Pensacola to begin operations against the United States. In retaliation Gen. Andrew Jackson captured the place, but in a few days withdrew to New Orleans. The British then built a fort on the Apalachicola river, and from there directcd expeditions of Indians and runaway Negroes against the American settlements. These expeditions continued long after peace was concluded in 1814. In 1818 General Jackson, believing that the Spanish were aiding the Seminole Indians and inciting them to attack the Americans, again captured Pensacola. By the treaty of 1819 Spain formally ceded East and West Florida to the United States; the treaty mas ratified in 1821, when the United States took formal possession, but civil government was not established until 1822.

The New Territory and Statehood.— Indian affairs became the most serious problem of the new territory of Florida. Immediately after the cession of Florida to the United States, pressure was brought to bear upon congress and the president to have the Seminole Indians removed and the country thrown open to settlement. The Indians, who had been allowed to occupy their lands in peace by the Spaniards, could not understand why they should be forced to move to new lands west of the Mississippi; but they consented, by the treaty of Ft. Moultrie in 1823. to live within certain limits. Conflicts followed, however, as the population increased, and a new demand was made to have the Indians removed. By treaties made at Payne's landing in 1832 and Ft. Gibson in 1833 the Indian chiefs agreed to exchange their Florida lands for equal territory in the western part of the U.S. But a strong sentiment against removal suddenly developed, and the efforts of the U.S. to enforce the treaty brought on the Second Seminole War (1835–42), which resulted in the removal of all but a few hundred Seminoles whose descendants continue to live in southern Florida. In 1845 Florida became a state of the United States.

The **Civil** War and Reconstruction. — On Jan. 10, 1861, an ordinance of secession, which declared Florida to be a "sovereign and independent nation," was adopted by a state convention, and Florida became one of the Confederate States of America. The important coast towns were readily captured by Union forces—Fernandina, Pensacola and St. Augustine in 1862 and Jacksonville in 1863; but an invasion of the interior in 1864 failed, the Union forces being repulsed in a battle at Olustee on Feb. 20, 1864. In 1865 a provisional governor was appointed by Pres. Andrew Johnson, and a new state government was organized. The legislature of 1866 rejected the 14th amendment to the federal constitution. and soon afterward Florida was made a part of the 3rd military district, according to the Reconstruction acts of 1867. Negroes were now registered as voters by the military authorities, and another constitutional convention met in Jan. and Feb 1868. A factional strife in the dominant party, the Republican, threatened to break up the convention. but through the efforts of Gen. George G. Meade the differences were reconciled. A constitution was framed and ratified by the electors, and Florida passed from a quasi-military to a full civil government on July 4, 1868.

Before the American Civil War Jacksonville. St. Augustine and even Tampa had attracted tourists and invalids seeking respite from the colder winters of the northern states. but tourism only became a profitable business enterprise in the 1880s. Among later visitors were several northern capitalists who recognized possibilities for further development in Florida: Hamilton Disston, who bought 4,000,000 ac. of land in central Florida in 1881; Henry B. Plant who bought several short-line railroads and built them into the Atlantic Coast Line system through central Florida to the west coast; and Henry M. Flagler. who built the Florida East Coast line into Miami and over the seas into Key West. The railroads brought not only winter visitors, but settlers who grew winter truck crops, planted citrus groves and mined phosphate. The population of the state doubled between 1870 and 1890; by 1900 there were about 500.000 residents and in each succeeding 20 years the population almost doubled.

The 20th Century. — The history of the state in the 20th century has been that of rapid expansion and is quickly told in the rise in population in 60 years from about 528.000 in 1900 to more than 4,000.000 in 1960. The population, which had been swelled during World War II by thousands of members of the several branches of the armed forces sent to the state for training, continued to increase after the war. Many new industries located or relocated in the state, a number of them providing products and services associated nith the missile research and launching centre at Cape Canaveral. The annual state tourist influx approaches 10,000,000 persons. Agriculture remains an important part of the economy, but citrus crops and cattle raising have replaced field 'crops as the chief agricultural products. The growth of metropolitan and urban areas brought a decided shift of population and changed Florida's character from that of a rural state to that of a distinctly urban state. As in other states this shift resulted in a political fight on the part of the urban areas to secure better apportionment of representation in the state legislature.

Among the notable events in the 20th century were: the disastrous Jacksonville fire of 1901; the passage of legislation abolishing peonage (1909) and the convict lease system for prisoners (1923); the completion of the overseas railroad to Key West in 1912; the frantic land boom of the early 1920s; and the disastrous hurricanes of 1926, 1928, 1935 and 1960.

GOVERNMENT

The basis of Florida's government was laid in the constitution of 1885 (a document that was preceded by four earlier constitutions), to which about 100 amendments have been ratified. The amending process is simple. proposal by three-fifths of all of the members of both houses of the legislature and ratification by a majority of the voters casting their ballots for the proposed amendment at the next general election. The material that has been added by amendment comprises more than half of the constitution. There are a number of important constitutional prohibitions and tax exemptions, including prohibitions against an income tax, an inheritance tax and an ad valorem tax on real estate; the exemptions include three that relate to homesteads — immunity from forced sale unless alienated by the onner, $5,000 real-estate tax and $1.000 personal-property tax exemptions.

Governmental powers are divided between the legislative, executive and judicial branches with the usual system of checks and balances. Representation in the legislature is apportioned among the 67 counties on the basis of a senate composed of 38 members selected from districts comprising one or more counties; the house of representatives is composed of 95 members with three representatives from each of the five largest counties in population. two from the next 18 largest and one each from the remaining 44 counties. The constitution provides for reapportionment every 10 years, but the rapid population growth in the most populous counties has made this a difficult task. Regular sessions of the legislature are held biennially for 60 days; the sessions may be extended for 30 days by a three-fifths majority vote. Special sessions of 20 days may be called by the governor and the legislature itself may call a special session for 30 days by a three-fifths vote of the members. A legislative council, with a legislative reference bureau, was created in 1949; this agency, composed of nine senators and nine representatives, serves as an interim planning and study committee between sessions.

The executive power is vested in a governor and six elected administrative officers; these officers serve four-year terms, but a governor may not immediately succeed himself in office. Executive authority is highly decentralized among more than 150 officers, agencies. boards and commissions. The most important agencies are the 32 ex officio boards and commissions of which the governor and the six administrative officers (the so-called cabinet), in full or in part, are members. including the budget commission and commissioners of state institutions The administrative agencies, established largely by statute, are supervised by officials appointed by the governor, including 22 examining boards for professions and vocations. Several agencies are under the control of the governor: the road department. industrial commission, racing commission. beverage department and motor vehicle commission. The heads of these departments are referred to as the "little cabinet." The only elective executive agency is the railroad and utilities commission whose three members are selected for four-year terms.

The judicial branch is composed of a supreme court of seven justices elected for six-year terms; the office of chief justice rotates among the members of the court. There are three district courts of appeals composed of three judges each, elected for six-year terms. There are 16 circuits of the circuit courts, with one circuit judge for every 50,000 inhabitants or major fraction thereof. To relieve the burden of litigation on the circuit courts. a number of courts of concurrent jurisdiction have been established in the more populous counties There is a county judge in each county; lesser courts have been created in several counties.

Each county elects a board of five county commissioners and at least eight administrative officers. An amendment to the constitution in 1956 excepted Dade county (the southeastern county which includes the Miami resort area) which adopted a county charter and a plan of metropolitan government. Municipal gov-

Florida: Places of 5,000 or More Population (1960 census)'

Place	Population				
	1960	1950	1940	1920	1900
Total State	4,951,560	2,771,305	1,897,414	968,470	528,542
Arcadia	5,889	4,764	4,055	3,479	799
Auburndale	5,595	3,763	2,723	715	—
Avon Park	6,973	4,612	3,125	890	—
Bartow	12,849	8,694	6,158	4,203	1,983
Belle Glade	11,273	7,219	3,806	—	—
Boca Raton	6,961	992	723	—	—
Boynton Beach	10,467	2,542	1,326	—	—
Bradenton	19,380	13,604	7,444	3,868	—
Brownsville†	38,417	20,269	—	—	—
Carol City	21,749	—	—	—	—
Chattahoochee‡	9,699	8,473	7,110	—	—
Clearwater	34,653	15,581	10,136	2,427	343
Cocoa	12,294	4,245	3,098	1,445	382
Coral Gables	34,793	19,837	8,294	—	—
Crestview	7,467	5,003	2,252	500	—
Cutler Ridge	7,005	—	—	—	—
Dania	7,065	4,540	2,902	762	—
Daytona Beach	37,395	30,187	22,584	5,445	1,690
Deerfield Beach	9,573	2,088	1,850	—	—
De Funiak Springs	5,282	3,077	2,570	2,097	—
De Land	10,775	8,652	7,041	3,324	1,449
Delray Beach	12,230	6,312	3,737	1,051	—
Dunedin	8,444	3,202	1,758	642	113
Eau Gallie	12,300	1,554	873	507	172
Eustis	6,189	4,005	2,930	1,193	411
Fernandina Beach§	7,276	4,974	3,492	5,457	3,245
Fort Lauderdale	83,648	36,328	17,996	2,065	—
Fort Myers	22,523	13,195	10,604	3,678	943
Fort Pierce	25,256	13,502	8,040	2,115	—
Fort Walton Beach	12,147	2,463	—	—	—
Gainesville	29,701	26,861	13,757	6,860	3,633
Goulds	5,121	—	—	—	—
Gulfport	9,730	3,702	1,581	—	—
Haines City	9,135	5,630	3,890	651	—
Hallandale	10,483	3,886	1,827	—	—
Hayden	5,471	—	—	—	—
Hialeah	66,972	19,676	3,958	—	—
Hollywood	35,237	14,351	6,239	2,264	—
Homestead	9,152	4,573	3,154	1,307	—
Jacksonville	201,030	204,517	173,065	91,558	28,429
Jacksonville Beach	12,049	6,430	3,566	357	—
Key West	33,956	26,433	12,927	18,749	17,114
Kissimmee	6,845	4,310	3,225	2,722	1,132
Lake	9,465	7,571	5,836	3,341	4,013
Lakeland	41,350	30,851	22,068	7,062	1,180
Lake Wales	8,346	6,821	5,024	796	—
Lake Worth	20,758	11,777	7,408	1,106	—
Lantana	5,021	773	234	—	—
Largo	5,302	1,547	1,031	599	—
Leesburg	11,172	7,395	4,687	1,835	765
Live Oak	6,544	4,064	3,427	3,103	1,659
Marianna	7,152	5,845	5,079	2,499	900
Melbourne	11,982	4,223	2,622	533	131
Miami	291,688	249,276	172,172	29,571	1,681
Miami Beach	63,145	46,282	28,012	644	—
Miami Shores	8,865	5,086	1,956	—	—
Miami Springs	11,229	5,108	898	—	—
Miramar	5,485	—	—	—	—
New Smyrna Beach	8,781	5,775	4,402	2,007	543
North Miami	28,708	10,734	1,973	—	—
North Miami Beach	21,405	2,129	871	—	—
Oakland Park	5,331	1,295	815	323	—
Ocala	13,598	11,741	8,986	4,914	3,380
Opa-Locka	9,810	5,271	497	—	—
Orlando	88,135	52,367	36,736	9,282	2,481
Ormond Beach	8,658	3,418	1,914	1,292	595
Palatka	11,028	9,176	7,140	5,102	3,301
Palm Beach	6,055	3,886	3,747	1,135	—
Palmetto	5,556	4,103	3,491	2,046	569
Panama City	33,275	25,814	11,610	1,722	—
Pensacola	56,752	43,479	37,449	31,035	17,747
Perrine	6,424	2,859	—	—	—
Perry	8,030	2,797	2,668	1,956	—
Pinellas Park	10,848	2,924	691	134	—
Plant City	15,711	9,230	7,491	3,729	720
Pompano Beach	15,992	5,682	4,427	636	—
Quincy	8,874	6,505	3,888	3,118	847
Riviera Beach	13,046	4,065	1,981	—	—
St. Augustine	14,734	13,555	12,090	6,192	4,272
St. Petershurg	181,298	96,738	60,812	14,237	1,575
St. Petersburg Beach ‖	6,268	1,722	398	—	—
Sanford	19,175	11,935	10,217	5,588	1,450
Sarasota	34,083	18,896	11,141	2,149	—
Sehring	6,939	5,006	3,155	812	—
south Miami	9,846	4,809	2,408	—	—
Tallahassee	48,174	27,237	16,240	5,637	2,981
Tampa	274,970	124,681	108,391	51,608	15,839
Tarpon Springs	6,768	4,323	3,402	2,105	541
Titusville	6,410	2,604	2,220	1,361	—
Valparaiso	5,975	1,047	221	—	—
Vero Beach	8,849	4,746	3,050	793	—
Warrington	16,752	13,570	—	—	—
West Miami	5,296	4,043	—	—	—
West Palm Beach	56,208	43,162	33,693	8,659	564
West Winter Haven	5,050	2,326	—	—	—
Westwood Lakes	22,517	—	—	—	—
Wilton Manor	8,257	883	—	—	—
Winter Garden	5,513	3,503	3,060	1,021	—
Winter Haven	16,277	8,605	6,199	1,597	—
Winter Park	17,162	8,250	4,715	1,078	366

*Populations are reported as constituted at date of each census. †Formerly Brownsville-Brent-Goulding. ‡Changed from River Junction in 1941. $Includes Fernandina and Fernandina Beach in 1950; previously known as Fernandina. ‖Pass-a-Grille Beach and St. Petershurg Beach consolidated since 1950; previously known as Pass-a-Grille Beach.

Note: Dash indicates place did not exist during the reported census, or data not available.

ernments, generally chartered by special acts of the legislature, are provided for 310 incorporated communities. Of the 617 units of government in Florida, more than 200 are special purpose or ad *hoc* district governments.

POPULATION

The population of Florida in 1850 (the first census after the state entered the union) was 87,445. Its population ranked 32nd among the 37 states and territories of the union and was classified as 100% rural. By 1900 the population had increased more than 500% to 528.542, ranked 33rd among the 48 states and territories and was classified as 79.7% rural. In the succeeding decades the population increased 42.4% from 1900 to 1910; 28.7% from 1910 to 1920; 51.6% from 1920 to 1930; 29.2% from 1930 to 1940; 46.1% from 1940 to 1950; 76.3% from 1950 to 1960. At mid-20th century the population ranked 20th among the 48 states and was 65.5% urban. By 1960 it ranked 14th among the 50 states and was nearly three-fourths urban. After mid-20th century the population increased by about 225,000 new inhabitants per year. Of this total, about 65.000 represent natural increase, the excess of births over deaths. The net annual immigration to the state is about 160,000 arrivals per year or more than 3,000 per week. The population per square mile in 1950 was 47.3, as compared with 49.9 for the nation as a whole. By 1960 the population per square mile had increased to 83.5 per square mile, as compared with 49.7 for the nation as a whole.

The five largest counties—Dade, Duval, Hillsborough, Pinellas and Broward (Fort Lauderdale) contain slightly less than one-half of the total population. The four metropolitan areas (Jacksonville, Miami, Orlando and Tampa-St. Petersburg) contain more than one-half of the total population. By 1960 50.1% of the population lived in these areas.

More than half of the population of Florida comprises migrants from other states, but there are very few foreign-born residents. The distribution by colour and nativity, according to the 1950 census was as follows: 73.7% native white; 4.4% foreign-born white; and 21.8% nonwhite. Practically all of the nonwhite population is Negro.

FINANCE AND TAXATION

The state derives more than half of its total income from taxation and about one-eighth from the federal government. State tax revenues are derived from the following sources: sales and use taxes, gasoline taxes, beverage taxes, motor-vehicle licences, pari-mutuel fees and taxes, cigarette taxes, unemployment compensation taxes and intangible property taxes. There is no state income tax and no state property ad valorem tax. Most of the state's revenue comes from the excise taxes. The state disburses more than half of its income for operating expenses and about one-third of its income goes for aid to counties and cities. State aid to counties includes about $160,000,000 for public schools and school debt.

EDUCATION

In 1947, Florida established a Minimum Foundation program for public schools which enables each county, with the potential help of state funds, to offer adequate educational opportunities to all children. The program provided that all schools have a term of 180 days, increased teachers' salaries and encouraged the training of new teachers. State educational scholarships for prospective teachers were doubled, provisions for kindergartens and junior colleges were made and many new school buildings were constructed. Almost 1,000,000 students were enrolled in public schools by mid-20th century.

The school program provides a broad program of adult education, of diversified co-operative training enabling the student to work part-time and of driver education. The state system of higher education is supervised by an appointive board of control subject to the ex officio state board of education. One institution, the University of Florida (founded in 1853), is located at Gainesville; two others are at Tallahassee—Florida State university (founded in 1857), and Florida Agricultural and Mechanical university (founded in 1887) for Negroes. These institutions are co-educational, and between them, enroll approximately 25,000 students. There is a medical college at Gainesville affiliated with the University of Florida.

The state also contributes to the support of the medical college of the Cniversity of Miami (founded in 1925), a private institution. Older private institutions of higher education include Rollins college at Winter Park (incorporated in 1879 and opened in 1885), Stetson university at DeLand (founded in 1883) and Florida Southern college at Lakeland (founded 1885).

HEALTH AND WELFARE

The public health program of Florida is directed by the state board of health and administered by 66 county health departments. Under the state program clinics are provided for mothers and children, and visiting nurses instruct in child care and nutrition; sanitarians guard and test water supplies and inspect food establishments and handlers.

Immunization programs are provided and many counties require certification as to health conditions before issuing building permits; many of the counties provide guidance clinics to assist in the solving of behaviour and mental problems.

The state maintains four hospitals for the treatment of tuberculosis, three hospitals for the mentally ill and a rehabilitation centre for alcoholics with out-patient clinics in several cities of Florida. Training of doctors is supported by the state at the medical colleges of the Universities of Florida and Miami. The crippled children's commission has developed programs which have attracted both public and private funds.

The public-welfare program of Florida generally follows the federal program of social security and public assistance. Florida spends about $70,000,000 annually for aid to aged persons, the blind, dependent children and the disabled. and smaller amounts for unemployment compensation and other aids and for administration. The state maintains training schools for delinquent boys at Marianna and Okeechobee and for girls at Ocala. Schools for the mentally retarded are operated at Gainesville and Fort Myers. Correctional institutions are operated at Apalachee for first offenders while the state penitentiaries for men are at Raiford and Belle Glade and for women at Lowell.

THE ECONOMY

About four-fifths of Florida's labour force are nonfarm workers. Of the total number of employees in nonagricultural establishments about 30% are engaged in retail and wholesale trade; about 15% each in government, services and manufacturing; about 10% in construction trades; and less than 10% in transportation, communication and public utilities; about 5% in finance, insurance and real estate; and about 1% in mining.

The geographical distribution of employment varies with the economy of each section according to the development of tourism, agriculture and industry: agricultural employment is well distributed in the farm and grove areas from Pensacola to Miami; businesses and trades that cater to tourism and hence employ food handlers. maids and porters are concentrated along the major highways on the east and west coasts. The pulp and paper industry is largely in the northern sections; food canning and preserving in the central citrus section; the apparel industry chiefly in the Miami area; printing and publishing in the largest cities; chemicals in and around Pensacola; and mining in Polk county.

The population increased 76.3% from 1950 to 1960. The per capita income of Floridans rose from $1,228 in 1950 to about $2.000 by 1960, approximating the average for the nation as a whole. Extractive, processing and fabrication industries contribute about 20% of the total personal income; trades, services and related industries contribute about 40%; federal, state and local governments about 20%; and unclassified sources, about 1 5 . More than half of the state's income is derived from aages and salaries. Proprietors' income and property income each amount to about 15%.

Agriculture. — Florida is one of the few states in which agriculture is an expanding industry. The refrigerated freight car made practicable the long-distance shipment of perishable truck and citrus crops; quick freezing and the wholesale marketing of frozen foods increased market demands. The successful control of insect pests and the introduction of cultivated pastures promoted beef production; livestock receipts amount to almost 25% of total farm receipts. More than 100 meat-packing plants process Florida cattle, most of the beef being bought in 30 livestock auction markets.

Citrus fruits account for almost 35% of the state's agricultural production; Florida accounts for about two-thirds of the total U.S. production. Vegetable production is important; 62 vegetables are grown commercially, mostly for winter trade. Part of the 23,000,000 ac. of forest land in the state is privately owned, and timber is cut for lumber and pulpwood mills. The number of commercial farms in the state increased after mid-20th century, while there was a decline in other states. The production, processing and distribution of agricultural products is one of the three major sources of income payments.

The perfection of manufacturing processes for the concentration of citrus juices through a "quick-freeze" operation resulted in a major new food industry which consumes more than half of the citrus production of the state. Commercial fishing is an important industry, the annual catch being valued at about $30,000,000.

Manufacturing and Industry. — The most significant economic factor in the growth of Florida has been diversification: in agriculture with new processing for crops, in tourism through expansion to a year-round business and in industry through over-all expansion and development. Florida's industrial growth began with the 20th century: between 1899 and 1933, the value added by manufacture increased at a rate of 3% each year; after 1933 the rate of growth was more than 7% annually. Florida is not, however, a major industrial state, accounting for only about 1% of total U.S. industrial employment.

The broadening of the industrial base is illustrated by the great increases in metalworking and fabricated metal production and the establishment of an electrical machinery industry. Industry groups which doubled their employment in 1950–60 include apparel. furniture, paper, chemicals, stone, clay and glass, and nonelectrical machinery.

Food processing, including canning and preserving, was the state's leading industry after mid-20th century; it was followed, in order, by pulp, paper and paperboard; cigars; ne spapers; and sawmills and planing mills. The most significant industrial development of the 1950s was the completion and opening of a natural gas line from Texas into the peninsula to serve all of the metropolitan areas. The state's leading power plants, industries and manufactured gas distributing systems were converted to the use of natural gas, assuring an ample supply of fuel for additional industries.

Beginning in 1956, several manufacturers of space missiles and jet engines established plants in Florida, and the national missile testing centre was established at Cape Canaveral. With nearby Patrick air force base, the centre employs 35,000 persons. There are more than 150 electronics manufacturers most of whom are located near Tampa and St. Petersburg.

Minerals. — Although the extraction of minerals from the earth in Florida is behind other states in volume, the state leads in the production of phosphate rock and fuller's earth. Both aluminum and uranium have been extracted from Florida phosphate, enough of the latter to warrant the establishment of a recovery plant by the Atomic Energy commission. Among the newer minerals extracted in the state are titanium. zirconium and hafnium; ilmenite and rutile are, in turn, processed from titanium. The chemical industries include the production of textile fibres by chemical synthesis. organic chemicals, fertilizers, inorganic chemicals and plastics and resins. A fourth of the nation's supply of turpentine and wood rosin is manufactured in Florida.

Tourism. — Agriculture, industry and tourism constitute a three-way economy for Florida. The equable year-round climate and nearness to centres of population have made it a leading vacation land. In 1927. about 1,800,000 visitors spent approximately $201,000,000. Three decades later, about 8,080,000 visitors spent approximately $1,323,000,000 on vacations in Florida. After mid-20th century tourism was one of the state's three largest business enterprises. Before 1920, the state was a rich man's vacation spot, but the automobile and better roads made the luxury of a former generation, a mass market.

Transportation and Communication. — There are more than 4,700 mi. of railroads. There also are 14,275 mi. of state-maintained paved roads and 28,145 mi. of paved roads maintained by counties and cities plus 20,000 mi. of improved but unpaved roads in Florida. International airports are at Miami and Tampa. Domestic and several foreign airlines operate from more than 100. commercial and municipal airports; there are more than 50 military airports and several private airports. The export-import trade through the state's 13 deep-water harbours regularly operating in foreign trade amounts to almost 10,000,000 tons, nearly balanced between imports and exports.

There are more than 40 daily newspapers and about 150 weekly newspapers; 130 radio stations, 16 commercial television and 6 educational television stations broadcasting in the state.

See also references under "Florida" in the Index volume.

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FLORIDABLANCA, JOSÉ MOÑINO Y REDONDO, COUNT OF (1728–1808), Spanish statesman, was born at Hellin, Murcia. on Oct. 21, 1728. He was the son of a retired army officer. He studied at Salamanca and practised as an advocate. After a successful embassy to Rome, Floridablanca succeeded Grimaldo as first minister to Charles III. He regulated the police of Madrid, reformed many abuses, projected canals, took measures for the improvement of trade and agriculture, and encouraged learning, science and the fine arts. The long-standing disputes with Portugal on the boundaries of the South American colonies were settled. An agreement signed at San Ildefonso (Oct. 1, 1771) was later followed by a treaty of alliance between the two powers signed at Pardo (March 24, 1778). At the outbreak of war between Great Britain and the North American colonies. Floridablanca advised a middle course, but Spain was drawn into the conflict in 1779. Floridablanca was much under the influence of French *philosophes* and economic writers. The French Revolution frightened him into reaction, and he advocated the support of the first coalition against France. He retained his office for three years under Charles IV; but in 1792, through the influence of the favourite Godoy, he was dismissed and imprisoned in the castle of Pampeluna. Here he was saved from starvation only by the intervention of his brother. He remained in seclusion till the French invasion of 1808. He was then nominated president of the central junta at Aranjuez. He died at Seville on Nov. 20, 1808. He left several short treatises on jurisprudence.

FLORIDOR (JOSIAS DE SOULAS, SIEUR DE PRIMEFOSSE) (*c.* 1608–1671), French actor, of whom De Visé wrote that he acted "like a gentleman . . . whose bearing and movements were so natural that even without speaking he inspired general admiration." He was born at Brie early in the 17th century. After about five years at the Marais theatre in Paris he joined the Hôtel de Bourgogne in 1643 and there rose to the position of manager and *orateur,* that is. the speaker who addressed the audience when the next play was to be announced. As an actor Floridor seems to have been better suited for parts that required more dignity than warmth. Robinet commented on his *"air charmant"* and *"noble manière,"* and Louis XIV held him in particular esteem. When Racine cast him in the role of Nero in *Britannicus* (1669), the spectators had difficulties in reconciling the irreproachable actor with the wicked part he had been assigned to play. (A. M. N.)

FLORIN, the name of several coins of the continent of Europe and of two coins struck in England at different times. The word comes through the Fr. *florin* from the Ital. *fiorino,* flower, Lat. *flos, florem.* Fiorino was the Italian name of a gold coin issued at Florence in 1252, weighing about 54 grains. This coin bore on the obverse a lily, from which it took its name of "the flower," on the reverse the Latin name of the city *Florentia,* from which it was also known as a "florence." "Florin" and "florence" seem to have been used in English indiscriminately as the name of this coin. The Florentine florin was held in great commercial repute throughout Europe, and similar coins were struck in Germany, other parts of Italy, France, the Netherlands (where the silver florin is still in use), etc.

The English gold florin was introduced by Edward III in 1343, half and quarter florins being struck at the same time. This gold florin weighed 108 grains and was to be current for six shillings. It was found, however, to be overvalued in proportion to the silver currency and was demonetized the following year. The florin did not reappear in the English coinage until 1849, when silver coins with this name, having a nominal value of two shillings (one-tenth of a pound) were struck. In 1887 a double florin or four-shilling piece was issued, but its coinage was discontinued in 1890. The design of the florin was altered in 1937. The reverse side consists of a rose, thistle and shamrock surmounted by a crown, surrounded by an inscription. *(See* also MONEY, MEDIAEVAL; NUMISMATICS; GULDEN.)

FLORIO, JOHN (GIOVANNI) (c. 1553–*c.* 1625), English teacher of Italian, lexicographer and translator of Montaigne. was the son of Michael Angelo Florio, a Protestant refugee of Tuscan origin. John, who was born in London about 1553, may have had some education at Tiibingen, and had returned to England by 1576. In 1581 he matriculated at Magdalen college, Oxford. At Richard Hakluyt's instigation he translated, as *Navigations and Discoveries* (1580), Giambattista Ramusio's account of the voyages of Jacques Cartier. Another translation, *A Letter lately written from Rome,* was printed in 1585. *Florio his Firste Fruites* (1578), consisting of a grammar and 44 lively dialogues in Italian and English, was followed by *Florio's Second Frutes* (1591), together with a collection of proverbs alphabetically arranged in *Giardino di Ricreatione.* Between 1583 and 1585 Florio was employed as tutor to the French ambassador's daughter. He was associated with

Giordano Bruno, whose works Florio used freely as a lexicographer. By 1594, and possibly some years earlier, Florio had been appointed tutor to the earl of Southampton. His Italian-English dictionary, *A Worlde oj Wordes* (1598), contains some 46,000 definitions, many amply informative, others racy and idiomatic. The second edition, *Queen Anna's New World of Words* (1611), was greatly enlarged.

In 1603 Florio produced his major translation, *The Essayes . . . of . . . Montaigne.* By modern standards of accuracy the freedom of this version is licentious; the style is uniformly elaborate where Montaigne is variously subtle or spare, but the book is rightly recognized as thoroughly good reading and was only temporarily displaced by Charles Cotton's version (1685). Florio revised it in 1613. From 1604 to 1619 Florio was groom of the privy chamber to Queen Anne. He was also her Italian tutor and probably taught Prince Henry. His last years were spent in poverty at Fulham, near London, still occupied with translations. Part I of *The New-Found Politicke* (1626) gives his rendering of Boccalini's *Ragguagli di Parnaso.* He died of the plague about 1625. His elaborate will is discussed by F. A. Tates, who identified two manuscripts in the British museum, *Gzardino di Ricreatione* and an Italian version of Ring James's *Basilikon Doron.* Florio left collections for the dictionary and ten dialogues which were apparently used by Torriano in his *Italian Tutor* (1640). *H.* G. Wright has made a good case for Florio's responsibility for the anonymous translation of the *Decameron* (1620). He is known to have had friendly connections with Sir Philip Sidney, Fulke Greville, Sir Edward Dyer, Matthew Gwinne, Barnabe Barnes, Nicholas Breton, Thomas Thorpe and Ben Jonson. He had his enemies too: John Eliot mocked him in *Ortho-Epia Gallica.* It has been supposed that Holofernes in *Love's Labour's Lost* was Shakespeare's gentler ridiculing of Florio's palpable pedantry and affectation; the most judicious consideration of this question is in F. A. Yates's *Study of Love's Labour's Lost* (1936). Florio was observant and critical of English manners and of the Elizabethan scene and indefatigably interested in words. He appears from his style as lively, learned, opinionated, fluent, industrious and, by his own epithet. the "Resolute John Florio."

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FLORIS (originally DE VRIENDT), **CORNELIS** (1514–157j) and **FRANS** (*c.* 1518–1570), Flemish artists, the former an architect, sculptor and medalist, the latter a painter, were brothers from a talented Antwerp (Belg.) family. Frans studied under Lambert Lombard in Liège, Belg.; and early in the 1540s both brothers went to Rome, returning with their sketchbooks crammed with impressions. Those of Cornelis bore fruit in ornamental engravings (issued 1548–57) which introduced Netherlandish artists to an exuberant version of the Roman grotesque style. Of the drawings which Frans made from antique sculpture and from Michelangelo's paintings, many survive; he was one of the first northern artists to feel the impact of Michelangelo's "Last Judgment" (unveiled 1541).

Both brothers were soon at the head of flourishing workshops in Antwerp. Cornelis supplied, among other works, the choir screen of Tournai cathedral and the tombs of the Danish kings Frederick I at Schleswig, Ger., (1550–52) and Christian II at Roskilde, Den., (1568–75). Of his architecture, the most important example is Antwerp town hall (1561–65); its remarkable amalgamation of a Gothic gable front with a Florentine palace façade became the model for Netherlandish town halls. Indeed, the somewhat severe Renaissance style which Cornelis evolved dominated later 16th-century Netherlandish architecture, and its influence was felt in northern Germany, Denmark and around the Baltic coasts. He died in Antwerp, Oct. 20, 1575.

Frans's success was even more phenomenal, thanks to the fashionable modernity of his style, an astonishing facility of hand and the ability with which. like Rubens, he organized an efficient picture-producing factory. But his extravagant mode of life brought him into financial difficulties and he died (in Antwerp, Oct. 1, 1570) overwhelmed with debt. Paintings that bear his signature (a double or triple F) are in Antwerp, Arnstadt, Vienna, Brussels, Stockholm, Florence and other cities.

Frans Floris' brilliant natural gifts seem obscured by his ill-digested borrowings from classical antiquity and from Raphael, Michelangelo, Tintoretto and others. His genius is best revealed in small details of his pictures, in his studies of heads and in such portraits as those of a falconer and his uife (1558; Brunswick, Ger.; Caen. Fr.). Here the bravura of the brushwork plainly foreshadows the painting of the Baroque. (D. KG.)

FLORUS, PUBLIUS ANNIUS (late 1st and early 2nd century A.D.), historian of Rome and poet. is important as the first of a number of African writers who, in the 2nd century, exercised considerable influence on Latin literature; he was also the first of the "new-fashioned" poets of Hadrian's reign, whose special characteristic was the use of lighter and more graceful metres (anapaestic and iambic dimeters), which had hitherto found little favour. He compiled, chiefly from Livy. a brief sketch of the history of Rome from the foundation of the city to the time of Augustus. The work, which some manuscripts call *Epitome de* T. *Livio bellorum omnium annorum DCC libri duo,* is a rhetorical panegyric of the greatness of Rome. Though almost valueless historically, it was much used in the middle ages. In the manuscripts the writer is variously given as Julius Florus, Lucius Annaeus Florus or simply Annaeus Florus; but from certain similarities of style he has been identified with Publius Annius Florus, who was also known to be the author of a dialogue *Vergilius orator an poeta,* of which a fragment of the introduction has been preserved. This states that he was born in Africa, and at an early age took part in the contest of poets instituted by Domitian in honour of Capitoline Jove. Having been refused a prize owing to the prejudice against African provincials, he left Rome and set up at Tarraco in Spain as a teacher of rhetoric. But he must have returned to Rome, for it is agreed that he is the Florus who addressed the lines to Hadrian beginning "Ego nolo Caesar esse" ("I do not wish to be Caesar"). quoted with Hadrian's answer by Spartianus. Twenty-six trochaic tetrameters, *De qualitate vitae,* and five graceful hexameters, *De rosis,* are also attributed to him.

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FLOTATION PROCESS: *see* METALLURGY; *ORE* DRESSING.

FLOTOW, FRIEDRICH, FREIHERR VON (1812–1883), German composer known for his opera *Martha.* Born on April 26, 1812, at Teutendorf, Mecklenburg, he studied under Antonin Reicha in Paris, where he established his reputation with *Le Naufrage de la Méduse* (1839), written in collaboration with Albert Grisar and Auguste Pilati. Between 1840 and 1878 he produced 19 light operas in France, Italy and Germany of which the best known is *Martha* (Vienna, 1847), in its original form a ballet given at the Paris Opéra in 1844. Introducing the Irish song, "The Last Rose of Summer," and appealing by its melodic charm, *Martha* won a place in the operatic repertory. Flotow also wrote ballets produced at Schwerin, where he was director of the court theatre, and incidental music for Shakespeare's *A Winter's Tale.* He died at Darmstadt, Jan. 24, 1883.

See R. Svoboda, *Friedrich von Flotows Leben* (1892).

FLOTSAM, JETSAM AND LAGAN, in common law, goods lost at sea, as distinguished from goods which come to land, which are technically designated wreck (*q.v.*). Jetsam (the same word as jettison) refers to the case when goods are cast into the sea and there sink and remain under water; flotsam where they continue floating on the surface; lagan where they are sunk in the sea, but tied to a cork or buoy in order to be found again. Flotsam, jetsam and lagan belong to the sovereign in the absence only of the true owner. Wreck, on the other hand (*i.e.*, goods cast on shore), was by the common law adjudged to the sovereign in any case, because it was said by the loss of the ship all property was gone out of the original owner. *See* WRECK.

FLOUNDER, a name given generally to flatfishes other than sole or halibut *(qq.v.)* and in England particularly to *Platichthys flesus,* which ranges from northern Europe to the Mediterranean. and often enters fresh water. The starry flounder *(P. stellatus)* of the Pacific coast of North America is a related species. In America the name is given to several species of flat fish: *e.g.,* winter flounder *(Pseudopleuronectes americanus)*, summer flounder *(Paralichthys dentatus)* and gulf flounder *(P. Albiguttus)*. *See* also FLATFISH.

FLOUR is defined as the fine, clean, sound product made by bolting wheat meal. The word is used in a less definite sense of other cereals and even noncereals or other substances in a finely powdered state, though in these cases it is usual to use such terms as bean, rice, potato or other flour. The term so defined is generic and covers a wide range of products differing by reason of the variety or form of wheat used in their manufacture, or by reason of certain qualities required for several purposes.

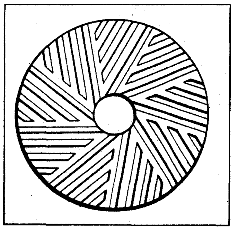

FIG. 1.—MILLSTONE FOR GRINDING WHEAT

Bread Flours.——As compared with wheat flour, all other materials used for making bread are of secondary importance. Rye bread is consumed in some of the northern parts of Europe and is popular in many parts of the United States: and breads commonly called corn pone, hoecake, johnnycake, made from corn meal, are largely eaten in the southern states and less generally throughout the corn belt. In southern Europe the meal of various species of millet is used and in India and China durra and other cereal grains are baked for food.

Buckwheat is employed in the U.S.S.R., the Netherlands and the United States, and in South America the meal of the tapioca plant; the flour of peas, beans and other leguminous seeds is also baked in cakes. But, excepting rye, none of these substances is used for making vesiculated or fermented bread, for only wheat and rye yield flours which, mixed with water, form doughs capable of satisfactory aeration or leavening.

Aside from its high nutritive value, due to its starch and gluten or protein content, and to a less degree to the mineral substances present, the most important characteristic of wheat flour is its capacity, when made into a dough, to enmesh gas, thus forming an open-textured, spongy, light bread. The gas formed either by the use of yeast as a leavening agent, or by the chemical reaction between an acid ingredient and bicarbonate of soda, is carbon dioxide (CO_2). Gas required for inflating the dough is produced by the growth of yeast. Yeast is a plant requiring food, and it must have sugar, nitrogenous matter and mineral salts in forms which it can assimilate; all flours contain some of these necessary yeast foods. They also contain certain enzymes. which may be called generically diastase. When dough is made these enzymes begin to operate on the starch of the flour, converting some of it, by stages, into sugar. The limiting factor in the quantity of gas evolved during panary fermentation is frequently a shortage of yeast-food; for example, the quantity of pre-existing sugar is insufficient, particularly if the proportion of yeast used is substantial and a prolonged fermentation is required. Therefore the yeast depends largely, and in the later stages of fermentation exclusively, for its saccharine food on the sugar produced in the dough by diastatic action. Modern bakery practice, in which all the operations between the mixing of the dough and the removal of the bread from the oven are performed to a definite time schedule, will not wait on the development of sugar in sufficient quantity to feed the growing yeast. Under certain conditions the addition of sugar or of special sugars made from corn starch is good practice. but it is preferable to use diastatic malt extract which produces sugar as the yeast uses it; in any case the yeast requires a sufficiently mixed food which includes some form of assimilable nitrogenous matter. *(See* BREAD.)

Baking Powder Leavening Agents.— Much of the bread baked in the home is of the hot bread or biscuit variety and is made by adding chemical leavening agents to the flour and water, or milk mixture. Baking powders are used in the production of biscuits, cakes and some forms of puddings, doughnuts, pancakes. etc. The formulas for baking powders vary somewhat, but all depend upon the release of carbon dioxide.

TYPES OF FLOUR

Self-raising **Flour.**—In relatively recent years millers added the chemical reagents necessary to the evolution of carbon-dioxide gas directly to their flour. The proportion of the alkaline body, bicarbonate of soda, is generally 1% to 1½% of the flour. Theoretically, a quantity of the acid body should be used just sufficient to neutralize the bicarbonate of soda: but in practice it is desirable and usual to use slightly more of the acid body (1¾% to 2¼%). The acid substance used in self-raising (called self-rising in the U.S.) flours is generally acid phosphate of lime. The manufacture of this chemical product has been greatly improved and it is excellent as to purity and constitution. When the finished self-raising flour contains 1½% of bicarbonate of soda, from 1½% to 2¼% of this phosphate should be used.

In the making of bread the growth of the yeast and the evolution of gas was a relatively long process, ranging from 3 to 20 hours. Modern practice, however, speeded up the fermentation process until the usual period of gas production was about seven hours. While these processes are proceeding, the flour as dough is being gradually rendered capable of easy distension and gas retention. It follows that the constitution and characteristics of the flour used must conform to the conditions as to time. temperature and proportion of yeast used so that there is no fixed standard of excellence in flour which can be always measured by any known factor, *e.g.,* the percentage of nitrogenous matter insoluble in water. On the contrary, widely differing characteristics are required, which the miller. as a specialist. must know and satisfy. So far as self-raising flour is concerned, he knows that the evolution of gas is rapid, and that the flour as dough must be capable of rapid distension and good gas retention. Therefore the wheats used in the manufacture of such flour differ substantially from those used for the manufacture of bread flours; and even in the manufacture of the latter regard must be paid to the conditions of time and temperature and to the sort and proportion of yeast used. These considerations led to many refinements of manufacture and to modern developments of milling.

Brown Bread Flours.— The consumption of brown bread or whole-wheat bread appears to have varied little in modern times, although more interest in whole-wheat breads was indicated. "Wheat meal" is not defined in Great Britain. It may be the entire product obtained by grinding cleaned wheat. and if designated whole-wheat meal it should be the 100% product; but it is usual and legitimate to describe as wheat meal either the 100% product or that from which bran equalling 5% to 10% of the whole has been abstracted. In the United States whole-wheat, entire-wheat and graham flour all mean flour containing all of the constituents of the cleaned grain. in their natural proportions.

Some persons benefit by the presence of bran or "roughage" in their food, and a proportion of whole-wheat bread is widely recommended. During World War I it was ascertained that brown flours formed 5% of the total flours consumed in Great Britain. This group of breadstuffs comprises certain well-known proprietary flours that are not whole-meal, and it is safe to say that wheat meals then formed only from 2% to 3% of the total flours consumed. There is no reason to think that this proportion was later substantially increased either in Great Britain or the United States.

Biscuit Flours.— For the manufacture of biscuits (crackers) certain types of flour are required, which differ materially from those used for bread. There are many kinds of biscuits, and specialization as to the types of flour required for them is carried to great lengths.

WHEAT

Wheat as Raw Material.— The embryo or germ from which the new plant originates forms from 1½% to 2% of the wheat berry. The endosperm is the food upon which the young plant lives till it is able to obtain its sustenance from the soil and air. The endosperm in its original form cannot, however, be assimilated by the embryo, and certain enzymes in the presenceof moisture gradually bring about the necessary changes. As a consequence the endosperm becomes liquid, and the bran functions as a container for it. This bran is very resistant to disintegration and can be found in the soil as an empty sac weeks or months after sowing.

The miller essentially divides wheat into two products, flour and offal, though there are several grades of each. The embryo or germ is sometimes regarded as a third product, but actually it goes into the two named. Until modern methods of milling were invented it was never obtained as a separate product. and even today it is impossible to separate more than about $\frac{1}{4}$ of the whole, that is to say, more than about $\frac{1}{4}$ of the 2% contained in the wheat berry. The germ, because of its oily nature, is particularly resistant to disintegration. Pressure applied either by millstones or rolls may flatten the particles and express some of its oil from the germ into the flour; but it is an error to suppose that flours manufactured by millstones contained the germ, and that those manufactured by modem methods do not. Formerly the germ aent mainly or wholly into the by-products; today some of it is extracted as substantially a separate product and is added, after cooking (which is necessary), to white flour to form certain special flours, *e.g.,* Hovis. a well-known English product. The remainder-goes mainly or wholly into the by-products of milling. Flours containing raw germ will not remain sound under trying conditions for long periods. The enzymes provided by nature to convert the endosperm into plant food reside mostly in or near the embryo or germ, and their activities have to be controlled or nullified in preparing the germ for use in bread; but ways have been devised whereby it can be included in certain flours.

Wheats and the Wheat Berry.—There are several races and very many varieties of wheat, some hard, some soft: some possessing so-called red bran, others white bran; some yielding white flours, others yellow flours; some growing and maturing rapidly, others slowly. On arrival at the mill their moisture content varies from 9% to 20%. Natural conditions of soil and climate enter into the selection of the varieties chosen for cultivation, and when a mill is situated in a great wheat-growing district the types of wheat available for its economic use may not differ widely; nevertheless, there are diversities in their constitution and character. But when, as in Great Britain, the wheats come from all parts of the world in an irregular supply, the miller must somehow manufacture flours of regular quality from raw material of very great diversity.

The miller divides the berry essentially into two products, flour and branny husk. The bran is made up of several layers. For present purposes it is unnecessary to deal with other than two of them. The outer skin (epidermis) is, to some extent. separated from the inner layers during the processes of milling, and is the principal constituent of the material known to millers as "bee's

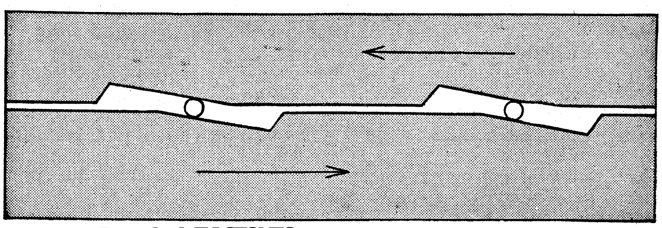

FIG. 2.—MILLSTONES: RUNNER AND BEDSTONE FACE

wing," a name indicative of its appearance. This bee's wing has a very high fibre content and is of low or little food value.

On the inner side of the bran there is a layer of rectangular cells known as the aleurone cells, of higher nutritive value than the bran. Theoretically wheat should yield much more flour than millers usually extract. Hence, if any attempt were made in commerce to increase the extraction, it is the inner side of the branny husk which should be attacked, not the outer one. When wheat was passed between millstones, it was principally the epidermis which was removed and passed as bran powder into the flour; the aleurone cells were left then, as they are now, on the finished bran. The addition of such powdered material to flour darkened it and had some effect in lowering its food value.

All wheats, moreover, have a crease. This greatly impedes an easy and satisfactory separation of wheat into its component commercial parts. It is also a receptacle for dust and dirt. In the early days of modern milling, millers attempted to split each berry down the crease and obtained a very dark product known as crease flour or crease dirt. This attempt proved to be a failure. A pair of fluted rolls, 60 in. long. grinds as a normal feed about 50,000,000 berries of wheat per hour, and it proved impossible to split each berry, or even most of them, in the desired way. Instead. wheat washing was introduced. The berry, furthermore, is furnished at one end with "hairs of beard" (which must not be confounded with the awns attached to the glumes), and these hairs have also to be removed by the miller.

Constitution of Flour.—The chemical constitution of flour may be stated as follows:

Starch	65 to 70%
Proteins	9 to 14%
Cellulose and fat	1%
Sugars	2½%
Mineral matter (ash)	4%
Water	13 to 15%

Actually, in exceptional cases, there are deviations beyond these limits. The principal proteins are gliadin and glutenin. When flour is made into a dough these two proteins constitute at least 80% of the material known as gluten. They are colloidal bodies and are of the greatest importance. It is wrong to say that very white bread is pure starch or relatively very starchy, for colour of crumb is largely due to the refraction and reflection of light, and the crumb of a loaf to be very white and bright must be well aerated; without a substantial or large proportion of these proteid bodies satisfactory aeration is impossible. Modern white bread is usually about 50% starch. The proportions of cellulose and ash present in flour are largely under the control of the miller. The cellulose is sometimes described as woody fibre, and by excluding particles of branny husk the proportion present of this indigestible matter is low. The ash consists principally of phosphates of potash and to a much smaller extent of phosphates of magnesia and lime, with traces of other constituents. The proportion of ash may be as low as 0.35% in the highest grades of flour or may rise to, say 1% in the commercially lowest grades. In no case is the presence of calcium salts of substantial significance, and this applies to wheat meals also. The form in which these constituents are combined in wheat has not been definitely ascertained. but if such salts may be divided into two groups, organic and inorganic, they are at that stage mainly or wholly organic, but become largely inorganic as a result of inorganic action during the milling and bread making processes.

MILLING PROCESSES

Milling processes may be conveniently divided into two stages: (1) the cleaning and conditioning of wheat; and (2) the separation of husk from kernel. Stated in these terms, milling may appear to be a simple process; actually it is a complicated one and, although modern milling developments have been in the direction of simplification, the diagram or flow sheet of a large modem mill would probably be unintelligible except to those trained in the techniques of milling. From the economic or technical point of view the amount added by milling to the value of the raw material is the measure of the merit of the work involved.

Wheat Cleaning and Conditioning.—The extraneous matter found in wheat consists principally of other cereals, seeds of many kinds. shapes and sizes, stones, chaff, straw, dust and dirt (earth). To extract these, many devices are employed. Sieves of perforated metal can extract substances either larger or smaller than wheat. But wheats differ so much as to size and shape of berry that better instruments than sieves are also necessary. Cylinders covered on their inner side with holes of varying sizes bored in zinc provide means of making more precise separations. Disks so bored rotating in a body of wheat are also employed. Ascending currents of air capable of precise regulation are passed through descending showers of wheat, and carry away particles which by reason of their shape or compactness of particle can be so separated. Wheat is scoured and brushed in various ways. One well-known machine consists essentially of a cylinder,, clothed on its inner side with emery; beaters revolving on a shaft serve the double purpose of scouring the wheat against the emery surface and of passing it through the length of the cylinder.

Conditioning is an English term; in the United States a somewhat similar operation is called tempering. Essentially it means that the physical condition of any given wheat is adjusted so that optimum separations of husk from kernel can be made. Sometimes water is added; sometimes it is abstracted. Adjustments must be made to suit the wheat under treatment. the conditions as to atmosphere and milling machinery subsequently used. and the flours to be produced. The factors employed are water, time and temperature. The methods of conditioning are still in the process of evolution. The results obtained by conditioning are mainly or wholly physical.

Grinding.— Roller mills are almost invariably employed for grinding today. When millers attempted at one operation to perform the whole of the grinding required, millstones were employed. This involved the use of friction, very great in amount and intensity: one passage between millstones involved at least 4 ft. of rough handling. Even when the wheats used were soft or mellow and therefore relatively resistant to disintegration, some of the husk of the wheat was reduced to powder. The Hungarians grew wheat of excellent quality, but the grain was hard and its skin friable. They therefore began. about 1870, to use roller mills. In other parts of Europe and in the eastern United States the wheats available were then mellow and the necessity for relatively gentle grinding mas not great. But when the states of the northwest and the western provinces of Canada were developed, the varieties of wheat found to be suitable were hard and had friable skins. Hence the American millers adopted the new Hungarian methods and British millers followed suit, for the ultimate users and consumers of flour would not accept flour or bread containing a large proportion of powdered husk. For these reasons gradual reduction by roller mills superseded the sudden death methods of grinding wheat by millstones.

A pair of cylindrical rollers, running at the point of contact in the same direction, nip and grind their feed at one point only in their circumferences. But a release of endosperm particles from the branny husk, and not mere crushing, being the object desired, the two rolls forming a pair are made to revolve at different speeds. This differential varies with the stage of milling. Furthermore, to effect optimum separations of husk from kernel it is necessary to obtain during the earlier stages of actual milling the endosperm particles in granular form. To effect this the rolls used in those stages are corrugated. The number and shape of these corrugations or flutes involve complicated technical points. The numbers range from 9 to 26 per inch of the roll's circumference. Still further to improve the separations the flutes are cut at varying angles in relation to the rolls' axes.

In conformity with the principle of gradual reduction, no attempt is made to obtain finished bran at one grinding; on the contrary, the wheat is broken down on the roller mills, known as the breaks, gradually by successive stages. These now number three, four or five; occasionally in some parts of the world six are used. Generally, millers aim to make as little flour as possible on the breaks, but some is made. The commercial product known as bran is separated from the stock, leaving the last break. The breaks as a stage of the milling process yield as finished products flour equalling from 8% to 18% of the original cleaned wheat and bran equalling from 10% to 15% of it. The remainder exists at that stage as granular products! known as middlings and semolina (*qq.v.*). These contain particles of pure endosperm, particles of pure husk and other particles consisting of endosperm with husk attached.

Ultimately, to resolve these intermediate products into finished flour and finished husk (known commercially in Great Britain as offals and in North America as feed) iurther grinding by rolls is required. These are known technically as reduction rolls or reductions, and generally have either smooth surfaces or very fine flutes ranging from 70 to 120 per inch of the roll's circumference. The speed and differential are adjusted to the work to be done, but the principle of gradual reduction is employed at these stages also. The central idea of such grinding is a release of endosperm particles from husk. In the case of particles consisting of endosperm only, it is desirable to reduce them in size by grinding. In no case should granular particles, however fine, be merely crushed.

Bolting.— This term in modern milling has a generic significance. In its simplest form it means separating by means of a sieve. Sieves are used largely in milling; they sort by size. Frequently several sieves are superimposed one above another to form the milling machine known as the plansifter. Though the principle of the plansifter is simple, it required a generation of experiment before a machine acceptable to millers generally was developed. Another form of bolting machinery is the octagonal, hexagonal or round reel mhich revolves at a slow speed. Here also separations are made according to size of particle. A framework is mounted on a central slightly inclined shaft. The framework is clothed with wire or silk cloth and the material to be separated is passed into the interior of the reel, whence it passes either through the cover or over the tail end of the reel. Another form of bolting is performed by the centrifugal. In this machine there is a reel or cylinder, generally hexagonal, revolving slowly and covered with silk or wire cloth. Inside are beaters revolving quickly mhich are set to throw the stock against the cover and to more it longitudinally. Primarily this also performs separations according to size of particle; but to some extent it sorts according to compactness of particle. The same thing can be said of the plansifter, but any such sorting depends on a nice adjustment of sieve space to the quantity of feed treated. After each grinding, whether by break or reduction rolls, some sort of separation by one or another of these bolting methods is performed, and the divisions and subdivisions of stock cause complexity. The meshes used vary from 10 to 140 per lineal inch.

PURIFYING, BLEACHING AND ENRICHMENT

Purifying.— In a technical sense purifying connotes separations of the granular products known as semolinas and middlings according to compactness of particle. For this purpose the machines known as purifiers have been designed and built. Before sorting by compactness of particle can be performed, sorting by size of particle is necessary, and must be carried out in great detail. There are various forms of this purification. Generally there is a sieve divided into a number of sections, each one having above it a separate air compartment. Through the sieve and each air compartment a current of air, under control as to intensity, is drawn. The best particles pass through the meshes of the sieve, some are held in suspension on the sieve and are floated over its end; others are caught in receptacles placed above the sieve.

Bleaching.— The principal colouring matter in flour is xanthophyll, with minor proportions of carotene and other unidentified colour pigments. As constituents of flour these seem to serve no useful purpose, and many consumers do not like bread which is even moderately yellow. These carotinoids are rendered colourless by oxidation and the flour then becomes nearly pure white in colour. This process occurs naturally when flour is stored for sex-era1 months, which permits the osygen of the air to react slowly with the colour pigments. Marked improvement in baking properties also occurs. Research on the reaction occurring in flour during storage led to the development of artificial bleaching which accomplishes in minutes what formerly took weeks. A current of air introduces the reactive substance to the flour stream before it goes to the packers.

Nitrogen peroxide, first employed in U.S. mills in 1904, is not extensively used at present. Nitrogen peroxide is made by passing a small current of air through a chamber in which flaming electrical discharges are produced intermittently. Flour thus treated may contain up to four parts per million of residual nitrites. Bleached flours must be so labelled if intended for sale in the Gnited States.

Nitrogen trichloride gas, produced by passing a stream of chlorine through a solution of ammonium chloride, matures as well as bleaches flour. At one time, 90% of U.S.-produced flour was thus treated. Criticism of flour bleaching with nitrogen trichloride, based on observations that it induced canine hysteria or running fits in dogs despite the fact that it has been shown that humans are not adversely affected and that dogs are not sensitive to amounts included in an average diet, led to its prohibition as a flour bleaching agent in the United States after Aug. 1, 1949. In Canada its use was discontinued May 1, 1949. The British government had not yet banned its use by the mid-1950s. Chlorine dioxide is generally accepted as an alternative flour bleaching agent in the United States and Canada. Intensive investigation showed it to be harmless.

Chlorine gas with 0.5% to 5% nitrosyl chloride is employed to some extent for soit-wheat cake flours and hard-wheat flours requiring very long fermentation. This agent affects the gluten strongly and the dosage must therefore be closely controlled. Traces of benzoyl peroxide will also bleach flour.

Enrichment.— Flour enrichment with thiamine, riboflavin, niacin and iron (optional, calcium and vitamin D) was made compulsory in the United States from Jan. 1943 to Oct. 1946 It mas made compulsory in a number of states, and the majority of US. bakers adhered to enrichment specifications, the program being supported by government organizations and nutritionists In Canada enrichment mas introduced in Feb 1953, though it was not made compulsory. In England, it was enforced in the 1950s for all flour of less than 80% extraction. However, the addition of *creta praeparata* was made compulsory for all flours. (See also GRAIN PRODUCTION AND TRADE; SEMOLINA; MIDDLINGS; etc.)

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(H. E. BA.; J. A. To.; R. H. H.)

FLOUR BEETLE, a term popularly given to certain species of beetles (fam. Tenebrionidae) which are pests of broken grain and particularly of prepared cereal foods. The most important species belong to the genus *Tribolium;* of these, the confused flour beetle (T. *confusum)* and the rust-red flour beetle (*T. castaneum*) are the most serious pests found in flour mills. Originally these insects probably fed on broken grain in the fields; with the cultivation of grains by man, the beetles easily invaded stored supplies of whole grain and flours, which furnished an abundance of food and excellent breeding conditions. Remains of either T. *confusum* or *T. castaneum* have been found in a grain jar in a pharaonic tomb of the 6th dynasty, dating about 2500 B.C. The beetles have been spread throughout most parts of the world.

The life cycle of the various species of *Tribolium* is very similar. In T. *confusum* the adults are small, elongated, reddish insects about $\frac{1}{8}$ in. long. The females lay 400 to 500 small white eggs, which are dropped in the flour or grain. The larvae are slender and wormlike, white in colour, tinged with yellow, and pass through 6 to 11 instars, reaching an average length of $\frac{3}{16}$ in. before pupating. The life cycle may be completed in 4 weeks, but generally requires 40 days or longer, depending upon the food available and other conditions necessary for development.

In flour mills these pests are difficult to keep under control because of their small size and rapid development. According to R. T. Cotton and G. B. Wagner (U.S. Dept. Agric., Bur. Ent. and Pl. Quar., Mim. Ser. E-419, 1938), the mills generally become infested in six principal ways: (1) through entrance of the beetles with the grain stream; (2) from infested flour used in blending operations; (3) from infested flours returned to the mills from grocers, warehouses, etc; (4) from infested secondhand flour bags; (5) from infested secondhand machinery; (6) from infested feed stored in the mill near the milling machinery. The principal measures employed for control are fumigation or sterilization'of incoming grain, frequent repair of flour sifters, cleaning and fumigation of conveyors, and general fumigation of the mill with lethal gases such as hydrocyanic acid gas, chloropicrin and methyl bromide. Supplementary control measures consist of spraying neglected corners, woodwork, etc., with pyrethrum and thiocyanate sprays, rebolting of flour which is being reconditioned, diversion of infested returned stocks, proper handling and storage of finished flour and fumigation and proper construction of warehouses. The beetles are often a source of annoyance to the housewife. All dry foods should be kept in tight containers; if the food becomes infested, it may be sterilized in a hot oven. Heavily infested supplies should be destroyed.

Other common flour beetles are the broad-horned flour beetle (*Gnathocerus cornutus),* the small-eyed flour beetle (*Palorus ratzeburgi*) and the long-headed flour beetle *(Laetheticus oryzae*). These are widely distributed forms similar in habits to the species of *Tribolium.*

See R. *T.* Cotton, *Insect Pests of Stored Grain and Grain Products* (1941). (R. L. WL.)

FLOURENS. GUSTAVE (1838–1871), French revolutionary and one of the most romantic figures of the Commune, mas born on Aug. 4, son of Pierre Flourens *(see* below). Gustave was trained by his father to succeed him. and had a brilliant scientific career up till his father's death in 1867, when the Collège de France, to which his evolutionary theories and his republican opinions were equally objectionable, abruptly signified that it had no further use for his services. Flourens indignantly left the country and went to Crete, where he joined the ranks of the insurrection against Turkey. In this hard guerrilla warfare he gained his chief military experience, and acquired such prestige among the Cretans that he was chosen president of the delegation elected by Crete in 1868 to sit in the Hellenic parliament. Had it been admitted *(see* TURKEY: *History),* war between Greece and Turkey might well have resulted; the Greek government solved their difficulties by kidnapping Flourens and sending him to France, while they turned his colleagues back to Crete. He then carried on republican propaganda in Naples till he was imprisoned, and in France, where he was dangerously wounded in a duel with Paul de Cassagnac. At the funeral of Victor Noir (Jan. 12, 1870) he attempted with his usual impetuosity, to lead an insurrection, but was thwarted by Rochefort, Delescluze, and Blanqui (*qq.v.*): he did in fact attempt a rising on Feb. 7, which collapsed at once, and he was condemned to imprisonment in a fortified place. During the siege of Paris he was ardently patriotic and commanded, first five battalions raised in Belleville, then a corps of tirailleurs. Together with 23 other *chefs de bataillon* he overturned the government on Oct. 31, 1870, charging it with treachery, but as he received support from no politician but Blanqui, withdrew from the hotel de ville after negotiation. On the outbreak of the Commune (March 18, 1871) Flourens was elected for the 19th and 20th *arrondissements* and made a colonel. He attempted by a personal example of bravery and devotion to diminish the incoherence and disorder around him: he exposed himself too rashly at Rueil in the sortie of April 3, was captured, and killed while a prisoner by a sabre cut from an officer.

See the *Grand Dictionnaire, etc., Larousse* (1869 etc.) *s.v.*
(R. W. P.)

FLOURENS, PIERRE (1794–1867), French physiologist, was born at Maureilhan, near Béziers, on April 15, 1794. After taking his M D. at Montpellier, Flourens began physiological research in Paris and in 1822 published his *Recherches expérimentales sur les propriétés et les fonctions du systkme nerveux dans les animaux vertébrés,* in which he, from experimental evidence, sought to assign their special functions to the cerebrum, corpora quadrigemina and cerebellum. He was chosen by Cuvier in 1828 to deliver for him a course of lectures at the Collège de France. In 1832 a professorship of comparative anatomy was created for him at the museum of the Jardin. In 1833 Flourens, in accordance with the dying request of Cuvier, was appointed a perpetual secretary of the Academy of Sciences, and in 1838 was returned as a deputy for the arrondissement of Béziers. In 1840 he was elected, in preference to Victor Hugo, to succeed J. F. Michaud at the French Academy; and in 1846 he was created a peer of France. In 1847 Flourens directed the attention of the Academy of Sciences to the anaesthetic effect of chloroform on animals. At the revolution of 1848 he withdrew completely from political life, and in 1855 he accepted the professorship of natural history at the Colltge de France. He died at Montgeron, near Paris, on Dec. 6, 1867.

Besides numerous shorter scientific memoirs, Flourens published *Expériences sur le système nerveux* (1825); *Cours sur la génération, l'ovologie, et l'embryologie* (1836): *Analyse raisonnée des travaux de G. Cuvier* (1841); *Buffon, hirtoire de ses travaux et de ses idées* (1844); *Fontenelle, ou de la philosophie moderne relativement aux sciences pkysiques* (1847); *Oeuvres complbtes de Buffon* (1853); *De la longdvitd humaine* (1854), *Histoire de la de'couverte de la circulation du sang* (1854); *Cours de physiologie compare'e* (1856); *De la vie et de l'intelligence* (1858); *De la raison, du génie, et de la folie* (1861); *Examen du livre de M. Darwin sur l'Origine des Espèces* (1864). For a list of his papers *see* the Royal Society's *Catalogue of Scientific Papers.*

FLOWER, SIR WILLIAM HENRY (1831–1899), English biologist who greatly influenced museum display, was born at Stratford-on-Xvon on Nov. 30, 1831. He took his M.B at London in 1851, and went to the Crimea as assistant-surgeon. On his return he became a member of the surgical staff of the Middlesex hospital, London, and in 1861 curator of the Hunterian museum of the Royal College of Surgeons In 1870 he also became Hunterian professor, and in 1884 was appointed to the directorship of the Natural History department of the British museum at South Kensington. He died in London on July 1, 1899. He made valuable contributions to structural anthropology and to the comparative anatomy of mammals.

His chief publications are: *Diagrams of the Nerves of the Human Body* (1861); *The Osteology of the Mammalia* (1870); *Introduction to the Study of Mammals, Living and Extinct* (1891); *Essays on Museums and other Subjects* (1898).

See C. J. Cornish, Sir *W.* H. *Flower* (1904), and *R.* Lydekker, *Sir William Flower* (1906).

FLOWER, a term popularly used for the blossom of a plant, and so by analogy for the finest part or aspect of anything. Here it is dealt with only botanically. The flower is characteristic of the highest group of plants—the flowering plants (Phanerogams)—and is the association of more or less leaf-like organs which are concerned with the production of the seed. In modern botany the group is often known as the seed-plants or Spermatophyta (*see* ANGIOSPERMS and GYMNOSPERMS). Following pollination, a seed develops from the ovule; the essential structures for seed production are the *stamens,* which bear the pollen, and the *carpels,* on which the ovules are formed. In comparative morphology, stamens and carpels are known as *sporophylls* because they bear the microspores developed in the microsporangia, or the megaspore developed in the megasporangium. Following germination *of* the megaspores, these are known as pollen grains, and the microsporangia as pollen sacs. The megasporangium, together with an outgrowth of maternal tissue, the integument, constitutes the ovule. In the more primitive gymnosperms the micro- or megasporophylls are generally associated in separate cones, to which the term "flower" has been applied. But it is to more definite and elaborate structures in the higher angiosperms that "flower" generally refers.

Bracts.—Flowers are produced from flower-buds in the axils of leaves called *bracts;* "bract" is properly restricted to the leaf from which the primary floral axis arises, while leaves which arise between the bract and the flower are *bracteoles.* Their arrangement is similar to that of foliage leaves. In many cases, bracts protect the young flower, but they are sometimes undeveloped, and usually fall off early. Sometimes, especially with bracteoles, no flower-buds arise in their axils. At the base of the general umbel in umbelliferous plants is often a whorl of bracts, the *general involucre,* while *partzal involucres* or *involucels* are found at the base of the umbellules. In Compositae the involucre surrounds the heads of flowers (fig. 12). A sheathing bract or *spathe,* enclosing one or several flowers is common among monocotyledons and may, in some palms, reach 20 ft. in length and enclose 200,000 flo ers. The spathe may be coloured *(Anthurzum)* or white (arum lily, *Zantedeschia ethiopica*). In grasses, the outer scales (glumes) of the spikelet are sterile bracts. Bracts may be changed into leaves.

Inflorescence.—The arrangement of flowers on the axis is called the *inflorescence.* The primary axis of the inflorescence is the *rachzs;* its branches, when present, are *peduncles,* which in turn may give rise to *pedicels.* A flower having a stalk is pedunculate or pedicellate; one with no stalk is sessile. To obviate any confusion, it is common to speak of the rachis as the *primary* floral axis, the peduncles as the *secondary* floral axes, and so on. The peduncle may be simple, bearing a single flower, or branched. When it proceeds from radical leaves, it is a *scape.* The floral axis may be shortened, as in daisy and fig, or flattened, convex or concave in form and bearing numerous flowers, as in marigold or in fig. Adhesions occasionally take place between the peduncle and the bracts, as in the lime-tree (fig. 1). The termination of the part upon which the whorls of the flower are arranged is the *receptacle.*

Two general types of inflorescences are recognized. In one, the flowers arise as lateral shoots from a primary axis, which continues to elongate, and the lateral shoots do not exceed the length of the primary axis. The flowers are said to be *axillary* and the inflorescence is *indeterminate.* In the other type, the primary axis ends in a single flower, but lateral axes arise from the axils of bracts and repeat the process, the development of each lateral axis being stronger than that of the primary axis beyond its point of origin. The flowers are thus *terminal* and the inflorescence is *determinate.* In indeterminate inflorescences, the lower or outer flowers expand first *(centrzpetal)*: in determinate inflorescences, it is the upper or inner flowers that open first *(centrifugal).* In some inflorescences (*mixed*), the primary axis has an arrangement belonging to one type, the branches one of the opposite type.

The simplest indeterminate form is one in which a lateral shoot in the axil of a single foliage leaf ends in a single flower. In this case the flower is *solitary.* A more complicated inflorescence is commoner. Thus if the primary axis, as in fig. 2, is elongated and gives off pedicels ending in a single flower a *raceme* is produced, which becomes a *panicle* if the secondary axes branch. If the lower flower-stalks art? developed more strongly than the upper, and thus all the flowers are on a level, a *corymb* is formed, which may be simple (fig. 4) or branched. If the pedicels are wanting, so that the flowers are sessile, the result is a *spike.* If this bears unisexual flowers it is a *catkzn;* if it becomes succulent and surrounded by a spathe it is a *spadix,* which may be simple (fig. 7) or branched. A spike with female flowers only and covered with scales, as in the hop, is a *strobilus.* In grasses there are usually numerous sessile flowers in small spikes (*spikelets*); if these are borne not on the primary but on secondary axes, they form a *panzcle.*

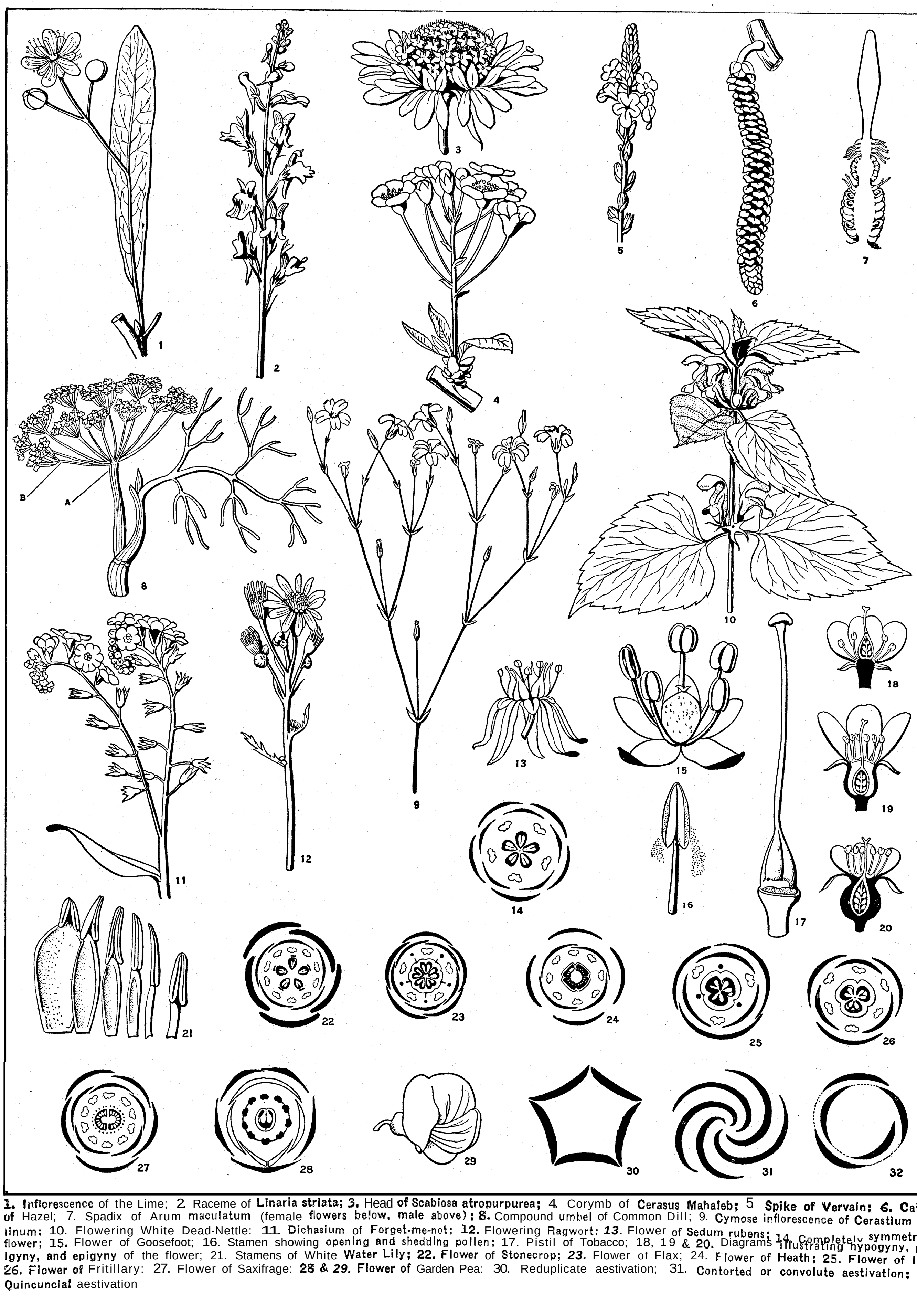
If the primary axis is contracted, other forms result. When it is so short that the secondary axes arise from a common point and spread out as radii of nearly equal length each ending in a single flower or dividing again similarly, an *umbel* (fig 8) is produced. If there are numerous flowers on a flattened, convex or concave receptacle, having short pedicels or none, a *capitulum* is formed, as in marigold and scabiosa (fig 3). If the margins of the receptacle are developed upwards, they may ultimately give rise to the *hypanthium* of the fig.

In compound indeterminate inflorescences, the lateral shoots, developed centripetally, bear numerous bracteoles from which floral shoots arise, which may have a centripetal arrangement similar to that on the mother shoot, or a different one. Thus we may have a group of racemes arranged in a racemose manner; compound umbels as in most Umbelliferae (fig. 8); a raceme of capitula; a raceme of umbels, as in ivy, and so on.

The simplest type of determinate inflorescence is where, as in *Anemone nemorosa,* the axis terminates in a single flower, no other flowers being produced on the plant This is a *solitary terminal* inflorescence. When the primary floral axis, before ending in a flower, gives off lateral unifloral axes which repeat the process, the result is a *cyme.* A cyme with two axes is a *biparous* cyme or *dichasium* (fig. 11); with one axis, it is *uniparous.* In the dead-nettle *(Lamzum)* the flowers arise in the axis of each foliage leaf and appear as if arranged in a whorl, but there is a central flower expanding first, and from its axis spring secondary axes bearing single flowers (fig. 10). The inflorescence is thus a dichasium and the clusters are called *vertzczllasters.* Where numerous lateral axes arise from the primary axis, a *cymose umbel* is produced. When these lateral axes grow strongly and develop irregularly, as in species of *Juncus,* the inflorescence is an *anthela.* In a uniparous cyme, the basal portion of the consecutive axes may become thickened and arranged more or less in a straight line, forming a false axis or *sympodium,* the inflorescence thus simulating a raceme. The uniparous cyme presents two forms; in a *scorpzoid* cyme the flowers are arranged alternately in a double row along one side of the sympodium, the bracts forming another double row on the opposite side (*e.g.,* Boraginaceae). In-a *helicoid* cyme, the flowers are in a single row and form a spiral round the false axis.

Compound definite inflorescences are by no means common, but in *Streptocarpus polyanthus* and in several calceolarias we probably have examples. Here we find *scorpzoid cymes of pairs of flowers,* each pair consisting of an older and a younger flower.

Both the determinate and indeterminate types are represented in mixed inflorescences. Thus in the ragwort (fig. 12) the *heads* of



1. Inflorescence of the Lime; 2. Raceme of Linaria striata; 3. Head of Scabiosa atropurpurea; 4. Corymb of Cerasus Mahaleb; 5 Spike of Vervain; 6. Catkin of Hazel; 7. Spadix of Arum maculatum (female flowers below, male above); 8. Compound umbel of Common Dill; 9. Cymose inflorescence of Cerastium collinum; 10. Flowering White Dead-Nettle: 11. Dichasium of Forget-me-not; 12. Flowering Ragwort; 13. Flower of Sedum rubens; 14. Completely symmetrical flower; 15. Flower of Goosefoot; 16. Stamen showing opening and shedding pollen; 17. Pistil of Tobacco; 18, 19 & 20. Diagrams illustrating hypogyny, perigyny, and epigyny of the flower; 21. Stamens of White Water Lily; 22. Flower of Stonecrop; 23. Flower of Flax; 24. Flower of Heath; 25. Flower of Iris; 26. Flower of Fritillary: 27. Flower of Saxifrage: 28 & 29. Flower of Garden Pea: 30. Reduplicate aestivation; 31. Contorted or convolute aestivation; 32. Quincuncial aestivation

flowers are developed centrifugally, while the *florets* open centripetally. Various combinations occur in different families.

Tabular View of Inflorescences

A. Indeterminate Centripetal Inflorescences.
- I. Flowers solitary, axillary, *Veronica hederifolia.*
- II. Flowers in groups, pedicellate.
  - i. Elongated form (Raceme), *Hyacinth;* (Corymb), *Prunus.*
  - ii. Contracted form (Umbel), *Cowslip.*
- III. Flowers in groups, sessile.
  - i. Elongated form (Spike), *Plantago.*
    - (Spikelet), *grasses.*
    - (Catkin), *Hazel.*
    - (Spadix), *Arum.*
    - (Strobilus), *Hop.*
  - ii. Contracted form (Capitulum), *Daisy.*
- IV. Compound Indeterminate Inflorescences.
  - *a.* Compound Spike, *Rye-grass.*
  - *b.* Compound Spadix, *Palms.*
  - c. Compound Raceme, *Astilbe.*
  - d. Compound Umbel, most *Umbelliferae.*
  - *e.* Raceme of Capitula, *Petasites.*
  - *f.* Raceme of Umbels, *Ivy.*

B. Determinate Centrifugal Inflorescences.
- I. Flowers solitary, terminal, *Tulip.*
- II. Flowers in cymes.
  - 1. Uniparous Cyme.
    - a. Helicoid Cyme.
      - (i) Elongated, *Alstroemeria.*
      - (ii) Contiacted, *Wittsteznra corymbosa.*
    - *b.* Scorpioid Cyme.
      - (i) Elongated, *Forget-me-not.*
      - (ii) Contracted, *Erodium.*
  - 2. Biparous Cyme (including Dichasium, Cymose Umbel).
    - *a.* Elongated, *Cerastium.*
    - *b.* Contracted (Verticillaster), *Dead-nettle.*
  - 3. Compound determinate Inflorescence. Many *Calceolarias.*

C. Mixed Inflorescences.
- Raceme of Scorpioid Cymes, *Horse-chestnut.*
- Scorpioid Cyme of Capitula, *Vernonia scorpioides.*
- Compound Umbel of dichotomous Cymes, *Viburnum.*
- Capitulum of contracted Scorpioid Cymes (Glomerulus), *Sea-pink.*
- Cyme of Capitula, *Rag-wort.*

Parts of the Flower.—The flower consists of the floral axis bearing the sporophylls (stamens and carpels) usually with protective envelopes. The axis is normally contracted, no internodes being developed and the portion beanng the floral leaves, the receptacle, is frequently a conical, flattened or hollowed expansion; rarely the axis is elongated and internodes are developed. Upon the receptacle the parts of the flower are crowded, usually forming a series of whorls, the parts of which alternate, but sometimes arranged spirally, especially if the axis is elongated. In a typical flower (fig. 22) there are four distinct whorls, an outer *calyx* of, *sepals;* within it, the parts alternating with those of the calyx, is the *corolla* of *petals;* next alternating with the parts of the corolla, the *androecium* of *stamens;* and in the centre, the *gynoecium* of *carpels.* Fig. 14 is a diagrammatic representation (*floral dzagram)* of such a flower, supposed to be cut transversely, the parts of each whorl being distinguished by a different symbol. The sepals are usually greenish, their function is mainly protective, shielding the delicate internal organs before the flower opens. The petals are usually showy. Sometimes (usually in monocotyledons) the calyx and corolla are similar; in such cases the term *periantlz* is applied, and the parts of the calyx are *petaloid.* In some cases the petals resemble sepals *(sepaloid).* In plants, as *Nymphaea alba* (fig. 21), where a spiral arrangement of floral leaves occurs, these tvhorls pass insensibly into each other. When both calyx and corolla are present, the plant is *dichlamydeous;* when one is absent, *monochlamydeous* (fig. 15). Sometimes both are absent *(achlamydeous),* as in willow. The stamens in their most differentiated form consist each of a stalk, the *filament,* and the *anther* (fig. 16) the latter composed of pollen sacs containing the powdery pollen which is ultimately discharged. The *gynoecium* or *pistil* terminates the floral axis. It consists of one or more carpels, separate or fused together (figs. 13, 17). The pistil is composed of the *ovary* (figs 17, 18), which contains the *ovules* destined to become seeds; the **stigma,** or receptive surface on which the pollen is deposited, and which is either sessile on the apex of the ovary as in the poppy or separated from it by a long *style.* The androecium and gynoecium are not present in all flowers. When both are present the flower is *hermaphrodite, perfect,* or *monoclinous,* and is represented by the symbol ☿. When only one is present the flower is *unisexual* or *diclinous,* and is either male *(staminate),* ♂, or female (*pistillate*), ♀. When all four whorls of organs are present the flower is *complete.* Usually the successive whorls of the flower, disposed from below upwards or from without inwards upon the floral axis, are of the same number of parts, or are a multiple of the same number of parts, those of one whorl alternating with those of the whorl next to it.

In the more primitive types of flower the receptacle is more or less convex, and the series of organs follow in regular succession, culminating in the carpels (fig. 18). This arrangement is *hypogynous,* the other series being beneath *(hypo)* the gynoecium. In other cases the floral organs spring from a cup around the ovary (*perigynous,* fig. 19). In some forms this is carried further and a cavity is roofed over by the carpels so that the outer members of the flower spring from the edge of a **cup** the rim of which is above the ovary (*epigynous,* fig. 20).

Symmetry of the Flower.—When a flower consists of parts arranged in whorls it is *cyclic,* and if all the whorls have an equal number of parts and are alternate it is *eucyclic* (figs. 14, 25). In contrast to cyclic flowers are those where the parts are in spirals *(acyclic).* Flowers which are cyclic at one portion and spiral at another (as many Ranunculaceae) are *hemicyclic.* In spiral flowers there is usually a gradual passage from sepaloid through petaloid to staminal parts (water lily, **fig.** 21). In some cases the parts of one whorl are opposite or *superposed* to those of the next. The superposition of the stamens on the sepals in the Caryophyllaceae is due to the suppression of the petals.

A flower is *symmetrical* when each whorl consists of an equal number of parts, or when the parts of any one whorl are multiples of that preceding it. Thus, a symmetrical flower may have five sepals, five petals, five stamens and five carpels (fig. 14) or the number of any of these parts may be a multiple of five. In the staminal whorl especially it is common to find additional rows. In fig 24 the parts are in fours; in figs. 25 and 26, in threes. The floral envelopes are rarely multiplied. Flowers in which the number of parts in each whorl is the same are *isomerous;* when the number in some whorls is different, the flower is *anisomerous.* It often happens that when fully formed, the number of parts in the pistillate whorl is not in conformity with that in the other uhorls. In such circumstances a flower is called symmetrical, provided that the other whorls are normal (fig. 27). A flower in which the parts are arranged in twos is *dimerous;* in threes, fours or fives, *trimerous, tetramerous* or *pentamerous* respectively. Trimerous symmetry is the rule in the monocotyledons, pentamerous the commonest in the dicotyledons, though dimerous and tetramerous flowers also occur in the latter group.

The various parts of the flower have a definite relation to the central axis. Thus in a tetramerous flower, one sepal may be next the axis (superior or posterior), another next the bract (inferior or anterior) and the other two *lateral* (fig. 24). *A* plane passing through the anterior and posterior sepals and through the floral axis is the *median* plane of the flower; a plane cutting it at right angles and passing through the lateral sepals, is the *lateral* plane; while the planes which bisect the angles formed by the lateral and median planes are *diagonat* planes In a pentamerous flower one sepal may be superior (Rosaceae and Labiatae) or inferior (pea family, figs. 28, 29); in the latter case the odd petal *(vexillum)* is then superior. In the Scrophulariaceae one of the two carpels is posterior, the other anterior, while in the Convolvulaceae the carpels are lateral.

When the different members of each whorl are alike, the flower is *regular;* differences in size and shape of the parts of a whorl make the flower *irregular* (fig. 28). When a flower can be divided by a single plane into two similar parts it is *zygomorphic* (as in Papilionaceae). Polysymmetrical flowers have a radial symmetry and can be divided by several planes into similar portions; such are all regular, symmetrical flowers. When the parts of any whorl are not equal to, or some multiple of, the others, the flower is asymmetrical. This alteration in the symmetrical arrangement has been traced to suppression or non-development of parts, degeneration or imperfect formation, cohesion or union of parts of the same whorl, adhesion or union of parts of different whorls, *multiplication* of parts and deduplicatzon (chorisis) or splitting of parts. Cultivation has a great effect in causing changes in the various parts of a plant. The changes in colour and form of flowers thus produced are endless.

As a convenient method of expressing the arrangement of the parts of a flower, *floral* formulae have been derived. The following is a simple mode: the whorls are represented by the letters S (sepals), P (petals), A (stamens), C (carpels) and a figure marked after each indicates the number of parts in that whorl. Thus $S5P5A5C5$ means that the flower is perfect; isomerous and pentamerous. The flower of Sedum (fig. 22) would be represented by $S5P5A5+5C5$, where $A5+5$ indicates that the staminal whorl consists of two rows of five parts each.

Aestivation. — The manner in which the parts are arranged in the flower-bud with respect to each other before opening is the aestivation, and distinctive names have been given to the different arrangements exhibited, both by the perianth members individually and in their relation to each other. As regards each perianth member of the flower, it is either spread out, as the sepals in the bud of the lime-tree, or folded upon itself (*conduplicate*), or slightly folded inwards or outwards at the edges, as in the calyx of some species of Clematis, or rolled up at the edges (involute or revolute), or folded transversely, becoming crumpled or corrugated as in the poppy.

When the parts of a whorl are in an exact circle, and are applied to each other by the edges only, without overlapping or folding, aestivation is *valvate*. The edges of each of the parts may be turned inwards (induplicate) or outwards (reduplicate). When the floral members overlap in the bud, two arrangements are found. In the convolute (contorted or twisted) condition, the parts may be rolled or wound together, covering each other completely, or the petals or other segments may cover each other partially, in which case the edge of one petal is overlapped by the one before it, while the other edge in turn overlaps the next segment. In imbricate aestivation an outer member overlaps the margins of the inner segments on both sides. When the parts are five, as in many dicotyledons, there may be two parts external, two internal and a fifth which partially covers one of the inner parts by its margin and is in turn partially covered by one of the external parts (quzncuncial), as in the calyx of Rosaceae. In the Leguminoseae, the vexillum is often large and folded over the others (vexillary) or the carina (the two anterior petals) may perform a similar office (carinal). Circular aestivation is generally associated with a regular calyx and corolla while spiral aestivation is connected with irregular as well as regular forms.

FLORAL ENVELOPES

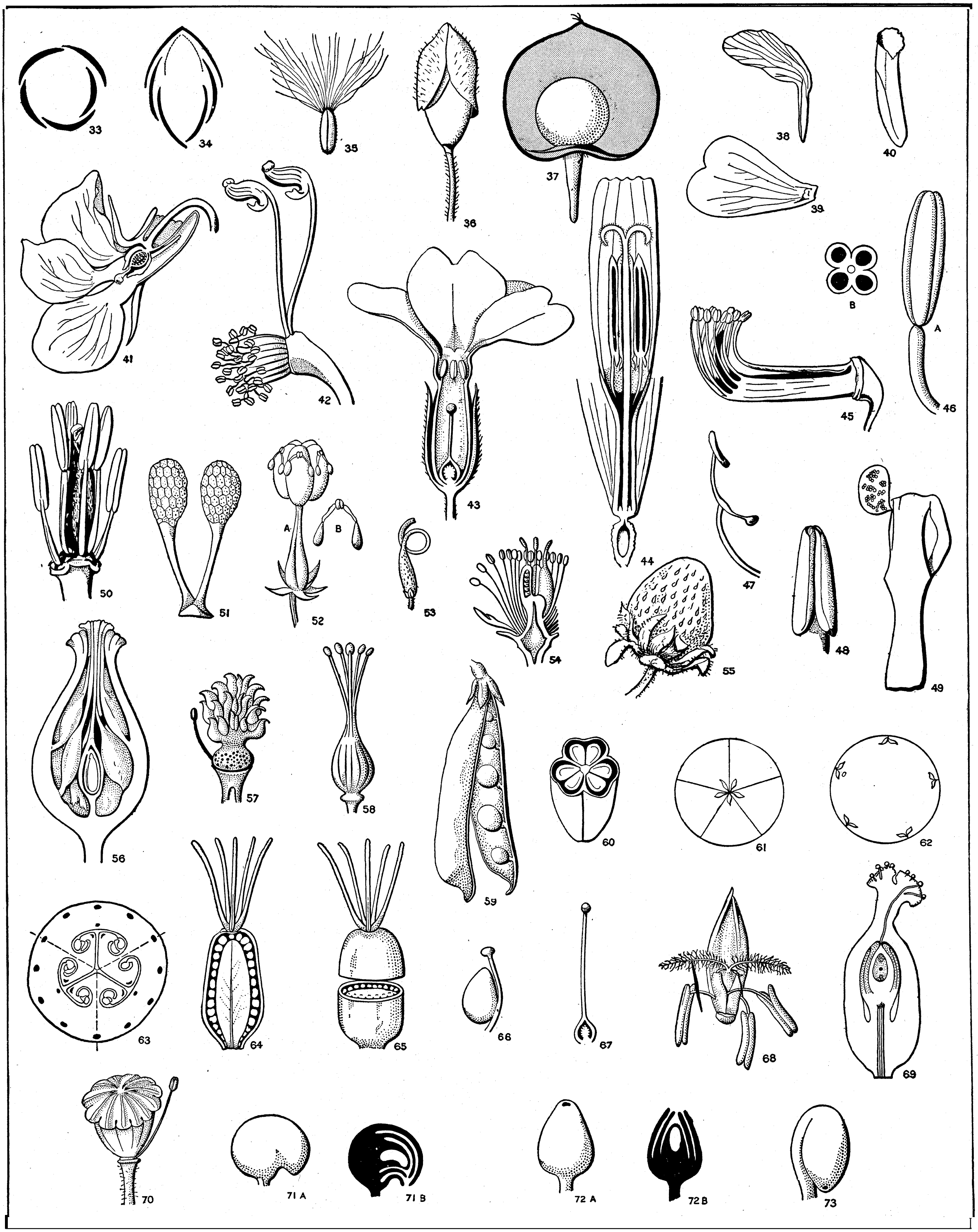
Calyx. — The sepals are sometimes free or separate from each other, at other times united to a greater or less extent; in the former case, the calyx is polysepalous, in the latter *gamosepalous* or monosepalous. The divisions of the calyx are usually entire, but occasionally are cut (rose); rarely they are stalked Sepals are generally more or less oval, elliptical or oblong, with blunt or acute apices. They may be erect or reflexed, spreading downwards (divergent or *patulous*) or arched inwards (connzvent). They are usually greenish (herbaceous) but sometimes they are coloured (petaloid). The vascular bundles sometimes form a prominent mid-rib, at other times, several ribs. The venation is useful as pointing out the number of leaves in a gamosepalous calyx. A polysepalous calyx with three sepals is *trisepalous*, with five, *pentasepalous*, etc. The sepals are occasionally of different forms and sizes. The number of members in a gamosepalous calyx is usually marked by divisions at the apex, which may be simple projections or may extend down as fissures, the calyx being *trifid* (three-cleft), *quinquefid* (five-cleft), etc.; or they may reach nearly to the base, the calyx being tripartite, *quinque*-partite, etc. The union of the parts may be complete and the calyx entire or truncate. The cohesion is sometimes irregular; thus a two-lipped or labzate calyx arises. Occasionally certain parts of the sepals are enlarged to form a spur as in *Tropaeolum*, Viola and Pelargonium. Degeneration may take place so that the calyx becomes dry and scaly (Juncaceae) ; or hairy (Compositae); or a mere rim (madder), when it is obsolete or marginate. In Compositae, the calyx is attached to the pistil and its limb is developed into hairs (*pappus*). The calyx sometimes falls off before the flower opens, as in poppies (*caducous*, fig. 36); or with the corolla, as in *Ranunculus* (deciduous), or it remains after flowering (persistent) as in Labiatae, or its base only is persistent. Sometimes a persistent calyx encloses the fruit without being incorporated with it (accrescent); or it may become inflated or vesicular (Lychnis).

Corolla. — The corolla is the inner floral envelope, and usually the most conspicuous whorl. As a rule the petals are highly coloured, the colouring matter being contained in the cell-sap (blue and red flowers) or in *plastids* (chromoplasts) as in yellow flowers, or in both (orange flowers). Petals are generally glabrous, but in some instances hairs are produced. They often close the way to the honey-secreting part of the flower to small insects whose visits would be useless for pollination. Coloured hairs occur on the perianth of Iris. Normally thin and delicate petals occasionally become thick and fleshy (*Rafflesia*), dry (heaths), or hard and stiff (*Xylopia*) Each petal often consists of two parts, a lower narrow unguis or claw, and an upper, broad lamina or lzmb (fig. 38). The claw is often wanting (fig 39) and the petals are then sessile. The limb may be flat, concave or hollowed. In hellebore the petals become tubular (fig. 40); in aconite (fig. 42), some resemble a hollow-curved horn, supported on a grooved stalk; while in columbine and violet (fig. 41) one or all are prolonged as a spur. In *Antirrhinum*, the spur is short and the petal is gibbous or saccate. These spurs, tubes and sacs serve as receptacles for nectar.

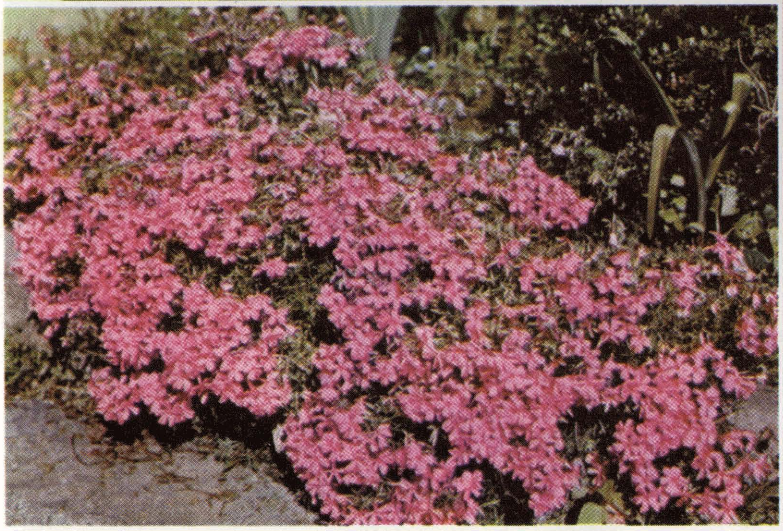
A corolla is *dipetalous*, *tripetalous*, etc., according as it has two, three, etc., separate petals; the general name *polypetalous* is given to corollas with separate petals, while those in which the petals are united are *monopetalous*, gamopetalous or sympetalous. This union generally takes place at the base and extends towards the apex. In the vine, the petals are separate at the base, adherent at the apex. In a sympetalous corolla the lower portion usually forms a tube, the upper parts a common limb, the point of union being the throat. The number of parts is determined by the divisions (teeth, fissures, etc.), or when, as rarely, the corolla is entire, by the venation. The union may be equal, or some parts may unite more than others.

Among regular polypetalous corollas may be noted that of the Rosaceae, usually composed of five petals; the *caryophyllaceous* corolla, in which there are five clawed petals;' the cruciform, having four petals in the form of a cross, as in the wallflower. Of irregular polypetalous corollas, the most marked is the *papilionaceous* (fig. 28–29), in which there are five petals — one superior next to the axis, usually larger than the rest; the *vexillum* or *standard;* two lateral, the alae or wings; two inferior, often united slightly to form a single keel or *carina*, which embraces the essential organs.

Regular sympetalous corollas may be campanulate or *bell*-shaped (*Campanula*); *hypocrateriform* or salver-shaped (Primula, fig 43) tubular (comfrey); rotate or wheel-shaped (forget-me-not) ; urceolate or *urn-shaped* (bell-heath). Some of these forms may become irregular as a result of certain parts developing more than others; thus in the foxglove there is a slightly irregular campanulate corolla. Other irregular sympetalous corollas include the labiate or lipped, having two divisions of the limb, the upper usually of two, the lower of three, united petals, separated by a gap. When the upper lip is much arched, and the gap is distinct, the corolla is *ringent;* when the gap is reduced to a chink, as in snapdragon, personate. In Calceolaria the lips become much hollowed out. When a tubular corolla is split to



33. Imbricated aestivation; 34. Vexillary aestivation; 35. Groundsel fruit with **pappus;** 36. Poppy calyx; 37. Fruit of Physalis Alkekengi; 38. **Unguiculate** petal of Wallflower; 39. Crowfoot petal; 40. Hellebore petal; 41. Pansy; 42. Part ot Aconite flower; 43. Primrose flower; 44. Dandelion flower; 45. Stamens of Garden Pea: 46. Anther of Rush; 47. **Salvia officinalis** anther; 48. Nightshade stamen; 49. Barberry stamen: 50. Stamens and pistil of Wallflower; 51. Orchid, poliinia; **52.** Asclepias: A. vistil, B. **pollinia;** 53. Broom pistil; 54. Section of Black Hellebore fiower; 55. Strawberry; 56. Section of Dog Rose fruit; 57. **Ranunculus** pistils; 58. **Flax** pistil; 59. Garden Pea fruit; 60. Ovary of Lily; 61. Quinouelocuiar ovary; 62. Five-carpellary ovary; 63. Melon fruit; 64. Cerastium hirsutum pistil; 65. Same cut horizontally; 66. Carpel of Lady's mantle; 67. Primrose pistil; 68. Grass flower with **glumes** removed; 69. **Polygonum Convolvulus** ovary; 70. Gynoecium and stamen of Poppy; 71. Ovules; 72. Ovules; 73. Ovule



PHOTOGRAPHS, (TOP LEFT, CENTRE LEFT) JOHN H. GERARD, (TOP RIGHT, BOTTOM LEFT) J. HORACE MC FARLAND COMPANY, (BOTTOM RIGHT) RUTHERFORD PLATT

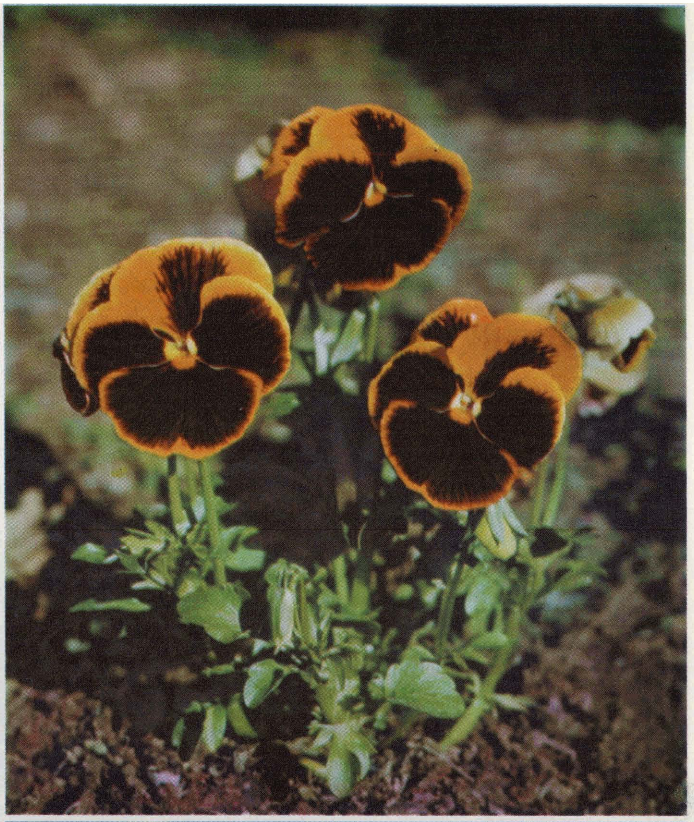
COMMON PLOWERS OF THE U.S.

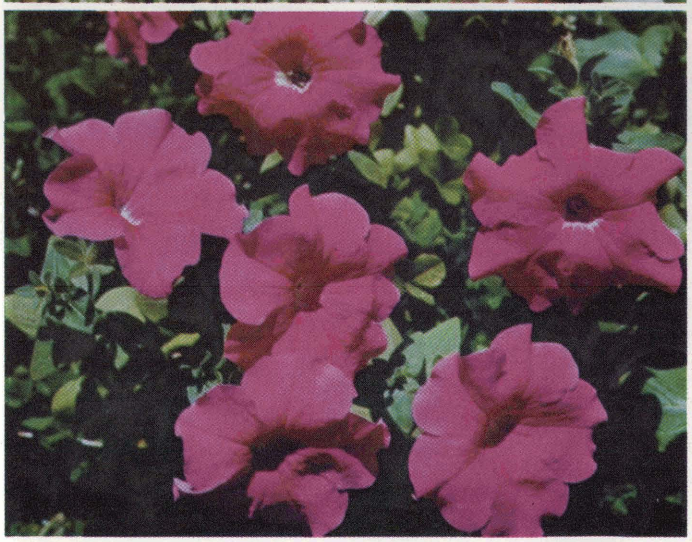
Top left: **Azalea** (*Azalea*), a flowering shrub
Top right: **Gladiolus** (***Gladiolus***)
Centre left: **Hydrangea** or **hortensia** (***Hydrangea macrophylla***), a flowering shrub
Bottom left: Phlox (***Phlox***), a native North American perennial
Bottom right: iris and white campion or cowbell (*iris* and ***Silene cucubalus***)

PHOTOGRAPHS, (TOP' LEFT) FRED BOND FROM PUBLIX, (TOP RIGHT) J. HORACE MCFARLAND COMPANY, (CENTRE RIGHT) SIMPKINS FROM NATIONAL AUDUBON SOCIETY, (BOTTOM LEFT) GOTTSCHO-SCHLEISNER, (BOTTOM RIGHT) RUTHERFORD PLATT

GARDEN FLOWERS

Top left: Regal lily (*Lilium regale*)
Top right: Marigold (*Tagetes patula*)
Centre right: Crocus (*Crocus*)
Bottom left: Zinnia (*Zinnia elegans*)
Bottom right: California Poppy (orange) and Lupine (*Eschscholtzia californica* and *Lupinus polyphyllus*)





PHOTOGRAPHS, (TOP LEFT, TOP RIGHT, CENTRE LEFT. BOTTOM LEFT) JOHN H. GERARD, (BOTTOM RIGHT) GOTTSCHO-SCHLEISNER

GARDEN FLOWERS

Top left: Chrysanthemum (*Chrysanthemum*)
Top right: Pansy (*Viola tricolor*)
Centre left: Lily-of-the-valley (*Convallaria majalis*)
Bottom left: Petunia (*Petunia hybrida*)
Bottom right: Naroissus (*Narcissus*)

PHOTOGRAPHS, (TOP) GOTTSCHO-SCHLEISNER, (CENTRE LEFT) W. H. HODGE, (RIGHT) JOHN H. GERARD, (BOTTOM LEFT) J. HORACE MC FARLAND CO.

COMMON FLOWERS OF THE U.S.

Top: An arbor of wisteria *(Wisteria)*, a flowering vine
Centre left: Hugo rose *(Rosa* ***hugonis*)**, a flowering **shrub**
Right: Qarden rose *(Rosa)*, Red Cheerful variety
Bottom left: Tree **peonies (*Paeonia suffruticosa*)**

PHOTOQRAPHS, (TOP) GOTTSCHO-SCHLEISNER, (LEFT) J. HORACE MC FARLAND COMPANY, (CENTRE RIGHT) W. W. HODGE, (BOTTOM RIGHT) IRVIN L. OAKES FROM NATIONAL AUDUBON SOCIETY

COMMON FLOWERS OF THE U.S.

Top: Formal beds of iris *(Iris)*
Left: Snapdragon (*Antirrhinum majus*)
Centre right: Carnation *(Dianthus caryophyllus)*
Bottom right: New England or purple aster *(Aster novae-angliae)*

PHOTOGRAPHS, (TOP LEFT, TOP RIGHT) LAURENCE E. PERKINS, (TOP CENTRE, CENTRE RIGHT) JOHN TOPHAM LTD., (CENTRE LEFT, BOTTOM LEFT, BOTTOM RIGHT) J. ALLAN CASH

BRITISH GARDEN AND WILD FLOWERS

Top left: Wallflower (*Cheiranthus cheiri*)
Top centre: Dahlia (*Dahlia*)
Top right: Lupin (*Lupinus*)
Centre left: Tulip and forget-me-not (*Tulipa* and *Myosotis*)
Centre right: Common wild daisy (*Bellis perennis*)
Bottom left: Polyanthus (*Primula*)
Bottom right: Wild celandine (*Ranunculus ficaria*)

PHOTOGRAPHS, (TOP LEFT, BOTTOM LEFT, BOTTOM RIGHT) RUTHERFORD PLATT, (TOP RIGHT) LUOMA FROM NATIONAL AUDUBON SOCIETY, (CENTRE LEFT, BOTTOM CENTRE) W. H. HODGE

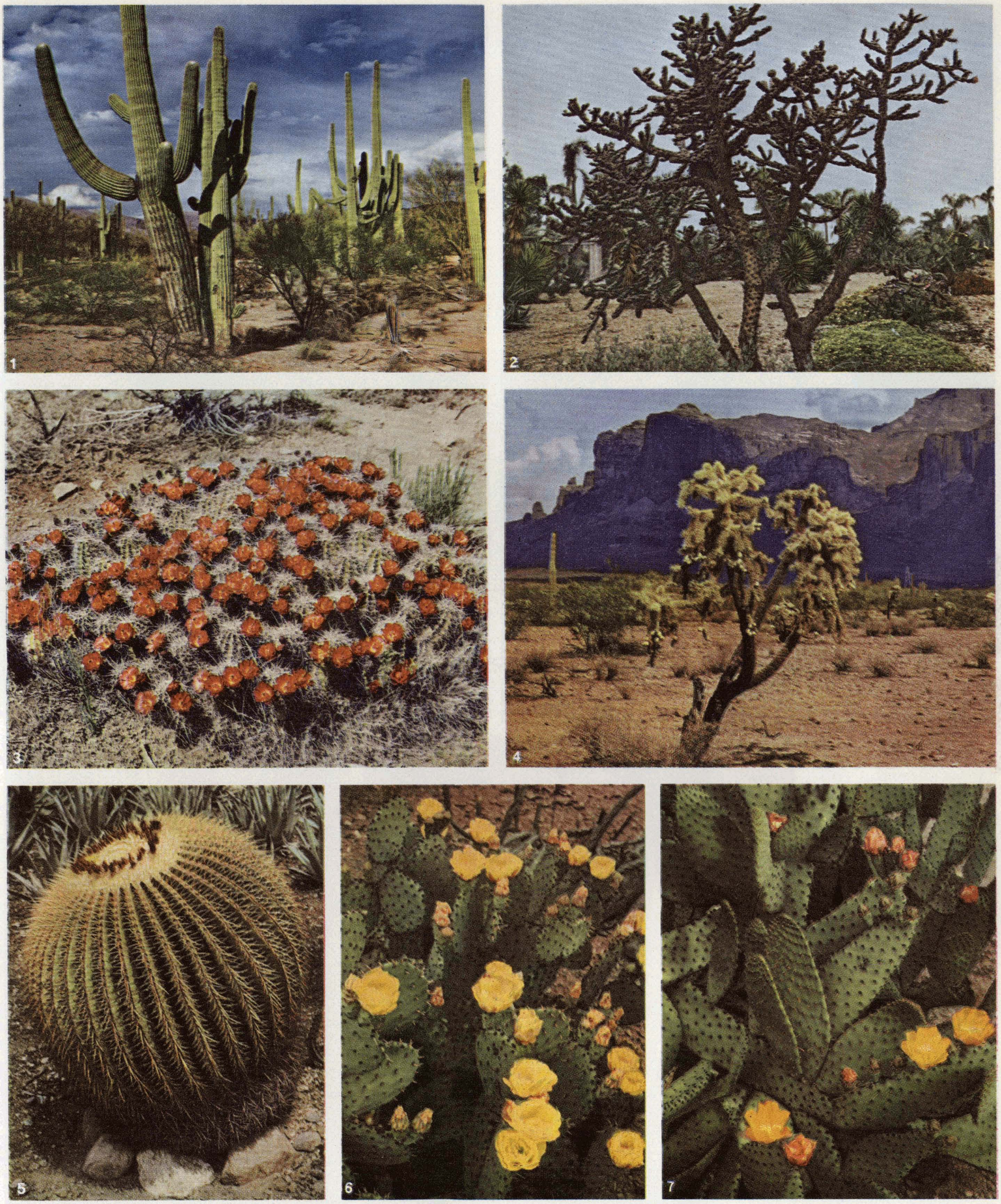
WILD FLOWERS

Top left: Wild rose *(Rosa)*, a summer flower
Top right: Mountain laurel (*Kalmia latifolia*) blooms during the spring
Centre left: White water lily (*Nymphaea odorata*) has a flowering season from summer to early fall
Bottom left: Common or bull thistle (*Cirsium lanceolatum*) has a flowering period from summer to early fall
Bottom centre: Queen Anne's lace or wild carrot (*Daucus carota*), a summer flower
Bottom right: Goldenrod *(Solidago)* blooms in the late summer and autumn

PHOTOGRAPHS, (TOP LEFT) W. H. HODGE, (TOP CENTRE) RUTHERFORD PLATT, (TOP RIGHT, BOTTOM LEFT, BOTTOM RIGHT) JOHN H. GERARD

WILD FLOWERS

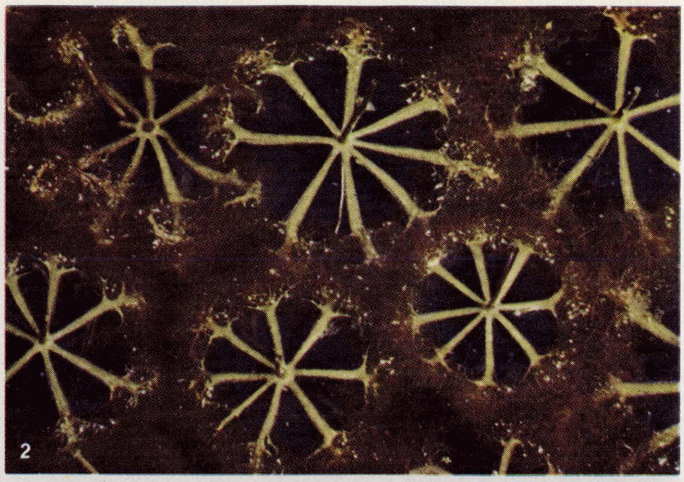
Top left: Indian pipe (*Monotropa uniflora*) is a summer flower
Top centre: Pink lady's-slipper or moccasin flower (*Cypripedium acaule*) appears in the spring and early summer
Top right: Dutchman's-breeches (*Dicentra cucullaria*) blooms during the spring and early summer
Bottom left: Swamp butteraup (*Ranunculus septentrionalis*) flowers during the spring and summer
Bottom right: Violet (*Viola sororia*), a spring and summer flower

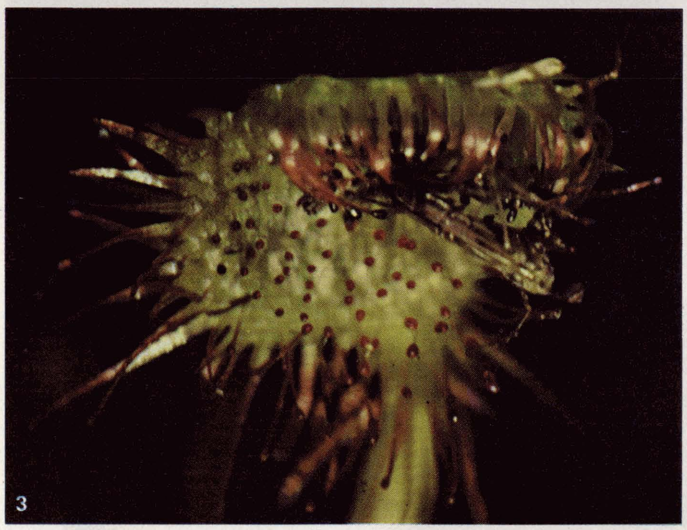


PHOTOGRAPHS BY FRED BOND FROM PUBLIX

CACTACEAE OF NORTH AMERICA

1. Saguaro *(Cereus giganteus)*, largest of the cacti in the U.S., varying in height from 10 to 50 ft. Native to southeastern California, Arizona, and Sonora, Mexico. 2. Cholla *(Opuntia imbricata)*, 6 to 12 ft. high. Found from Colorado to Texas and central Mexico. 3. *Echinocereus triglochidiatus* var. *melanacanthus*, a small cactus found from Utah to Colorado, Arizona and New Mexico. 4. Jumping cholla *(Opuntia fulgida)*, 6 to 15 ft. high. Native to Arizona and Sonora, Mexico. 5. Barrel cactus *(Echinocactus Grusonii)* of central Mexico. It ranges in diameter from 2 to 4½ ft. 6. *Opuntia Engelmanii*, Arizona to Texas and Chihuahua, Mexico. The plant forms clumps 2 to 10 ft. in diameter and 2 to 4 ft. high. 7. Cow's tongue *(Opuntia linguiformis)*, San Antonio, Texas, 5 to 10 ft. high. This plant is actually a variety of *Opuntia Lindheimeri*





PHOTOGRAPHS, RUTHERFORD·PLATT

1. Venus's fly-trap ***(Dionaea muscipula).*** The lobe at the left is open, while that at the right, with spikes interlocked, imprisons an insect which the plant is digesting. The lobes close when the insects touch small sensitive bristles on the upper surface

2. **Closeup** view of the floating leaves of bladderwort ***(Utricularia).*** a water plant. On the leaves are small bladders with trap doors which **open** only inward

3. Roundleaf **Sundew** ***(Drosera rotundifolia).*** Sticky tentacles on the leaves catch insects, which are passed by other tentacles toward the centre of the leaf and are drowned and digested

4. The parrot pitcher plant ***(Sarracenia psittacina)***

5. Common pitcher plant ***(Sarracenia)*** in late spring, with a spider on the lid. Spiders and insects slide down the lid into the pitcher's detentive surface, where strong downward-pointing bristles trap the victims

6. Butterwort ***(Pinguicula planifolia).*** Insects are attracted to the sticky surface of the leaves, which then curl inward, crushing the victims

form a strap-like process on one side, it is *ligulate* or *strap* shaped (fig. 44), as in many Compositae.

Petals are sometimes suppressed and at times the whole corolla is absent. In *Amorpha* there is only a single petal. In the Ranunculaceae some genera (e.g., *Ranunculus*) have both calyx and corolla, while others (e.g., Anemone) have only a coloured calyx.

The term *nectary* includes those parts of a flower which secrete a honey-like substance, as the glandular depression on the petal of Ranunculus (fig. 39). The honey attracts insects, which convey pollen to the stigma. The horn-like nectaries under the galeate (hollow and vaulted) sepal of Aconitum (fig. 42) are modified petals, as are the tubular nectaries of hellebore (fig. 54).

Petals are attached to the axis usually by a narrow base. When this attachment is by an articulation, the petals fall off either immediately after expansion (*caducous*) or after fertilization (deciduous). A corolla continuous with axis, as in *Campanula,* may remain in a withered state while the fruit is ripening. A sympetalous corolla falls off in one piece.

ESSENTIAL ORGANS

As a stamen represents a leaf developed to bear pollen or microspores, it is spoken of in comparative morphology as a microsporophyll; similarly the carpels which make up the pistil are the megasporophylls (see ANGIOSPERMS). In plants with hermaphrodite flowers, self-pollination is often provided against by the structure of the parts or by the period of ripening of the organs For instance, in Primula (fig. 43), some flowers (thrum-eyed) have long stamens and a short styled pistil, others (pin-eyed) short stamens and a long-styled pistil; these are dimorphic. In some plants the stamens are perfected before the pistil (*proterandrous*); more rarely, the pistil is perfected first (*protogynous*). Plants in which protandry or protogyny occur are dichogamous. When the same plant bears unisexual flowers of both sexes it is *monoecious* (hazel); when the male and female flowers are on separate plants, the plant is *dioecious* (hemp); when there are male. female and hermaphrodite flowers, it is polygamous.

Stamens.—The stamens, collectively constituting the androecium, arise from the receptacle within the petals, with which they generally alternate, forming one or more whorls. Their normal position is below the pistil (inferior), but they may be above (superior) or, as in Saxifragaceae, half inferior or half superior. Sometimes they adhere to the petals (*epipetalous*), or to the pistil, so as to form a column (*gynandrous*). These arrangements are important in classification. Stamens vary in number from one to many, even hundreds. In acyclic flowers there is often a gradual transition from petals to stamens, as in the white water lily (fig. 21). When there is only one whorl the stamens are usually equal in number to the sepals or petals. The additional rows of stamens may be developed in centripetal order or interposed between the pre-existing ones or placed outside them, *i.e.,* be developed centrifugally (geranium). When the stamens are fewer than 20, they are determinate; when more, indeterminate, represented by the symbol ∞. A flower with one stamen is *monandrous,* with two, diandrous, with many, *polyandrous,* etc.

The function of the stamen is the development and distribution of the pollen, which is contained in the anther. If the latter is absent, the stamen cannot perform its functions. The anther is developed before the filament, which may be absent (*e.g.,* mistletoe), when the anther is sessile.

The Filament.—The filament is usually thread-like and cylindrical, or slightly tapering towards its summit. It may, however, be thickened and flattened in various ways. The length sometimes bears a relation to that of the pistil, and to the position of the flower. Though usually of sufficient rigidity to support the anther in an erect position, the filament is sometimes (e g., grasses) delicate and hair-like, so that the anther is pendulous (fig. 68). It is generally continuous, but sometimes is bent or jointed (geniculate), or spiral (*e.g.,* pellitory). In Fuchsia it is red, in *Adamia,* blue; in Ranunculus *acris,* yellow. The filament is usually articulated to the receptacle and the stamen falls off after fertilization, but in Campanula, the stamens remain in a withered state. The filaments may cohere to a greater or lesser extent, the anthers remaining free. Thus, all the filaments may unite to form a tube round the pistil (*e.g.,* mallow), the stamens being *monadelphous,* or they may be arranged in two bundles (*diadelphous*), as in the pea, where nine out of ten unite, the posterior one being free (fig. 45).

The Anther.—The anther consists of lobes containing the minute pollen qrains, which, when mature, are released through an opening. There is a double covering to the anther—the outer exothecium resembling the epidermis and often bearing stomata; the inner *endothecium* formed by a layer or layers of cellular tissue, the cells of which have thickened walls. The endothecium generally becomes thinner towards the part where the anther opens out, and there disappears. The anther appears first as a simple protuberance of meristem, upon which indications of two lobes soon appear. Cpon these projections rudiments of the pollen-sacs, usually four, two on each lobe, are seen. In each differentiation takes place in the layers beneath the epidermis, by which an outer small-celled layer surrounds an inner one of larger cells. These central cells are the pollen mother-cells, the outer cells forming the endothecium while the exothecium arises from the epidermis.

When all four pollen-sacs remain permanently the anther is quadrilocular (fig. 46). Sometimes, however, the sacs in each lobe unite to give a bilocular anther. Further fusion of the lobes or the abortion of one of them (*e.g.,* hollyhock) leads to a *unilocular* anther. Occasionally there are numerous cavities in the anther (*e.g.,* mistletoe). The lobes are generally more or less oval or elliptical. The division between them is marked on the face of the anther by a furrow, and there is usually a suture indicating the line of dehiscence. Stamens may cohere by their anthers becoming syngenesious (*e.g.,* Compositae).

The Connective.—The anther-lobes are united by the connective which is either continuous with the filament or articulated with it. When the filament is continuous and prolonged so that the lobes appear to be united throughout their length, the anther is adnate or adherent. When the filament ends at the base of the anther, the latter is innate or erect. In these cases the anther is fixed. When, however, the attachment is narrow and an articulation exists, the anthers are movable (versatile) as in grasses (fig. 68). The connective is sometimes extended backwards and downwards (*e.g.,* violet) to form a nectar-secreting spur.

Anther *Dehiscence.*—The opening or dehiscence of the anthers to discharge their content takes place by clefts, valves or pores. When the anther-lobes are erect, the cleft is along the line of suture—longitudinal dehiscence (fig. 16). In other instances the opening is confined to the base or apex, each loculus opening by a single pore (e.g., *Solanum,* fig. 48); in the mistletoe there are numerous pores. In the barberry (fig. 49) each lobe opens by a valve on the outer side of the suture (valvular). Anthers dehisce at different periods during the process of flowering, sometimes in the bud but more commonly when the flower is expanded. They may dehisce simultaneously or in succession. These variations are connected with the arrangements for the transference of pollen. Introrse anthers dehisce by the surface next the centre of the flower, extrorse anthers by the outer surface; when along the sides (e.g., Iris) they are laterally dehiscent.

Stamens occasionally become sterile by non-development of the anthers and are then called *staminodes.* Some stamens are enclosed within the tube of the flower (included), others are *exserted, i.e.,* extend beyond the flower (e g., Plantago); sometimes they are exserted in early growth, but become included later (e.g., Geranium *striatum*). When there is more than one whorl, the stamens on the outside are often longest (*e.g.,* many Rosaceae), but sometimes the reverse is the case. When the stamens are in two rows, those opposite the petals are usually the shorter. In some flowers the stamens are *didynamous,* only four out of five being developed and the upper pair longer than the lateral (e g., Labiatae, Scrophulariaceae). When there are six stamens, four may be long and two short (tetvadynamous), the latter alternating with the pairs of long ones (*e.g.,* Cruciferae, fig. 50).

Pollen.—The pollen-grains consist of small cells, developed from the large, thin-walled mother-cells in the interior of the pollen-sacs. Two divisions (reduction divisions) occur in each mother cell to form four cells which are the microspores. The pollen grain results from the division of the microspore nucleus (germination), followed by an increase in size and differentiation of the cell wall into an outer exine and an inner *intine.* The mature grains commonly form a powdery mass. Then the walls of the mother-cells are absorbed and the grains float freely in the fluid of the pollen-sacs. The fluid gradually disappears and the mature grains form a powdery mass. In most Orchidaceae and Asclepiadaceae the pollen-grains are united into masses (pollinia, figs. 51, 52) by viscid matter. Each of these has a stalk (*caudicle*) which adheres to the prolongation at the base of the anther (rostellum) by a viscid gland (retinaculum). Gynostemzum is sometimes applied to the part of the column in orchids where the stamens are situated. The number of pollinia varies.

The exine is a firm membrane which defines the contour of the pollen-grain and gives it colour (generally yellow). The exine is either smooth or covered with projections and is often covered with viscid or oily matter. The intine is uniform, thin, transparent and extensible. In some aquatics (e.g., *Zostera*) only one covering exists.

Pollen-grains vary in diameter from $\frac{1}{300}$ to $\frac{1}{700}$ in. or less. They are most commonly ellipsoidal, but may be spherical, cylindrical and curved, polyhedral (Compositae) or nearly triangular in section. There are rounded pores varying in number from one to fifty, and through one or more of these the pollen-tube is extruded in germination. In monocotyledons there is usually only one; in dicotyledons, where they may form a circle round the equatorial surface, they number from three upwards. Within the pollen-grain is granular protoplasm with oily particles and occasionally starch. The mature pollen grain usually contains a vegetative cell, and a generative cell which later divides to form the two male cells, or sperms. (*See* ANGIOSPERMS; GYMNOSPERMS.)

Pollination.—When the pollen-sacs are ripe, the anther dehisces and the pollen is shed. In order that fertilization may be effected, the pollen must be conveyed to the stigma of the pistil. This pollination (*q.v.*) is promoted in various ways, the whole form and structure of the flower being adapted to the process. In some plants (*e.g.,* pellitory) the mere elasticity of the filament is sufficient; in others (*anemophilous*) pollination is effected by the wind (*e.g.,* grasses) and in such cases enormous quantities of pollen are produced; but the common agents of pollination are insects. To attract them to the flower the odoriferous secretions and gay colours are produced, and the position and complicated structure of the parts of the flower are adapted to the perfect performance of the process. It is comparatively rare in hermaphrodite flowers for self-pollination to occur and the various forms of dichogamy, dimorphism and trimorphism prevent this.

Disk.—Under the term disk is included every structure intervening between the stamens and the pistil. It presents great varieties of form, such as a ring, scales, glands, hairs, petaloid appendages, etc., and often contains nectar. The disk frequently arises by degeneration or transformation of the staminal row. In the Cruciferae, it consists of tooth-like scales at the base of the stamens. The enlarged receptacle covering the ovary in Nymphaea may be regarded as a disk.

The Pistil.—The pistil or gynoecium occupies the centre or apex of the flower and is surrounded by the stamens and floral envelopes when these are present. It constitutes the innermost whorl, which after flowering is changed into the fruit and contains the seeds. The ovary contains the ovules attached to the placenta. The pistil consists of one or more modified leaves, the carpels (megasporophylls). When a pistil consists of a single carpel, it is simple or *monocarpellary* (fig. 53); when composed of several carpels, it is compound or *polycarpellary* (fig. 54). Each carpel has its own ovary, style (when present) and stigma and may be regarded as formed by a folded leaf, the upper surface of which is turned inwards, towards the axis; the lower outwards, while the ovules develop from the margins. A pistil is usually formed by more than one carpel. These may be arranged at the same height in a whorl, or at different heights in a spiral. When they remain separate and distinct (*e.g.,* hellebore, fig. 54) the pistil is *apocarpous;* when they unite (*e.g.,* pear) it is syncarpous. A flower with a simple pistil is monogynous; with two carpels, dzgynous, with three, *trigynous,* etc.

The union in a syncarpous pistil is not always complete; it may take place by the ovaries alone (fig. 58), when the organ becomes a compound ovary; or by ovaries and styles; or by stigmas and the summits of these styles. Various intermediate states exist; the union is usually most complete at the base.

The ovary is usually spherical or curved, sometimes smooth on its surface, at other times hairy and grooved. The grooves usually indicate the divisions between the carpels. When the ovary is on the centre of the receptacle, free from the outer whorls, so that its base is above the insertion of the stamens, it is superior (e.g., *Primula,* figs. 43, 67). When the floral parts are inserted above the ovary, the ovary is said to be inferzor (e.g., *Fuchsia*). In many Saxifragaceae there are intermediate forms (*half-*inferzor).

The nature of the inferior ovary has long been a disputed question, and two chief interpretations have been proposed. The first, based chiefly upon ontogenetic studies, is that the tube to which the floral parts are attached is receptacular in nature, produced by the upgrowth of the receptacle around the gynoecium or by the invagination of the tip of the floral axis. Following invagination or upward growth the receptacle in many forms became fused to the ovary wall. This may be termed the "receptacular" theory and has been widely advocated. The second, or "calyx tube" theory, supported by evidence from vascular anatomy, conceives the perianth tube or calyx tube to be the product of the bases of the sepals, petals and stamens; from an evolutionary viewpoint these have become progressively fused to each other and then to the ovary wall. It is also possible that in some forms (Rosa) the lower portion of the calyx or floral tube is receptacular (*axile*), the upper portion derived from floral structures. In some forms (Darbya, Santalaceae) the inferior ovary has undoubtedly resulted from invagination and fusion of receptacle and ovary. In most forms investigated by the anatomical method, however, the tissues surrounding the ovary are appendicular and composed of the fused bases of the floral organs. This is true of most Rosaceae and Ericaceae; in the apple, for instance, around which controversy has raged, the outer part of the flesh is appendicular, not receptacular.

The Placenta.—The ovules are attached to the placenta, through which the vascular bundles pass. The placenta is usually formed on the edges of the carpellary leaf (marginal *placentation*). But often the placentas arise from the axis (*axile* placentation) and are not connected with the carpellary leaves. In marginal placentation, the placenta is borne on the inner or ventral suture, corresponding to the margin of the carpellary leaf, the outer or dorsal suture corresponding to the mid-rib. As the placenta is formed on each margin of the carpel, it is essentially double. When the pistil is simple, the inner margins unite and usually form a common placenta. When the pistil is apocarpous, there are generally separate placentas at each margin. In a syncarpous pistil, however, the carpels are so united that the edges of each of the contiguous ones, by their union, form a septum or *dissepiment,* and the number of these septa consequently indicates the number of carpels in the pistil. When the septa extend to the axis, the ovary is divided into cells (locules), being *bilocular, trilocular,* etc., according to the number, each cell corresponding to a single carpel. In these cases, the marginal placentas meet in the axis and unite to form a single central one. When the carpels of a syncarpous pistil do not fold inwards, the ovary is *unilocular* and the placentas are parietal (e.g., Viola). Often the margins of the carpels which fold in to the centre split there into two lamellae, each of which is curved outwards and projects into the locule, dilating at the end into a placenta. In some cases cohesion proceeds so far that the placentas of a single carpel are fused to form one (*e.g.,* Cucurbitaceae, fig. 63). Cases occur (Caryophyllaceae, Primulaceae) in which the placentas are not connected with the walls of the ovary (free *central* placentation, figs. 64, 65). It was formerly considered that such a placenta was a prolongation of the axis; anatomical evidence has shown, however, that the placenta is composed chiefly of the fused margins of the carpels, the septa having degenerated. Some residual axile tissue may be present, especially at the base of the placenta.

Occasionally divisions take place in ovaries which are not formed by the edges of contiguous carpels. These spurious *dissepiments* are often horizontal and develop only after fertilization. In Cruciferae, however, they are vertical and arise from the prolongation of the placentas.

The Style.—The style proceeds from the summit of the carpel (fig. 67) and is traversed by a narrow canal, a continuation of the placenta. The canal may be lined by a transmitting tract, or filled, at least in part, with specialized transmitting tissue. The tract or tissue is continuous with the stigma. In some cases, owing to more rapid growth of the dorsal side of the ovary, the style becomes lateral (fig. 66); this may be accentuated so that the style appears to arise from the base (basilar); but it still indicates the organic though not the apparent, apex of the ovary. Several basilar styles may unite (*e.g.,* Boraginaceae) to form a single gynobasic style. The style is usually cylindrical, filiform and simple; sometimes it is grooved on one side, or flat, thick, angular, compressed or even petaloid (e.g., Iris). It may bear hairs, which aid in the application of pollen to the stigma (collecting hairs, e.g., *Campanula*). The styles of a syncarpous pistil, when separate, alternate with the septa; when united, the style is simple (fig. 67). The style of a single carpel may be divided. The length of the style depends upon the relation which should subsist between the position of the stigma and that of the anthers to allow proper application of pollen.

The Stigma.—The stigma is the termination of the conducting tissue of the style and is usually in direct communication with the placenta. It consists of loose cellular tissue and secretes a viscid matter to which the pollen grains adhere. The stigmas alternate with the septa of a syncarpous pistil, *i.e.,* correspond to the back of the loculi; but in some cases half the stigma of one carpel unites with half that of the next, the stigmas being thus opposite the septa (*e.g.,* poppy). The divisions of the stigma usually mark the number of carpels in the pistil, but sometimes (*e.g.,* Gramineae) the stigma of a single carpel divides. It may be terminal or lateral and may present sensitive laminae which close when touched (e.g., Mimulus). It may be globular, umbrella-like, ovoid (e.g., Fuchsia), radiating, as in the poppy, where the true stigmatic rays are attached to a shield-like (peltate) body. The lobes of the stigma may be flat and pointed, fleshy and blunt, smooth, granular or feathery (*e.g.,* many grasses, fig. 68). In Orchidaceae, the stigma is on the anterior surface of the column beneath the anthers.

The Ovule.—The ovule is usually produced on the margin of the carpellary leaf, but sometimes ovules arise all over the surface of the leaf, or from a basal placenta (Polygonaceae) or laterally (*e* g., Primulaceae). The ovule is usually contained in an ovary and is *angiospermous;* but in the Coniferae and Cycadaceae it has no proper ovarian covering and is naked or gymnospermous. It is attached to the placenta either directly (sessile) or by a funicle (figs. 71, 72, 73) which may become much elongated after fertilization. The ovule is attached to the placenta or funicle by its base or *hilum,* the opposite end being its apex.

The ovule first appears as a small projection from the placenta. The cells multiply and assume an enlarged ovate form constituting the nucellus (megasporangium). This nucellus may remain naked and alone form the ovule, as in some parasitic families; but in most plants it becomes surrounded by integuments, which appear first as rings at the base of the nucellus, which gradually spread over its surface. In some cases (*e.g.,* Compositae), only one covering is formed, but usually another is developed subsequently, covering the first completely except at the apex, where neither integument invests the nucellus, but leaves an opening, the micropyle. In most angiosperms a single megaspore 'mother cell is differentiated within the nucellus. Most commonly two divisions (reductional) occur to form an axial row of four megaspores. One megaspore, usually that farthest from the micropyle, develops into a megagametophyte (embryo sac); the other three disintegrate. Only vestiges of the nucellus remain when the ovule has developed into a seed.

The point where the integuments are united to the base of the nucellus is the chalaza, which is often coloured, is denser than the surrounding tissue and is traversed by vascular bundles from the placenta. When the chalaza is at the hilum and the micropyle is opposite, there being a short funicle, the ovum is ortlzotropous (fig. 72). When by more rapid growth on one side than on the other, the nucellus and integuments are curved on themselves so that the micropyle approaches the hilum, the ovule is *campylotropous* (*e.g.,* Cruciferae, fig. 71). In an inverted or anatropous ovule (fig. 73), the commonest form in angiosperms, the apex with the micropyle is turned towards the point of attachment of the funicle to the placenta and the funicle coalesces with the ovule to form. the *raphe.* The ovule thus curves from the point of origin of the integuments and if a second integument is formed, it does not extend to the side adherent to the raphe. Forms intermediate between these types occur. When there is a single ovule with its axis vertical, it may be attached to the placenta at the base of the ovary (basal placenta), when it is erect (*e.g.,* Compositae) ; or it may be inserted a little above the base on a parietal placenta (ascending); or it may hang from an apical placenta at the summit of the ovary, its apex being directed downwards (inverted or pendulous); or from a parietal placenta near the summit (*suspended, e.g.,* Euphorbiaceae). Sometimes a long funicle arises from a basal placenta, reaches the summit of the ovary and there, bending over, suspends the ovule (*e.g.,* sea-pink); at other times the hilum appears to be in the middle and the ovule is horizontal. When there are two ovules in the same cell they may be side by side (collateral) ; or one erect and the other inverted; or one above the other, as is the case in ovaries containing a moderate number of ovules. When the ovules are determinate (*i.e.,* uniform and can be counted) their attachment usually forms a good character for classification. When very numerous (indeterminate) and the placenta little developed, their position shows great variation and their form is altered by pressure into various polyhedral shapes.

Fertilization.—When the pistil has reached a certain stage in growth, the egg is ready for fertilization. The pollen-grain having reached the stigma in angiosperms, or the summit of the nucellus in gymnosperms, it is detained there, and a pollen-tube protrudes through a pore in the grain. The pollen-tube (or tubes) passes down the canal (fig. 69), through the conducting tissue of the style, when present, and thence to the micropyle of the ovule, one pollen-tube going to each ovule. Frequently the tube has to pass some distance into the ovary to reach the micropyle, being guided by hairs, grooves, etc. In gymnosperms the pollen-grain resting on the apex of the nucellus sends off its pollen-tubes which at once penetrate the nucellus. Ultimately the apex of the tube perforates the tip of the embryo-sac, the male cells are discharged into it, and fertilization is effected. Consequent upon this, after a longer or shorter period, those changes begin in the embryo-sac which result in the formation of the embryo plant, the ovule being converted into the seed, the ovary enlarging to form the fruit, often incorporated with which are other parts of the flower (receptacle, calyx, etc.). In gymnosperms the pollen-tubes, having penetrated a certain distance down the tissue of the nucellus, are arrested in growth for a period, sometimes nearly a year. See ANGIOSPERMS: Flower; FRUIT; SEED.

PHYLOGENY OF FLORAL ORGANS

The writings of Goethe (1790) and de Candolle (1813) are chiefly responsible for what has come to be known as the "classical" theory of the fundamental nature of the flower. According to this, the flower is a highly modified and abbreviated shoot, determinate in growth, and the floral parts are homologous with leaves. The sepals are held to be modified foliage organs, and the carpels greatly reduced and infolded leaves bearing ovules along their margins. Differences of opinion have been expressed concerning the nature of the petals; on the one hand they have been considered modified sepals, on the other metamorphosed and sterile stamens. The latter point of view has been more generally accepted. The classical theory has been almost universally adopted as an instrument of description in taxonomic and morphological studies. An important modification of the classical theory was suggested by A. Arber in 1937 In the attempt to understand what is meant by the term homology, it was suggested that the carpel, for example, should not be regarded as an infolded foliage leaf, but that the essential organs, carpel and stamen, together with the leaf, should be viewed as the products of parallel evolution.

A further explanation of the ultimate origin of the leaf and floral organs has been found in a theory which derives the carpels and stamens on the one hand, and leaves on the other, from dichotomous branch systems such as existed in ancient and extinct plants of the Palaeozoic. Certain areas of the terminal branchlets of such systems are assumed to have been nonsporogenous, and to have given rise to primitive foliar organs following webbing and fusions Similarly, other and sporangium-bearing areas became webbed and fused to form carpels. The modern stamen, likewise, came into being as the result of extensive reduction of a fertile branch system or portion of such a system. Thus carpel and stamen were never primarily photosynthetic organs; the carpel is not an infolded leaf, for it never passed through the leaf stage in evolution, and both sporophylls and leaves are the end products of parallel evolution from branch systems of different categories. Support for this viewpoint has been supplied by anatomical and ontogenetic studies; in these latter (1941–43), it was shown that carpel and stamen are reduced axes, differing in their earlier development from that of perianth parts and foliage leaves, but showing the same mode of development as that of a shoot. Beginning about 1925 a number of other theories bearing on the phylogeny of the flower have been proposed, but none of these met with general acceptance.

(C. L. WN.; X.)

COMMERCIAL FLOWER GROWING

Europe.—Until the outbreak of World War II in Sept. 1939, flower growing for the wholesale markets was a truly great industry in several European countries, particularly in Great Britain, France and the Netherlands and, to a lesser extent, in Belgium, Germany and Italy. France had an extensive flower production area in the south, much of the produce being exported to England and other parts of Europe. Vast numbers of bulbs of Lilium candidum, white Roman hyacinths and paperwhite narcissi were also produced for export to England and elsewhere, the bulk of *Lilium* candidum reaching the United States.

The Netherlands, prior to 1939, was a large producer of cut-flowers under glass, quantities being exported, but the even more Important phases of her horticultural industry were the production of nursery stock—trees, shrubs and other ornamental plants—and bulb growing. The Dutch bulb industry was gigantic, the estimated area being 15,000 ac. Much of the land devoted to these cultures had been reclaimed from the sea. Several hundred million tulips, daffodils, hyacinths, lilies, irises and other bulbs were exported, Great Britain being the heaviest buyer with the United States a moderately good second. What were not exported or planted for the succeeding year's crops were forced in greenhouses around Boskoop and Haarlem, many of the cut flowers being shipped to the great auction market at Aalsmeer and from there sent to the leading cities of Europe.

England.—Prior to 1940, England alone devoted fully 6,000 ac. to outdoor crops of flowers, largely for cutting, independent of almost as much devoted to the production of ornamental plants for sale. This area included flowering bulbs, at least 2,000 ac. being devoted to daffodils, tulips and numerous other hardy kinds. The major proportion of all the named daffodils in commerce originated in England, where daffodil breeding had been carried on since the 19th century.

But of even greater importance was the glasshouse production of cut-flowers. Some areas in England, particularly around Cheshunt, Hampton and Worthing, are literally covered with glass, the major pre-1940 crops consisting of carnations, roses and chrysanthemums, with forced bulbs a special feature during the winter and early spring, before the outdoor blooms become available. From chrysanthemums alone the annual income was around £250,000, and, including ornamental plants in pots, the total yearly income from greenhouses was close to £1,500,000, while the entire flower production income was at least £2,000,000. Added to the glasshouse income was that derived from forced tomatoes, cucumbers and sundry fruits, quantities of which were produced in greenhouses that were not entirely devoted to flower crops throughout the year.

The necessity of food production after the outbreak of war in 1939 compelled curtailed production of flowers, and, at the end of 1943, British growers' flower production was limited to 10% of what it had been in 1939, while outdoor cultures of cut-flowers, bulbs and other ornamentals were limited to 25%. The provision for 10% under-glass production was primarily for the purpose of reserving stocks for future propagation.

United States.—Floriculture in the United States made its greatest progress after the close of World War I. The general prosperity that followed caused a tremendous expansion in glasshouses which, because of climatic conditions, are essential to flower growing, especially in the northern states. The 1930 federal census of horticulture showed that there were nearly 174,000,000 sq.ft. covered with greenhouses in the United States, the receipts of the growers being nearly $110,000,000. Their investment in land, buildings and equipment was almosr $222,500,000. The number of firms making reports, on which these figures were based, was 14,982, and the area they controlled, including open-ground cultures, was nearly 50,000 ac. In the succeeding years up to 1941, the area devoted to outdoor flower crops increased by 15,000 to 20,000 ac. because of the great development in commercial flower growing in California, Florida and the Carolinas. However, a shortage of labour and the necessity of growing more food caused considerable reduction in 1943 and 1944.

The major greenhouse flower crops at the time of the outbreak of World War II had changed somewhat from what were the recognized leaders at the close of World War I. Roses, as always, were in the lead, with carnations and chrysanthemums almost as important as seasonal crops. Snapdragons (Antirrhinums) had far outstripped sweet peas, while violets had fallen to a comparatively minor position, stocks (Mathiola) being a far more important late winter and early spnng crop. Orchids and gardenias, formerly classed as aristocrats, had become more or less commonplace, the production of these flowers throughout the year having multiplied at least tenfold without seriously lowering the market prices, except at certain times of the year.

In the same period, 1920–40, the production of outdoor or field grown flowers also vastly increased. California had developed a great flower shipping industry and, until the eastern growers successfully hastened the flowering of chrysanthemums by shading with black cloth for a certain number of hours daily during July and August, California blooms ruled most markets during September and October Other flowers grown on a vast scale in California for fall and winter shipping include asters and other annuals. Around 1930 Florida, Virginia and North Carolina became important cut-flower producers, gladiolus production in Florida becoming a big industry. Millions of spikes of these flowers reached all the northern markets and won such popularity that they became standbys from November to April, the Florida stock being followed by stock from Virginia and North Carolina. As a consequence, greenhouse men in the north practically ceased growing gladiolus as an early spring crop.

Florida also took up the production of early crops of delphinium and various annuals, and, as a result of Quarantine no. 37, a regulation which forbade the entry of all narcissus bulbs into the United States, Florida after about 1925 produced practically all the paperwhite narcissus bulbs required by the U.S. trade. Florida also became the largest producer of amaryllis and caladium bulbs in the world. North Carolina, besides growing gladiolus for cut blooms on a large scale, also shipped to all parts vast quantities of bulbous ins and daffodil flowers.

In the more northern regions the peony likewise took on great importance as a cut-flower for the wholesale markets, literally carloads being shipped to all points, particularly from Indiana and Illinois, while many other states began to produce great quantities for the neighbouring markets. The delphinium, after the introduction of the strain known as Pacific Giants around 1930, also became a highly important cut-flower, vast quantities of these flowers being grown for the New York, Philadelphia and Boston markets and to a lesser extent for other large city flower markets.

The narcissus embargo also brought about the development of a large daffodil growing industry, the major production of bulbs being in the states of Washington and Oregon, where the climate is especially suitable. Long Island and Virginia also produce goodly quantities of hardy narcissus bulbs. The total output probably exceeds 40,000,000, all of them sold in the United States, perhaps two-thirds of the supply used by florists for cut-flowers. Iris bulbs of the Dutch hybrid and tingitana hybrid types also are grown on an enormous scale in the northwest, millions of bulbs being shipped east mainly for forcing during the winter and spring by florists. Tulips and hyacinths also are successfully gromn in the northwest, the cultures of these being greatly increased after the invasion of the Netherlands in 1940 stopped all exports from that country. In 1943 the harvest of tulip bulbs in the northwest and Long Island probably exceeded 12,000,000.

The U.S. production of hyacinth bulbs is comparatively small, but the quality is sufficiently good to prove that such bulbs can be successfully grown as well as various other so-called Dutch bulbs. California, too, became a great producing centre of the more tender flowering bulbs. For many)ears all the freesia bulbs required by florists have been raised in California, the output running to many millions, and practically all the varieties in a wide range of colours have been originated there by careful breeding. Other bulbs grown on a big scale and imported before World War I include anemones, ranunculus, tuberous begonias, gloxinias, etc.

Indeed, it can be saiely said that practically all the flowering bulbs which commercial cut-flower growers and retail merchants require are produced on U.S soil with the exception of lilies for forcing. The so-called Easter lily (*Lilium longiflorum*), prior to 1940, was largely a Japanese monopoly, the only other source for U.S. forcers being Bermuda, which ior many years had supplied the U.S. trade with only a small proportion of its needs. However, from the close of World War I the U.S. department of agriculture experiment stations and various commercial growers had continually experimented with lily bulb production. More bulbs of the fine garden lily, *Lilium regale*, are grown in the United States than anywhere in the world.

Gladiolus bulb production in the United States was established as an industry shortly before World War II, and after that time the production multiplied many times, the annual sales of bulbs for commercial and garden purposes probably being not less than 100,000,000. The chief gladiolus bulb farms are in the northwest and in Michigan, but in almost every state, except in the south, gladiolus bulb farms are to be found, though for the most part the producers of bulbs are not interested in the cut-flower business.

Another phase of the U.S. flower industry is the production of azaleas, rhododendrons and numerous other plants for forcing, which prior to 1925 were largely imported in the dormant or resting stage. After a period of scarcity, resulting from the embargo regulations of Quarantine No. 37, nurserymen in the east began turning out azaleas as fine as ever came from Belgium, although the fact that the plants had to be carried over at least two winters in frost-free glass structures naturally increased the cost until the producers reached mass production. One New Jersey firm after a few pears never had less than 1,000,000 azalea plants on hand. Production costs were further lowered when the southern states took up azalea propagation on a large scale, and until 1941 the sale of azalea plants in flower from Christmas until spring was many times greater than in the heyday of inexpensive European plants. To a great extent this was due to the fact that the small-flowered Japanese Kurume azaleas, introduced into the United States around 1916, gained great popularity among commercial growers because they force readily and can be propagated from cuttings as easily as the hardy garden sorts, whereas the Indica varieties have to be propagated by graiting, a process that calls for greater skill and special greenhouse facilities. Another type of azalea that also helped to popularize this race of plants for commercial forcing is known as the Rutherfordiana, a race of hybrids originated by a New Jersey nurseryman through crossing various types. These hybrids are larger flowered than the Kurumes, very floriferous and force readily, but are not fully hardy

U.S. plant breeders have been highly successful in raising special strains or varieties of plants suited to U.S. conditions under glass. The first truly perpetual flowering carnations for fall, winter and spring blooming were developed in the United States, and only rarely after 1900 did foreign varieties make good under U.S. conditions, whereas many of the most popular varieties grown under glass in Europe were of U.S. origin. The forcing roses did not prove to be so international, ior only in rare instances were European varieties successiul in the United States or vice-versa, but nevertheless most of the principal iorcing roses in the U.S. were the result of interbreeding between European and U S. sorts.

U.S. seedsmen likewise were successful in breeding varietal strains of flower seeds suited to U.S. glasshouse conditions Winter flowering sweet peas were first developed commercially in New Jersey and aiter 1910 became an increasingly important winter and early spring crop under glass. The winter flowering snapdragon after 1930, however, gained an even greater popularity than the sweet pea, and it is probably a fact that among cut flowers raised from seed the snapdragon by 1943 was by iar the most important subject grown under glass, millions of spikes being shipped into the various markets. All the varieties of greenhouse snapdragons are of U.S. origin. Stocks, specially suited for greenhouse work. were of even later introduction. U.S. breeders developed remarkably fine types from European varieties. Calendulas, which under U.S. culture also became important flowers for winter, lost some favour with the advancement of snapdragons and stocks, though the marigold, a near relative, gained some attention aiter 1935; under U.S. hands a winter blooming type developed. U.S. breeders also gave considerable attention to flowering pot plants raised from seed, including cinerarias, calceolarias and cyclamens, so that the cutting off of the noted German strains of these flowers during World War II did not seriously inconvenience the American florists.

Bulb Forcing.—The general system of forcing bulbs into flower is practically the same in all countries, but in the United States some of the larger growers erect special bulb cellars instead of burying the pots or flats (shallow wooden boxes) outdoors. Daffodils, tulips and hyacinths, being truly hardy, must, after they are planted in pots or boxes in September, October or November, be kept cool and in the dark for at least two months to induce rooting. They are either placed in cool, dark cellars or buried under eight inches of soil outdoors and later protected by straw to prevent freezing. When well rooted, the flats or pots are given a greenhouse temperature of about 50° F. When the top growth is sufficiently advanced more heat is given, usually about 60° F. By special pre-cooling treatment prior to planting, the bulbs can be flowered several weeks earlier. The leading yellow trumpet daffodil is King Alfred. Probably more of this variety are forced in the United States than all other varieties put together. Other varieties forced in considerable quantities are Sir Watkin, The First, Tresserve, Springglory, Glory of Sassenheim, Early Surprise, Cassandra, Helios, Laurens Koster and Vanwaveren's Giant.

Tulips for earliest forcing are the so-called single earlies, such as Thomas Moore, Prince of Austria, De Wet, Couleur de Cardinal, Keizerskroon, Risingsun and White Hawk, but the Darwin type is much more favoured in the United States because the stems are longer and much more suitable for cutting. Popular forcing varieties are Allard Pierson, Wm. Pitt, Wm. Copland, Rose Copland, Pride of Haarlem, Bartigon and Carrara. Intermediate types, known as Mendels and Triumphs, are crossbreeds between the very early sorts and the Darwins, these forcing more readily than the latter with longer stems than the earlies.

Hyacinths are very responsive to forcing, provided they are kept cool and the flower buds are out of the neck of the bulb before above 50° is given. Generally speaking, daffodils and hyacinths are in bloom 3 to 4 weeks after being given warm treatment. Tulips are more variable according to their natural blooming habits, and extreme forcing for Darwins is not advisable, though from pre-cooled bulbs flowers are obtained in early January.

Other **Types** of Flowers.—Carnations.—The general cultural practice for carnations is to root cuttings in sand between December and March, grow in pots or flats and plant out in the field in late April. The plants are lifted in July and benched in the greenhouse in well prepared soil. By repeated pinching back until the plants are brought inside, well-branched, bushy plants are obtained. If early blooms are not wanted. pinching is continued until September. The major aim is to secure a heavy crop in December and on through the succeeding months until late June when the plants are usually thrown out, though some growers successfully carry the plants through a second season, as is the custom in Great Britain. In some areas the growers do not plant in the field but bench in the late spring, this method being helpful in controlling stem and leaf diseases. Carnations thrive best in a cool temperature with abundant ventilation. Expert growers never allow the night temperature to exceed 50° during the fall and winter.

Roses *Under* Gtnss—While numerous small growers successfully handle carnations in a greenhouse partly devoted to other crops, roses need a house to themselves and in the main are grown by specialists on a large scale solely for the wholesale markets, some of the largest producers growing as many as 1,000 000 plants in giant houses 40 to 50 ft. wide and from 300 to 800 ft. long. A steady night temperature of around 60° F. is maintained. The plants are either propagated by grafting in heat on Manetti stocks early in the year and benched in June, or semidormant budded plants are planted in April These budded plants are mostly budded in the field by Pacific coast growers specially for eastern forcers. High humidity, steady warmth and skilful pinching enable growers to start cutting quality flowers from September on, the two big cropping periods being Christmas and Easter, though generally roses from under glass are available every day in the year. Nowhere in the world are such fine roses produced in midwinter as in the eastern United States. On the other hand, outdoor roses in the eastern United States cannot compare with those grown in England, where the summer temperature is much lower.

The most popular of all forcing roses in the U.S. is Better Times, light red. In many areas, probably more of this variety is grown than of all other varieties together. Other varieties largely grown are: pink—Briarcliff, Peters' Briarcliff, Hapny Days, Pink Delight, Rapture, Hollywood, Queen Mary; red—Peerless, Rome Glory, Chieftain; yellow—Mrs. F. D. Roosevelt, Lestra Hibbard, Joanna Hill, Golden Rapture; yellow-red—Talisman; white—White Killarney Improved, Snow White, Starlight, American Pride.

Lilies.—As stated above, Japan used to supply the bulk of the forcing lily bulbs, the varieties being Giganteum for all-year-round cold storage, and Erabu for storage until spring. Both are forms of *Lilium longiflorum,* Giganteum doing best at a steady 60° F. temperature, while Erabu can be grown at a much lower temperature. With these lilies unavailable, American growers after 1940 had to depend upon the Bermuda-grown Harrisi and Howardi and the domestic grown Floridi from Florida, Creole from Louisiana and Croft from the northwest. A newer source was Mexico, whence goodly numbers of bulbs first arrived in 1942. All these lilies are also forms of *Lilium longiflorum.* Only at Easter time are lilies in pots called for in large numbers.

The usual practice is to plant Bermuda-grown bulbs in early fall and, for Easter on, other types after a period in cold storage, successive batches being planted from late December on. The bulbs are planted either in pots, boxes, raised benches or ground beds, and temperature control and careful watering are the major factors for success.

Chrysanthemums.—The culture of chrysanthemums in the United States is carried on on a tremendous scale, both for the wholesale markets and by retail growers for their local trade. In California they are grown on scores of acres in the open with cheesecloth covering, but in other sections all except certain early types are grown entirely under glass. Cuttings are rooted from early March until late May, planting on benches or ground beds being done up to late June. The large flowered sorts are usually kept to one to three stems, each producing one bloom. The small-flowered spray or pompon types are pinched to induce several stems, each carrying a spray of flowers, the quality of which is improved oy partial disbudding. While in California chrysanthemums start blooming in early September or before, good quality flowers in the east can be had at this date only by the shading method. Midseason or October bloomers, when shaded with black cloth each day from 4 P.M. until 7 A.M. during July and August, are induced to set flower buds and bloom several weeks earlier. In the reverse way, by using electric lights nightly during late summer the plants are delayed in flowering.

Chrysanthemums require cool treatment from fall onward and need much attention to keep them free from insect pests and good support to prevent crooked stems. Greenhouse culture throughout the season is favoured because the stems are then softer; grown outdoors the stems become woody and when cut do not take up water freely and the flowers therefore do not keep as well. The spray varieties are perhaps more largely grown than the large flowered kinds. They are sold by the bunch, while the large blooms are marketed by the dozen. Literally hundreds of varieties are grown by florists in different parts of the country. The small flowered varieties. grown under type headings as pompons, singles and anemone flowered, are legion, some thriving better in some sections than others. (T. A. W.)

FLOWERLESS PLANTS: see ALGAE; BRYOPHYTA; FERNS; FUNGI; LIVERWORTS; MOSS.

FLOWER PAINTING. Broadly speaking, flower painting may be divided into two big classes: that of the East, and that of the West. In the East, flower painting very early attained to a high state and became an individual, extremely beautiful art in China between the 7th and 17th centuries. Japanese painters, adopting many of the traditions of Chinese art, created a phase of flower painting which rose to superb heights in the 16th and 17th centuries. In the West, flower painting proceeded slowly from Egyptian, Grecian and Roman days, on through the Italian Renaissance, until, mainly in the north of Europe, again in the 16th and 17th centuries, almost with one bound, it reached a distinctive and highly developed form of painting in the Netherlands, and from there spread to nearly every country of Europe. The two schools grew under conditions so separated that each remained until recent times quite untempered by the other.

Flower painting of modern times is something of a heritage of both these divisions, but mainly of the Western group, to which has been added a richer and fuller sense of colour, finer and more subtle effects of light and atmosphere resulting from the greater development of visual perception and the delving into the realms of science, as developed by the French impressionists. The manner of painting flowers has followed the changes that have taken place in painting generally, whether of the East or of the West. In method, in the West, the early form was fresco, then oil; now water-colour and pastel are employed in addition. With the Chinese and Japanese, except in wall painting, it has always been a phase of water-colour painting, and their marvelous use of the brush on silk or paper has given a character found nowhere else in the world of art. In the Western world, flowers have been associated for the most part with man. They have appealed to his finer feelings; they have graced his life. He has used them as symbols, decorations, adornments, offerings and as enrichments to his home and his surroundings, while in the East they have always been thought of as a beautiful part of the great order of things in the universe, a part of nature of which man himself is likewise but a part. Flower painting, therefore, has developed along a far different line in the East from what it has in the West. In the East it has always been approached from a contemplative, philosophic and poetic point of view, while in the West it has been, for the most part from an objective one. In the West, we find flowers used in the early days only as accessories in the art of painting. At first they are painted as symbolical and decorative adjuncts. Later they assume a realistic phase in their conjunction with the religious and mythological subjects. But not until about the 16th century do they appear as subjects for paintings for their own beauty. In the East, however, they have formed a very distinct branch of painting for over a thousand years. The Chinese divided their paintings into four general subjects: landscape, man and objects, flowers and birds, plants and insects. Three of these main divisions deal directly in the broad field of nature; the third and fourth divisions are closely related, and being based on much the same conceptions as their landscape painting, follow it as a natural development.

THE ART IN CHINA AND JAPAN

The close observation and contemplation of nature by the artists of the East have produced in their work a rare character and charm. Their flower paintings vibrate with life and force; they are beautifully rhythmic. Their lilies nod and sway on delicate stems; lotus flowers vigorously grow from earth and water into light and sunshine. Their vines hang and sway in the breeze, their peonies unfold, their plum blossoms spread their petals and gently float away in the breeze almost as they open. Flowers in their paintings are associated with the passing of the seasons and the moods of nature. Generally they are painted with the birds of the seasons naturally associated with them at the time of flowering, in their natural habitat, and always with a great understanding of their life and growth. The Chinese artists ever communed with nature. It is said of Chao Ch'ang, of the early 11th century, that "every morning he would walk round the gardens and examine some flower carefully, turning it over and over in his hand. Then he would paint." Of I Yuan-chi, it is said that "he laid out a garden, planted it with bamboos and rushes, and kept there a variety of water fowl, so as to be able to watch them in movement and repose." Kuo Hsi writes about this same time: "Those who study flower painting take a single stalk and put it into a deep hole and then examine it from above, thus seeing it from all points of view. Those who study bamboo painting take a stalk of bamboo, and on a moonlight night project its shadow on to a piece of white silk on a wall."

Of the early Chinese flower paintings few remain to the present day, but of those known, the earliest are of the T'ang dynasty (A.D. 618–907) and show an art that must have been highly developed through many earlier centuries. Pien Luan. of the late 8th century, was noted for his paintings of birds and flowers. Hsiao Yiieh of the same century painted the bamboo exclusively. Hsii Hsi, of the early 10th century, was famous for his painting of flowers. "Peonies in the Wind" and "Ducks in a Lotus Pond" are typical titles. In his time he was considered an artist of the front rank, and has been called "the father of bird and flower painting.': He was famous for his paintings of the lotus flowers which were the inspiration for many painters in later times both in China and Japan. Huang Ch'uan and his son Huang Chu-ts'ai were noted painters of flowers of this same century. Two pictures, "Fowls" and "Peonies," in the British Museum are attributed to the father, while there is record of a large number of paintings of birds and flowers by the son.

The three centuries of the Sung dynasty (960–1279) saw flower painting advanced to a great art. It was a period of intense nature study, a period where a passion for flowers was common, a period when flowers were associated with nature and with every mood of nature. Many flower painters flourished, and their paintings are filled with an elusive poetic quality, combined with accurate form and rhythmic beauty of. growth. In this phase of Chinese art, the Sung artists are pre-eminent. Hsü Ch'ung-ssŭ was a painter of flowers and insects, and is accredited with being the first to paint directly without first sketching the subject. Chao Ch'ang, who followed something of his methods, attained great fame. It is said of him that he "not only produces an accurate resemblance, but hands over to you the very soul of the flower" also. Ch'êng T'ang was famous for his paintings of bamboo, as was Chou Shun. Li-Ti excelled as a flower painter, Chao-Mêng-Chien delighted in painting the plum and narcissus, while Cheng Ssŭ-hisao devoted himself to the painting of orchids.

In the Yüan period, 1279–1368, there are few outstanding flower painters. Ch'ien Hsiian, born in the earlier dynasty, was noted, and Li Kan achieved great fame as a painter of the bamboo. In the Ming dynasty, 1368–1644, though a decline had set in, much of the tradition of the golden age of the Sung period was carried on, and a number of flower painters are found. Mr. Fenollosa claims for Lin Liang first place of all Ming artists. Lu Chi painted his flowers and birds with a landscape background. Sun K'an specialized in the painting of the chrysanthemum. Other flower painters of this time were Ch'ên Shun, Kao Ku, Sun K'o-hung, whose paintings were noted for beauty of movement in flowers, and Chou Chih-mien, also noted for the rhythm and spirit he attained. In the Ch'ing or Manchu dynasty, 17th to the 20th century, though no new vigour has been added, and marked signs of decadence are seen, many of the traditions in flower painting of the earlier Sung and Ming periods were maintained with vitality, at least to the beginning of the 18th century.

In Japan, flower painting, inspired greatly by the Chinese masters of the T'ang, Sung and Ming periods, possess many of their characteristics, grafted often on to the traditions of their own Japanese native schools of painting.

The most impressive periods were the Ashikaga period (1335–1573) and the Tokugawa, from about 1600 into the 19th century. The first strongly upheld traditions of the Sung painters. The native Japanese tradition slumbered, and a sort of Chinese renaissance in Japan took place. The gorgeous coloured scrolls, which had been typical, were replaced by bold simple ink paintings of birds and flowers and landscape. It was the philosophic, contemplative art of earlier Chinese painters. So far as flower painting was concerned, it was the interpretation of the life and growth of the flowers and their association with nature. Sesshiu and Kano Masanobu, the first of the great Kano school, both of whom had great influence and many followers, painted flowers in the classic Chinese style. Utanosuke, son of Kano Masanobu, achieved a great reputation for his distinguished painting of flowers and birds He died in 157j. About 1600 began the Tokugawa period of Japanese art. Chinese ideals were developed along with the Japanese tradition for rich colour and sumptuous decorative effects. Artists with great skill and understanding vied with each other in producing a phase of flower painting, combining all the beauty of the growing flower with superb design and gorgeous colour, that remains unique in the entire field of painting. The three outstanding masters of flower painting of this period are Koyetsu (1557–1637), the leader in this movement, Sotatsu, considered by Japanese critics as the greatest of flower painters after Utanosuke, and Korin (*c.* 1657–1716) who "is perhaps the most Japanese of all the artists of Japan." Their influence carried forward to recent times, but there are few, if any artists since who have inherited their skill or genius.

OCCIDENTAL FLOWER PAINTING

In the West, as has been said, the earliest painted flowers are only to be found as symbols or as decoration. The blue water-lily of the Nile, symbolizing a full harvest, is constantly found in the painted decoration of the Egyptians. Flowers repeatedly appear in the religious paintings of the Renaissance. The lily, emblem of purity, is painted in almost every picture of the Annunciation and of the Madonna. In Roman times garlands and festoons of flowers were painted as decorations. Fine examples, in excellent preservation, are those painted in fresco on the walls of the house of Livia on the Palatine. Crivelli and Mantegna continually in their pictures echo much of this festive decorative floral and fruit painting of the Romans. Flowers form a part in many of the pictures by Botticelli, and though generally introduced for their symbolism, or decoration, they show close observation of growing flowers and a delight in painting flowers for their own beauty, and are rapidly assuming an objective, or realistic character. They slightly suggest those found in some, of the paintings of the late Ming period in China. Botticelli died in 1515, and this century witnessed an unprecedented interest in flowers and gardens. The Italians and Dutch both developed the making of gardens to a fine art. Merchants brought new and beautiful flowers from every corner of the earth to enrich them. In Holland this collecting of rare flowers became the fashion, and collectors of both Italy and Holland employed artists to paint them.

From 1550 to 1650 numerous painters in Italy, Spain and the Netherlands painted flower pictures for the beauty of the flowers themselves. Many of them attained great reputations, and a few were great masters. They exercised an influence that was immediately felt throughout Europe, and which has continued even to the present day. Jan Bruegel (1568–1625) is generally acclaimed as one of the first to develop this manner of painting to a fine art, and, since he introduced flowers as decorative elements in religious painting something in the manner of the early painters of the Italian Renaissance, and later painted flower pictures, he may be considered as the most important link in the chain which leads to the highest point of flower painting in the West. Caravaggio (1569–1609), an Italian, as a young man made many paintings of flowers and fruit while in Rome. He did much to advance solidity and light and shade in painting, and his influence was felt both in Spanish and Dutch painting From then on this feeling for light and shade and third-dimension was a markedly noticeable addition to painting. This phase, observed with greatest understanding, was almost scientifically accurate, and showed direct observation and study from nature. Daniel Seghers (1590–1661) painted in something of the same manner as Bruegel, whose pupil he was. He, too, used flowers in conjunction with religious subjects, but they seem rather to be painted as offerings to the Madonna and saints than as garlands of enrichment. As paintings of flowers, they are very beautiful, with much of the charm of their form, looseness and grace of growth, and delicacy of texture. Individual flowers are masterpieces of close observation and painted with feeling for and knowledge of the flowers themselves.

The painting of garlands and festoons as accompanying decorations to other subject matter led in turn to separate flower paintings. Jan D. van Heem (1606–1684) developed this phase of flower painting to an amazing degree. His technique was masterly. His composition, colours, arrangements, lighting and feeling for the forms of flowers, which he generally painted against a simple dark background, produced a most finished and unified result. As an objective painter, he advanced flower painting to a point far in advance of what had gone before. He has seldom been surpassed. He achieved a great and deserved reputation, and is one of the real masters of this art. His influence was unmistakable, not only among the Dutch and Flemish painters, but throughout Europe. Almost simultaneously, we find groups of artists painting flower pictures in various countries, much in the manner of de Heem. In Italy, there were many, the most noted among which were: Giovanni Battista Ruoppoli (1600–59); Mario Nuzi da Fiori (1603–73) (a pupil of Cavaliere Tommaso Salini's [1570–

1625], who was a contemporary of the Italian Caravaggio and the Flemish painter Jan Bruegel, and who is claimed by Lanzi to have been "the first that composed vases and flowers accompanying them, with beautiful groups of foliage"); and the Roman, Michelangelo de Campidoglio (1610–70). In Spain, various members of the Arellano family painted in the van Heem and Caravaggio manner, the most famous being Juan de Arellano (1614–1672) whose flower paintings, generally painted in pairs, are greatly prized throughout Spain.

Later a German, Abraham Mignon (1639–1697), pupil of de Heem's, who worked in Holland, made for himself a reputation second only to his master. He, in addition to painting grouped flowers and fruit, painted growing flowers but with little of their rhythmic beauty of growth and no sense of their envelopment by air and light. Andrea Belvedere (1646–1732), a Neapolitan, is another painter, of this later time, with something of the Dutch tradition, much of Ruoppoli and something of Juan de Arellano's. Like him his flower paintings are often in pairs. His pictures are crowded but there is much, as in Arellano's, of the easy free growth of the flowers. The crowning point of this kind of flower painting was reached by Jan Van Huysum (1682–1749), who painted well into the 18th century. His flowers are masterly in the drawing of their exquisite and beautiful forms, superb in their third-dimensional quality, and in their delicate and gracious contours. His combinations of colour, his contrasting of light flowers against dark and his design of the wealth of blossoms portrayed, produced gorgeous decorative effects and place him without question as one of the greatest masters of flower painting. Yet his paintings lack a feeling for the living flower and do not possess that quality of growth so superbly grasped by the artists of the East. They lack, too, the beauty of transmitted light and translucent colour that gives so much of the ethereal quality to flowers. These qualities were to come later in the painting of the French school of the 19th century. However, in his time his pictures were unequalled for exquisiteness and grace of form, and were masterpieces of faultless finish. Rachel Ruysch (1664–1750) painted in a similar manner and is by some critics considered his equal. Van Huysun's influence was considerable; and flower pictures in his manner continued to be painted on into the 19th century. They are not as sumptuous, have not the same perfected finish and have not usually the same beauty of form. Often they have an increased harshness.

In France there is an evidence of greater concern for the living character of the flower, a sense of its lightness and delicacy, or, its heaviness, on its stem—a sense for the frailness of flowers that makes Huysum's seem almost moulded from thin metal. Such a painter as Laurent Melaine (1745–1809) gives evidence of this, as does Francois Pret, of whom there seems to be no existing biography or even dates, but, whose robust and richly painted flowerpiece in the Prado, places him as a master, and moves the art of flower painting a step forward. It is in France, in the second part of the 19th century that flower painting reveals a new and glowing character. The changes brought about in painting by the French painters of this time are well known. The naturalistic trend of Courbet; Manet's aesthetic interest in colour and his admiration of Japanese art, tending to rich vivid masses of pure colour; Monet's interest in light, and colour in light—all these had their influence on flower painting.

France produced, adding these new phases to those of the Dutch school, a group of flower painters that is unsurpassed. In the decade between 1830 and 1840 were born Edouard Manet (1832–83), Antoine Vollon (1833–1900), Fantin-Latour (1836–1904) and Claude Monet (1840–1926). Manet and Monet were the real influences for added characteristics of painting, but Fantin-Latour was the great painter of flowers. In Manet's flower painting rich arrangement of colour in a bright and surrounding light gives a sumptuous quality. His flowers are painted with great gusto, freshness and luminosity. His influence is perhaps stronger on the painters of flowers of to-day than that of any other painter; but Monet's influence has been of an unmeasurable quantity also. He made the world see colour in light, pure colour of a vibrating, iridescent quality. In his pictures he has perhaps painted flowers rather more as a medium by which to express this feeling for pure colour in light and in space than because of the beauty of the flowers in themselves. Latour, on the other hand, understood flowers, their delicacy of form, growth and colour, and painted them for their own great beauty, but, in doing so, combined the qualities of his two great contemporaries. His pictures are beautiful arrangements of form and colour with all the living vibrating, if passing, qualities of: the flower, placed in full light with atmosphere surrounding them, and they mark to the present time the high spot of Western flower painting.

Between the realistic Dutch period and the French impressionistic, William Henry Hunt (1790–1864) in England, painting in a method quite his own, produced flower pictures in water colour that, ungracious as they generally are, had much of the exactness of floral structure with a suggestion in colour, that was slightly related to what the French later developed to such a supreme degree. Later still, Francis E. James (1849–1920) developed in water-colour a crisp delightful phase of flower painting. Contemporary with the great French impressionists, John La Farge (1835–1910) in America was a true flower painter, and the forerunner of a number of flower painters in this country.

Abbott Thayer, Wilton Lockwood, Maria Oakley Dewing, Charles Demuth and Laura Hills are artists who have found in flowers subjects for their paintings, and each has added something to the art. (See also PAINTING: WATER-COLOUR PAINTING.)

(G. W. D.)

FLOWERPECKER or midget, common names for many species of tiny, often brilliantly coloured song birds of the family Dicaeidae. Their greatest centre of abundance is in the Indo-Malayan region, extending east to the Solomon Islands and south across Australia. They are mainly three to four inches long, with short tails and fairly short wings. The male is usually more brilliantly coloured than the female, often with crimson or orange, black or dull blue, and gray. The bill is rather thick, short, triangular, slightly down-curved, and finely serrated at the tip. Flowerpeckers feed in tree tops and bushes along forest borders and gardens, on tropical mistletoe berries and tiny insects and spiders.

The nest, with four or five white eggs, may be a tiny cup of fibres and down suspended from a twig, or may be placed in a natural cavity of a tree or tunneled burrow in the ground. The nest of the species known as pardalotes, or diamond birds, confined to Australia, is in the ground, one species even digging its burrow in the desert plains of the southwest interior. (G. F. Ss.)

FLOWERS, ARTIFICIAL. Imitations of natural flowers are sometimes made for scientific purposes (as the collection of glass flowers at Harvard university, which illustrates the flora of the United States), but more often as articles of decoration. A large variety of materials have been used in their manufacture by different peoples at different times—painted linen and shavings of stained horn by the Egyptians, gold and silver by the Romans, rice-paper by the Chinese, silkworm cocoons in Italy, the plumage of highly coloured birds in South America, wax, small tinted shells, etc. At the beginning of the 18th century the French, who originally learned the art from the Italians, made great advances in the accuracy of their reproductions, and towards the end of that century the Paris manufacturers enjoyed a world-wide reputation. About the same time the art was introduced into England by French refugees and soon afterwards it spread also to America.

The industry is now a highly specialized one and comprises a large number of operations performed by separate hands. Four main processes may be distinguished. The first consists of cutting up the various fabrics and materials into shapes suitable for forming the leaves, petals, etc. This may be done by scissors, but more often stamps are employed which will cut through a dozen or more thicknesses at one blow. The veins of the leaves are next impressed by means of a die, and the petals are given their natural rounded forms by goffering irons of various shapes. The next step is to assemble the petals and other parts of the flower, which is built up from the centre outwards; and the fourth is to mount the flower on a stalk formed of brass or iron wire wrapped round with suitably coloured material, and to fasten on the leaves required to complete the spray.

FLOYD, JOHN (1572–1649), English Jesuit, was born in Cambridgeshire. When at Rome in 1592 he joined the Jesuits, and by 1606 was a missionary priest in England. He had considerable fame as a preacher and teacher, and was frequently arrested. His last years were spent at St. Omer where he died on Sept. 15, 1649. His works are listed in Fellow's *Bibl. Dict. Eng. Caths.* (1885).

FLOYD, JOHN BUCHANAN (1807–1863), American politician, was born at Blacksburg, Va., on June 1, 1807. He was the son of John Floyd (1770–1837), governor of Virginia, 1830–34. In 1826 he graduated from South Carolina college, after which he practised law in Virginia and in Helena, Ark. He was a representative in the Virginia legislature, 1847–49, and governor of Virginia, 1849–52; afterward he was again returned to the state legislature. In 1857 President James Buchanan appointed him secretary of war.

When Maj. Anderson on Dec. 26, 1860, transferred his forces in Charleston harbour from Ft. Moultrie to Ft. Sumter, the move that resulted in the outbreak of hostilities in the Civil War, Floyd claimed that the act was contrary to his orders. When the president and a majority of his cabinet upheld and defended Anderson's move, Floyd resigned and returned to his Virginia home, becoming a secessionist in his sympathies. A few days previous to his resignation President Buchanan had requested a resignation because of certain financial irregularities in Floyd's department due to extremely careless administration. Whether the request had reached Floyd at the time he resigned and the Ft. Sumter incident merely furnished him with a pretext for a more honourable exit is not known. Charges made later that he used his office to furnish arms to the south in anticipation of war were disproved by an investigating committee of the house of representatives Jan. 1861. He was commissioned a brigadier general in the Confederate service and employed first in operations in western Virginia. In Feb. 1862, he became commander of the Confederate forces at Ft. Donelson. When resistance seemed useless he escaped with part of his forces, leaving Gen. S. B. Buckner to surrender to Gen. U. S. Grant. For this President Jefferson Davis relieved him of his command. He died at Abingdon, Va., Aug. 26, 1863.

See P. G. Auchampaugh, *James Buchanan and his Cabinet on the Eve of Secession* (1926); J. F. Rhodes, *History of the United States, 1850–77*, vol. iii; R. M. Hughes, "Floyd's Resignation from Buchanan's Cabinet," *Tyler's Quarterly*, vol. v (1923).

FLUDD or **FLUD, ROBERT** [ROBERTUS DE FLUCTIBUS] (1574–1637), English physician and mystical philosopher, son of Sir Thomas Fludd, treasurer of war to Queen Elizabeth in France and the Low Countries, was born at Milgate, Kent. After studying at St. John's college, Oxford, he travelled in Europe for six years, and became acquainted with the writings of Paracelsus. He subsequently returned to Oxford, became a member of Christ Church, took his medical degrees, and ultimately became a fellow of the College of Physicians. He practised in London with success, although it is said that he combined a good deal of faith-healing with purely medical treatment. Following Paracelsus, he endeavoured to form a system of philosophy founded on the identity of physical and spiritual truth. The universe and all created things proceed from God, who is the beginning, the end and the sum of all things, and to Him they will return. The act of creation is the separation of the active principle (light) from the passive (darkness) in the bosom of the divine unity (God). The universe consists of three worlds: the archetypal (God); the macrocosm (the world); the microcosm (man). Man is the world in miniature; all the parts of both sympathetically correspond and act upon each other. It is possible for man (and even for the mineral and the plant) to undergo transformation and to win immortality. Fludd's system may be described as a pantheistic materialism, which, allegorically interpreted, he put forward as containing the real meaning of Christianity, revealed to Adam by God himself, handed down by tradition to Moses and the patriarchs, and revealed a second time by Christ. The opinions of Fludd had the honour of being refuted by J. Kepler, P. Gassendi and M. Mersenne. Though rapt in mystical speculation, Fludd was a man of varied attainments who did not disdain scientific experiments. He was an ardent defender of the Rosicrucians, and Thomas De Quincey considered him to have been the immediate, as J. V. Andrea was the remote, father of freemasonry. Fludd died in London on Sept. 8, 1637.

See J. B. Craven, *Robert Fludd, the English Rosicrucian* (1902), where a list of his works is given; A. E. Waite, *History of the Rosicrucians* (1887); Thomas De Quincey, *The Rosicrucians and Freemasons*; J. Hunt, *Religious Thought in England* (1870). His works were published in 6 vols., Oppenheim and Gouda, 1638.

FLÜGEL, JOHANN GOTTFRIED (1788–1855), German lexicographer, was born at Barby near Magdeburg, on Nov. 22, 1788. He was originally a merchant's clerk. Emigrating to the United States in 1810, he made a special study of the English language. He returned to Germany in 1819, and in 1824 was appointed lector of the English language in the University of Leipzig. In 1838 he became American consul, and subsequently representative and correspondent of the Smithsonian institution at Washington, D.C., and several other leading U.S. literary and scientific institutions. He died at Leipzig on June 24, 1855.

The fame of Flügel rests chiefly on the *Vollstandige Englisch-Deutsche und Deutsch-Englische Worterbuch*, first published in 2 vols. (Leipzig) in 1830, which had an extensive circulation not only in Germany but in England and the U.S. In this work he was assisted by J. Sporschil, and a new and enlarged edition, edited by his son Felix Flügel (1820–1904), was published at Brunswick (1890–92). Another edition, in two volumes, edited by Prof. Immanuel Schmidt and S. Tanger appeared (Brunswick, London and New York) in 1906. Among his other works were *Vollstandige Engl. Sprachlehre* (1824–26); *Triglotte, oder Kaufmannisches Wörterbuch in Drei Sprachen, Deutsch, Englisch und Franzosisch* (1836–40); *Kleines Kaufmannisches Handwörterbuch in Drei Sprachen* (1840); and *Praktisches Handbuch der Engl. Handelcorrespondenz* (1827, 9th ed. 1873). All these passed through several editions. In addition, Flügel also published in the English language: *A Series of Commercial Letters* (Leipzig, 1822), a ninth edition of which appeared in 1874 under the title *Practical Mercantile Correspondence* and a *Practical Dictionary of the English and German Languages* (2 vols., Hamburg and Leipzig, 1847–52; 15th ed., Leipzig, 1891). The last was continued and re-edited by his son Felix.

FLUID MECHANICS: *see* MECHANICS, FLUID.

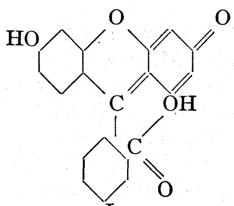
FLUKE, a name given to several kinds of fish, flat in shape, especially to the common flounder; also to a trematode worm, resembling a flounder in shape, which infects the liver and neighbouring organs of certain animals, especially sheep, and causes liver rot. The most common is *Fasciola hepatica* (*see* TREMATODES). The name is given to a species of kidney potato; to the holding plates, triangular in shape, at the end of the arms of an anchor; and to the triangular extremities of the tail of a whale. The use of the word as a slang expression seems to have been first applied in billiards to an unintentional scoring shot.

FLUORESCEIN, a synthetic colouring matter, was discovered in 1871 by A. von Baeyer who prepared it by fusing together phthalic anhydride (*q.v.*) and resorcinol (*q.v.*) at temperatures between 180° and 200° C. The chemical formula of fluorescein is $C_{20}H_{12}O_5$. Its name follows from the fact that the deep-red solutions of its sodium or potassium salt exhibit an intense yellowish-green fluorescence so strong that it can be seen in dilutions as high as 1:40,000,000.

Because of its very high tinctorial power, the sodium salt of fluorescein, a dyestuff sold under the name of uranine, is used as a water tracer and a water marker. Millions of pounds of the product were used during the years of World War II for marking spots on the surface of the ocean. Eosine. a bright scarlet dyestuff, used mostly for the manufacture of a brilliant red pigment, is made by brominating fluorescein to its tetrabromo derivative.

Likewise erythrosine, somewhat bluer in shade than eosine, is tetraiodofluorescein. Rose Bengal, once an important colouring matter for dyeing wool and silk in rich. dark-red shades, was made by condensing tetrachlorophthalic anhydride with resorcinol and then iodinating the resulting tetrachloro fluorescein The product, no longer of commercial importance. was tetraiodotetrachloro fluorescein.

Structure and Preparation. — Fluorescein is resorcin phthalein. and is usually considered to have the quinoid structure I. although there is positive evidence that in solution it consists of an equilibrium mixture of I and the benzenoid form II. Moreover, derivations of both forms have been made, particularly the esters and ethers.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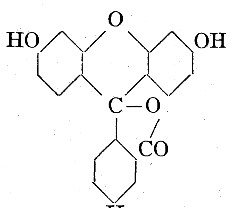
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Commercially, fluorescein is of considerable importance and is made by heating resorcinol, phthalic anhydride and zinc chloride together at temperatures between 180° and 190° C.. the latter agent hastening the reaction between the other two compounds. The melt is extracted with hot water whereby most of the zinc chloride is dissolved out. The remaining mass is then dissolved in dilute caustic soda, the solution is filtered and the fluorescein is precipitated with acid. By repeating the extraction and precipitation process several times, fluorescein can be obtained in a comparatively pure form. It is a yellow amorphous powder. insoluble in water. but soluble in alcohol from which it crystallizes in dark-red nodules. (J. H. Ss.)

FLUORESCENCE: *see* LUMINESCENCE.

FLUORINE is the most electronegative and most reactive of all known chemical elements. The applications of its compounds range from the use of sodium fluoride as a water additive to the process by which uranium hexafluoride separates and concentrates uranium isotopes in atomic energy installations.

Fluorine is a pale greenish-yellow gas with an irritating odour resembling that of hypochlorous acid. Inhalation of the gas is dangerous except in very low concentration. In the liquid state. fluorine is clear yellow and the solid becomes colourless at −252° C.

Fluorine stands at the head of the halogen family in the periodic table (atomic weight 19. atomic number 9, chemical symbol F). There is only one stable and naturally occurring nuclear species of fluorine, F^{19}, but radioactive isotopes with mass numbers 17 (half life 70 sec.), 18 (112 min.) and 20 (10.7 sec.) have been prepared. Additional properties are listed in the table. The element was first isolated in 1886 by H. Moissan who obtained it by the electrolysis of anhydrous hydrogen fluoride containing dissolved potassium fluoride. He used a U-shaped platinum apparatus including an anode made of platinum iridium alloy, and this classical research brought final success to 75 years of scientific effort.

Numerical Properties of Fluorine

Molecular formula	F_2
Outer electron configuration	$2s^2, 2p^5$
Boiling point	−188° C.
Melting point	−223° C.
Density relative to air	1.32
Density of liquid	1.108 g. per c.c.
Atomic volume of solid	14.62 c.c.
Ionization potential	17.42 v.
Electron affinity	4.13 ev
Covalent radius	0.72 Å
Radius F^- in crystals	1.36 Å
Standard potential $F^- \rightleftarrows \frac{1}{2}F_2 + e$	2.85 v.

The chief source of fluorine is the mineral fluorspar or calcium fluoride, CaF_2, which is widely distributed geologically. It also occurs in cryolite, Na_3AlF_6, fluorapatite, $CaF_2.3Ca_3(PO_4)_2$, as well as in sea water, bones, nails and teeth in small amounts.

When fluorspar is distilled with concentrated sulfuric acid, essentially anhydrous hydrogen fluoride is liberated, which boils at 19.5° C. and dissolves in water to form hydrofluoric acid. Hydrogen fluoride is available in large commercial quantities, and is used widely as a solvent, as a versatile catalyst in organic chemistry and as a reagent for the replacement of chlorine by fluorine in organic compounds.

Elementary fluorine is prepared both commercially and in the laboratory by electrolysis of solutions of potassium bifluoride, KHF_2, in anhydrous hydrogen fluoride. The electrolytic cells or generators are constructed of steel or monel metal with especially treated carbon anodes and usually operate at moderate temperatures (about 100° C.). The process is efficient and the product, which is also available in cylinders under pressure, is of high purity. However, a jet of fluorine under pressure can be dangerous, since it instantly inflames organic matter, many metals and numerous other substances. Both hydrogen fluoride and the corresponding acid. which attacks glass and is used for etching, are corrosive and toxic.

In inorganic chemistry, the highly reactive fluorine combines readily with nearly all the other elements except the inert gases. It reacts with all metals forming a large number of single, double and complex salts, and also with most of the nonmetals. Because of the small size of the fluoride ion, it forms many stable complexes with positive ions; for example, $SiF_6^{=}$, $AlF_6^{\equiv}$.

Elements having variable valences usually show their several oxidation states in combination with fluorine; *e.g.*, the sulfur fluorides S_2F_2, SF_2, S_2F_{10}, SF, and SF,, the latter being the most stable. Many of these compounds have found significant use in the laboratory or in industry.

Boron fluoride. BF_3, and antimony fluoride, SbF_3, as well as hydrogen fluoride are important catalysts for organic reactions; cobaltic fluoride, CoF_3, and chlorine trifluoride, ClF_3, are good fluorinating agents; sulfur hexafluoride, SF,, is used as a gaseous insulator; and uranium fluoride, UF_6, to separate uranium isotopes. Also sodium fluoride. NaF, is used in the treatment of dental caries, and is often added to otherwise deficient water supplies (fluoridation) to reduce tooth decay in children *(see* DENTISTRY).

In the field of organic chemistry fluorine has become increasingly important. On account of the small size and great reactivity of the fluorine atom. elementary fluorine reacts with hydrocarbons to form corresponding fluorocarbons in which all hydrogen has been replaced by fluorine. These may be regarded as the parent substances from which a large number of completely fluorinated, or perfluorinated, organic compounds may be considered to be derived. These compounds are usually characterized by great stability, chemical inertness, high electrical resistance and other valuable physical and chemical properties. They may also be prepared by treating organic compounds with cobaltic fluoride, as well as by the new commercial process of electrolyzing their solutions in anhydrous hydrogen fluoride.

Unsaturated fluorocarbons and their derivatives readily yield polymers and plastics such as Fluon or Teflon $(CF_2CF_2)_x$ and Fluorothene or Kel-F $(CF_2{=}CFCl)_x$, which' are highly resistant and have found considerable commercial application. Closely related substances have found usage as resistant incombustible water-repellent lubricants and coatings. Fluorocarbon chemistry has come to be regarded as a significant subdivision in the organic field.

Another method for introducing fluorine into organic compounds consists of the replacement of nonaromatic chlorine, bromine or iodine by fluorine through the action of hydrogen fluoride, antimony fluoride or other inorganic fluorides as the fluorinating agents. These reactions have been extensively studied, and perhaps the most important commercial application is the large-scale production of dichlorodifluoromethane, CF_2Cl_2 (Freon), the stable nontoxic coolant used in most household refrigerators. A whole series of related substances (Freons, Genetrons) are also widely used as refrigerants and propellants, while the nontoxic compound CF_3Br is an excellent fire extinguisher.

Trifluoroacetic acid. CF_3COOH, can be made from the corresponding chlorine compound by this method as well as by the electrolytic process, and is available in commercial quantities along with related perfluorinated acids, which are also the source of many derivatives.

The stable $-CF_3$ group has been introduced as a side chain into aromatic compounds, and fluorine may be substituted directly on the aromatic nucleus by the diazo reaction. Such products have found use in the dye and pharmaceutical industries and also as insecticides. Finally, the $-CF_3$ group has been combined with many other elements, both metallic and nonmetallic, such as magnesium, nitrogen, phosphorus, arsenic and sulfur, and the products have been employed in organic synthesis and in other ways.

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(L. A. B.)

FLUORITE or fluorspar is a common mineral composed of calcium fluoride, and the principal fluorine mineral. The name is derived from its low melting point and its use in metallurgy as a flux and comes from the Latin *fluere*, "to flow." The term fluorescence was derived from the behaviour of fluorite. Most varieties fluoresce strongly under ultraviolet light or other radiations. It may phosphoresce upon heating or after exposure to ultraviolet light. A variety called chlorophane emits a green light upon heating. (See LUMINESCENCE.)

Fluorite is used as a flux in the manufacture of open-hearth steel and in the making of aluminum fluoride and artificial cryolite, used in the production of aluminum (*q.v.*). It is used in opalescent glass, iron and steel enamelware, in the production of hydrofluoric acid, in the refining of lead and antimony and as a catalyst in manufacturing high-octane fuels (see also FLUORINE). Clear colourless fluorite of optical quality is used for apochromatic lenses because of its low index of refraction and low dispersion. A variety known as Blue John from Devonshire, as well as other types, have been used for ornamental vases and other articles.

Fluorite is common in hydrothermal veins, sometimes being the chief mineral, and sometimes the gangue mineral with various metallic ores, such as silver, lead and copper. It is found in pneumatolytic deposits associated with cassiterite, topaz, tourmaline and quartz. It is also found in sedimentary rocks such as limestone and dolomite.

A few of the important occurrences are at Cumberland, Yorkshire, Derbyshire and Cornwall in England; Saxony and Hartz mountains, Germany; the Austrian, Italian, Swiss and French Alps; northern Norway and the Kola peninsula, Russia (yttrium variety); Ontario and British Columbia, Canada; and in the United States in Illinois, Kentucky, Montana, New Mexico and Colorado.

Fluorite crystallizes in the cubic system. The commonest form is the cube, but octahedrons are sometimes found. Composite crystals have been found, made up of an aggregate of tiny cubes in the shape of an octahedron. Penetration twins of two cubes are common.

The octahedral crystals, usually light coloured, have been attributed to high-temperature formation, and the darker cube forms to low-temperature formation. Twinned crystals in the form of interpenetrating cubes are common. A large number of additional forms have been observed in combination, including those with crystal indexes of 110, 210, 310, 211, 311, 221, 331, 123 and 124 (see CRYSTALLOGRAPHY).

The structural arrangement of fluorite consists of calcium ions at the corners and face-centres of the cubic cell, with the fluorine ions at the centres of the eight small cubes into which the unit cube may be divided by the principal planes of symmetry.

Fluorite is no. 4 in Mohs' scale (*q.v.*) of hardness. It has an excellent octahedral cleavage. It is usually in crystals or in cleavable masses, but it is rarely columnar or fibrous. The specific gravity is 3.18, but it may be as high as 3.5 for yttrium and cerium varieties. It is usually transparent or translucent, with a vitreous lustre.

There is a wide range of colours; when pure it is colourless and clear. but commonly it is green, blue, yellow, purple, brown or blue-black; rarely pink or red. The colour may vary irregularly, and sometimes is in zones parallel to crystal faces. There may be a difference in the colour of the transmitted and the reflected light.

The formula is CaF_2, and it is usually quite pure. In certain localities it is found with the rare earths yttrium or cerium replacing calcium in amounts up to 15% to 20%. Dark coloured fluorite from Bavaria contains free fluorine and calcium ions released by radiation. When ground to a powder, this gives an odour of hydrogen fluoride and ozone.

Fluorite may contain minute cavities filled with water, bituminous matter or gas. Inclusions of tiny chalcopyrite crystals are sometimes found. (L. S. RL.)

FLUSHING (Dutch *Vlissingen*), in the province of Zeeland, Netherlands, on the south side of the island of Walcheren, at the mouth of the estuary of the western Scheldt, 4 mi. S. by W. of Middelburg, with which it is also connected by tramway and canal. Pop. (1957 est.) 28,148 (mun.). An important naval station and fortress up to 1867, Flushing later became a packet station. In 1872 the railway was opened which, in conjunction with the boat service to England (Queenborough and Harwich), formed one of the main routes between England and the continent. In 1873 the harbour, docks and canal works were completed. Yet the navigation of the port remained far behind that of Rotterdam or Antwerp.

As a summer resort Flushing acquired considerable popularity. It possesses a town hall, containing a collection of local antiquities, a theatre, an exchange, an academy of sciences and a school of navigation.

The Jakobskerk, founded in 1328, contains monuments to Admiral de Ruyter (1607–76) and Jacob Bellamy (1757–86).

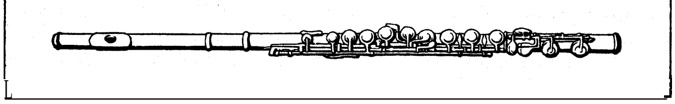
The chief industries are connected with the shipbuilding yards and packet service. The chief imports are ordinarily colonial produce and wine, wood and coal; exports, agricultural produce, shrimps and meat.

Flushing was occupied by Germany in 1940.

FLUSHING, former township and village of Queens county, N.Y., U.S., on Long Island, at the head of Flushing bay; after 1898 a part of the borough of Queens, New York city. Settled in 1644 by English nonconformists who had probably been living at Flushing, Holland, it uas the country seat of many rich New Yorkers and colonial officials before the American Revolution. Flushing Meadow park was the site of the 1939–40 New York world's fair and from 1946 to 1949 served as temporary headquarters for the United Nations general assembly.

FLUTE, in music, is a general term applied to wood-wind instruments consisting of a pipe pierced with lateral holes and blown directly through the mouthpiece without the intervention of a reed. The flute family is classified according to the type of mouthpiece used. *i.e.*, (1) those with the simple lateral mouth-hole or embouchure which necessitates holding the instrument in a transverse position; (2) those nith the whistle or fipple mouthpiece which allows the performer to hold the instrument vertically in front of him; (3) those having no mouthpiece of any sort, in which the column of air is set in vibration by blowing obliquely across the open end of the pipe, as in the ancient Egyptian nay, and the pan-pipe or syrinx (*q.v.*).

Of these the transverse flute has now entirely superseded, not only the obsolete third class, but also the whistle flute, which has



BY COURTESY OF CARL FISCHER, INC.
THE BOEHM FLUTE. MODELLED BY THEOBALD BOEHM

survived only in the so-called penny whistle, in the "flute-work" of the organ (*q.v.*), and in the French flageolet.

The Transverse *Flute* or *German* Flute includes the concert *flute*, known both as flute in C and as flute in D, the piccolo (*q.v.*) or octave flute, and the fife (*q.v.*), and consists of a tube open at one end and nominally closed at the other by means of a plug or cork stopper. Virtually, however, the tube is an open one giving the consecutive harmonic series of the open pipe or of a stretched string.

The compass of the modern flute is three octaves with chromatic semitones from middle C upwards. The sound is produced by holding the flute transversely with the embouchure turned slightly outwards, the lower lip resting on the nearer edge of the embouchure, and blowing obliquely across, not into, the orifice. The flat stream of air from the lips, known as the air-reed, breaks against the sharp outer edge of the embouchure. The current of air, thus set in a flutter, produces in the stationary column of air within the tube a series of pulsations or vibrations caused by the alternate compression and rarefaction of the air and generating sounds of a pitch proportional to the length of the stationary column, which is practically somewhat longer than the length of the tube. The length of this column is varied by opening the lateral finger-holes.

The bore of the early flute with six finger-holes was invariably cylindrical throughout, but towards the end of the 17th century a modification took place, the head joint alone remaining cylindrical while the rest of the bore assumed the form of a cone having its smallest diameter at the open end of the tube. The conical bore greatly improved the quality of tone and the production of the higher harmonics of the third octave. Once the conical bore had been adopted, the term flute was exclusively applied to the new instruments, the smaller flutes, then cylindrical, used in the army being designated fifes (q v.). At the present day in England, France and America, the favourite mode of construction is that introduced by Theobald Boehm, and known as the "cylinder flute with the parabolic head." though the conical type is still usually employed in military bands

The quality of tone depends somewhat on the material of which the flute is made. Silver and gold produce a liquid tone of exquisite delicacy suitable for solo music, cocus-wood and ebonite, a rich mellow tone of considerable power suitable for orchestral music. The tone differs further in the three registers, the lowest being slightly rough, the medium sweet and elegiac, and the third bird-like and brilliant. The proportions, position and form of the stopper, and of the air chamber situated between it and the embouchure are mainly influential in giving the flute its peculiar slightly hollow timbre. due to the paucity of the upper partials of which, according to Helmholtz, only the octave and twelfth are heard.

The technical capabilities of the flute are practically unlimited to a good player who can obtain sustained notes diminuendo and crescendo, diatonic and chromatic scales and arpeggios both legato and staccato, leaps, turn, shakes, etc., with the greatest facility

Instruments of the flute type appear to be of very ancient origin The Hindus, Chinese and Japanese all claim to have had them from time immemorial. the like applying to the Egyptians, and also to the Greeks and Romans.

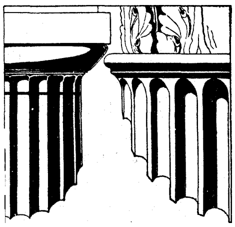
The first essentially western European trace of the transverse flute occurs in a German ms. of the 12th century, the celebrated *Hortus deliciarum* of the abbess Herrad von Landsperg, in which Fol. 221 shows a syren playing upon an instrument of this type, which Herrad explains in a legend as a *tibia.*

According to Quantz, it was in France, and about the middle of the 17th century, that the first modern modifications were introduced in the manufacture of the flute, including the abandonment of the cylindrical bore in favour of a conical one, and the introduction of keys. But no maker had as yet devoted his attention to the rational division of the column of air by means of the lateral holes, and it was left for Theobald Boehm, a Bavarian maker, to embody this and many other improvements in the completely remodelled instruments which he brought out in 1832 and in 1846.

The old English *fipple flute* or *flute à bec* is described under the headings RECORDER and FLAGEOLET. (X.)

In architecture flute describes vertical channels or curved sinkages used in a series for decorative purposes, especially when employed upon the shafts of columns. Flutes may be separated from each other by a sharp edge or ridge known as an arris, or by a small, vertical flat surface known as a fillet. The earliest known flutes occur in Egyptian columns. where they are obviously the result of the attempt to decorate simply the piers of a rockcut tomb If the corners are cut off a square pier. an octagonal pier results: if its corners are in turn cut off, one of 16 sides Such piers are common in the tombs at Beni Hassan (12th dynasty). In many, the sides are made slightly concave in order to emphasize the vertical lines at the corners The result is a fluted pier. In the temple at Karnak (c. 1400 B C), and that of Queen Hatshepsut, at Deir-el-Bahri (c. 1500 B C.), similar fluted supports appear. Such piers are sometimes known as Proto-Doric.

Whether borrowed from the Egyptians or developed independently. flutes became universal in Greek Doric building. In early examples they are segmental in plan, but later a section approximating an elliptical curve, or one formed with three centres, was the most common type as such a curve gave greater emphasis to the line of the arris, without too great depth in the flute itself. In columns of the Ionic and Corinthian orders the flutes are separated by fillets and here, more than ever, an elliptical section is necessary. in order to bring the edges of the flute as nearly parallel to a column radius as possible. In general, flutes separated by fillets are deeper than flutes separated by arrises, varying from one quarter of the width, as in the Ionic columns in the cella of the temple at Bassae (c. 450 B C), to one half the width, as in the Erectheurn. The number of flutes varies from 16 to 24 in Doric examples. with 20 as the most common number. In Ionic and Corinthian columns, the number of flutes is usually greater, averaging 24, but in the archaic temple of Artemis at Ephesus (*c.* 500 B C) there are 52. Similarly in the Persian palace columns of Susa and Persepolis, obviously influenced by Greek work, the number of flutes is great, varying from 30 to 52. Roman columns mostly followed Greek precedent, but with less refinement and a general substitution of semicircular and segmented flutes. in place of the refined Greek ellipses. In some of the smaller Roman examples, particularly in domestic work, the lower portions of the flutes are filled either with a convex moulding known as reeding or by merely filling them to a flat surface in an effort to preserve the arrises and fillets from damage. Tnisted, helical or spiral flutes are found occasionally in Roman work, are frequent in mediaeval Italy and were spasmodically used during the high Renaissance and Baroque, as in Sammichele's Bevilacqua palace at Verona (1530). Except where there was direct imitation of Roman work, as in much of the Romanesque of Burgundy and Provence, fluting was not used in mediaeval work outside of Italy.



FLUTE

Flutes are frequently used to decorate horizontal bands. especially the coronas, or flat projecting portions of the Corinthian cornice, and also in friezes. as in much English and American late Georgian work. Fountain basins and sarcophagi are also often fluted, in many cases with flutes not vertical, but taking an S curve. Fluting occurs in mediaeval work only in styles where there was much imitation of Roman work, as the Romanesque of Burgundy and Provence. (T. F. H.)

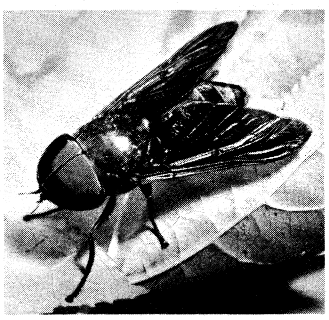
FLUX, in metallurgy, a substance introduced in the smelting of ores to promote fluidity, and to remove objectionable impurities in the form of a slag. The substances in commonest use are: —lime or limestone, to slag off silica and silicates, fluorspar for lead, calcium and barium sulphntes and calcium phosphate, and silica for removing basic substances such as limestone. Other sub. stances are also used, but more commonly in assaying than in metallurgy. Sodium and potassium carbonates are valuable for fluxing off silica; mixed with potassium nitrate, sodium carbonate forms a valuable oxidizing fusion mixture, "black flux" is a reducing flux composed of finely divided carbon and potassium carbonate, and formed by deflagrating a mixture of argol with quarter to half its weight of nitre. Borax is very frequently employed; it melts to a clear liquid and dissolves silica and many metallic oxides. Potassium bisulphate is useful in the preliminary treatment of refractory aluminous ores. Litharge and red lead are used in silver and gold assays, acting as solvents for silica and any metallic oxides present. The word is derived from Lat. *fluxus,* a flowing, and retains this meaning in medicine, etc.

FLUXIONS, a form of the calculus developed by Sir Isaac

Newton (*q.v.*), beginning in 1665. The word "fluxion," as used by him, denoted the rate at which a variable (flowing quantity, fluent) increases or decreases at a given instant of time. If x and y were taken to be the flowing quantities (fluents) $y = x^3$, then it could be shown that $\dot{y} = 3x^2\dot{x}$. In the alternative differential notation we should have $dy = 3x^2dx$. See CALCULUS. DIFFERENTIAL AND INTEGRAL.

FLY, a common name used in a restricted sense by entomologists for any two-winged insect belonging to the order Diptera (*q.v.*), and more loosely as part of the common names of many other insects that are not true flies. Thus, stone flies belong to the order Plecoptera; green fly, black fly, white fly and lantern flies to Hemiptera, suborder Homoptera; May flies to Ephemeroptera; dragonflies and damsel flies to Odonata; alder flies to Neuroptera; scorpion flies to Mecoptera; caddis flies to Trichoptera; butterflies to Lepidoptera; sawflies and ichneumon flies to Hymenoptera; and fireflies to Coleoptera.

The name fly is also used to distinguish the winged adult stage of many insects; *e.g.*, ant lions are voracious larvae whose winged adults are called ant lion flies. It may also be applied to any small. abundant, probably noxious insect, as in the farmers' name turnip fly for the turnip flea beetle. Flies used in fly-fishing (see FISHING) are designed to imitate the aquatic insects that have bred in the water and that are snapped at by fish when they hatch out as winged adults at the surface (mostly May flies, stone flies and caddis flies).



JOHN H. GERARD

FIG. 1. — BLACK HORSEFLY (TABANUS ATRATUS); ABOUT NATURAL SIZE

Without other qualification "fly" popularly indicates the housefly (*q.v.; Musca* damestica) or other true flies of generally similar build (fig. 1). "Fly" used as a collective noun ("the horses went down with fly") refers to disease-carrying. biting flies, and especially to attacks by the tsetse fly (*q.v.; Glossina*). "Fly-blown" means contaminated with the eggs and larvae (maggots) of blowflies; figuratively, it has also come to mean in a state of chronic neglect. The true flies, Diptera, are the subject of this article; for information on other so-called flies see titles under their common names, as ALDER FLY; BLACKFLY; CADDIS FLY; DRAGONFLY ; etc.

INTRODUCTION

Importance of Flies. — Estimates of the total number of known species of true flies in the world range from 60.000 to 85,000. Nearly every study of any group results in the discovery of new species and often of new genera. Probably most completely known are the tsetse flies, confined to tropical Africa. The mosquitoes. of the family Culicidae. have attracted many more workers than any other group of insects, yet even in this family there are groups, of no special medical importance, that are comparatively poorly known (see MOSQUITO). The pomace fly or small fruit fly, *Drosophila melanogaster,* has been laboratory bred for many years and intensively used in genetics studies (see DROSOPHILA).

Flies probably affect human welfare in more different ways than any other insects. These may be summarized as follows: direct transmission of specific diseases such as malaria, where the fly (in this case the mosquito) is an essential link in the chain; fortuitous or mechanical transmission, for example, through the contamination of food by houseflies; myiasis, or invasion of the human body by larvae of certain flies; similar infections or infestations of farm stock or draft animals; damage to cultivated plants by the feeding of the larvae of flies. (See ENTOMOLOGY: Applied *Entomology.*)

Characteristics. — The true flies are among the most highly evolved insects, and share a common ancestry with the orders Neuroptera. Mecoptera, Trichoptera and Lepidoptera, forming the so-called Panorpoid complex of R. J. Tillyard. The two most characteristic features of true flies are the modification of the hind wings into balancing organs and the structure of the proboscis in relation to feeding habits.

Wings of Flies. — True flies never have more than one pair of wings, which are on the second thoracic segment (mesothorax), and which correspond to the forewings of butterflies and to the elytra, or wing covers, of beetles. The hind wings, on the third thoracic segment (metathorax), have become modified into stalked organs like drumsticks, known as halteres, which are used to maintain stability in flight. The halteres vibrate in a fixed plane, and if the fly pitches. rolls or yaws in flight, nerve cells at the bases of the halteres are excited, producing impulses that affect the musculature in such a way as to make the necessary corrections in balance. This is similar in principle to the automatic pilot of an airplane.

The veins, or stiffening ribs, of the wing follow a definite pattern, which is remarkably constant in each genus and even in each species and thus proves of great value in classification. All flies have strong veins supporting the leading edge of the wing, as is shown in the examples illustrated in fig. 2. Some, like the horseflies (*Tabanus*), have most of the veins that were present in the hypothetical primitive insect; others, as shown, have fewer and weaker veins over much of the wing. These variations undoubtedly affect the functioning of the wing in flight, but exactly how remains to be explained. Also to be determined is whether a correlation exists between wing venation and observable differences in flight among flies.

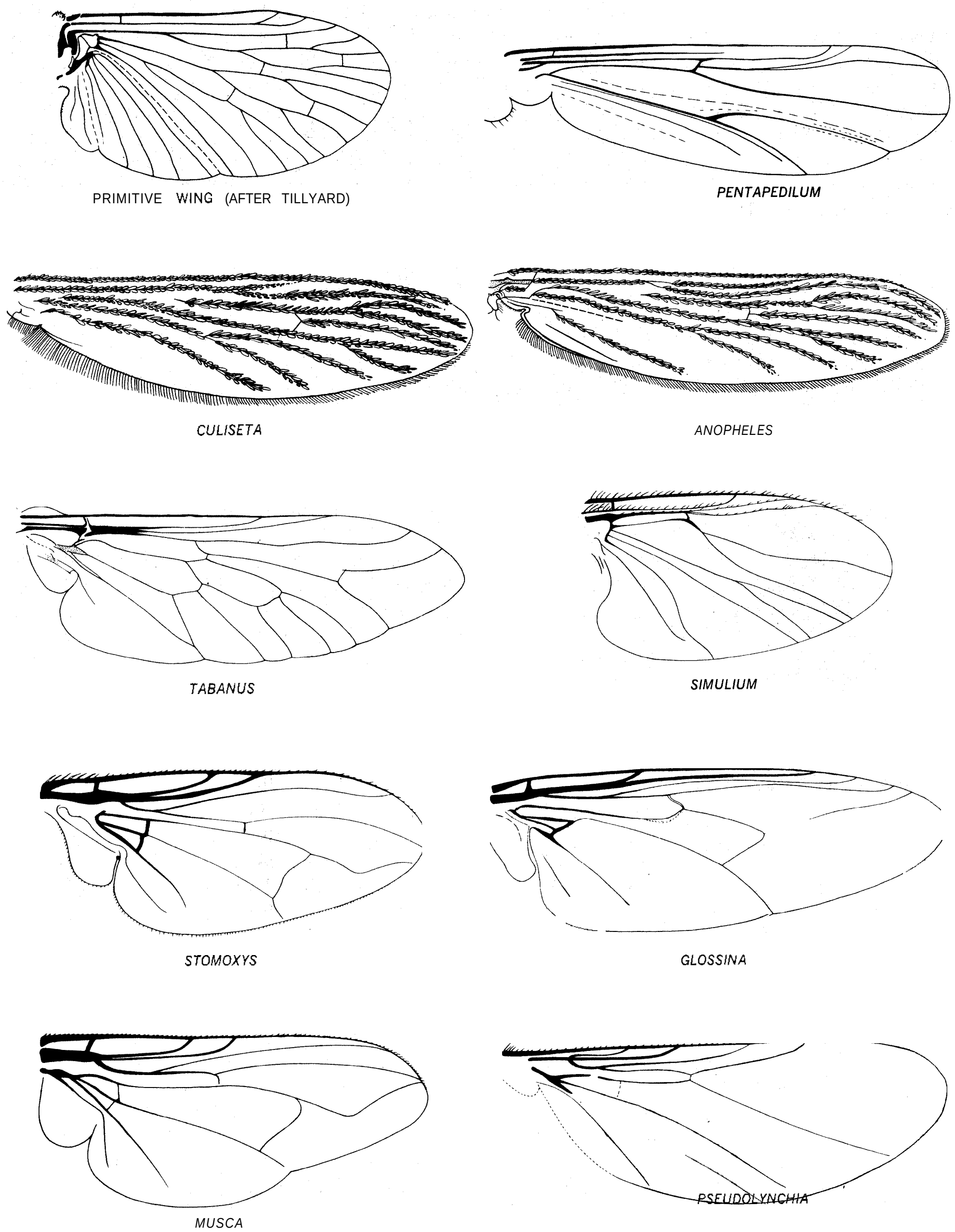
There are many flightless flies in which the wings are reduced in size, peculiar in shape, or missing altogether. A few species have functional wings that are used for the nuptial flight, after which they are broken off near the base. Flightlessness in certain flies may generally be associated with a parasitic life or with isolation on a remote island, on a high mountaintop, in a cave or in any habitat that is so restricted that a winged insect might easily stray and be unable to make its way back again. Yet this is not the whole story: the family Nycteribiidae, parasitic on bats, are all wingless; the family Streblidae, equally restricted to bats, are mostly fully winged. Flightless flies occur sporadically in many different families and, while some advantage can usually be seen in the loss of wings, it would seem that other flies can live in the same situation and still retain their powers of flight.

Despite the reduction or absence of wings, wingless flies can be recognized as belonging to the Diptera by the structure of the thorax, which always retains some of the modifications suited to the possession of one pair of wings. The dorsal, or upper, aspect of the thorax consists mainly of the dorsally enlarged middle segment, or mesothorax, which has evolved to accommodate the huge muscles of flight; the prothorax and metathorax, by comparison, are insignificant. The lower, or ventral, aspect of the thorax is much more equally divided into three segments, to each of which a pair of legs is attached.

Mouth Parts and Feeding Habits. — Adult flies feed upon fluids, which they draw up through a tubular proboscis. The component parts of the proboscis, when they are all present, are the same as those of grasshoppers or of beetles, which masticate solid food: labrum, or upper lip; a pair of mandibles; a pair of maxillae, with maxillary palps; a hypopharynx; and a labium, the lower lip. In flies these mouth parts are combined in various ways to form two distinct tubes (fig. 3), saliva being expelled through one and liquid food drawn in through the other.

Flies can be broadly divided into those that "mop-up," or sponge, liquid food from an exposed surface and those (erroneously called biting flies) that pierce the skin of another insect or of a vertebrate animal in order to suck blood.

Flies With Spongelike *Mouth Parts.*—The basic food of both sexes of most flies is carbohydrates. mostly in the form of nectar and pollen, and, of course, water and perhaps mineral salts. To get these substances. flies frequent flowers, pools of water, fresh dung, and most damp, rotting or fermenting matter. The great majority of living flies do not pierce skin or suck blood, but satisfy themselves with liquid food mopped up by the labium. The tip of the labium is divided into two lobes, called labella, the inner faces



FROM HERMS, "MEDICAL ENTOMOLOGY"; BY PERMISSION OF THE MACMILLAN CO., PUBLISHERS

FIG. 2.— WINGSOF DIPTERA

of which are lined with tiny, branching, open tubules, the pseudotracheae (fig. 3).

In normal use these tubules act as a fine sieve, allowing only liquids and the most minute solid particles to enter the proboscis, They are modified in various ways to suit the feeding habits. In many flies the labella has become a huge, spongelike organ, as in the housefly (fig. 4).

Flies With Piercing *Mouth* Parts. — The basic carbohydrate diet suffices to provide the adults of most flies with energy for flight and mating, but the females of some species need proteins to provide nourishment for the eggs. The habit of bloodsucking. interpreted as a way of obtaining this extra protein, was therefore primitively confined to female flies. This situation persists in such families as mosquitoes (Culicidae), black flies and buffalo gnats (Simuliidae), sand flies (Psychodidae), biting midges (Ceratopogonidae) and horseflies (Tabanidae).

At least some of these bloodsuckers can lay one batch of eggs without a blood meal. but all require blood before they can ripen a second batch. According to J. A. Downes (1958) the ancestral flies were apparently bloodsuckers. The mandibles and maxillae are drawn out into lancet blades, or stylets, which, by means of a combination of sharpened edges and backwardly projecting teeth, are suited for piercing the skin of vertebrates and lacerating capillaries. The released blood is drawn up into the food channel of the proboscis.

Some flies that earlier evolved spongelike mouth parts, losing the stylets, have secondarily developed piercing adaptations, associated with the return of these species to a bloodsucking habit. Thus robber flies (Asilidae) and dance flies (Empididae) have the hypopharynx, which bears the salivary duct, sharpened at its tip, and usk it like a bradawl against their insect prey. Many flies with big, spongy labella are able to turn these back to expose a pair of prestomal "teeth," with which they can rasp through the skin of other insects (*e.g.,* in Dolichopodidae) or even vertebrates and man (in *Musca crassirostris*).

The really efficient bloodsuckers of this group. such as the tsetse fly (*Glossina*), its relative the stable fly (*Stomoxys*) and the parasitic Hippoboscidae, Nycteribiidae and Streblidae have hardened the labium and reduced the spongy labella. while retaining prestomal teeth, so that the proboscis becomes a sort of miniature hollow drill In all flies that have redeveloped the bloodsucking habit this modification of the proboscis has been adopted by both sexes.

STRUCTURE

Size. — Flies have a tremendous range of size. The smallest midges are about 1 mm. long, and are difficult to see, except when a swarm is caught by sunlight and appears as a cloud of dancing specks. The largest robber flies (Asilidae) may be almost 3 in. (75 mm.) long, with a 2- to 3-in. wing span; the bulkiest flies, Pantophthalmidae, and some Asilidae, are not quite so long, but may be about 50 mm.. their bulk exceeding that of the tiny midge by about 125.000 times.

Shape.—Flies vary from slender. elongate insects, like the crane flies (fig. 5), to thickset, bristly flies like the housefly and bluebottle. Nearly all have a large, mobile head, a great part of which is occupied by the compound eyes. Male flies of many species are holoptic, the eyes meeting in the middle line and almost obliterating the rest of the head; females are almost invariably dichoptic, the eyes being separated by a strip called the frons. Where this difference is present, the sexes are easily distinguished, but in Xsilidae and in many families of the Acalypterae (see below) both sexes have separated eyes. In the family Diopsidae and in a few genera in other families, the eyes, held far apart at the end of long stalks, have the appearance of some sort of range finder.

Simple eyes, ocelli, believed mainly to perceive intensity of light rather than to make an image, are found in many flies as a group of three at the top of the head (vertex). Ocelli are clearly not essential, since flies without them seem in no way handicapped.

Body Parts.—The relative size and shape of the eyes and antennae among various families of flies vary considerably (fig. 6). As in other insects the antenna is composed of three parts: the basal segment, or scape; the second segment, or pedicel; and the remaining end portion, called the flagellum, which though superficially subdivided is one long compound segment. The long-horned flies, suborder Nematocera (literally, "thread-horn"), are so-called because nearly all the members have a long, threadlike flagellum consisting of a number of similar divisions. In the rest of the Diptera, the short-horned flies, the flagellum is much shorter, and constitutes a complex third segment that is variously modified but generally carries some of its divisions in the form of an appendage called either a style or an arista, according to its length and point of attachment.

The mouth parts have already been discussed. The maxillary palps are generally prominent, but only rarely take on a distinctive shape.

The thorax is always remarkable for the great development of the middle segment (mesothorax), but otherwise does not vary very greatly. Occasionally it bears spines of unknown function (*e.g.,* in Stratiomyidae and some Diopsidae). The posterior section of the mesothorax is the scutellum, a shield-shaped structure that seems to play an important part in flight mechanics. Occasionally the scutellum is enlarged: in Thyreophoridae it is abnormally long and triangular, and in Celyphidae it covers the abdomen dorsally, making these flies look like bee-tles.

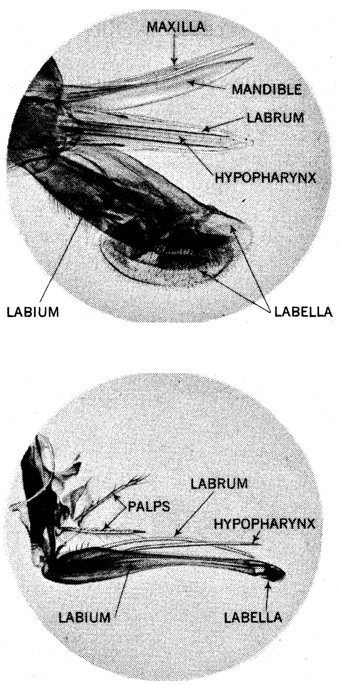


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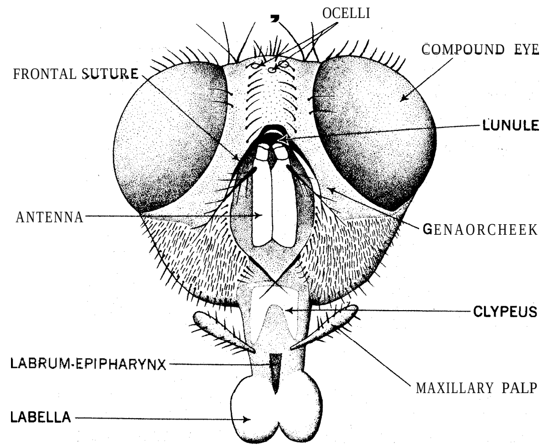
FIG. 3.—THE TWO TYPES OF PIERCING MOUTH PARTS OF BLOODSUCKING FLIES (GREATLY MAGNIFIED)

(Above) Mouth parts of a horsefly (*Tabanus*), showing bladelike maxilla and mandible, and spongelike labella; (below) mouth parts of a stable fly (*Stomoxys*), showing the reduced maxilla and mandible, the palps and the thin, hard labium and labella produced as the piercing organ

The legs have all the segments well developed: coxa; trochanter; femur; tibia; and five-segmented tarsus. The legs are generally bristly. and in predaceous flies (*e.g.,* Asilidae, Empididae, Ephydridae) the femur and tibia of one or more pairs are often enlarged and equipped with strong spines or bristles that aid in seizing prey. Often the male may have the legs specially adapted to grip the &- male during pairing, and in some species (notably in Dolichopodidae) the tarsus and sometimes the tibia are broad and bear conspicuous tufts of hair or scales white or brilliantly coloured, which are used in a courtship display. The tip of the tarsus ends in a pair of claws, particularly strongly developed in parasitic flies; beneath each claw there is generally a pad called a pulvillus and centrally an empodium, which may be either a similar pad or a fine bristle.

The abdomen may be long and cylindrical or short and barrel-shaped, but nearly always the segmentation is clearly shown. Usually from four to seven segments are clearly visible, and constitute the abdomen proper. or preabdomen; the eighth to eleventh segments make up the postabdomen, which provides the organs of copulation in male flies and the ovipositor, or egg-laying apparatus, in females. The male postabdomen is very flexible and may be rotated round its longitudinal axis through anything up to 360°, in correlation with differences in the attitudes of the two partners during pairing. The shape and structure of the ovipositor of the female is directly adapted to the method of egg laying. If the eggs are merely dropped onto the ground, the ovipositor is very simple, but if they are laid inside the heads of grasses and in similar places, the ovipositor may be a bladelike organ. Flies that penetrate plant tissue, including fruit flies (Trypetidae or Tephritidae) that pierce the rind of young fruit, have a telescopic ovipositor; those laying eggs in sand or loose earth may have spiny or bristly ovipositors that assist in excavation.



FROM A. D. IMMS 'GENERAL TEXTBOOK OF ENTOMOLOGY' METHUEN & CO

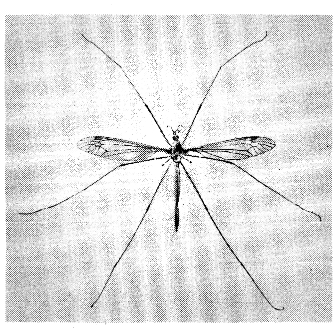
FIG. 4.—HEAD AND MOUTH PARTS OF A FLY OF THE FAMILY **MUSCIDAE** (GREATLY MAGNIFIED)

LIFE HISTORY

Early Stages.—Flies are holometabolous insects; that is, they hatch from the egg as a larva that is quite different from the adult insect in shape and in habitat. At the end of larval life the insect passes through a quiescent pupal stage during which a complete metamorphosis occurs, the larva being transformed at one step into the adult fly, which emerges from the puparium in its final form. After a few hours the newly emergent adult has hardened fully and developed its full size and colour (fig. 7, 8). Contrary to popular belief, small flies never grow into big ones.

Egg.—The eggs of most flies are spindle-shaped and smooth (only rarely with external structures) : the eggs of some anopheline mosquitoes are supported in water by air floats, whereas the eggs of some Drosophilidae and some Muscidae have respiratory "horns" or lobes that, according to H. E. Hinton (1959), ensure a supply of oxygen to such eggs, which are liable to be submerged in rain water. The egg-laying female nearly always lays eggs where the larvae will be able to find its food at hand.

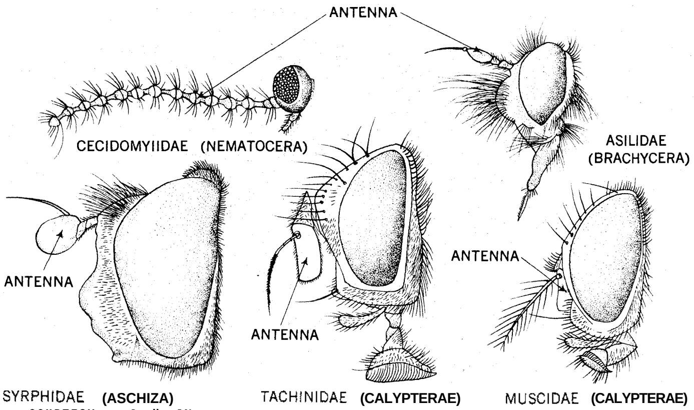
Larva.—The larvae of a very large number of flies feed upon decaying matter, either of vegetable or animal origin. That is why this order of insects has acquired an unsavoury reputation, though in fact these larvae are doing an invaluable service in breaking down organic material and redistributing its elements. Thus compost heaps and all natural media of this nature, including leaf mold, rotting seaweed and the like, are the breeding places of great numbers of flies. Other fly larvae live in carrion and in animal flesh of varying stages of decay. Dead bodies pass through a sequence of stages as the processes of putrefaction go on, and there is a corresponding succession of larvae, each group of flies laying its eggs at such a time that their larvae appear when conditions of temperature, humidity and acidity are best for that species. Larvae living inside growing plant material and causing damage and loss of crops include those of gall midges (Cecidomyiidae), frit flies (Chloropidae) and large fruit flies (Trypetidae).



BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM (NATURAL HISTORY)

FIG. 5.—CRANE-FLY (TIPULA FULVIPENNIS); ABOUT NATURAL SIZE

As among larger animals there are herbivores and carnivores



BY COURTESY OF C H CURRAN

FIG. 6 — HEADS OF FLIES OF CERTAIN FAMILIES, SHOWING DIFFERENT TYPES OF ANTENNAE (MAGNIFIED)

or their equivalents. In a mass of dung. for example, there are larvae that feed upon the dung itself or upon the molds that grow on it; these are the primary feeders. which themselves are preyed upon by other dipterous larvae. According to D. Keilin, many Muscidae begin life in the first group. but as the larvae become larger and more rapacious they start to prey on their fellows. On vegetation. in the soil and in rotten wood are carnivorous larvae. notably of Syrphidae, Tabanidae and Stratiomyidae, that apparently roam about devouring anything they come upon Many of them live in wet soil or in mud beneath water The truly aquatic dipterous larvae also are divided into primary and secondary feeders.

Simuliidae. most Chironomidae, mosquitoes (Culicidae) and some Syrphidae feed on minute organisms, nhich they sweep into their mouths nith mouth brushes: some mosquitoes. Stratiomyidae. Tabanidae and Ephydridae have exclusively carnivorous aquatic larvae. Larvae of Ephydridae may lead a predaceous existence in most inhospitable media, including brine pools and even pools of crude petroleum round oil wells (the "petroleum fly" of California).

Dipterous larvae never have true. segmented legs such as are seen in, say, larvae of beetles. They often have other appendages, however: gills for breathing under water: telescopic siphons for reaching to the open air; prolegs, or fleshy swellings with spines, which are used to get a purchase when crawling or for clinging to underwater vegetation; or lateral fringed processes that may increase the surface area and help to keep the larva from sinking in a very liquid medium.

Larvae of the more primitive families of the suborder Nematocera generally have a well-developed head. with chewing mouth parts and conspicuous mandibles. Their bodies, usually rather elongate and often with spiracles or breathing apertures on the thorax and on each abdominal segment (*e.g.*, fungus gnats, or Mycetophilidae), have a fairly characteristic form in each family. In the more advanced families, especially in the Cyclorrhapha (see below), the larvae are either grublike or maggotlike; they have no head capsule, and their mouth parts are "mouth hooks," visible through the transparent skin.

The head end of a maggot is pointed, and the posterior end is bluntly truncate; there is one pair of inconspicuous spiracles on the prothorax and a larger. more obvious pair at the posterior end. The shape of these larger spiracles is often the only good structural character that can be used for identification of various larvae.

The larvae of Nematocera can usually be named to the family and sometimes, as in mosquitoes. even to the species; among the maggotlike larvae of the higher Diptera such a small proportion have ever been matched with their adults. and the differences between them are so slight. that identification becomes inspired guesswork, based as much upon where the larva was found as upon its systematic characteristics.

The length of larval life varies very considerably. The flies that are of practical importance as medical or agricultural pests are generally those that have several generations a year, and so are able to multiply rapidly during a favourable season. Such flies require about three weeks to proceed from egg to adult, of which time the egg may occupy about two days and the larva and pupa about nine days each. This duration, however, is much affected by temperature and humidity, and larval life may be greatly prolonged under unfavourable conditions. In cold weather a housefly may spend a much longer time as a larva, and many flies have only one generation a year, passing the winter either as larvae or as pupae.

A few flies may have a larval life of two years or even longer. This is particularly true of larvae of Tabanidae. which are predatory on other soil-living insects and which must often go for long periods without meeting any suitable prey.

Pupa.—Most larvae of flies leave their food material when they are fully fed and ready to pupate. Some aquatic groups. notably mosquitoes and the rat-tailed larvae of Syrphidae. have an aquatic pupa that remains in the water: but other groups. such as horseflies (Tabanidae), move to the muddy margins of ponds or streams to pupate. Most larvae that feed either in plant tissues or in rotting materials move out to pupate in the soil or in a dry, sheltered place, often some distance from their larval habitat.

The pupae of the more primitive families reveal externally the structures — head, antennae, legs. wings, etc.—of the developing adult (fig. 7). In addition they may have other structures peculiar to the pupal stage, *e.g.*, the powerful spines in Asilidae and Bombyliidae, which are used by the pupae to move to a more convenient place before the emergence of the adult. The pupae of the Cyclorrhapha are entirely enclosed in a puparium. a protective case formed from the skin of the last larval stage. Such puparia are barrel-shaped and generally brown, red or black. The structures that show through the puparium are anterior and posterior spiracles and bands of spicules of the larvae; no adult structures can be seen externally. A cocoon, on the other hand, is a pupal shelter made from extraneous materials such as soil, sand, silk, etc.

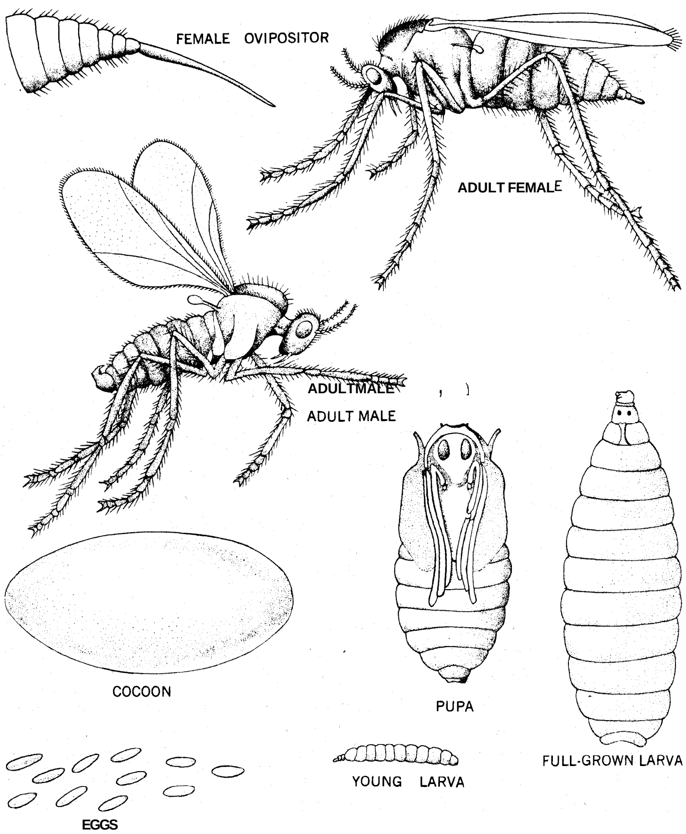


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FIG 7 — LIFEHISTORY OF THE ROSE MIDGE (DASYNEURA *RHODOPHAGA*) (ALL VIEWS GREATLY MAGNIFIED)

Cocoons occur sporadically throughout the Diptera, when the circumstances of pupation call for extra protection.

CLASSIFICATION

True flies fall into three suborders. which are usually referred to as Nematocera. Brachycera and Cyclorrhapha. There have been two lines of evolution from the ancestral Diptera, one of them leading to the Nematocera, which first appear in Upper Triassic deposits (about 170,000,000 to 180,000,000 years ago); along the other line, those families that have remained fairly primitive from the Lower Jurassic (beginning about 160,000,000 years ago) onward constitute the Brachycera, whereas those of the Tertiary (beginning about 70,000,000 years ago) are the most advanced flies, the Cyclorrhapha, and appear to be in active evolution at the present time. Although there are about 90 families of flies, it is relatively easy to place almost any adult specimen in its family. Identification of larvae, as has been noted, is much more difficult.

The following outline is one of several taxonomic schemes applied to the Diptera:

Suborder Nematocera
" Brachycera
" Cyclorrhapha
Series Aschiza
" Schizophora
Section Acalypterae
" Calypterae

Suborder **Nematocera.**—As mentioned earlier the name refers to the threadlike flagellum of the antenna, composed of a number of similar divisions that are inaccurately called segments. The maxillary palps also have several segments, and droop instead of projecting forward. Flies of this suborder might collectively be called the midges and gnats. Most of them are tiny or fragile, or both.

Tipulidae are the slender-bodied crane flies (sometimes called "daddy longlegs" because of their resemblance to the spider so called), with long, thin legs that are easily broken off. The familiar crane flies are fairly big, but the majority of the family are small and not often noticed. About 10,000 species have been described. The larvae live in moist situations where there is plenty of decaying vegetable matter. Some are pale and fleshy, like many larvae that live inside food material that they need never leave; others, which feed at the roots of plants (including grasses) and which come out on the surface at night, have a tougher skin and are known as leatherjackets (*q.v.*). A few tipulid larvae are carnivorous.

Closely related are Tanyderidae, a small, primitive family; Ptychopteridae, which have an aquatic larva with a respiratory "tail"; Trichoceridae, the winter gnats, which prefer cool, shady places in summer, and which come out on quite cold days in winter to dance in the sunlight; and Xnisopodidae (Rhyphidae), which have similar habits, but also breed in damp places indoors and often appear on windows.

Psychodidae are small, hairy midges, which are divided into the bloodsucking and the nonbloodsucking groups. The former, the Phlebotominae, are the true sand flies, though the name is often used for the Ceratopogonidae (*see* below). They occur in the drier tropical and subtropical areas, and transmit a number of diseases (*see* ENTOMOLOGY: *Medical and Veterinary Entomology*). The nonbiting Psychodinae, the moth flies, have broad wings covered with hair and scales. They breed in damp places in organic matter, and are common round drains and sewers. The larvae of some species are abundant in the filter beds of sewage works, where they play an active part in breaking down the sludge. Most houses have a few of them about.

Chironomidae are the familiar midges that dance over the water on summer evenings. Their larvae are mostly aquatic, and some that live in stagnant conditions have hemoglobin in their bodies and are called bloodworms. The adult midges are fragile, elongate flies, usually pale green; the males often have very bushy antennae. The behaviour of the swarms in relation to air currents and to moving objects is an interesting field of study.

Ceratopogonidae are tiny, bloodsucking relatives of the Chironomidae, and are called biting midges, and also "punkies," "noseeum's" and often, inaccurately, sand flies. *Culicoides* is the best-known genus. The larvae live in damp, decaying vegetation. The adults bite most intensely early and late in the day. Some genera attack other insects, sucking fluid from the wing veins.

Blepharoceridae are an aquatic family, the larvae of which have special suckers with which they cling to boulders in rapid streams; the adults have a characteristic network of fine wing veins. Deuterophlebiidae are closely related. Thaumaleidae (Orphnephilidae) are another aquatic family, with larvae similar to those of Chironomidae.

Simuliidae are the black flies, turkey gnats or buffalo gnats, the last name aptly describing their humpbacked appearance. The adult flies suck blood from man and other mammals and from birds. They cause extreme annoyance to and loss of blood from their victims: and in some tropical countries carry onchocerciasis, a disease caused by a nematode worm that parasitizes the flies. Many cases of blindness arise from this infection. The larvae of Simuliidae live in water that is rich in oxygen, either rapidly flowing water or water supporting a great deal of aquatic vegetation. The larvae attach themselves to rocks or plants by a posterior sucker and filter food from the water with mouth brushes. The pupae are also aquatic, and have respiratory filaments.

Bibionidae are shining flies, mostly blackish, with a hairy covering and the legs armed with elaborate spurs. *Bibio marci*, St. Mark's fly, is conspicuous about the Feast of St. Mark (April 25), while *Dilophus febrilis* (undeservedly called a "fever fly") often occurs in great numbers, especially on blossoms, in spring. The larvae are sometimes found in great numbers at the roots of plants, which they may damage. Scatopsidae are superficially very similar but have no tibial spurs, and the eyes form a bridge over the antennae. They breed in decaying material and excrement, and sometimes appear on windows.

Mycetophilidae, or fungus gnats, are very small, fragile, dull black insects, soft-bodied and with filamentous antennae. They are common in all cool, moist places. and their larvae are believed to feed on molds and fungus growths. Some breed directly in fungi and may be a pest to growers of mushrooms. The Sciaridae used to be placed in the same family, but are now separated: they have the eyes meeting in a bridge over the antennae, like the Scatopsidae. The larvae of some Sciaridae, which migrate in columns, are called army worms.

Cecidomyiidae, gall midges, are very fragile flies that are little-known as adults. Many of their larvae live in plants and cause them to form galls, but a number are free living in decaying materials or are predatory or parasitic on other small insects. The larvae are remarkable among Nematocera in having no head capsule, and indeed almost no structure, except for a clove-shaped "breastbone" that is a useful aid to recognition. The larva of the Hessian fly, *Phytophaga destructor*, causes the stems of winter wheat to break. The genus *Miastor* is able to reproduce by paedogenesis; *i.e.*, its larva may be seen to be filled with a mass of daughter larvae, which consume their parent before she has metamorphosed toward the adult stage.

Finally, the family Culicidae comprises three subfamilies. The largest of these is the subfamily Culicinae, the mosquitoes (*q.v.*); the other two subfamilies are much smaller. Chaoborinae are much like mosquitoes as adults. but their larva is different. The phantom larva of *Chaoborus* (*Corethra*) has two conspicuous air sacs that help to adjust the larva's density to match the water in which it lives; it is carnivorous. The Dixinae have adults rather like small crane flies, but their larvae are like those of anopheline mosquitoes.

Suborders Brachycera and **Cyclorrhapha.**—With very few exceptions, all flies other than Nematocera are "Brachycera" in the sense that they have shorter antennae. with the divisions of the flagellum fused into a compound third segment. They can be divided into Brachycera-Orthorrhapha. in which the adults emerge irom the pupa by making a straight or a T-shaped slit; and Brachycera-Cyclorrhapha, in which a circular slit opens a cap in the puparium. It is convenient to shorten these terms to Brachycera and Cyclorrhapha respectively, particularly since the shape of the slit is not a characteristic that can be used in practical identification. In practice all the families are placed in a generally accepted order, starting with the most primitive. M. L. Aczél (1954) proposed the names Orthopyga and Campylopyga for these two suborders. This scheme, based upon the position of the post-abdomen with regard to the preabdomen, is controversial; its chief interest is that it moves the family Dolichopodidae from the Brachycera to the Cyclorrhapha (see below).

Brachycera.—The first group of the Brachycera is the Homeodactyla, with three equal pads (pulvilli) on the foot and no strong bristles between them. Stratiomyidae, the soldier flies, are flower-loving flies, brightly coloured, generally found near water; they often have aquatic, carnivorous larvae. The discal cell (large cell at the base of the wings) is greatly contracted.

Rhagionidae (Leptidae) are primitive in most structures except antennae, and much resemble Anisopodidae of the Nematocera. The adults are furtive (*e.g.,* the downlooker fly). A few suck blood. The females of Atherix ibis and A. variegata die in clusters over their eggs on waterside vegetation. Larvae of the subfamily Vermileoninae live in pits like ant lions.

Tabanidae include horseflies, gadflies, clegs and deer flies. All male tabanids, and the females of some genera, feed from flowers, but females of the best-known genera, especially of Chrysops, *Tabanus* and *Haematopota,* are fierce bloodsuckers. Their larvae live in moist earth, wet sand or mud, and many, but not all, are carnivorous.

Allied to these three families are a number of primitive genera that lie close to the stem of evolution of the Brachycera: various families have been proposed for these, such as Coenomyiidae; Xylophagidae;. Xylomyiidae; Rhachiceridae; Pelecorrhynchidae and Pantophthalmidae. The last-named family includes giant flies (2- to 3-in. wing span), confined to tropical America; their larvae live in wood. Nemestrinidae, with complex wing venation, have larvae that parasitize beetles. Acroceridae (Cyrtidae) are globular little flies whose larvae parasitize spiders.

The group Heterodactyla have only two pulvilli on the foot, with a bristlelike empodium between them. Scenopinidae, window flies, are small and smooth-bodied but have a relatively large carnivorous larva, like a small worm, which is often found in carpets.

Therevidae are hairy, dusty-looking flies, with a larva very much like that of *Scenopinus.* Asilidae, robber flies, are a big family of fiercely predaceous flies; armed with a strong proboscis and protected by many bristles, they will attack even wasps bigger than themselves, catching them in flight and sucking them dry. Apioceridae and Mydaidae are related families, smaller and little-known.

Bo byliidae, bee flies, are covered with hairs and scales, and hover over flowers like bees, or dart in flight like wasps (*Systropus*). Many have a long proboscis. Their larvae are parasites or scavengers in the nests of bees and wasps; they also parasitize the egg pods of locusts and the larvae of moths.

The Empididae are a large family of predaceous flies which are rather like the Asilidae but are recognized by the more spherical head, sharper proboscis and different wing venation. They seem to replace the Asilidae in temperate regions. Males of *Hilara* spin silk from glands in the fore tarsi, and make a bundle: with or without prey, which they offer to the female during mating.

Dolichopodidae, long-legged flies, are bristly and usually metallic blue or green; they are abundant on damp vegetation, and prey on other insects, which they envelop in the labella of the proboscis and tear open by means of prestomal teeth. These mouth part's foreshadow those of Cyclorrhapha and support the view of Aczél, who excludes the Dolichopodidae from the Brachycera; yet the larvae cannot be certainly distinguished from those of Empididae.

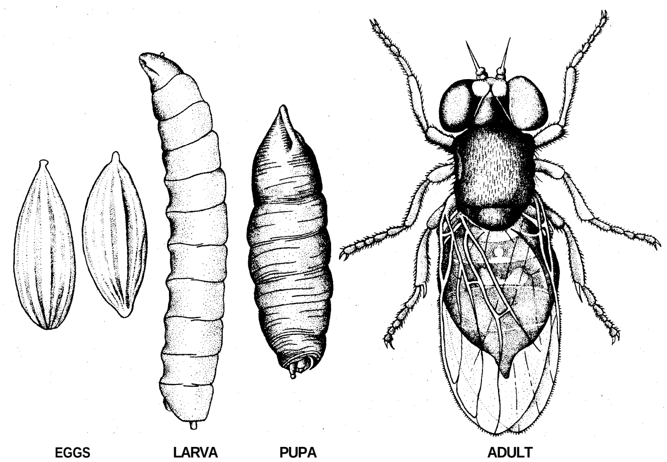
Cyclorrhapha.—*Series Aschiza.*—The first division, series Aschiza, have the small frontal lunule shown in fig. 4 but no frontal suture dividing the frons from the face. The five families included are highly individual, and seem to be evolutionary offshoots at the base of the Cyclorrhapha.

Syrphidae (hover, or flower, flies) are a large family of conspicuous insects. They are smooth, bristleless, shining flies, often large and bulky, with an amazing ability to hover in one place with very rapidly beating wings. Nearly all adult Syrphidae feed from flowers, but the larvae inhabit, almost every kind of possible food material. The beneficial ones devour aphids. The rat-tailed larvae live in stagnant water and have a telescopic breathing tube.

Platypezidae, with peculiar flattened tarsi, live as larvae in fungus; Pipunculidae, with a curious almost spherical head, have larvae parasitic upon plant bugs. Phoridae are tiny black flies with a characteristic wing venation: one or two strong veins near the leading edge and the rest weak and running parallel to each other across the wing. The larvae live in almost any decaying animal matter in a dry or even mummified state. Some live with ants or with termites, and are sometimes separated as a family, Termitoxenidae. Lonchopteridae, in contrast, are small flies with pointed wings; only a few species exist.

Series *Schizophora.*—Cyclorrhapha of this group have a frontal suture, or more properly ptilinal suture, from which is pushed out an inflated sac, called a ptilinum, when the adult fly is breaking out of the puparium, making its way out of the soil. The air in the ptilinum is used to inflate the crumpled adult body to full size, the ptilinum being drawn into the body in the process. The series is divided into two sections, the Acalypterae and the Calypterae.

Section Acalypterae are so-called because the calypter, a flap at the base of the wing, is small and inconspicuous. This is a complex assemblage of species, nearly all small ($\frac{1}{4}$–$\frac{1}{3}$ in.), that appear to be in active evolution, since so few clearly defined groups exist. Conopidae are an exception; they are large flies, wasplike, with larvae that are parasitic on adult bees, wasps and Orthoptera. Among other conspicuous families are Trypetidae, the large fruit flies, which include the Mediterranean and the Queensland fruit flies, and others that are dangerous enough to have legislation directed against them (see FRUIT FLY). Like the related Otitidae the large fruit flies often have patterned, or "pictured," wings. Chloropidae (fig. 8) include the frit fly (*q.v.*) of oats and the gout fly of barley as well as the eye gnats that carry conjunctivitis and the yellow swarming fly that invades houses in autumn. Agromyzidae include many species with leaf-mining larvae that tunnel in leaves and sometimes damage ornamental shrubs. Drosophilidae are world-famous for the intensive research into the laws of heredity that has been carried out on several species including Drosoph-



FROM ESSIG, 'COLLEGE ENTOMOLOGY", BY PERMISSION OF THE MACMILLAN CO , PUBLISHERS

FIG. 8.— LIFESTAGES OF A CHLOROPID FLY (HIPPELATES PUSIO)

ila melanogaster. Many Ephydridae, shore flies, are powerful predators both as adults and as larvae; some are equipped with raptorial legs for this purpose. The petroleum fly, previously mentioned, belongs to this family. In all, there are more than 40 families of Acalypterae, of which a majority breed in many kinds of decaying materials.

Section Calypterae.—These are structurally the most advanced of all flies. Representative of this group are the housefly and the bluebottle — short. stout, bristly, active flies. They generally have large calypters, except in the Cordyluridae. They also have a characteristic cleft in the second antenna1 segment. The species are very numerous and difficult to classify, especially the females, since often the only obvious differences are in the male genitalia.

Only a few large families are recognized, and even these are subject to dispute. Oestridae are parasitic as larvae in the skin and in head cavities of mammals; the sheep nostril fly, *Oestrus ovis,* and the warble fly of cattle, *Hypoderma,* are well-known. These flies have virtually no mouth parts, and during their short adult life they do not feed.

The other Calypterae are divided according to the presence or absence of bristles on a chitinous plate (sclerite) on the side of the thorax, the hypopleural bristles: the families Muscidae and Cordyluridae have none; Calliphoridae and Tachinidae have them present. Cordyluridae, predatory flies with small calypters, are exemplified by the yellow dung flies that may be seen rising in a cloud from cow dung. Muscidae includes the housefly (*q.v.*) and its many allies, most of which feed on fluids by mopping them up. A number, however, including the tsetse fly, *Glossina,* and the stable fly, *Stomoxys,* have a hardened proboscis that can pierce skin.

Tachinidae are very bristly flies with larvae that are parasitic in a number of other insects, and consequently they rank as beneficial to mankind. Calliphoridae differ from Tachinidae in not having a strong convexity of the postscutellum, a chitinous plate of the thorax, and in their habits. Typically they breed in carrion, like the bluebottle, *Calliphora,* and play a useful part in disposing of animal remains. From this feeding habit many have progressed to infesting open wounds, then to attacking living tissues.

The sheep maggot fly, *Lucilia sericata,* and others, cause much distress to and loss of sheep. The Congo floor maggot, *Auchmeromyia luteola,* seems to be a specific parasite of man in its larval stage, whereas *Callitroga macellaria,* the secondary screwworm fly, causes a great loss of tissue and mutilation in man and other animals. *Sarcophaga* and its allies are the flesh flies, remarkable for their habit of producing living larvae, which can begin to feed at once; they are sometimes placed in a separate family, Sarcophagidae.

Disputed Groups. — There remain a few groups of Cyclorrhapha, the position of which is in dispute. *Braula coeca,* a tiny, wingless, beetlelike fly clings to worker honeybees, and its larva lives on the wax of the honeycomb. According to A. D. Imms (1942 j it is placed next to Chamaemyiidae in the Acalypterae.

Adults of Gasterophilidae have reduced mouth parts, and their larvae live as parasites in the intestines of mammals; *Gasterophilus,* in horses and zebra; *Gyrostigma,* in rhinoceroses; *Cobboldia,* etc., in elephants. Although this group seems so like the Oestridae, some authors have suspected mere convergence and removed them to Acalypterae; but F. Zumpt *(1957)* put them back next to the Oestridae.

Finally, there are three families of flies that are parasitic and bloodsucking as adults: Hippoboscidae, on mammals and birds, and Nycteribiidae and Streblidae, on bats. Adult females of these families nurture the larva until it is fully fed and drop it when it is ready to pupate. They have thus long been grouped together as the section Pupipara, and in spite of some criticism this still seems to be the best way to treat them. All Nycteribiidae are wingless, and so are some Hippoboscidae, including the sheep ked, *Melophagus ovinus.*

For a discussion of basic anatomy, function and evolution of flies and other insects *see* INSECT; for economic importance and control *see* ENTOMOLOGY. *See* also separate entries on various flies under their common names, and references under "Fly" in the Index volume.

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FLYCATCHER, the name for songbirds of the family Muscicapidae, a large group numbering nearly 100 genera and many hundreds of species of small birds found only in the old world, where they are distributed throughout Europe, Asia, Africa, Australia, the Malays and the Southwest Pacific islands. They are closely related to the thrushes and old world warblers. They are mostly 5 to 7 in. long. Some are dull-coloured, like the common pied and spotted flycatchers (*Muscicapa*) of Europe, the former grayish, the latter black and white; some are very dark, like the black flycatcher (*Meleanornis*) of Africa. Some are bright, with breasts of orange or yellow or chestnut, or with earwattles of emerald, turquoise, purple, or red among African species. Bright breasts are also found in the yellow robins (*Eopsaltria)* of New Caledonia and the scarlet robins *(Petroica)* of Australia and the Southwest Pacific. The blue fairy flycatcher *(Erannornzs)* is bright light blue with a long fan-tail. A great many species known as fantails *(Rhipidura),* found throughout oriental-Malay-Australian-Southwest Pacific areas. are coloured with gray, brown, rufous or white. The paradise flycatchers *(Tchitrea)* of Africa and tropical Asia, are black and chestnut or white, which also make striking patterns for the long tail streamers. Flycatchers inhabit tree tops or undergrowth in forests, or borders and open moods, both in lowlands and mountains, where they dart from a perch to catch insects on the wing.

The name is also applied to an entirely different family of songless (but not voiceless) perching birds, the Tyrannidae, or tyrant flycatchers, including some four score genera and 400 species confined to the new world and widely distributed from Patagonia to northern Canada and Alaska, though only *11* genera and *31* species occur north of the Mexican border. These include the well known kingbirds *(Tyrannus)* and scissor-tailed flycatchers (*Muscivora*), phoebes *(Sayornis)* and peewees (*Myiochanes*), the noisy crested flycatchers (*Myiarchus*) and the inconspicuous greenish least flycatcher and its relatives *(Empidonax),* as well as the gorgeous vermilion flycatcher *(Pyrocephalus).* They are found wherever there are trees, from which they dart forth to snap their flattened, hook-tipped bills and catch insects on the wing, as do the true flycatchers of the old world. In the cooler parts of their range, flycatchers are migratory, due to winter shortage of flying insects. *See* KINGBIRD; PEEWEE; PHOEBE. (G. F. SS.)

FLYING, COMMERCIAL: *see* AVIATION, CIVIL; TRANSPORT: *Air Transport.*

FLYING BOAT: *see* SEAPLANE.

FLYING BRIDGE, a type of ferryboat propelled by the resistance of a rope or chain attached to a fixed buoy acting against the forces of the stream. The rudder is fixed obliquely which causes the boat to move at right angles toward the buoy. See also FERRY.

FLYING DOCTOR SERVICES comprise a method for supplying medical service by airplane to areas where doctors are few and communications difficult. The plan for the first such service was conceived in 1912 by the Rev. John Flynn, superintendent of the Australian Inland mission of the Presbyterian Church. The large, isolated areas of the Australian outback which lacked highways, railroads and wire or wireless facilities for sending messages were imposing formidable hardships and retarding white settlement. Flynn's dream dawned into reality in May 1928 when the first base of what is now the Royal Flying Doctor Service of Australia began operating at Cloncurry, Queensland, under Dr. K. St. Vincent Welch. Flynn recruited an Adelaide electrical engineer, A. H. Traeger, to develop a low-powered, portable. pedal-driven! Morse radio transmitter-receiver with a range of 300 mi. This "transceiver," with the use of airplanes, made possible the world's first system of regular long-distance medical consultations and the flying of doctors to patients in emergencies. By 1962, 13 bases, run by state branches, covered two-thirds of the Australian continent and part of Tasmania. St. Vincent Welch traveled 20,000 mi. and attended 255 patients in his first year; by the 1960s doctors flew 500,000 mi. a year in 1,600 flights and conducted 10.500 radio consultations with patients at 1,300 outposts; the service also handled 250,000 radio messages annually. The Australian state governments contribute one-third of the finances; the rest comes from voluntary and outpost subscriptions and message charges. The flying doctor service is free.

Other parts of the world regularly use aircraft for the assistance of the isolated sick. In Canada the Saskatchewan Air Ambulance service was inaugurated in 1947; by the end of 1961 it had flown more than 15,000 patients to city hospitals. Newfoundland operates from the International Grenfell association at St. Anthony an air ambulance service, likewise begun in 1947, covering north Newfoundland and Labrador. The Royal Canadian Air Force operates a search and rescue service for Eskimos and Indians in the Arctic.

In east Africa the African Medical and Research foundation, established in 1957 by joint British and American enterprise, was enabled in 1961 to begin a flying doctor service with a single airplane provided by private United States benefaction. In collaboration with this body, the Flying Doctor Service of Africa, Ltd., registered in the United Kingdom, planned a pilot scheme to be based on Gusau, northern Nigeria. (E. A. BE.)

"FLYING DUTCHMAN," a spectre ship believed to haunt the waters around the Cape of Good Hope. Its appearance is considered by sailors ominous of disaster. The commonest legend declares that the captain, Vanderdecken, was condemned for blasphemy to sail round the cape forever, unable to "make" a port. This legend was adapted by Wagner in his opera *Der fliegende Hollander* (produced 1843).

A German form of the legend alleges that the captain, called Von Falkenberg, is condemned to sail forever round the North sea, in a ship without helm or steersman, playing at dice for his soul with the devil. Sir Walter Scott's version, in *Rokeby,* is that the vessel was laden with bullion. A murder was committed on board and the plague broke out among the crew and closed all ports to the ship. The story has frequently been used in literature.

See G. Kalff, *De Sage van den Vliegendea Hollander. Naar behandeling, Oorsprong en zin Onderzocht* (1923).

FLYING FISH, the name generally given to fishes of the family Exocoetidae, in which the pectoral fins are greatly enlarged. The lower lobe of the caudal fin is very long and, with strong strokes of the tail, these fishes emerge rapidly from the water and, with the pectoral fins outspread, sail through the air at a great speed, for distances up to 200 yd. It is probable that the flight is an effort to escape from large piscivorous fishes, such as bonitos. There are numerous species of Exocoetidae, all of them from warm seas.

The so-called flying gurnards *(Dactylopterus)* are not related to the flying fishes. They have relatively larger pectoral fins than *Exocoetus,* but appear to be less efficient fliers, perhaps because the caudal fin lacks the long lower lobe. There are three or four species from tropical seas.

Pantodon, a little African fresh-water fish, has large pectoral fins and is said to fly; but perhaps the most interesting flier is *Gastropelecus,* a Characin of the rivers of South America, a deep-bodied fish nith a large rounded, sharp-edged ventral keel, formed by the greatly expanded coracoid bones, which serve for the attachment of the enormous muscles of the pectoral fins.

This fish has been seen by Eigenmann to progress by rapid beats of the strong pectoral fins, uith the keel just cutting the surface of the water, and finally to emerge in a true, but not prolonged. flight.

The Catalina flying fish (*Cypselurus californicus*) of southern California waters. sometimes 18 in. long, one of the largest known species, is a strong flier, with enlarged ventral as well as pectoral fins.

FLYING FOX or **FOX BAT,** the name applied to the fruit-eating bats of the genus *Pteropus,* which contains more than half the family Pteropidae. This genus is confined to the tropics of Asia, Madagascar, Australia and east to Samoa. It comprises numerous species, a considerable proportion of which occur in the islands of the Malay Archipelago. The flying foxes are the largest of the bats, the kalong of Java *(Pteropus vampyrus)* measuring about a foot in length, and the wings measuring 5 ft. across. Flying foxes are gregarious, nocturnal bats, suspending themselves during the day head downward from the branches of trees with their wings wrapped about them. They are good eating. something like hare. Toward evening these bats fly off in companies to the village plantations, where they feed on all kinds of fruit, doing much damage.

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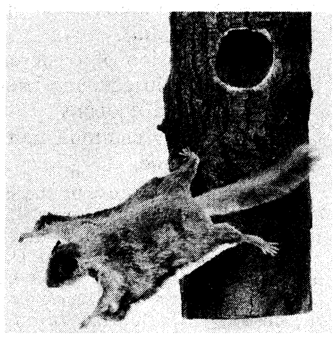
FLYING FOX (PTEROPUS GIGANTEUS)

The flying fox of India (P. *giganteus)* is a smaller species, but is found in great numbers wherever fruit is to be had in the Indian peninsula.

FLYING LEMUR, a name for two species of Cynocephalus (*q.v.*) or Galeopithecus. belonging to the primitive mammalian order Dermoptera, found only in the Australian region. They are called Colugo by the natives.

FLYING SQUIRREL, the name applied to two very different groups of nocturnal, tree-dwelling rodents, in both of which a parachute-like expansion of the skin of the flanks enables them to take long gliding leaps. They all have large, dark-adapted eyes, and are omnivorous, berries, seeds, nuts and insects being the chief diet.

The first group, allied to the true squirrels (Sciuridae), comprises about 11 genera forming the subfamily Petauristinae and occurs from Scandinavia to Japan and the Malay region, and in North America from northern Canada to Honduras. The greater number of species occur in the Indian and Malayan regions; here some, *Petaurista* species, reach large size, more than a yard in total length and may be foxy red, red spotted with white, or black in colour. The gliding membranes of these large species are more extensive than those of smaller forms; a fold connects the hind limbs with the tail. Flying squirrels glide from a position high on one tree to a lower level on another tree or log, sometimes covering 200 ft. or more in a glide. Species of the North American genus *Glaucomys* are



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NORTH AMERICAN FLYING SQUIRREL (GLAUCOMYS VOLANS) smaller buff-coloured sciurids (*see* RODENTIA).

The second group, more correctly called scaly-tailed squirrels,. is African and consists of certain members of the family Anomaluridae, some of which, however, have no parachute. The flying species differ from those of the last group in that the membrane is supported by a bone at the elbow joint instead of by a cartilage at the wrist. There are two flying genera, *Anomalurus* and *Idiurus,* each containing several species. They are all similar in habits to the previous group and, like them, are very squirrel-like in appearance.

The term "flying squirrel" is also applied to certain marsupials but these are more properly called flying phalangers. *See* PHALANGER; MARSUPIALIA. (J. E. HL.; X.)

FLY RIVER, a large stream in southern New Guinea, the largest in Papua. It rises in the Victor Emanuel mountains near the centre of the island and flows first south and then southeast into the Gulf of Papua. It is more than 700 mi. in length and is navigable with a steam launch for a distance of more than 500 mi. from its mouth. For approximately 100 mi. it forms the boundary between Papua and Netherlands New Guinea. The Fly river enters the Gulf of Papua in a great estuary nearly 50 mi. across which is filled with a series of low shifting mud islands. The largest, Kiwai, lies in the centre of the estuary and is inhabited. The effect of the tide is felt for a distance of 150 mi. up the river, and at the point where it ceases the stream is 600 yd. wide and averages 39 ft. in depth. About 300 mi. from its mouth the Strickland river, a tributary as large, and perhaps larger, than the Fly, enters from the north, having its source also in the Victor Emanuel mountains. About 500 mi. from the mouth another large tributary, the Alice, comes in from the right. Perhaps 550 mi. from the mouth the Fly river divides into two nearly equal branches, the one from the left, named the Palmer, being regarded as the tributary. There are no white settlements in the whole vast extent of territory drained by the Fly river, and for the last 400 mi. of its course the land is too low and unhealthy for white occupation, though the natives are fairly numerous. The low country is inundated annually. The first hills are found about 480 mi. up the river, and from here on nights are cool and the climate healthier. Despite its great navigable length the river is commercially unimportant.

The mouth of the Fly river was discovered by Capt. Blackwood in 1842 and named after one of his ships. It was first explored by Macfarlane and D'Albertis in 1875–76.

FLYSCH is a term long used by geologists to denote a particular formation of Tertiary age (1,000,000 to 70,000,000 years) occurring in the northern Alpine region. The term is now commonly applied to similar deposits of other ages and other places.

Although flysch is said to mean "slippery earth" in the local Swiss-German dialect, it is applied by geologists to a sequence of gray shales rhythmically interbedded with thin, hard, dark gray sandstones of graywackelike character. The total thickness is commonly many thousands of feet; the individual beds, however, are thin, a few inches to a few feet in thickness. Fossils, notably rare, indicate marine deposition. The flysch facies is now generally believed to have accumulated in moderate to deep (up to 1,000 fathoms) marine waters. The deposition of coarse angular sands, commonly graded-bedded and locally conglomeratic, is attributed to turbidity flow — catastrophic incursions of debris-laden muddy waters. The extraordinary coarse conglomeratic mudstones found in some flysch are thought to be a product of submarine mudflows.

Flysch deposits characterize many ancient geosynclinal accumulations. Such deposits occur in old Pre-Cambrian formations of Canada. in the Lower Paleozoic of the Caledonian geosyncline in Great Britain, in the Late Paleozoic of the Armorican geosyncline of Europe and in the late Ordovician and in the later Devonian of the Appalachians, in the Alpine Tertiary, in the Tertiary of the Caucasus and the Himalayas and in the Tertiary'beds of the Carpathian geosyncline.

For identification and discussion of periods, formations and terms *see* GEOLOGY.

See also *ALPS.*

See Z. L. Sujkowski, "Flysch Sedimentation," *Bull. Geol. Soc. Amer.,* 68:543–554 (1957). (F. J. P.)

FLYWHEEL, a relatively heavy rotating wheel attached to a shaft, whose principal purpose is to store kinetic energy while there is more energy coming onto the shaft than is departing, and to give up some energy when the energy leaving the shaft is greater than that received.

The amount of kinetic energy which can be stored in a flywheel or any rotating body is a function of the moment of inertia of the body and its angular speed. Thus a given flywheel stores energy only as its speed increases; it gives up energy as it slows down. Almost all reciprocating machines (for example, automotive engines) need a flywheel in order to run smoothly. This can best be understood by considering the operation of a single-cylinder engine. In a two-stroke cycle engine for a lawn mower or outboard motorboat. for example, the explosion occurs and the high gas pressures result in work being done as the piston moves down. Most of the work is done during the early part of the stroke and the amount gradually decreases. hioreover, on the return stroke of the piston, not only is no work done by the shaft but work has to be done on it to drive the piston to compress the gases for the next explosion. Since the law of conservation of energy says that energy is indestructible, the energy to compress the gases must be supplied from somewhere. This "somewhere" is the kinetic energy of the flywheel (and other rotating parts), and the flywheel got it from the excess work done while the pressure of the burned gases was high. Thus, the speed and energy of the flywheel increase while excess engine work is done; then, while the engine is not producing enough energy to do the job, the flywheel supplies the necessary additional energy, slowing down in the process. This speeding-up and slowing-down is ordinarily not noticeable because it happens so quickly.

If a two-cylinder engine is used, so that the explosion occurs in one cylinder while compression takes place in the other, the work done is more uniform. but not constant. In this case, a somenhat smaller flywheel (same speed, speed variation, and power) will do the same job as before. The impulses overlap still more in an eight-cylinder engine, but a flywheel is nevertheless needed.

The size and weight of the flywheel depend not only on how constant the rate of work is but also upon the amount of speed variation that is permissible. If the speed must be nearly constant, as in driving an electric generator, a larger flywheel for a reciprocating engine is required than in most other situations. The larger and heavier the flywheel, the less will be the speed variation.

In such machines as punches and shears, the major part of the work. that is, the actual punching and shearing, is done in only a small fraction of an operating cycle. If a flywheel is used, the machine not only runs with less speed variation but the peak requirement of power from the motor is reduced. In these machines, the motor may be so small that the major source of energy during the cutting operation is the kinetic energy of the flywheel. (V. M. F.)

FOÀ, EDOUARD GEORGES (1862–1901), French 'explorer whose travels increased the knowledge of west and central Africa, was born at Marseilles on Dec. 17, 1862. In 1886–89 he explored the interior of Dahomey, and in 1891–93 made two extended journeys in Nyasaland and the lower Zambesi valley. Finally in 1894–97 he crossed Africa from the Zambesi mouth to Libreville on the Atlantic coast, covering unexplored ground in the upper Congo basin. He died at Villers-sur-Mer, Calvados, on June 29, 1901. His works include *Le Dakomey* (1895); *Chasses aux grands fauves pendant la traversée . . . du Zambèze au Congo Français* (1899; Eng. trans. F. Lees, 1899); and *De l'Océan indien a l'Océan Atlantique* (1900).

See *Résultats scientifiques des voyages en Afrique d'Edouard Foà* (1908). (R. L. HL.)

F.O.B., a contraction for "free on board," an expression used in commerce to denote that a price quoted is inclusive of all costs of carriage and delivering the goods on board the ship or other medium which is to take them to their destination.

FOCA, a town of Bosnia and Hercegovina, Yugoslavia, occupied by Italy in 1941. Pop. (1953) 3,992. It is famous for its silver filigree work and inlaid weapons. The soil produces excellent walnuts. Close to the frontiers of Novipazar and Montenegro, Foca (Chocha) was the scene of almost incessant border warfare during the middle ages. No monuments of this period are left, except the Bogomil cemeteries and the beautiful mosques which are the most ancient in Bosnia. Foca was a trading station of the Ragusans in the 14th century, if not earlier. In the 16th century it was the residence of the governor of Hercegovina. It was captured by the Montenegrins in World War I.

FOCH, FERDINAND (1851–1929), French marshal, was born at Tarbes on Oct. 2, 1851. His father's family had long been settled in the south of France, leaving the district of Ariège in the 17th century to establish themselves as woollen manufacturers in the small town of Valentine where they took a prominent part in municipal affairs. On his mother's side, Marshal Foch came of a race of soldiers, his maternal grandfather having been a gallant officer of the Grand army. His father was a lawyer at Tarbes (Hautes-Pyrénées) who later became a revenue official, and he was frequently transferred from place to place, taking his son with him. The future marshal thus received his education successively at the Lycées at Tarbes and Rodez, the seminary at Polignan and the Jesuit college at St. Étienne.

It was not long before his teachers were struck with his "geometrical mind," and it was decided that he should enter the École Polytechnique, to prepare for which he was sent to St. Clement's college at Metz. After a few months there, however, the war of 1870 interrupted his studies. He enlisted in the infantry but the armistice came before he saw any fighting, and he returned to Metz to finish preparing for his examination. One of his fellow students has described how, in the midst of a lesson, they learned on March 11, 1871, by the booming of the German guns, that the treaty of peace had made Metz a city of the German empire. None could foresee that the young student was destined, as marshal, to restore the city to France.

He sat for his examinations at Nancy, which was still occupied by Edwin von Manteuffel's troops, and was admitted to the École Polytechnique, where he made his mark. In 1873 he was commissioned and served successively at Fontainebleau, Tarbes and Rennes. He then passed into the École Supérieure de Guerre where, after a tour of duty on the general staff, he was appointed a professor on Oct. 31, 1894. His lectures soon made a sensation. both by the evident soundness of the matter and the originality of the form. Even thus soon his pupils bore witness to the excellent qualities of their professor, who presently became one of the leaders in military doctrine, The lessons given between 1894 and 1900, collected in volumes, constitute the chapters of Foch's great works: De la conduite de la guerre and Des *principes* de la guerre, which appeared in 1897 and 1899.

In teaching six batches of staff college students Foch fortified his own military science as well; his years at Paris were, in fact, of capital importance in the higher development of his intellect. When he vacated his post no one doubted that he would return ere long in another capacity. After holding two regimental commands of artillery and spending a year on the staff of the 5th corps, he was, so to say, imposed on the government by the opinion of the whole army as the fittest selection for the command of the École de Guerre that he had made famous. It was Georges Clemenceau—at that time prime minister—who made the appointment, giving him the rank of general, and from that day began the cordial relations between the great statesman and the great soldier which were to be revived later under memorable conditions.

The general held his post as head of the école for four years, during which time he threw himself with untiring zeal into the work of this famous centre for military study, giving it a permanent stamp and forming a whole new generation of picked officers. When, in 1911, he was nominated to the command of the 13th division at Chaumont, Foch was one of the very few outstanding figures of the army, and it was not surprising that after a brief period in command of the 8th corps the wish of everyone acquainted with the higher military personnel brought him to the head of the splendid 20th corps, stationed about Nancy, which was accounted one of the best elements of the "couverture." Thus in 1913 he entered, to the sound of trumpets, the town where he had passed his examinations to the tune of the German army fifes and whence, before long, he was to march out for World War I.

General Foch, who had married Mlle. Julie Bienvenue, had at that time three children—two married daughters and a young son who was destined to be one of the first to fall in the war. Although still attached to his Pyrenean home, the general spent his holidays on a small estate that he had acquired at Trofeunteniou in Brittany. In the summer of 1914 France was so far removed from any idea of attacking Germany that Foch had left Nancy to spend a month in far-away Brittany. A week later events led to his recall.

The **Outbreak** of War.—He was then a man of 63, but his rare moral: intellectual and physical vigour kept him singularly young. Foch was a man of thought and also, above all, a man of action. Gifted with an intelligence which was never allowed to be idle, ever widening the scope of his knowledge, reflective and delighting—to use his own striking phrase—to "phosphoresce," the great soldier was even stronger in will than in intellect. "Victory = Will. . . . Victory goes always to those who deserve it by the greater force of will. . . . A battle won is a battle in which one will not acknowledge oneself beaten"—these are but a few of the maxims found in his books, in which the word will occurs on every page. And in truth, although his gray eyes sparkled with intelligence, the forehead and, even more, the mouth revealed that will which he was able to communicate to all those who came in contact with him in the course of war. It was this will which gave such solidity to his character and protected it from all weaknesses. What is more, it stimulated both conscience and intelligence. He spoke of "these natures, hungry for reponsibility, which alone turn out great men," and his own was one of these natures that no sentimental considerations could either divert or check. For the rest, his clarity of mind translated itself by a realistic and somewhat ironic common sense. "What is it about?" was a favourite phrase of his in all circumstances, for he believed in clear vision before direct action.

The 20th corps formed part of the and army and Foch was therefore one of the commanders of Gen. Edouard de Castelnau's army, which, on Aug. 19, 1914, was thrown into annexed Lorraine. It will be remembered that this army, after some successes, met formidable resistance in the region of Morhange and failed with heavy losses. Foch had had no part in forming the plan. which met with so cruel a check; he was but one of the executants. He had thrown his army corps resolutely at Morhange and, when repulsed, was still able to organize with perfect coolness its retreat on the solid positions of the Couronne de Nancy. Not content to await the enemy there he resumed the offensive and, on Aug. 20, threw himself on the German regiments which were waiting to attack in the "gap of Charmes," and in overthrowing them prepared the victory in Lorraine. He was preparing to take his part there when he was called to the Grand Quartier Général, where Gen. Joseph Joffre entrusted him with the command of an army.

At that time the French were retiring in good order from Belgium and the Ardennes toward the region of the Marne. As a gap tended to open between the 4th and 5th armies. Joffre gave Foch the mission of forming a new army (the 9th) between them, co-ordinating his action with theirs. He was on the ground before the corps entrusted to him had arrived. In a few days he forged out of them a solid and supple little army which was already well in hand when the celebrated order of Sept. 4 arrested the retreat and prescribed the battle which was to lead to the victory of the Marne.

Foch, after passing the marshes of St. Gond, established himself on the heights which dominate the Petit Morin and of which Fere Champenoise marks the crest. It was thought that his role would be limited to supporting Franchet d'Esperey's army on his left. But when the German armies, which instead of turning the left of the French armies as they had expected, were themselves turned on the right, they tried to penetrate the allied centre precisely in this region of Fere Champenoise and Foch had therefore suddenly to support the main strain of the battle, and that with troops inferior in number. The heights were for a moment carried by the Germans from Mondemont to Fère Champenoise. It was then that, by a clever manoeuvre, Foch rapidly transferred the 42nd division from his left to his centre and thus was able to gain the upper hand and force the enemy back. The extreme fatigue of his troops prevented him from pushing his successes, but he hung on to the retreating Germans and entered Chalons-sur-Marne behind them. His part in the victory of the Marne was capital and it was recognized by a glorious citation in general orders. *(See* MARNE, 1ST BATTLE OF.)

His reputation was so increased after this great crisis that Joffre immediately entrusted him with a new mission—this time one without parallel. Scarcely had the operations of the Marne terminated when, the two armies mutually trying to outflank one another, the "race to the sea" set in from the Oise to the Flemish coast which was only to be closed by the arrival of the Belgian army and the formation of a continuous front right to Nieuport. The British corps, for their part, had been moved into the region of Ypres, while Joffre detached from the now stable front between the Oise and the Vosges all the forces that he could spare to meet a great attack between the Oise and the sea.

To co-ordinate the action of the heterogeneous troops hurriedly thrown into these regions, a leader of great authority was wanted at once to take the higher direction of the operations of the French armies and to co-operate harmoniously with the Allied armies so as to assure the co-ordination necessary to victory. On Oct. 4, Foch was sent to the Nord to fulfil this mission with the title of deputy to the commander-in-chief.

He did not limit himself to giving the French armies, from Picardy to Flanders, the most energetic orders but put himself in close and cordial relations with Field-Marshal Sir John French and King Albert I, and established the essential liaison between the Allied armies. Ceaselessly finding the necessary reinforcements and dispatching them to the aid of the hard-pressed British and Belgian corps, he was able by his friendly and generous activity to impose his own resolute ideas and so make himself the soul of the battle of Flanders that, after the fierce fighting of the Yser and of Ypres, ended in mid-November by the definite check of the German invasion for the year 1914. In all this Foch had not merely confirmed his prestige as a strategist but had won for himself the friendly admiration of his Allies so completely that, even then, it could be foreseen that if, one day, circumstances required unity of command there could be no better choice for it than Foch. Did not David Lloyd George say: "He could not have done more for us had he been one of our own generals."

Foch was left therefore in contact with the British and Belgian corps in the capacity of general commanding the Group of Armies of the North. He held the post for two years and thus presided over the two Artois offensives of May and Sept. 1915 and the battle of the Somme (*q.v.*) in the summer of 1916 which the German attack on Verdun prevented from assuming the amplitude and decisive character that had been intended.

After brilliant initial successes the Somme battle seemed to sink in the autumn mud. The disappointment that it caused led to a movement of dissatisfaction with the higher leaders who had presided over it. Joffre having been relieved of his command, Foch was deprived of his also and relegated to Senlis for a mission of inspection. The story was that he was fatigued. This was hardly the case, but he accepted this semidisgrace with resignation and his valuable advice was always at the disposal of Gen. Louis Lyautey, who had become minister of war.

When, in May 1917, Gen. Henri Pétain was called to the chief command, he himself suggested to the government that Foch could be usefully employed in the post of chief of the general staff. Having been sent into Italy on the morrow of Caporetto to establish a much-needed understanding with Gen. Luigi Cadorna's headquarters, and having remained in constant and cordial relations with Field-Marshal Sir Douglas Haig, there was little doubt that when the time came Foch mould appear as the single commander that so many people desired by the end of 1917. When, in March 1918, the Germans launched their first grand offensive and the Allied line threatened to break, the necessity of this command became obvious to everybody. It was at Doullens that Foch, on March 29, received from the representatives of the French and British governments that mission of higher co-ordination that on April 14 became more precise in the form of the chief command of all the Allied armies fighting in France. Already he had grasped this command with a firm hand. As a result of the close cooperation of the Allies he stopped the Germans at the gates of Amiens, and thereby brought about the final failure of their attempt to break the Anglo-French front and penetrate to the channel.

Henceforward his whole energies were directed toward assuring this fruitful co-operation. Thus he brought strong French reinforcements to help the British armies, attacked in March and April, and engaged British and U.S. divisions in the battle of the Aisne in May, twice checking German offensives that for a moment were triumphant. And when the Germans came to a standstill in the pockets that they had driven into the Allied front, he prepared the counteroffensives which, when the hour struck, were to shake and crumple the German front.

The counteroffensive was on the point of being launched against the flanks of these pockets, from the Aisne to the Marne, when, on July 15, a new German offensive took place *(see* MARNE, 2ND BATTLE OF). This met with a partial check which had the effect of deepening the pocket in which Foch intended to grip the enemy. The victorious attack of July 18 on the enemy's flanks forced him to retire and gave the signal for the grand Allied offensives.

Foch was now determined to halt no more. He realized that the German armies were beginning to be exhausted but that if they were to be overthrown, the blows must fall thick and fast. The great offensive of Aug. 8 in the region of the Somme which, as it gradually spread and became more violent, forced the Germans to retire on to the Hindenburg line, was almost immediately followed by the new offensive against that strong position where French and English vied with each other in valour. Once the line had been forced, Foch launched his famous directive of Sept. 3 which was in fact the program of the general attack. The stages of this semiconcentric attack are well known. It stretched from the Meuse into Flanders and was designed to draw the enemy from all parts back on to the region of the Ardennes where Foch hoped to pin them and grasp them. The directives, which issued from the headquarters of Bombon (and later, Senlis), are clear, resolute and pitiless. At this point Pétain, Haig and Pershing worked in closest harmony with their French colleague. The directives of Oct. 10 and 19 were followed by successes—hard won and unequal, it is true, but which on Nov. 5 culminated in the general retreat of the beaten and exhausted German armies.

Foch, following them closely, had already prepared an operation on a large scale to make an end of them. While the Germans were to be thrown back into the difficult Ardennes region, a huge group of armies under the orders of Castelnau, with Gen. Charles Mangin as principal executant, were to attack on the Moselle and the Sarre and. reaching the Rhine, were to bar the line of retreat from the encircled Germans. It was at this point that the Germans asked for the Armistice. On Nov. 8 Foch, who had been engaged in drawing up the conditions for three weeks past, received the German plenipotentiaries at Rethondes and by his masterful attitude brought them to accept all conditions on Nov. 11, obtaining with the occupation of the left bank of the Rhine the results which he had expected to gain from the supreme battle.

The career of Foch was not at an end. Europe acclaimed him as the leader who had secured the victory. Marshal of France since Aug. 7, he now became a British field-marshal and later a marshal of Poland. He was elected a member of the *Acade'mie française,* which body, emulating the *Acade'mie des sciences,* gave him a wonderful reception, and at Paris, on July 14, 1919, he passed under the *Arc de triomphe de l'e'toile* at the head of the victorious troops. From New York to London and from Brussels to Warsaw he passed from triumph to triumph. He was not, however, content with a parade role, and, as president of the Inter-Allied military commission. he was repeatedly called upon to take measures in support of the action of the Allied governments. In Jan. 1929 the marshal was taken ill and after a long wasting illness, he died suddenly on March zo. He lay in state beside the grave of the Unknown Soldier at the Arc de Triomphe, and was then laid to rest at the Invalides near the tomb of Napoleon. *(See* WORLD WAR I.)

(E. M. L. M.)

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De la conduite de la guerre, 3rd ed. (1915); *Prkceptes et jugements du Markchal Foch extraits de ses oeuvres, précédés d'une Ctude sur la vie militaire du maréchal par A. Casset* (Nancy, 1919) with English translation by Hilaire Belloc (1919). *See* also A. *H.* Atteridge, *Marshal Ferdinand Foch* (1919); A. L. Grasset, *Le Maréchal Foch* (1919); H. de Lacroix, *Le Maréchal Foch* (1921); P. Painlevé, *Comment j'ai nommé Foch* (1923); R. Recouly, *Foch, His Character and Leadership* (1920) and *Foch, My Conversations with the Marshal* (1929); E. Mayer, *La psychologie du commandement* (1924); Maj. C. Bugnet, *Foch Speaks* (1929); Sir George Grey Aston, *Marshal Foch* (1929).

FOCŞANI, a town of Rumania, in the region of Galatz; on the Milcov river, which formed the ancient frontier between Moldavia and Walachia. Pop. (1956) 28,244. The chief buildings are the prefecture, schools, synagogues, and many churches, including those of the Armenians and Protestants. It is a commercial centre of some importance, the chief industries being oil and soap manufacture and tanning. A large wine trade is carried on, and corn is shipped in lighters to Galatz. The annual fair is held on April 29. The vicinity is rich in iron, copper, coal and petroleum. Near Focşani the Turks suffered a severe defeat from the Austrians and Russians in 1789.

FOCUS, a point at which converging rays meet, toward which they are directed or from which diverging rays are directed; in the latter case it is called the virtual focus (see LENS; MICROSCOPE; TELESCOPE). In geometry the word is used to denote certain points, such as the focuses of an ellipse or the focus of a parabola *See* ANALYTIC GEOMETRY; CONIC SECTION; ELLIPSE; HYPERBOLA; PARABOLA; PERSPECTIVE.

FODDER: *see* FEEDS, ANIMAL.

FOG. A cloud in contact with the ground, fog is usually the result of a condensation process taking place in air near and at the earth's surface, but at mountain-summit stations it may be merely the result of clouds formed in the free air and drifted onto the mountain slopes by the winds. (See CLOUD.)

Physical Characteristics.—A fog is a cloud of particles, usually water droplets (water fog) but sometimes of ice crystals (ice fog). There is no essential distinction between fogs and free-floating clouds in the atmosphere. Fogs seldom produce precipitation, if any at only very small rates; in this respect they are similar to many of the free clouds seen in the sky that are not giving precipitation. Fogs and those clouds which do not tend to develop precipitation are said to be colloidally stable; that is, there is no marked tendency within them for the size of some of the droplets to grow rapidly at the expense of the other drops. Clouds (fogs) of this type are characterized by relatively small-sized drops, predominantly much less than 100 μ in diameter (rain drops are 400–1,000 μ), and also their drop-size spectrum (more or less bellshaped in general) has a smaller range than found in colloidally unstable or precipitating clouds. But the size distribution, median and modal size, etc., in fogs vary greatly from case to case, according to the method of formation, history of the fog, its age, the wind, temperature and radiation conditions, thickening or thinning tendency, admixture of smoke or other "foreign" aerosols, effects of rain or snow falling into it from above, etc. Theory and certain experiments suggest that initially a fog formed by a simple adiabatic expansion should have a fairly uniform drop size, assuming sufficient uniformly effective condensation nuclei are present (often the case in nature). Since observations on fogs rarely show this uniform size, it must be assumed that considerable coalescence of droplets takes place with time, through collisions because of turbulence and the faster falling of the resulting larger droplets.

Normally water fogs form and persist at relative humidities of 100%, but many cases are reported with humidities between 95% and 100%, presumably because special nuclei effective somewhat below 100% are present, or because of pollution. However, NaCl particles deliquesce at about 70% relative humidity and this effectprobably explains the fogs and hazes sometimes reported at sea with humidities from 75% to 95%.

The concentration of droplets in fog rarely exceeds 100 per cubic centimetre, and the liquid water contents are usually of the order of hundredths of a gram per cubic metre and less (whereas rain and many warm, unstable clouds have 0.1 to 3 g. per cubic metre.) Fogs, however, often appear to be denser than any clouds, because a large number of small drops is a more effective light-absorbing medium than a smaller number of larger drops.

Various theories of scattering and transmission of light have been applied to fogs, with conflicting results. Measurements show that the transmission is greatest in the visible spectrum, and the difference in transmission of visual colours is trivial.

There is a tendency for the climatological probability of fog formation to decrease at low temperatures, largely because of the very low water content of cold air masses and the unfavourable effects of snow cover and atmospheric circulation conditions where very low temperatures prevail. Fogs of water drops become rare at temperatures below 15° F., and well inland practically none occur between —15° F. and —28° F. Below —28° F., however, ice-crystal fogs frequently appear in the vicinity of towns and airfields where there is moisture given off from combustion of hydrocarbon fuels, and over water surfaces through evaporation. Ice fog has become a serious problem at some airfields in Alaska and northern Canada, where very low temperatures prevail for months each year. Otherwise in the polar night only a very thin frost haze can form; it persists widely over the arctic ice pack in winter.

The visual range in fog has been analyzed as an integral part of the general problem of visibility (*q.v.*) which has defied both satisfactory theoretical analysis and measurement. It is noteworthy that the routine observation of fog as a meteorological element has been confined, in all weather services and observatories, to recording (1) the observer's opinion as to whether or not true fog exists at or in sight of the station at the time of observation, and (2) the observer's estimate of the horizontal visual range, in general or in each direction, in terms of the distance to the remotest object that can just be distinguished. The latter is given in miles, yards, metres or in International Visibility or other code numbers. Until the 1929 International Meteorological code was generally adopted, many different codes for reporting the types and intensities of fog were in use, and as a result the older statistics given in terms of dense, thick, moderate or light fog, mist, haze, days with fog, etc., are often useless for climatological comparisons between stations or countries that used different codes. Significant distinctions have long been observed in some countries between ground fog, high fog, stratus, steam fog, ice-crystal fog, smoke, dust, etc. These morphological categories are of meteorological value, particularly nowadays in connection with forecasts for air navigation, and most of them have been embodied as hydrometeors in the International Meteorological code. The code in the 1950s still defined various intensities of fog in terms of visual range. Careful observers will not file weather reports in which the hydrometeor indicated under "weather" is inconsistent with that indicated under "visibility." Nevertheless, it is a manifestly difficulttask, often requiring arbitrary considerations, for an ordinary observer to decide whether he is enveloped in a thin water fog, or a light haze (British "mist"), or a light obscuration by smoke or dust. Even the dense fog reported in cities may be caused as much by smoke as by water (called a smog). Therefore, a good deal of circumspection is in order when analyzing fog-frequency and fog-intensity statistics. The use of estimated visual range as some kind of a measure of the density and constitution of a fog can be misleading, for the visual range, according to accepted approximate "laws," depends on the liquid water or solid-particle content, the size distribution, the type of particle, the type and intensity of illumination, the background contrast, the observer's eyes, etc. (*See* VISIBILITY.)

Meteorology of Fog.—The treatment of fog phenomena from the point of view of synoptic meteorology or weather forecasting has proceeded along lines largely independent of the study of the physical or chemical constitution of fog. Observations of fog formation and morphology in relation to the wind direction and speed, pressure and temperature distribution, topographical relations, antecedent weather, etc., long ago revealed the basic processes which lead to saturation or fog dissipation. Sverre Petterssen has given the best summarization of the fog processes in the following table:

Fog-producing Processes

1. Evaporation from:
   a. Rain that is warmer than the air (rain-area fog or frontal fog)
   b. Water surface that is warmer than the air (steam fog)
2. Cooling because of:
   a. Adiabatic upslope motion (upslope or orographic fog)
   b. Flow of air across the isobars toward lower pressure (isobaric fog): effect negligible
   c. Falling pressure (isallobaric fog; unimportant)
   d. Radiation from the underlying surface (radiation fog)
   e. Advection of warmer air over a colder surface (advection fog)
3. Mixing:
   a. Horizontal mixing unimportant by itself, and strongly counteracted by vertical mixing

Fog-dissipating Processes

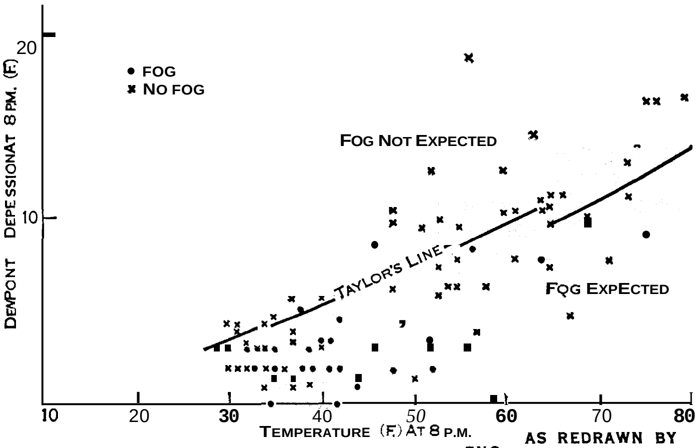
1. Sublimation or condensation on:
   a. Snow with air temperature below freezing (excepting ice-crystal fogs)
   b. Snow with air temperature above freezing (melting snow)
2. Heating because of:
   a. Adiabatic downslope motion
   b. Flow of air across isobars toward higher pressure (effect negligible)
   c. Rising pressure (unimportant)
   d. Radiation absorbed by the fog or the underlying surface
   e. Advection of colder air over a warmer surface
3. Mixing:
   a. Vertical mixing (important in dissipating fogs and in producing stratus clouds)

Source: Sverre Petterssen, *Weather Analysis and Forecasting*, McGraw-Hill, 1940.

It has been the fashion to classify fogs into types each identified with a single process supposed to produce it. While the logic and clarity of such a scheme has obvious advantages for didactic purposes, it is difficult to apply that sort of classification in a strict way to real cases or in the practice of weather forecasting, because several of the processes enumerated are commonly operating together at the same time. The relative importance of the processes varies from case to case and with time in a given case; no two fogs are conditioned by precisely the same combination of factors. Thus, the forecaster, must apply a great measure of judgment, acquired as much by experience as by theoretical understanding of the processes. There are in the standard textbooks many useful generalizations about the characteristics and favourable processes and antecedents for advection fogs, radiation fogs, upslope fogs, frontal fogs, etc., based on the general impressions of forecasters and a few detailed analyses. But it has remained for the studies of Joseph J. George and collaborators to show fully how complex the fog forecast-analysis problem is and how strikingly it differs from one air terminal to another. Previous studies were usually restricted to detailed analyses of isolated single cases and did not provide sufficient material for quantitative generalization. George's method—taking a cue from early work of G. I. Taylor—is to analyze a large number of past fog situations at each station, classifying them according to combinations of processes acting along the previous trajectory of the air fogging the terminal; probability diagrams are constructed to show the critical limits of the most dangerous combinations of factors. The general picture may be similar for all stations in a meteorologically homogeneous region, but for practical use by the forecaster the data must be worked up at each station, since the numerical values may differ considerably. George also showed that for aviation-forecasting purposes it is infeasible to attempt to distinguish between low stratus and fog, especially for the fog types (common to the southeastern U.S. where he worked) in which the ceiling gradually lowers to the ground during the development of the fog situation. He proposed what appears to be the first (but partial) classification of fog types that is practical for use by forecasters: (1) prewarm frontal and postcold frontal fog; (2) orographic (upslope) fog; (3) advection fog; (4) radiation fog; and (5) radiation-advection fog.

The preparation of a statistical (or so-called objective) system of fog forecasting for a given airfield or station involves the careful selection of the important parameters that will predict fog formation (or dissipation).

This is done a *priori* on basis of experience, known general principles, and detailed analysis of past cases. The forecasting relationships of these parameters to the combined visibility and ceiling (*i.e.*, fog) conditions of aviation-operational concern are then determined by means of scatter diagrams. Pure radiation fogs are most amenable to such an approach, since usually only dew-point depression and temperature preceding clear nights need be considered, as illustrated by the use of Taylor's well-known fog-prediction diagram (see figure). In case of the other types of fog, wind speed, trajectory of the air coming to the station, terrain and weather conditions along that trajectory: etc., must be added to the equation, and then a series of diagrams is required to express the prediction relationships. Forecasting by means of such procedures alone is not always sufficiently successful to justify their use; it is suggested by some workers that the inclusion of the vertical gradients of wind and moisture content may improve the results. There are limitations to the statistical method imposed by inadequacies of the weather observations available. Nevertheless, the application and development of this approach to fog forecasting is steadily gaining ground in the leading weather services. Only the complex California type of coastal stratus, which is involved in



AS REDRAWN BY ENG., TAYLOR'S FOG PREDICTION DIAGRAM FOR KEW, MOOK (*Bull. Amer. Met. Soc.*, JUNE 1950)

The points plotted show all cases during 1900–05 when the wind at 8 p.m. was less than 5.5 m.p.h. and the sky was clear; if fog occurred by the next morning a dot was plotted, if no fog a cross. The line divides roughly the dots from the crosses. Below the line the chances were about equal that fog would form or not form if the line was used to forecast (for Kew)

a seabreeze sort of air movement from the cold shore waters onto the coastal plains—formed at sea as advection fog and reinforced by nocturnal radiation over the land—has generally proved quite refractory to statistical attempts.

The geographical and seasonal distribution of fog is determined by the relative occurrences of each process or type of fog at given points over the earth. In general, the oceans of middle and high latitudes have a large maximum frequency of fog in the summer because of advection of warm air over cold water. A few advection fogs appear over the cold lands in winter. The continents are the home of radiation fogs, which tend to have a maximum frequency in autumn or winter in middle latitudes, in summer in high latitudes and in the rainy season in the tropics. Superimposed on these regimes characteristic of land *v.* sea, is a tendency for frontal fogs to occur in the circumpolar belt of cyclonic storms, which pass through the middle latitudes in winter shifting to higher latitudes in summer. The annual march of fog frequency at most places in the world can be explained by one of or some combination of these basic fog-type regimes, as R. G. Stone demonstrated in a study of fog distribution in the U.S. The advection fogs are individually apt to be widespread, dense and deep, especially over the colder ocean waters. Radiation fogs are usually shallow though dense; the sky is often visible (ground fog)—and they generally are restricted in coverage to valleys, marshes and low ground. However, the high (radiation) fogs of California and western Europe are extensive: deep, dense and persistent for days, whereas ground (valley) radiation fogs are usually nocturnal only. The frontal fogs with cold fronts are brief and infrequent, but the type formed under a warm front by falling rain is apt to be deep and extend for hundreds of miles, one of the most troublesome of all weather conditions hindering aviation.

Artificial Fog Dissipation.—Under discussion and experiment for many years, no practical use was made of artificial fog dissipation until World War II. Many proposed methods were unscientific or not practical. The feasible methods are of two basic types: (1) to evaporate the drops by heating the foggy air, or by injecting a drying agent into it, and (2) to remove the drops physically by some means of inducing their precipitation. A practical heating method (Fido; Fog. Intensive. Dispersal of) was developed by the British during World War II and was successfully used to clear aerodromes in England. Oil was burned in rons of jets arrayed around the field. The amount of heat required depends on the latent heat needed to evaporate the water in a unit volume of the fog and the amount of foggy air to be cleared in a specified time. Even with a moderate wind, the equipment used cleared a large field up to 100 ft. or more above the runways in a few minutes. Under windy conditions the equipment must have much more rapid heat output and a more flexible burner system so that the centre of heating can be shifted rapidly to the windward. Such developments were improved and further tested after the war but high installation and operating costs prevented their general use. Henry G. Houghton and William H. Radford successfully demonstrated the precipitation of fog by means of a vertical curtain of fine salt spray through which the wind drifted the fog, leaving a small runway clear to the lee. The use of chloride or chemically active agent may be precluded for airfields because of destructive effects on the aircraft and the installations, soil, etc. Precipitation by means of dropping electrified particles, or passing the fog through an electrostatic (Cottrell) precipitator, or coalescing the drops by intense high-frequency sound, have been demonstrated in laboratory experiments but appear to be impractical for large-scale use. Meanwhile air navigation interests place much faith in development of radio and radar beacons and powerful lights to make landing and take-off feasible and safe in fog. On the basis of successes in dissipating clouds by seeding with dry ice or silver iodide, it was suggested that some types of fog might be economically cleared from certain airports in this manner.

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FOGAZZARB, ANTONIO (1842–1911), Italian novelist who opposed to the literary realism of his time an idealism stressing romantic feeling and minute analysis of psychological problems. Born at Vicenza, March 25, 1842, he was a pupil of the priest and poet Giacomo Zanella, whose religious spirit continued to inspire his work. A poetic romance *Miranda* (1874) was his first published work; *Malombra* (1881), *Daniele* Cortis (188j), *Il mistero* del poeta (1888) established his reputation as a novelist. Popularity came with the great success of Piccolo *mondo antico* (1895), which was acclaimed. even by critics unsympathetic to his religious and philosophical ideas, as the best Italian novel since Manzoni's I *Promessi sposi* (1827). It tells the story of the contrasted love of Franco and Luisa and of the pathetic death of their little daughter, against a background of the struggle in Lombardy between the Italian nationalists and the Austrians. An even greater sensation was caused by *Il santo* (1906), condemned as unorthodox and placed on the Index for its presentation of a mystical modern reformer of the church and its satire of the clerical world of its time. Other successful novels were Piccolo *mondo moderno* (1900–01) and Leila (1911). Fogazzaro also wrote short stories: plays and poems. He became a member of the Italian senate in 1896 and died in Vicenza, March 7, 1911. Many of his novels have been translated into English.

Although Fogazzaro's literary importance lies in his idealistic portrayal of virtue and feeling. and his interest in the psychological problems of his characters, which was strongly opposed to the realism (*verismo*) of other writers of his time, he owed his contemporary popularity to his talent for describing domestic interiors in aristocratic society and his intimate studies of the conflict between religious aspirations and sensual appetites. A liberal Catholic, he derived from Antonio Rosmini his sincere desire to revive the church (see ROSMINI-SERBATI, ANTONIO). This sometimes led him to accept modernist ideas, which he reluctantly abandoned in obedience to the church's condemnation. His position is made clear in La *parola* di Dolt *Giuseppe Flores* (published posthumously in 1920). A critical edition of Fogazzaro's works by P. Nardi was published in 14 volumes (1930–41).

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FOGBOW, a white rainbow, about 40° in radius. It has a reddish outer margin and an inner margin of bluish tinge, but the whole of the middle of the band is uncoloured. It occasionally accompanies fogs (*q.v.*) and its origin resembles that of the normal rainbow, but the smallness of the water drops (under 0.05 mm.) causes the colours to be mixed and the resulting band to be nearly white. See HALO.

FOGELBERG, BENEDICT (or BENGT) **ERLAND** (1786–1854), Swedish sculptor. was born at Gothenburg on Aug. 8, 1786. His father sent him in 1801 to Stockholm, where he studied at the school of art. He then studied in Paris, first under Pierre Guérin, and afterward under the sculptor Bosio. for the technical practice of sculpture. In 1820 Fogelberg went to Rome, where the greater part of his remaining years were spent. He died at Trieste on Dec. 22. 1854. The subjects of Fogelberg's earlier works are mostly taken from classic mythology. Of these, "Cupid and Psyche." "A Bather" (1838), "Venus and Cupid" (1839) and "Psyche" (1854) may be mentioned. His "Odin" (1831), "Thor" (1842), and "Balder" (1842), though influenced by Greek art. are of greater interest. His portraits and historical figures, as those of Gustavus Adolphus (1849), of Charles XII (1851). of Charles XIII (1852), and of Birger Jarl, the founder of Stockholm (1853), are faithful and dignified works.

FOGGIA, a town and episcopal see of Puglia, Italy, capital of the province of Foggia, 243 ft. above sea level, in the centre of the great Apulian plain 201 mi. by rail S.E. of Ancona and 123 mi. N.E. by E. of Naples. Pop. (1957 est.) 120,628 (commune). The name is perhaps derived from the pits or cellars under the pavement slabs of the open spaces (foveae) in which the grain of the neighbourhood is stored. The town is the medieval successor of the ancient Arpi. 3 mi. N.; the Normans, after conquering the district from the Eastern empire, gave it its first importance. The date of the erection of the cathedral is 1172; it retains some fine Norman architecture but was much altered after the earthquake of 1731. Only one single gateway of the palace of the emperor Frederick II (1223, by Bartolommeo da Foggia) is preserved. There died his third wife. Isabella, daughter of King John of England. Charles of Anjou died there in 1285. After his son's death, it was a prey to internal dissensions and finally came under Alfonso I of Aragon, who converted the pastures of the Apulian plain into a royal domain in 1445, and made Foggia the place at which the tax on the sheep was to be paid and the wool to be sold. It remained a great wool market. During World War II the city was occupied by British troops in Sept. 1943.

Foggia is a railway centre, on the main line from Bologna to Brindisi, where this is joined by the line from Benevento and Caserta. There are also branches to Rocchetta S. Antonio (and from there to either Avellino, Potenza, or Gioia del Colle), to Manfredonia and to Lucera.

See R. Caggese, *Foggia e* la *Capitanata*, well illustrated (Bergamo, 1910); A. Haseloff, *Bauten der Hohenstaufen in Unteritalien*, i, 67 ff. (Leipzig, 1914).

FOG SIGNALS are employed for the purpose of guidance or warning when visual marks or signals are obscured by fog or their visibility is materially reduced by atmospheric conditions. Permanent fog-signals intended for the guidance of the mariner are usually established in conjunction with coast and harbour lighthouses and lightships. Fog signals are used in railway working to narn engine drivers when the ordinary signals are obscured by fop: these commonly consist of detonators, fixed on the rail, which are exploded as the leading wheel of the engine passes over them.

Coast fog-signals are of three kinds: (1) aerial-acoustic; (2) submarine-acoustic, including submarine bells and oscillators, which are usually established on light-vessels as an auxiliary to aerial-acoustic signal; and (3) wireless or radio fog-signals. Aerial-acoustic signals may be divided into three classes; first, those sounded by compressed air. such as sirens, diaphones and reed-horns; second, explosive signals, including nitrated-gun-cotton charges, guns and rockets. the last two seldom used; and third bells and gongs. The use of wireless fog-signals has been largely extended since 1921 nhen the first permanent coast signal of this description was established, and they are of great importance to aerial as well as to marine navigation. Aerial-acoustic signals are audible at greatly varying distances and, under certain atmospheric conditions, may be heard at a considerable distance though at the same time wholly inaudible in intervening areas. Wireless and submarine signals, on the other hand, are unaffected by the atmospheric conditions which impair the audibility of aerial sound-signals. (*See* also LIGHTHOUSES: *Fog Signals;* RULE OF THE ROAD AT SEA.) (N. G. G.)

FÖHN, a warm, relaxing wind experienced on the northern side of the Alpine range most frequently in winter and early spring. Similar local winds occur elsewhere; *e.g.,* Norway, Greenland and North America. In the last case it is known as the chinook (*q.v.*) and descends the Rocky mountains to the western prairies as a warm, dry wind which evaporates a great deal of the winter snow.

The fohn approaches the ridge from the south, is cooled during its ascent, and moisture may be condensed from it, giving rain or snow. It descends the northern slope by some process still obscure, during which it becomes warmed and dried. and has important local effects with reference to human activities.

See also WINDS. MOUNTAIN AND LOCAL. (ML. FE.)

FOIL. 1. A leaf (from Lat. *folium*); so used in heraldry and in plant names (*e.g.,* the trefoil clover) and hence applied to anything resembling a leaf. In architecture the word appears for the small leaflike spaces formed by the cusps of tracery in windows or panels, and known, according to the number of such spaces, as quatrefoil, cinquefoil, etc. The word is also found in counterfoil, a leaf of a receipt or cheque book, containing memoranda or a duplicate of the receipt or draft kept by the receiver or drawer as a counter or check. Foil is particularly used of thin plates of metal, resembling a leaf, not in shape as much as in thinness. In thickness foil comes between leaf and sheet metal. In jewellery a foil of silvered sheet copper, sometimes known as Dutch foil, is used as a backing for paste gems, or stones of inferior lustre or colour. This is coated with a mixture of isinglass and translucent colour, varying with the stones to be backed, or, if only brilliancy is required, left uncoloured but highly polished. From this use of foil, the word comes to mean, in a figurative sense, something which by contrast or by its own brightness served to heighten the attractive qualities of something else placed in juxtaposition. The commonest foil is that generally known as tinfoil. The ordinary commercial tinfoil usually consists chiefly of lead, and is used for the wrapping of sweetmeats, tobacco or cigarettes. A Japanese variegated foil gives the effect of damaskeening. Many thin plates of various metals, such as gold, silver and copper, together with alloys of different metals are soldered together in a particular order. a pattern is hammered into the soldered edges and the whole is hammered or rolled into a single thin plate, the pattern then appearing in the order in which the various metals were placed.

2. An old hunting term, used of the running back of an animal over its own tracks to confuse the scent and baffle the hounds (from O. Fr. *foler,* to tread). It is also used in wrestling, of a throw. Thus comes the common use of the word, in a figurative sense, with reference to both these meanings, of baffling or defeating an adversary, or of parrying an attack.

3. As the name of the weapon used in fencing the word is of doubtful origin.

FOIL FENCING: *see* FENCING.

FOIX, COUNTS OF. The counts of Foix were a distinguished French family which flourished from the 11th to the 15th century and during the 13th and 14th centuries were among the most powerful of the French feudal nobles. Living on the borders of France and having constant intercourse with Aragon, they were in a position peculiarly favourable to an assertion of independence.

The title of count of Foix was first assumed by Roger, grandson of Roger I, count of Carcassonne (d. 1012), when he inherited the town of Foix and the adjoining lands which had hitherto formed part of the county of Carcassonne. Roger died about 1064 and was succeeded by his brother Peter, who died six years later and was succeeded by his son, Roger II. This count took part in the crusade of 1095 and was afterward excommunicated by Pope Paschal II for seizing ecclesiastical property; but subsequently he appeased the anger of the church by rich donations. When he died in 1125 he was succeeded in turn by his son, Roger III, and grandson Roger Bernard I. The latter's only son, Raymund Roger, accompanied the French king, Philip Augustus, to Palestine in 1190 and distinguished himself at the capture of Acre. He was afterward engaged in the wars of the Albigenses and, on being accused of heresy, lost his lands to Simon IV, count of Montfort. Raymund Roger, who came to terms with the church and recovered his estates before his death in 1223, was a patron of the Provençal poets and counted himself among their number. He was succeeded by his son, Roger Bernard II. called the Great, who assisted Raymund VII, count of Toulouse, and the Xlbigenses in their resistance to the French kings and was excommunicated on two occasions. Roger Bernard II died in 1241. His son, Roger IV, who followed, died in 1265 and nas succeeded by his son, Roger Bernard III, who, more famous as a poet than as a warrior, was taken prisoner both by Philip 111 of France and by Peter III of Aragon. This count married Margaret, daughter and heiress of Gaston VII, viscount of Béarn (d. 1290). This union led to the outbreak of a long feud between the houses of Foix and Armagnac, which was continued by Roger Bernard's son and successor, Gaston I, who became count in 1302 inheriting both Foix and Bkarn. Becoming embroiled with the French king, Philip IV, Gaston was imprisoned in Paris; but quickly regaining his freedom he accompanied King Louis X on an expedition into Flanders in 1315. He died on his return to France in the same year. His eldest son. Gaston II, became reconciled with the house of Armagnac and died at Seville in 1343. He was succeeded by his son, Gaston III (1331–91), surnamed Phoebus on account of his beauty, the most famous member of the family. Like his father he assisted France in its struggle against England, being entrusted with the defense of the frontiers of Gascony; but when the French king, John II, showed a marked preference for the count of Armagnac, Gaston left his service and went to fight against the heathen in Prussia. Returning to France about 1357 he delivered some noble ladies from the attacks of the adherents of the *Jacquerie* at Meaux and was soon at war with the count of Armagnac. In 1362 the latter was defeated and compelled to pay a ransom; peace was made in 1377.

Early in 1380 the count probably was appointed lieutenant of the king in Languedoc, but when Charles VI became king later in the same year this appointment was cancelled. Gaston refused at first to heed the royal command and was supported by such towns as Toulouse; but as early as Sept. 1381, he abandoned the struggle against John, duke of Berry, who had been chosen as his successor. Left without legitimate sons, Gaston was easily persuaded to bequeath his lands to King Charles VI. who thus obtained Foix and Béarn when the count died at Orthez in 1391. Gaston was very fond of hunting but was not without a taste for art and literature. Several beautiful manuscripts are in existence which were executed by his orders and he himself wrote *Déduits de la chasse des bestes sauvaiges et des ozseaulx de proye.* Froissart gives a graphic and enthusiastic description of his court and his manner of life.

Almost immediately after Gaston's death King Charles VI granted the county of Foix to Matthew, viscount of Castelbon, a descendant of Count Gaston I. Dying without issue in 1398. Matthew's lands were seized by Archambault, count of Grailly and *captal* of Buch, the husband of his sister Isabella (d. 1426), who became count of Foix in 1401. Archambault's eldest son, John (*c.* 1382–1436), who succeeded to his father's lands and titles in 1412 and married Joan, daughter of Charles III, king of Navarre, played an important part in the wars of his time, supporting at different periods the kings of Aragon, France and England. The next count was John's son: Gaston IV, who married Leonora (d. 1479), a daughter of John, king of Aragon and Navarre. In 1447 he bought the viscounty of Narbonne and, having assisted King Charles VII in Guienne, was made a peer of France in 1458. In 1455 his father-in-law designated him as his successor in Navarre, and Louis XI of France gave him the counties of Rousillon and Cerdagne and made him his representative in Languedoc and Guienne. But these marks of favour did not prevent Gaston IV from joining a league against Louis in 1471. His eldest son, Gaston, the husband of Madeleine, a daughter of Charles VII of France, died in 1470; and when Gaston IV died two years later, his lands descended to his grandson, Francis Phoebus (d. 1483), who became king of Navarre in 1479 and was succeeded by his sister Catherine (d. 1517), the wife of Jean d'Albret (d. 1516). Thus the house of Foix-Grailly was merged in that of Albret and subsequently in that of Bourbon; and when Henry of Navarre became king of France in 1589 the lands of the counts of Foix-Grailly became part of the French royal domain.

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FOIX, PAUL DE (1528–1584), French prelate and diplomatist, was ambassador to England from 1561 to 1565. He was then sent to Venice, and returned a short time afterward to England to negotiate a marriage between Queen Elizabeth and the duke of Anjou. He fulfilled several important missions during the reign of Henry III of France. In 1577 he was made archbishop of Toulouse, and in 1579 was appointed ambassador to Rome, where he died on May 15, 1584.

There is some doubt as to the authenticity of *Les Lettres de Messire de Paul de Foix . . .* (1628). See *Gallia Christiana* (1715 *et seq.*); "Lettres de Catherine de Médicis," edited by Hector de la Ferrière (Paris, 1880 *et seq.*) in the *Collection de documents inédits sur l'histoire de France.*

FOIX, a town of southwestern France, in the middle ages capital of the counts of Foix, and now capital of the *département* of Ariège, 51 mi. S. of Toulouse, on the Southern railway from that city to Ax. Pop. (1954) 6,093. It stands at the confluence of the Arget with the Ariege. Foix probably owes its origin to an oratory founded by Charlemagne, which later became an abbey, in which were laid the remains of St. Volusien, archbishop of Tours in the 5th century. The county of Foix included roughly the eastern part of the modern *département* of Ariege; *i.e.,* the basin of the Ariège. During the later middle ages it consisted of a number of small lordships subordinate to the counts of Foix, with a share in the government of the district. Protestantism early entered the county, and severe religious struggles ensued. The *états* of the county can be traced back to the 14th century. The old town is dominated by an isolated rock crowned by the castle (12th, 14th and 15th centuries). St. Volusien is a Gothic church (14th century). The town is the seat of a prefecture, a court of assizes and a tribunal of first instance, and has a chamber of commerce. Iron-working is carried on.

FOKINE, MICHEL (1880–1942), Russian-U.S. choreographer who exerted a profound influence on the theatrical dance of his time. Born April 26, 1880, in St. Petersburg, he trained in the Russian Imperial ballet, graduating in 1898. He entered the ballet of the Maryinsky theatre and quickly established a reputation as an excellent dancer in such classic ballets as *Raymonda* and *The Sleeping Beauty.*

Dissatisfied with the rigid classic tradition enforced there by Marius Petipa, Fokine believed that in ballet the dancing, mime, music, scenery and costumes should all contribute toward the dramatic expression of the theme.

For charity performances and pupils' recitals he staged his early ballets *The Vine* (1906), *The Animated Gobelins,* later titled *Pavillon d'Armide* (1907) and *Chopiniana* (1908), revised as *Les Sylphides* The latter, an evocation of the romantic ballet, is recognized as one of the finest works in dance repertoire. *The Dying Swan* (1905), composed for Pavlova, is another well-known early work.

As principal choreographer of the Diaghilev Ballet Russe, Fokine had the opportunity to put his theories into practice, creating such distinguished works as *Petrushka, The Firebird, Prince Igor* and *Scheherazade.* For Vaslav Nijinsky and Tamara Karsavina, brilliant interpreters of his work, he created *Le Spectre de la Rose.* His wife, Vera Fokina, danced in many of his ballets.

From 1919 Fokine taught in New York city, continuing to create new ballets and revive old ones for various companies. He died in New York city, Aug. 22, 1942.

See Cyril W. Beaumont: *Michel Fokine and His Ballets,* new ed. (1942). (LN. ME.)

FOKKER, ANTHONY HERMAN GERARD (1890–1939), Dutch-U.S. airman and pioneer aircraft designer and manufacturer, was born at Kediri, Java, on April 6, 1890. He was educated at Haarlem, Neth., and began his aviation career at the age of 20, obtaining his international pilot's certificate in 1911. As the Netherlands offered insufficient opportunities, he went to Germany and established a small aircraft factory at Johannisthal near Berlin in 1912, in which year he participated in a competition for the design of military aircraft at St. Petersburg. The German government became interested in his designs and he received orders for aircraft and a three-year contract for the training of pilots.

Shortly before World War I Fokker set up a factory at Schwerin, Mecklenburg, and many aircraft of his design played a part in that war. He perfected the interrupter gear which made it possible to fire a machine gun straight ahead through the propeller. After the war he left Germany and established the Fokker works at Amsterdam. He also founded aircraft construction firms in the United States, where he became a naturalized citizen. During the later years of his life, he concentrated on the design and development of commercial aircraft. He died in New York city on Dec. 23, 1939. His autobiography *The Flying Dutchman* was published in 1931. (D. CR.)

FOLARD, JEAN CHARLES, CHEVALIER DE (1669–1752), French soldier and writer on tactical theory, was born at Avignon on Feb. 13, 1669. His military ardour was first awakened by reading Caesar's *Commentaries,* and he ran away from home and joined the army. He was almost continuously on active service, in Italy, in Flanders and, in 1714, under Charles XII of Sweden. Charles XII he regarded as the greatest captain of all time, and it was at Stockholm that Folard began to formulate his tactical ideas in a commentary on Polybius. On his way back to France he was shipwrecked and lost all his papers, but he set to work at once to write his essays afresh, and in 1724 appeared his *Nouvelles Découvertes sur la guerre dans une dissertation de Polybe,* followed (1727–30) by *Histoire de Polybe traduite par . . . de Thuillier avec un commentaire . . . de M. de Folard, Chevalier de l'Ordre de St. Louis.*

Folard spent the remainder of his life in answering the criticisms provoked by the novelty of his theories. He died friendless and in obscurity at Avignon in 1752.

Folard's military writings contain a great number of independent ideas, sometimes valuable and suggestive. The central point of his tactics was his proposed column formation for infantry. Struck by the apparent weakness of the thin line of battle of the time, he desired to substitute the shock of a deep mass of troops for former methods of attack, and further considered that in defense a solid column gave an unshakable stability to the line of battle. Controversy at once centred itself upon the column. While some famous commanders, such as Marshal Saxe and Guido Starhemberg, approved it and put it into practice, the weight of military opinion throughout Europe was opposed to it. History justified this opposition, even though the French Revolutionary armies won several victories with infantry columns.

FOLD. In geology, folds are undulations or waves displayed by the stratified rocks of the crust of the earth. Stratified rocks are generally formed by the accumulation of material in horizontal and nearly horizontal sheets. Some stratified rocks are of sedimentary origin, deposited in rivers, lakes and seas; other stratified rocks are of volcanic origin, deposited as lava flows or as layers of fragmental explosive material. In many places the sheets or strata. as they are more appropriately called, are no longer horizontal hut have been thrown into folds. Some folds are so gentle that the inclination of the strata is barely perceptible; other folds are so pronounced that the strata of the two flanks may be essentially parallel, either steeply inclined as in isoclines (see fig. 4) or lying nearly flat as in recumbent folds (see fig. 2).

Folds show a wide range in magnitude; some are miles or even hundreds of miles across; others, a few feet across, are visible in single outcrops; still others may be perceived only under the microscope. The tops of the large folds have almost invariably been removed by erosion so that only the truncated inclined strata can be seen (fig. 3).

For discussion of the significance of folds in the occurrence of oil and gas and in petroleum geology the reader is referred to the article MINE PROSPECTING AND DEVELOPMENT.

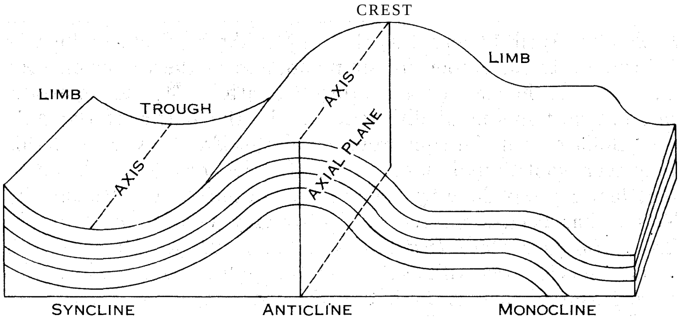

FIG. 1.—DIAGRAM ILLUSTRATING THREE FORMS OF FOLDS. WITH GENERAL DESCRIPTIVE TERMS

Origin of Folds.—The long linear folds, so characteristic of mountainous regions, are believed by many to result from compressional forces acting parallel to the surface of the earth and at right angles to the fold. Whether compressional forces are due to contraction of the crust of the earth or to the drag of subcrustal convection currents or to some other cause is not known. Some geologists believe that many folds are the result of strata sliding, under the influence of gravity, from a vertically uplifted area. The large folds that are essentially circular in plan are due to vertical forces of unknown origin. Many smaller domes, those one-half mile to two miles in diameter, are caused by the rise of masses of rock salt (salt domes) or by the injection of mushroom-shaped masses of magma (laccoliths). (See SALT DOME; LACCOLITH.)

The push exerted by an advancing glacier may throw weakly consolidated rocks into folds. The compaction of sedimentary rocks over buried hills results in gentle folds.

Geometry of Folds.—The axial plane or axial surface of a fold is the plane or surface that divides the fold as symmetrically as possible (fig. 1). The axial plane may be vertical, horizontal or inclined at any intermediate angle (fig. 2). An axis of a fold is the intersection of the axial plane with one of the strata of which the fold is composed (fig. 1, 2).

Although in the simpler types of folds the axis is horizontal or gently inclined, it may be steeply inclined or even vertical. The angle of inclination of the axis, as measured from the horizontal, is called the plunge. The folds illustrated in fig. 3 are plunging away from the reader at an angle of about 20°. The portion of

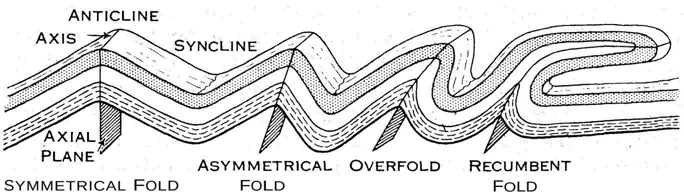

FIG. 2.—FOLDS. PROGRESSIVELY DECREASING FROM LEFT TO RIGHT IN THE INCLINATION OF THE AXIAL PLANE

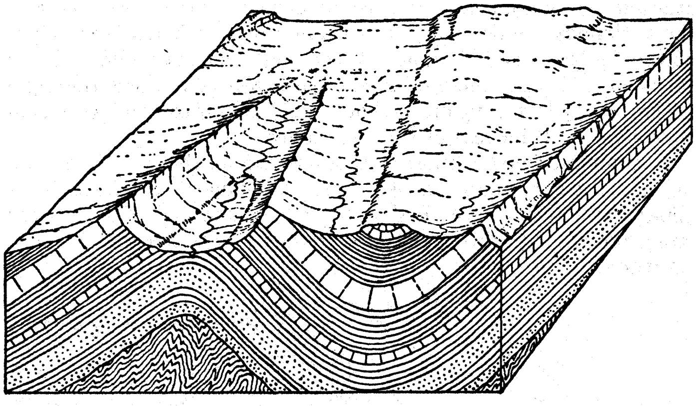

FIG. 3.—PLUNGING ANTICLINES AND SYNCLINES

the fold between adjacent axes forms the flanks, limbs or slopes of the fold (fig. 1).

An anticline is a fold that is convex upward (fig. 1). A syncline is a fold that is concave upward. An anticlinorium is a large anticline on which minor folds are superimposed. A synclinorium is a large syncline on which many minor folds are superimposed. A symmetrical fold (fig. 2) is one in which the axial plane is vertical. An asymmetrical fold (fig. 2) is one in which the axial plane is inclined. An overturned fold or overfold has the axial plane inclined to such an extent that the strata on one limb are overturned (fig. 2). A recumbent fold is one in which the axial plane is essentially horizontal (fig. 2). Isoclinal folds have the two limbs essentially parallel to each other and thus approximately parallel to the axial plane (fig. 4). In an area where the strata are generally horizontal, they may locally assume a steeper dip; a fold of this type, with only one limb, is called a monocline (fig. 1).

Many folds are distinctly linear; that is, their extent parallel to the axis is many times their width. But some are not linear and are more or less circular in plan. A dome is such a fold that is convex upward (fig. 5); this means the strata dip outward from a central area. A basin is such a fold that is concave upward; that is, the strata dip inward toward a central area.

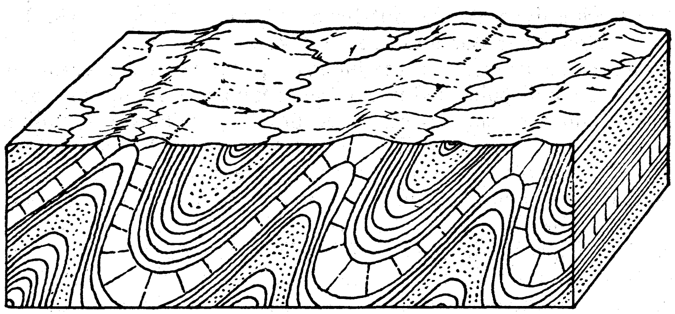

FIG. 4.—STEEPLY INCLINED OR ISOCLINAL FOLDS

Examples.—Folded strata are characteristic of many of the mountain ranges of the world. In the Appalachian valley and ridge province of eastern North America, extending in a southwesterly direction from Albany, N.Y., to central Alabama, the folds are symmetrical folds, asymmetrical folds and overfolds (fig. 2); the axial plane dips southeasterly. Only the eroded stumps of these folds are now preserved (fig. 3, 4). The distance from the crest of one fold to the next is from one to ten miles, and the height of the folds—the difference in altitude of the same bed in the trough of a syncline and on the crest of an anticline (fig. 1)—is two to five miles.

Many of the folds in the Rocky mountains of western North America are similar to those in the eastern United States. But in the southern and central Rockies of Colorado and Wyoming the distance from the crest of one major anticline to the crest of the next is 10 to 50 mi.

The Jura mountains of Switzerland and France offer a classic example of symmetrical and asymmetrical folds. The crests of the anticlines are one-half to two miles apart, whereas the height of the folds is one-half mile. When they were being folded, the rocks of the Jura mountains slid northwesterly along the rigid basement, just as a rug on the floor might fold if one end were held stationary and the rest of the rug moved.

Recumbent folds, similar to those shown on the right-hand end of fig. 2, are common in the Alps. In places many recumbent anticlines and synclines are piled on top of one another. Some of the larger recumbent folds in the Alps are many miles across. *See* also GEOLOGY.

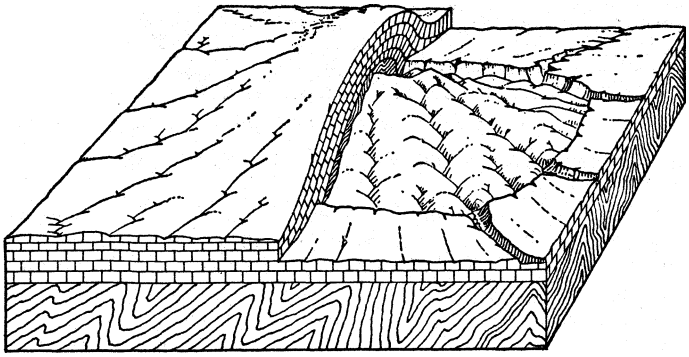

FIG. 5.— DOME. THE LEFT-HAND PART OF THE DIAGRAM REPRESENTS CONDITIONS BEFORE EROSION; THE RIGHT-HAND HALF REPRESENTS CONDITIONS AFTER CONSIDERABLE EROSION

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FOLENGO, TEOFILO (GIROLAMO) (1491–1544), the most important of the Italian macaronic poets. who used an Italian vocabulary treated according to Latin rules of form and syntax, was born in Mantua, Nov. 8, 1491. In 1509 he entered the Benedictine order (taking the name Teofilo, by which he is known) and lived in the convents of Brescia, Mantua and Padua until he was 33. In 1525 he left the order, to which he was readmitted in 1534 after having lived as a hermit for a time near Sorrento. He died in a convent near Bassano. Dec. 9, 1544.

Folengo's masterpiece is the *Baldus,* a poem written in macaronic hexameters and published under the pseudonym of Merlin Cocai. Four versions of this poem (in 20 books) are known, published in 1517, 1521, 1539–40 and 1552 (mod. ed. by A. Luzio, Le *Maccheronee,* 1927–28). It narrates the adventures of Baldo, a descendant of Roland's cousin Rinaldo, in a comic style which avoids parody. The first 11 books deal realistically with the popular world of Cipada (birthplace of Baldo, near Mantua), while the last books contain a number of episodes which reveal the author's rich vein of fantasy. Folengo uses macaronic Latin in a masterly way, revealinga sound humanistic education, besides his familiarity with his native dialect. His minor works are of little literary value. The *Moschaea,* inspired by the *Batracomiomachia,* deals with the war between the flies and the ants; the *Zanitonella* describes the love of two peasants; the Italian poem *Orlandino* (1526) and the *Caos del Triperuno* (1527; written in Italian, Latin and macaronic language, partly in verse and partly in prose) have only autobiographical interest. Folengo wrote also two poems on Christ's life (La *Humanità del Figliuolo di Dio* and *Palermitana*) and a *sacra rappresentazione* (*Atto della Pinta*), of which only a very corrupt version is known. Of his three tragedies only the titles are known. Folengo's *Opere italiane* were edited by U. Renda in three volumes (1911–14).

See G. Billanovich, *Tra don Teoflo Folengo e Merlin Cocaio* (1948); E. Bonora, Le *Maccheronee di T. Folengo* (1956). (G. A.)

FOLEY, JOHN HENRY (1818–1874), Irish sculptor, was born at Dublin on May 24, 1818. He studied at the schools of the Royal Dublin society and the Royal academy, London. He began to exhibit at the academy in 1840, and in 1844 was commissioned to do the statues of John Hampden and Selden for the houses of parliament. He became A.R.A. in 1849, and R.A. in 1858. He executed many commissions in London and Dublin, and for India. He was responsible for the symbolical group "Asia," as well as the statue of the prince himself, for the Albert memorial in Hyde park; and "Stonewall Jackson," in Richmond, Va. The statue of Sir James Outram at Calcutta is probably his masterpiece. Foley died at Hampstead on Aug. 27, 1874.

See W. Cosmo Monkhouse, *The Works of J. H. Foley* (1875).

FOLEY, SIR THOMAS (1757–1833), British admiral, entered the navy in 1770, and served under Admiral (afterward Viscount) Keppel and Sir Charles Hardy in the Channel, and with Rodney's squadron was present at the defeat of De Lángara off Cape St. Vincent in 1780, and at the relief of Gibraltar. Still under Rodney's command, he went out to the West Indies, and took his part in the operations which culminated in the victory of April 12, 1782. In the Revolutionary War he was engaged from the first. As flag-captain to Adm. John Gell, and afterward to Sir Hyde Parker, Foley took part in the siege of Toulon in 1793, the action of Golfe Jouan in 1794, and the two fights off Toulon on April 13 and July 13, 1795. At St. Vincent he was flag-captain to the second in command, and in the following year was sent out in command of the "Goliath" (74), to reinforce Nelson's fleet in the Mediterranean. In the battle of the Nile the "Goliath" led the squadron round the French van, and this maneuver contributed not a little to the result of the day. Whether this was done by Foley's own initiative, or intended by Nelson, has been a matter of controversy (see *Journal of the Royal United Service Institution,* 1885, p. 916). His next important service was with Nelson in the Baltic. The "Elephant" carried Nelson's flag at the battle of Copenhagen, and her captain acted as his chief-of-staff. From 1808 to 1815 he commanded in the Downs. Sir Thomas Foley, who rose to be full admiral and knight grand cross of the Bath, died while commander in chief at Portsmouth in 1833.

FOLGER, HENRY CLAY (1857–1930), U.S. lawyer and capitalist, was born in New York city on June 18, 1857. He attended Amherst college, Amherst, Mass., graduating in 1879, and studied law at Columbia university, obtaining his LL.B. in 1881. As a student he was employed by Pratt and company, a part of the Standard Oil group, and later became a director of the company. In 1908 he became a director of Standard Oil Company of New York and in 1911 became its president. The firm prospered under his direction and in 1923 he became chairman of the board. A devoted Shakespearean scholar, Folger built a fine Shakespearcan collection and erected a library to house it in Washington, D.C. (H. J. SG.)

FOLGORE DA SAN GIMIGNANO, a 14th-century Italian poet, of whose life little is known. Some of his anti-Ghibelline political sonnets, and a few of his sonnets on the pleasures of the months and the days of the week, were translated by D. G. Rossetti and by J. A. Symonds.

FOLIES-BERGÈRE. This Parisian music hall, variety-entertainment theatre, destined to become one of the major tourist attractions of France, opened in a new and spacious theatre on May 1, 1869, located in the rue Richer. Its designation was taken, after litigation over the originally chosen name of Folies-Trévise, from the nearby rue Bergère. The opening performance included two operettas, a pantomime featuring the famous Paul Legrand as Pierrot, and a variety of specialty numbers. During the siege of Paris the theatre became a hall for political meetings but at the conclusion of the war opened again under the management of Leon Sari. By the last decade of the 19th century, its repertory resembled that of a vast circus but without the equestrian numbers. Vaudeville sketches, playlets, musical numbers in great variety, ballets, eccentric dances, acrobats and balancing performers, tightrope walkers, magicians and sleight-of-hand artists, trained animal acts, elaborate choral numbers, spectacular and mechanical effects on a vast scale, operettas and musical comedies attracted Parisians and tourists alike. For other patrons the pursuit of gallantry, intrigue and affairs of love in the promenades and the refreshment rooms was the chief attraction.

Under the management of the Lallemands, their nephew, Edouard Marchand, introduced the first "girls" to the Folies. In 1894 the vogue of the strip tease seized the music halls of Paris and the Folies took it over and elaborated it to the extent that, in the 20th century, its reputation for *les girls* overshadowed its many other beautiful performances. During the period of World War I the exhibition of feminine pulchritude in the nude became and continued to be the most sensational aspect of a Folies show.

Most of the great entertainers and music-hall artists of France have played at the Folies. The list includes, among many others, Fernandel, Colette, Yvonne Printemps, Raimu, Yvette Guilbert, Colette Fleuriot, Yvonne Menard, Maurice Chevalier, Mistinguett of the beautiful and highly-insured legs and Josephine Baker. Charlie Chaplin began his career at the Folies in 1902 at the age of 14. By the mid-20th century the elaborate shows at the Folies required 10 months of planning and preparation, about 40 different sets, 1,000 to 1,200 individually designed costumes, in addition to the elaborate electrical and mechanical effects. The large and splendidly equipped stage, complete with elaborate machinery and extensive lighting apparatus, allows the management to stage sumptuous and grandiose spectacles.

Through touring the Folies-Bergère became widely known throughout France and in many other European and South American cities.

See Paul Derval, *The Folies-Bergère,* trans. by Lucienne Hill (1954).
(H. C. Hr.)

FOLIGNO, a town and episcopal see of Umbria, Italy (anc. Fulginiae), 771 ft. above sea level, province of Perugia, from which it is 25 mi. S.E. by rail. Pop. (1951) 19,707. The cathedral has a Romanesque south façade of 1133. In the same piazza as the south façade is the Palazzo Trinci, completed in 1407. (Both buildings were damaged during World War II but were later repaired.) There are a number of notable Renaissance churches and buildings, and several churches contain paintings by Umbrian masters. Raphael's "Madonna di Foligno," now in the Vatican, was originally painted for the church of S. Anna.

Foligno changed hands often during the 13th century, and was destroyed by Perugia in 1281. From 1305 to 1439 it was governed by the Trinci family as deputies of the Holy See, until owing to the defection of one of them, Corrado II, Pope Eugene IV sent a force against Foligno, to which the inhabitants opened their gates, and Corrado was beheaded. Until 1860 Foligno belonged to the states of the church. It suffered from a severe earthquake in 1832. Foligno is an industrial centre. Products include textiles, paper and leather goods.

FOLIO, a term in bibliography and printing, with reference either to the size of paper employed, or of the book, or to the pagination. In the phrase "in folio" it means a sheet of paper folded once, and thus a book bound up in sheets so folded is a book of the largest size and is known as a folio. Similarly, folio is one of the sizes of paper adapted to be thus folded. In bookkeeping the word is used for a page in a ledger on which the credit and debtor account is written; in law writing, for a fixed number of words in a legal document, used for measurement of the length and for the addition of costs. In Great Britain a folio is taken to contain 72 words, except in parliamentary and chancery documents, when the number is 90. In the United States 100 words form a folio.

FOLIOT, GILBERT: *see* GILBERT FOLIOT.

FOLIUM: *see* CURVES, SPECIAL.

FOLK DANCE. Folk dance began with primitive man when it served as his first and only means of communication. Through dance, he endeavoured to understand, as well as to control by means of magic, his supernatural world. He employed dance, therefore, as a medium of understanding and of bringing about the solicitation and placation of his gods, the driving away of evil spirits, the destruction of enemies, the changes in the seasons, the rising and setting of the sun, the waning and waxing of the moon, the pursuit of his various occupations, precipitation and other factors conducive to the fertility of vegetation, animals and human beings, and the initiation of his youth into adulthood.

G. Stanley Hall has stated that, whenever members of alien primitive tribes sought closer acquaintance with each other, they asked a single question in sign language: "What do you dance?" And as these respective members performed their dances, each was acquainted with answers to the innumerable questions that might have been posed. In the process of time, primitive tribes evolved into the separate nations which comprise the modern world. Each nation then developed its particular folk dances stemming from this common heritage of primitive man. *See* also FOLKLORE.

The folk dances of contemporary countries fall into two main categories: those which have retained their ritualistic origins and are therefore performed by smaller selected groups or individuals on special, commemorative occasions; and those which are distinctly recreational in nature, evolved for general participation in much the same manner in which ballroom or social dancing is engaged in by persons of all ages. The folk dances of all countries, therefore, share a common heritage and reflect the same basic thematic sources developed first by primitive man. They are distinctive, however: with respect to the inevitable changes and adaptations related to religious, historical, geographical, topographical, climatic, sociological and other factors which have proved the determining influences in the development of the specific folk dances of a particular time and place.

Folk dances may be defined as the authentic, traditional dances of a given country, handed down from generation to generation in the manner of all traditions, customs, beliefs, superstitions and folkways without alteration except that which has occurred unconsciously through such repetition. In other words, the genuine folk dances of all countries are those which have not been altered deliberately. National dances, by the same token, are those traditional folk dances which are the most widely known and popular in all sections of a country regardless of geographical barriers and local variations. Not every country acknowledges a so-called national dance. Illustrative, however, are the tarantella of Italy, the *Hambo* of Sweden, the *Csárdás* of Hungary, the *Kolo* of Serbia and the Balkans, the *Schuhplattlers* of Bavaria and the *Jarabe tapatio* of Mexico. Ethnic, or ethnologic, dances differ from traditional and authentic folk and national dances in that they result in art forms emanating from the folk dances of a certain country, but representing a highly specialized development of skill and subsequent theatricalized presentation. The ethnic dances of a country are presented as spectacles with distinctive audience appeal rather than as communal experiences in which all participate. Such countries as China, Japan and Spain have both folk dances in which various groups participate as well as ethnic dances for theatre purposes.

Illustrative folk dances of various countries are examined briefly.

Great Britain.—Dances of England may be classified into three main categories: (1) Sword dances, of a ritualistic nature) and originating from ancient pagan fertility rites, are performed traditionally between Christmas and the New Year, commemorative of their association with the presentation of sword plays during this particular season of each year. Death and resurrection are symbolized in recurring figures in such traditional sword dances as "Sleight's," the "Flamborough" and the "Beadnell." (2) Morris dances are performed with both handkerchiefs and sticks and originated from the more ancient sword dances associated with primitive sacrificial rites. The morris dances are linked with the season of Whitsuntide as a spring agricultural festival, and are related to primitive fertility rites in that they celebrate the conquest of spring over winter and the purging of fields and villages from evil spirits. Morris dances are both processional and stationary in design and include such well-known examples as "Tideswell Processional," "The Blue-Eyed Stranger," "Bean-Setting" and "Shepherd's Hey." (See MORRIS DANCE.) (3) Country dances are the recreational, social, general dances which evolved, no doubt, from the more ancient sword and morris dances of England but developed into folk dances for recreational purposes reminiscent of such expressions as "dancing on the green" or that particular centre of each English village upon which groups gathered to celebrate any festive occasion. English country dances are performed in circular, square and line formations. They include such popular dances as "Rufty Tufty." "If All the World Were Paper," "The Ole Mole:" "The Black Sag." "Gathering Peascods" and "Row Well. Ye Mariners." English sword, morris and country dances are performed in the 20th century in many villages, towns and cities on those occasions with which they are associated traditionally.

The folk dances of Scotland may be classified into four main categories: sword dances: flings, reels and schottisches. Both the sword dance and the Highland fling may be traced to war as a basic theme. The sword dance was performed on the eve of battle; around swords and scabbards crossed upon the ground. and the touching of either portended evil for the ensuing encounter. The Highland fling. however. was originally a dance of victory performed vigorously and exultingly on the scene after a successful battle. Both the sword dance and the Highland fling arepopular among modern competitive dance events in many Scottish folk festivals and Highland games. While the sword dances and flings are primarily solo dances, the schottisches and reels are popular group dances for recreational purposes, arranged in formations for two or more couples. All Scottish folk dances are highly stylized. They are executed with exactness in timing, sharpness of line and excitement of spirit. The precise use and contours of arms, legs, and feet are suggestive of a much later development of the classical ballet.

The folk dances of Ireland are variations of three main types—jigs, reels and hornpipes. They are primarily step dances, so called because of the rapid, exact and nimble movement of the feet and the subsequent production of rhythmic patterns as they touch the floor with great speed and dexterity. Irish folk dances are recognized as one of the antecedents of contemporary tap dance. The folk dances of Ireland are danced in the form of solos, duos and group dances for two or more couples. They are stylized to preclude any distraction from the intricate rhythms of the feet and are danced with erect bodies. a minimum of movement and the absence of posturings and affectations which might detract from the effectiveness of their primary characteristic — the rhythmic patterns of the feet.

Continental Europe. — The folk dances of Scandinavia and of countries comprising the European continent are too great in number and too diversified in type to permit more than a few cursory generalizations. These countries share such common folk dance forms as the polka, the schottische, the waltz, the *varsovienne,* the march and the two-step. They share, also, the same thematic bases for their origins augmented by other influences which arose in the process of regional development into separate nations. The folk dances of Norway, Sweden, Denmark and Finland reflect the cold climate of these countries through the vigorous style of their execution as well as the legends and superstitions that are a part of their respective cultures. Many of the folk dances of the Slavic countries are characterized by sharp changes in dynamics and tempo consonant with racial temperaments. Those of Switzerland are both delicate and robust in style and execution and suggestive of a serenity of spirit.

The folk dances of France vary from the simple, rollicking, follow-the-leader type of the farandole and the exuberant *branles* and *voltas* (which led to the waltz) to the more ordered gavottes, *rigaudons, contredanses* and cotillions. Illustrative are the *Branle Gascon,* the *Pont-Aven* and the *Quimper* gavottes. Countryfolk of various nations have attributed special significance of religious origin to bridges, associating them with the spanning between this world and the hereafter. Commemorative of this association is such a simple popular French folk dance as *Sur le Pont d'Avignon* and the frequent recurrence of *pont,* meaning "bridge," in other folk songs and dances.

Mexico. — The folk dances of Mexico and of other Latin-American countries are distinguished by the influences of their heritages, with styles reflective of subtle, romantic temperaments, and of the climatic conditions of the countries themselves. Those of Mexico fall into two main categories reflective of the history of this country. One group reveals distinctly the early Aztec culture and is Indian in character. the other reflects the influences of the Spanish conquest. Illustrative of the Indian influence is *Los Matlanchines,* an impressive ceremonial dance performed either in couples or by men only, depending upon the locale in which it appears; indicative of the Spanish influence are the *Zapateados* or step dances which include the *Jarabes,* the *Jaranas* and the *Huapangos,* danced in a variety of regional versions.

United States. — The folk dances of such areas as Hawaii reveal diversity directly traceable to the different lineages of the somewhat cosmopolitan inhabitants. Most widely known, however, is the hula with its many variations from the religious and ceremonial of ethnic import to those for popular entertainment.

Although the ultimate origin of the hula is somewhat obscure, it is fairly well established that it stems directly from ancient fertility rites. since fertility of plant. animal and human life was a primary theme of all dances of antiquity. Now a general term for all the folk dances of Hawaii. the hula was originally regarded as a sacred and religious dance and was safeguarded from desecration through the observance of tabus and through the performance of priestly rites.

The art of gesture was highly developed in the hula, through the movements of the hands and arms pantomiming the story of the accompanying song. while the movements of the feet and hips sustained the basic rhythm of the dance.

Aside from Hawaii, the United States is thought by some to possess no indigenous folk dances except those of the early North American Indians who comprised its first inhabitants. However, there has been a constant interchange of folkways from decade to decade, peoples from each country developing their own distinctive folk dances in the process of their specific growth and development. Folk dances of the United States, therefore, may be traced to those of other homelands. They have evolved ultimately into four distinctive types, which may be designated as play-party games, round dances for individual couples, group dances in parallel lines, and circular formations and square dances for four or more couples. Play-party games are those simple folk dances stemming from early Puritan days when both dancing and the use of musical instruments were denounced. Ingenious pioneers found a way to dance. therefore, by calling their dances "games" and by supplying vocal accompaniments. "Paw-Paw Patch" and "Shoo Fly" are only two dances illustrative of a great wealth of American folk dance literature devoted to this particular type of dance for recreational purposes.

Round dances in the United States reveal their kinship with those of other countries in that they include polkas, schottisches, waltzes, *varsoviennes,* two-steps and marches. but they reflect. also, distinctive adaptations in steps, style and manner of execution with respect not only to their performance in the United States as a whole but in the various sections, as a logical outcome of different periods in development. For example, the *varsovienne* of the early settlements in Virginia is very different from the "Put Your Little Foot" of Texas and the southwest, and yet both are U.S. variations of a folk dance form common to many countries. One of the earliest group dances performed in both circular and line formations is the "Virginia Reel," which may be traced directly to the English "Sir Roger de Coverly." The latter is illustrative of innumerable dances brought to America by early English settlers in Virginia. where the dances underwent many changes and adaptations so that they now bear but a faint resemblance to their progenitors. "Hull's Victory" is illustrative of an American folk dance with war as a basic theme.

Square dances are of two basic types: those that first evolved in the early settlements of New England and in some of the southern states. and those that were developed later in the southwestern and western sections. Although sharing many of the identical steps and figures, the former have retained the quiet, smooth, dignified: conservative and uniform style of some formal English country dances and French quadrilles, while the latter reflect the kind of rugged individualism that prompted later generations of pioneers to explore and develop new sections of the country. Marked differences in these two versions of the square dance include the substitution of "patter calls" of a homespun nature for simple. shouted "prompt calls," and a much freer and more boisterous type of movement, permitting the individual dancer to "cut didoes" in interpolating improvised steps within the general framework of the orderly figures of a particular square dance.

The list of American square dances is reflective of the particular section in which they have developed. as "The Texas Star." "Life on an Ocean Wave,'! "Tennessee Running Set" and "Birdie in a Cage."

The dances of the North American Indians, the first inhabitants of the Cnited States. present a sharp contrast to the dances evolved by those who settled later in the country. Their themes and purposes were those of primitive peoples everywhere. These primeval tribal dances provide for the folklorist one of the most authentic links with the past in those pueblos in New Mexico. Arizona and other southwestern states in which they are performed today in conjunction with rituals as old as the tribes themselves. Although the various tribes developed dances unique with respect to their history and mores, all shared such common ceremonial dances as those pertaining to war, solicitation for rain, fertility of crops and success in the pursuit of game, placation of gods, purging of evil spirits. etc.

Many tribes, therefore, developed and still dance today their Eagle, Buffalo and Deer dances commemorative of prowess in hunting; Corn dances in which high jumps were sought to ensure tall growth of the corn; Snake dances in which live and poisonous snakes were handled and then released to ensure rainfall after a long drought; and innumerable fertility dances in which fruits, vegetables, pine branches and phallic symbols were all used either as part of the costume or carried in the hands. Although there were solo dances on the part of the medicine men and others of distinction. the majority of the dances of the North American Indians were communal. A circular formation was deliberately employed to achieve unity and cohesiveness.

In schools and colleges, folk dance is incorporated in the curriculum and taught, properly, as a folk art rather than as a medium of exercise only. Such an approach presupposes its presentation with all of the associated learnings such as origins, beliefs, customs, legends. costumes and festivals. It is used, therefore, as a means of promoting understanding and appreciation of peoples of other times and places. as well as a means of gaining skills, knowledge and wholesome recreation.

Good courses of study, therefore, include both ceremonial and ritualistic dances along with those that are purely social and recreational.

Private folk dance organizations, civic and recreation centres and church groups also sponsor folk dancing. Cities as well as villages in all countries of the world incorporate folk dancing in the commemoration of special holidays and events.

See also DANCE and under names of various dances. (A. S. D.)

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(W. TY.)

FOLKESTONE, a municipal borough, seaport and seaside resort in the Folkestone and Hythe parliamentary division of Kent, Eng., 17 mi. S.E. of Canterbury by road. Pop. (1951) 45,203. Area 6.3 sq.mi. Folkestone is an important port of the continental passenger service to Boulogne. The older part of the town lies in a small valley which opens steeply to the Dover strait. To the north, the town is sheltered by hills 400 to 500 ft. high, on one of which, Castle hill, is an ancient earthwork. Along the cliff west of the old town a broad promenade with lawns and flower beds. nearly 2 mi. long, called the Leas. extends west to Sandgate and is connected with the shore road and gardens below. On this cliff stands the parish church of St. Mary and St. Eanswith. mainly Early English, built to receive the relics of St. Eanswith. The original church, attached to a priory, was founded near the site of a convent built by Eadbald, king of Kent and father of Eanswith, in A.D. 630. for his daughter The town contains a public library and museum, a technical school, the Leas Cliff hall (a musical centre). a repertory theatre and the Royal Victoria hospital, built in 1889–90 and several times enlarged.

William Harvey, discoverer of the circulation of the blood, was a native of Folkestone and is commemorated by a memorial on the Leas. Sir Eliab Harvey, his nephew, founded the grammar school in 1674. Folkestone has its own court of quarter sessions.

Folkestone harbour has a deep-water pier, which, before World War I, was lengthened to 1,480 ft. and has berths for eight steamers, with a railway platform and lighthouse. The area of the inner and outer harbours is a little over 12 ac. There is a fishing industry, and in addition to passenger traffic a large general trade is carried on

The railway line to Dover (7 mi.) passes through a series of cuts and tunnels in the chalk cliffs, by way of the Warren (on the east of the town overlooking East Wear bay) and Abbot's and Shakespeare's cliffs. In 1915 a serious landslide in the Warren closed the railway for four years. In 1920 the earl of Radnor presented the Warren and East cliffs to the town and they have been developed as parks. The remains of a large Roman villa were excavated near the East cliff in 1924.

Folkestone (Folcantan) was among the possessions of Earl Godwine when he was exiled from England; at the time of the Domesday survey it belonged to Odo, bishop of Bayeux. From early times it has been a member of the Cinque Port of Dover, and had to provide one out of the 21 ships furnished by that port for the royal service. It shared the privileges of the Cinque Ports, whose liberties were exemplified at the request of the "barons" or burgesses of Folkestone by Edward III in 1330. The corporation, which was prescriptive, was entitled the mayor, jurats and commonalty of Folkestone. In 1629 the inhabitants obtained licence to erect a port.

By the end of the 18th century the town had become prosperous by the increase of its fishing and shipping trades, and by mid-19th century it was one of the chief health and pleasure resorts of the south coast. In 1805 the threat of invasion by Napoleon caused three Martello towers to be built, east of the town. It was an important embarkation point during World War I and one of the ports permitted to civilians. In World War II, 7,000 houses were damaged by enemy air raids.

FOLKLAND (folcland). This term occurs three times in Anglo-Saxon documents. In a law of Edward the Elder (c. i. 2) it is contrasted with bookland in a way which shows that these two kinds of tenure formed the two main subdivisions of landownership: no one is to deny right to another in respect of folkland or bookland. By a charter of 863, King Aethelbert exchanges five hides of folkland for five hides of bookland which had formerly belonged to a thane, granting the latter for the newly-acquired estates exemption from all fiscal exactions except the threefold public obligation of attending the fyrd and joining in the repair of fortresses and bridges. Evidently folkland was not free from the payment of gafol (land tax) and providing quarters for the king's men. In Ealdorman Alfred's will the testator disposes freely of his bookland estates in favour of his sons and his daughter, but to a son who is not considered as legitimate five hides of folkland are left, provided the king consents.

Two principal explanations have been given to this term. J. Allen thought that folkland was the common property of the nation (folc), out of which the king could carve dependent tenures for his followers more or less after the fashion of continental *beneficia.* These estates remained subject to the superior ownership of the folk and of the king: they could eventually be taken back by the latter and, in any case, the heir of a holder of folkland had to be confirmed in possession by the king.

Another theory was proposed by Sir Paul Vinogradoff in 1893. It considers folkland as landownership by folkright—at common law, as might be said in modern legal speech. In opposition to it bookland appears as landownership derived from royal privileges. The incidents recorded in the charters characterize folkland as subject to ordinary fiscal burdens and to limitations in respect of testamentary succession. Conversely, "bookland," land held under a royal charter, was normally free from fiscal dues and could be bequeathed at its holder's will. This view of the matter was accepted by the chief modern authorities. (P. VI.)

FOLKLORE. The word was coined by the English antiquarian W. J. Thoms in 1846 to denote the traditions, customs and superstitions of the uncultured classes in civilized nations. The meaning of words, however, is prescribed not by definition but by usage. and the scope of folklore came to include what was deliberately excluded in the early definition. popular arts and crafts. *i.e.*, the material as well as the intellectual culture of the peasantry. Mainly as the result of the work of the English anthropologists, Sir Edward Tylor, Sir James Frazer, and others, who directed attention to the use of the analogies presented by the practices and beliefs of the primitive cultures to illustrate and explain the superstitions and traditional customs of the European peasantry, no sharp boundaries were drawn in practice between the field of folklore and that of social anthropology (*q.v.*).

The Study of Folklore.— Interest in the traditions, ballads, stories and superstitions of the common folk is no novelty of recent date. One has only to think of the Caroline antiquaries such as John Aubrey whose manuscript notes upon the *Remaines of Gentilisme and Judaisme* were written in 1687, though first printed in their entirety in 1881. or of the renewed interest in popular poetry in the 18th century as evinced by such works as Thomas Percy's *Reliques of Ancient English Poetry,* an interest which reached its literary zenith under the influence of Sir Walter Scott in the early part of the 19th century. The customs of the folk no less than their songs attracted the attention of the 18th-century antiquary. John Brand's *Observations on the Popular Antiquities of the British Isles* was first published in 1777; in the early 19th century W. Hone's *Everyday Book* (1826) and *Year Book* (1829) deserve mention. But the work of the German Grimm brothers, whose *Kinder- und Hausmärchen* was published in 1812 and *Deutsche Mythologie* in 1835. laid the foundations for a study of folktales and popular superstitions upon a more scientific basis and envisaged its problems from a wider point of view than that of the local antiquarian or literary romantic.

The collections of material from different parts of Europe, which were the fortunate consequence of the example set by the Grimms. revealed that, as Aubrey had already noticed, there were many popular beliefs and practices to which parallels could be found in the records of classical antiquity. and that there was a large stock of tales! customs and beliefs which was common to all European countries. For a time speculation, which was led astray by a mistaken philological theory and by a belief, later proved erroneous, that the *Vedas* represented a primitive stage of "Aryan" culture, attempted to derive this common stock from the original ancestors from whom the various peoples who now speak languages belonging to the Indo-European family were thought all to have been descended. A prominent feature of the theories of this school, of which Max Müller was the protagonist, was the view that mythology and folktales were vestigial relics of an allegorical religious literature connected with the worship of natural phenomena. But the work of Tylor. followed by that of Frazer, whose *Golden Bough* extended to the primitive cultures the results of J. W. Mannhardt's researches into the agricultural customs of the peasantry of Europe, and made popularly effective by the adroit pen of Andrew Lang, demolished these theories by demonstrating that analogies to these supposed survivals of "Aryan" religion among the European peasantry were to be found also among primitive peoples in all parts of the world. Popular superstitions in Europe, it was later suggested, were not debased remnants of an elaborate archaic religious system, but vestiges of the stages of culture which the higher strata of civilized society had passed through but had outgrown. The world-wide distribution of similar or identical customs was explained by the hypothesis that the normal reactions of the human mind at similar stages of its development to similar conditions of environment will everywhere produce similar results.

Of the trend of the study of folklore in modern times two features may be noticed. First its materials were greatly enriched by the systematic collection and recording of data, particularly in the smaller countries of Europe. There the strong revival of national sentiment among the smaller nationalities supplied an effective stimulus, and the opportunities for collection proved exceptionally rich where the conditions of European civilization had been introduced relatively recently into what were previously peasant societies. Second. with greater knowledge the complexity of the material was more adequately appreciated, and a more cautious and more historical approach to its problems was general.

The acceptance of Tylor's doctrine of survivals led for a time to an exaggerated emphasis upon similarities, which were sometimes superficial, to the neglect of differences, which were often fundamental. Survivals, it was held, could not be dated; it might therefore be assumed that they belonged uniformly to an infinitely remote antiquity, and since no individual originator could be traced or named, some held that all popular songs, ballads and stories were "collective creations of the folk." How a ballad, or indeed any work of art, could actually be evolved by this committee process was never satisfactorily explained, but the view, which possessed a certain sentimental attraction, received some support from the works of the French school of sociologists, Emile Durkheim and his pupils, who endeavored to interpret the data of folklore and social anthropology in terms of contemporary theories about the psychology of crowds.

The modern tendency was to recognize that the survivals of which the material of folklore consists are not all of equal antiquity. Difficult though it undoubtedly is, the main task of the student is that of analysis and stratification. Many of the general ideas which find expression in popular customs and superstitions are doubtless the product of simple psychological reactions to environment! which are common to human nature in all parts of the world, but an examination of the detailed forms in which they have been given expression often reveals substantial differences. The distribution and, where possible, the chronological development of these specific forms demand the most careful attention. Only thus can the data be disentangled. For, if much is very old, much is relatively recent. Culture is affected by foreign contacts of all kinds, whether peaceful or warlike, and within a single society, the learning of one generation has a way of becoming the folklore of another. Much that is handed down eventually by oral tradition, perhaps in a debased and distorted form, has its origin in literature. The satisfactory analysis, therefore, of folklore material demands the use of every available instrument, historical, literary and philological, as well as that of comparative analogy.

What is quite certain is that in this, as in other fields of scientific enquiry, there is no master key which will unlock all secrets with a single simple formula.

Folktales and Popular Stories.— The fields of folklore and social anthropology as mentioned above are not rigidly separated. Thus it is not uncommon to find in a scientific monograph upon the social and religious customs of some primitive people a chapter devoted to their folklore. This will usually be found in practice to contain legends, stories, riddles and proverbs. Neither the storytelling faculty nor the ability to give forcible expression to moral and social truths or prejudices in picturesque apothegms are limited to any section of the human race. Though in particular cases a proverb may have been borrowed by one people from another, the generic similarity of many proverbs which have a wide distribution (*e.g.,* "one swallow does not make the summer") may well be due to the coincidence of independent invention.

The problem of stories is more complicated. Popular stories fall into three main categories; myths, legends and stories which are told primarily to provide entertainment. As distinct from these last, myths have a purpose. They are essentially aetiological, or, as R. Kipling would say, *"Just-So Stories."* Their object is to explain (1) cosmic phenomena (*e.g.,* how the earth and sky came to be separated); (2) peculiarities of natural history (*e.g.,* why rain follows the cries or activities of certain birds); (3) the origins of human civilization (*e.g.,* through the beneficent action of a culture-hero like Prometheus); or (4) the origin of social or religious custom or the nature and history of objects of worship. It will be obvious that myths which fall into the first three categories are likely to present resemblances which may be explained as coincidences, identical questions having provoked similar replies, whereas the myths of our fourth class are likely to differ as widely as the particular customs or local deities which they seek to explain.

Legend may be said to be distorted history. It contains a nucleus of historical fact the memories of which have been elaborated or distorted by accretions derived from myths or from stories of our third kind. In so far as they are historical the similarities between the legends of different peoples must be due to coincidences of real circumstance; in so far as they are fiction? the similarities will be of the same kind as those of myths or fairy stories from which they have really been borrowed.

The majority of the recorded stories of primitive peoples, with the possible exception of the animal tales to which the African peoples are peculiarly addicted, fall into the categories of myth or legend, perhaps because disinterested or unmotived flights of the inventive imagination and fancy, which are rare or rudimentary among primitive peoples, are essentially products of a relatively advanced civilization. But the problems presented by stories, which are neither myths nor legends, cannot be restricted to Europe; for there is a large stock both of incidents and of plots which is common to all countries between Iceland and India. Is this to be accounted for by the coincidence of independent invention or by diffusion? Theodore Benfey, whose *Pantschatantra* was published in 1859, maintained that India had provided the great reservoir of stories from which European folktales were derived. In Germany the work of Köhler and in England the writings of Clouston helped to elucidate the debt of western Europe to oriental story books, and in France Emmanuel Cosquin devoted great learning to the maintenance of the extreme view that all European folktales had their prototypes in India.

If we are unable to accept the Indianist position, we may be grateful for definite gains which these scholars achieved. First, they established the fact that certain kinds of similarity can only be accounted for by diffusion. While it is conceivable and often probable that a general idea or an isolated incident may have occurred independently to story tellers in different countries, it is to ask too much of coincidence to suppose that the same plot, *i.e.,* an identical series of incidents arranged in the same logical order of interest, could be independently invented more than once. Second, they proved that an undoubted influence had been exerted upon the folktales of Europe by the big literary collections of Indian stories, which passed through Persian and Arabic translations to the west. Factors in promoting this influence were the pilgrimage to Jerusalem, the crusades and the medieval contacts between eastern and western civilization which were occasioned by the material and intellectual expansion of Islam. In medieval Europe translations of oriental story books like the *History of the Seven Wise Masters* provided entertaining literature for the cultured, and eastern tales were collected in preachers' handbooks of *exempla,* as they were called, in order to enliven and adorn popular sermons. Popular satire, again, as represented by the *fabliaux* of France and Germany adapted this material to its purpose. It was later used again by the writers of *novelle* who presented it in some cases but little altered (*e.g.,* G. Straparola and Basile) or in others (*e.g.,* Boccaccio) transmuted by genius into the gold of literature.

Thus from the middle ages onward there was constant interchange of stories over the whole area, and there are some, though fewer, instances of a common property which goes back to classical times and even to the 5th century B.C. But it is difficult to believe that Indians have had a monopoly of invention, or that stories have not been spread mainly by exchange. The arguments which postulate a necessarily Indian origin for stories which are recorded only in modern oral tradition in India are unsound. For there is no guarantee of their antiquity upon Indian soil, and indeed there are other reasons to suppose that many of them entered India with Islam.

Further there exist particular plots, the distribution of the variants of which suggests that they have traveled from west to east, and not from east to west.

See also FOLKLORE (AMERICAS INDIAN); NEGRO, AMERICAN; FOLK DANCE; SOCIAL ANTHROPOLOGY. (W.R. H.; X.)

See M. Leach (ed.), *Funk and Wagnalls Standard Dictionary of Folklore, Mythology and Legend,* 2 vol. (1949).

FOLKLORE (AMERICAN INDIAN). Indian folklore exhibits a wide range of topics touching every aspect of traditional life and including secular and religious myths, folk tales and historical legends, as well as a rich folk science in star, plant and animal lore. Much of it is sheer art, expressing the love of telling stories, posing riddles and playing games—the joy of poetry, music and the dance that may accompany ritual. The folklorist has been interested in the kinds of tales. how and when they are told. where found and what forms they take. This article is concerned only with the myths and folklore of North American tribes.

Plains Indians themselves distinguish two classes of tales: the supposedly real or historical and the fictional. Such differences map be noted from lead lines: "A tribe was settled. . . ," "Spider was traveling. . . ." The eastern woodlands Indians distinguish among events "which truly happened" (myths); adventures with supernaturals ("they-went-to-hunt-for-meat tales"); and tribal history. Animal stories are virtually universal. Perhaps the most striking aspect of Amerind literature is the wide distribution of the tales of creation. the deluge, the "trickster" cycle, contest or ordeal stories, twin-hero and other myths.

Tales were traditionally told during the winter period of quiet "when the earth sleeps"; the storyteller filled an educational role, recounting night after night animal stories and trickster cycles to children. Creation myths and the origins of ceremonies were recited mainly in public to adult audiences. Definite rules governed the telling of stories—the host put up a feast. the narrator chose the topics and he continued so long as the children listened, stopping at the first sign of drowsiness. Myths and tales were widely disseminated from village to village and tribe to tribe. Warriors brought back "news" and captured bards from distant peoples. To this day, stomp-dance songs composed in Oklahoma reach New York and Ontario and the pan-Indian gatherings in the southwest have spread the modern "hoop dance" to metropolitan Indians of Chicago and New York.

Remarkable concordances of language, myths and geographical region mark off certain folklore areas as follows: Eskimoan; northeast Xlgonkian: Iroquoian of the Appalachian uplands; and southeastern. The Plains, the far west and the southwest are more complex. however. Certain tales are common to the north Pacific and Arctic coasts, another series spans the territory between the north Atlantic and the middle Pacific coast and a third extends along the Rocky mountains. The tale of the animal bringing up the earth from the bottom of the water is told over an enormous area; though at home in the watershed of the Great Lakes, its distribution includes the Mackenzie basin, the middle and south Atlantic coasts and a few isolated spots on the Pacific coast. An early connection has been inferred for the beautiful allegory of the loon's necklace, or the man who recovered his eyesight, which occurs both in Greenland and Oregon. Likewise, close relations obtain between Algonkian tales and those of the Pacific coast. Stories of the rabbit that tried to rival the ways of other animals are told of Longfellow's *Hiawatha* (Schoolcraft's "Nanabush"), and in Alaska they are told of the raven.

A story continental in distribution, lacking only in California and on the Arctic coast, is that of the bungling host—a person who is fed by the magic powers of his host but fails ignominiously to imitate him. Legends of the stars have followed trade routes from the Great Plains up the Ohio and westward to the Pacific. An appealing plot is that concerning "Thrown-Away," an outcast orphan boy who is brought up magically to become a hero. Characteristically western are themes involving "Eye Juggler," an animal that plays ball with his eyes and finally loses them; an ascent to the sky by means of a ladder of arrows; and the contest between beaver and porcupine in which beaver invites porcupine to swim and porcupine invites beaver to climb. Migration legends form another pattern of distribution in the southwest and the Mississippi river basin.

A series of complicated Xmerind tales has old world counterparts. Among the Samoyed of Siberia, as on the northwest coast of North America, children escape a pursuing cannibal by a magic flight. In Siberia a thrown whetstone becomes a ravine, a flint cast away is transformed into a mountain and a comb becomes a thicket; in America the whetstone becomes the mountain. a bottle of oil a lake, and the comb a thicket. Indian lore was enriched by contact: the French *voyageurs* traded oral literature nith the ax and gun across Canada, and the Negro slave in the southeast introduced fairy and animal tales from Africa.

Material collected in different parts of the continent presents marked differences as to themes, actors, plot and formal structure. It is not the selection of themes or even the actors that permits recognition of certain types of stories as characteristic of certain areas, but rather the fundamental ideas underlying the plots and composition or style. Elaboration of the tale may be extremely variable but the constant element is always some plot—such as "Thrown-Away" or the twins; "Turtle's War Party"; "Wisahka and His Brother" or "Tar Baby"—that characterizes the mythology of a particular area.

The majority of North American "test tales" have human heroes in a human setting and refer to social phenomena. In the southwest the quest for "long life" is a consistent theme of Apache mythology—an example that M. E. Opler cited in applying such themes to a characterization of the culture. In the trickster mythology, P. Radin saw the presence of a personage and motif having a permanent appeal and an unusual attraction from the beginnings of civilization, possibly reflecting universal psychic experiences of mankind. In part, the animals that appear in tales are determined by the particular fauna of each habitat. The same stories are told of all these creatures. Raven, the hero of a cycle in the northwest, is replaced farther south by the mink and then by the blue jay; the coyote ("Old Man Coyote") is the pornographic trickster on the plateau; the rabbit replaces him on the Plains and the spider in the southwest; a human trickster prevails among the Iroquois and Algonkin of the east. These tricksters are not to be equated with either animals or human beings but regarded, in Jungian terms, as the workings of a mythological imagination depicting man's struggle with nature and with himself.

Most Amerind origin myths deal with the transition from a mythological period to the modern age, usually brought about in a series of disconnected incidents by the act of a particular culture hero. Usually, the universe is assumed to be already present, and the plot is concerned with the discovery of elements, seasons, plants and animals that already exist or have been released on the earth for the use of mankind. Chaos does not precede the origin of the world. Four types of origin tales are noted: (1) accidental happenings (far north); (2) a decision by a council of animals (Plains and woodlands); (3) a contest between two beings, good and evil (California and east); and (4) the culture hero who travels about over the earth setting things right (east and northwest coast).

An absence of moralizing is offset by a high incidence of explanatory elements in the tales, particularly on the western plateau. Among the southern Caddoan tribes, an explanation of the stars predominates; on the plateau, animal behaviour is stressed; the Iroquois, Blackfoot and Kwakiutl have numerous tales relating to ceremonies; and the southern tribes tell a great number of cosmogonic tales.

Grouping of the tales into long episodes is characteristic and deliberate. The disconnected tales of the northwest present a striking contrast to such long and systematic origin myths of the east as the Iroquois myth of the holder of the Heavens (the cosmology) and the Deganawidah epic (the origin of the Iroquois political systemj. The structure of southern Plains, Navaho and Pueblo myths is similarly complex and is built around the idea of emergence from the ground. Unlike the southeastern tribes, the northern Iroquois, and also the Cherokee, lack extensive migration legends such as the *Walam Olum* of the Delaware.

Such historic sources as the *Jesuit Relations* record fragments of cosmogonic myths, journeys to the land of the dead and legends of the origins of supernatural power, which establish the tales as pre-Columbian. But the absence of written documents relating to the trickster cycle throws the investigation back on methods of inferring history from distribution. Efforts to describe tribal culture from folklore sources, first on the northwest coast, then on the Plains and later in the southwest, demonstrated that myths are not always exact tribal autobiographies and quite often novelistic tales outweigh realism. But in the pueblos of the Rio Grande dependence on tilling the soil, the necessity of irrigation and authoritarianism are mirrored in the tales which afford instances of disciplinary action consistent with modern political organization. Cases in which individuals have introduced new rituals and myths in postcontact times are found; *e.g.,* among the Navaho, in the history of the ghost dance (*q.v.*) and in the careers of the native prophets.

Interest has been increasing in the contributions of the Indian to American folk culture. Storytellers are still found among older reservation Indians and the growth of mythology continues in the beliefs held regarding tribal history, particularly treaties and relations with the federal government. Such traditions sometimes can be verified.

Music, poetry and the dance that comprise Indian ceremonialism have been collected since the mid-19th century. Musical scores have been printed and recordings are available on disks and tape for most areas. There is at least one successful attempt to render the native texts into English poetry. The choreography, which is inseparable from the songs and the ritual poetry, has been arranged according to the technique of Rudolf von Laban by modern students of the dance. The collected literature on the subject—much of it in native texts—is immense, but a comprehensive program of tape recording might yet rescue from oblivion style lost in transcription.

See also GHOST DANCE; MANITO; NATIVISTIC MOVEMENTS; PEYOTISM; PLAINS INDIANS; RELIGION: *Primitive Religion;* SUN DANCE; TOTEMISM: *North America.*

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FOLK-SONG. Any art if it is to have life must be able to trace its origin to a fundamental human need. Such needs must prompt expression among people even in their most primitive and uncultivated state. To this rule the art of music is no exception; Parry has pointed out that the universal law of evolution demands that we should be able to trace even the most elaborate compositions of Beethoven or Wagner back to some primitive germ. This primitive, spontaneous music has been called "Folk-song," a rather awkward translation of the German word "Volkslied," but nevertheless a word which stands for a very definite fact in the realm of music.

It has been said that if me did not know by experience of the existence of folk-song we should have to presuppose it theoretically to account for the art of music.

Fortunately theory is borne out by practice. We find that unlettered and untravelled people have both the desire and the power to express themselves musically and these attempts at musical expression are not mere clownish nonsense, nor are they, as we are sometimes told, degraded reminiscences of "cultured" music, but are something *sui generis;* moreover, among these spontaneous expressions are to be found melodies which are the most treasured possessions of our art—such melodies as "Searching for Lambs" (England), "Ca' the Yowes" (Scotland), "The Londonderry Air" (Ireland), "Innsbriick Ich musz dich lassen" (Germany), "Magali" (Provence), are ample proof of this, and these are only a few examples out of hundreds.

Moreover, as we have already seen, the folk-song must of necessity bear within it the seed of all the future developments of the art. Such a tune as "The Lady in the Dark," from Playford's *Dancing Master*, exhibits in miniature the same ground plan as many a movement from a Beethoven Symphony: indeed this tune has been described as a "Symphony eight bars long."

Folk-music has, of course, its limitations. To start with, folk-music like all primitive art is an applied art, the vehicle for the declamation of a ballad or the stepping of a dance, and it is, therefore, bounded by the structure of the stanza or the dance-figure. Secondly, folk-music (at all events that of the Teutonic and Latin races) is non-harmonic; there is nothing but the melodic line.

But these limitations have their compensating advantages. A tune which is only eight bars long, and which has to be repeated as often as 20 times to accompany a ballad or a dance, must have certain peculiar qualities if it is not to become wearisome; and we find that the best folk tunes only show their true quality after several repetitions.

Again, the purely melodic character of traditional song gives it a wide range of outline, impossible to melodies which are bound by the progressions of underlying harmonies. Melodies of an harmonic nature are almost always in the major or minor modes, but in folk-song other modes, chiefly the Dorian or Mixolydian, are frequent.

The fact that these modes are also to be found in another great body of purely melodic music, namely the plain-song of the Roman Church, has led to the assumption that "modal" folk-songs must be "ancient," or even derived from mediaeval church music. On the propriety of dubbing a folk-song "ancient" or "modern" more will be said later; as to the supposed derivation from plain-song, surely the simple explanation is that folk-song and plain-song, being purely melodic, are based on the same principles; surely no similarity except that of mode can be traced between such tunes as "Seventeen come Sunday" and "Jesu dulcis memoria."

A further and very important limitation of folk-song must be mentioned, namely that it survives by purely oral tradition. By our hypothesis the inventors and disseminators of folk-music are unlettered, and are therefore unable to stereotype their inventions by means of reading and writing. It is on this that the whole nature of folk-song and all questions of its origin and development depend.

It is sometimes held that the word "folk-song" should be used in what is called a "broad" sense so as to include not only genuinely traditional music, but all those songs of a popular character which are habitually sung by the people of a country. But, in fact, the difference between these two classes of music is a real and scientific one, which is properly recognized by the Germans in their distinction between a "Volkslied" and a "Volksthümlicheslied." What common denominator can be found which will cover, on the one hand, such a song as "Tom Bowling" and, on the other, the "Lazarus" tune in *English County Songs?* In the one case we can judge the date and even guess at the composer; but who can date a folk-song? Indeed, a folk-song is neither new nor old; it is like a forest tree with its roots deeply buried in the past but which continually puts forth new branches, new leaves, new fruit.

Collectors are often asked by would-be intelligent enquirers as to the age of some folk-song, as if the question of age were either important or relevant. Others (sceptics) suggest that the traditional singer "made it up himself." The answer to this, of course, is that quite possibly he did to some extent "make it up himself," although this in no way adds to, or takes away from, its scientific or artistic value. It is not the question of age or authorship that is important in a folk-song but that of spontaneity and beauty. When a collector nowadays hears a song sung by a traditional singer he may be pretty sure that, if the singer is a true artist, he will have unconsciously added something of his own to what he sings. A folk-song then is always grafting the new on to the old. This is the answer to the question: "How old is that folk-song?" A folk-song is neither new nor old because it is continually taking on new life; it is an individual flowering on a common stem.

This brings us to the vexed question of the "communal growth" of folk-song; and here it may be pointed out that much useless derision has been wasted over a supposed theory of "communal origin." No one has ever laid it down as an indisputable proposition that folk-song has a communal origin, though even this is not so impossible an idea as some people suppose. No one insists that some individual must have invented every word of our language. Who invented "father" or "plough" or "sun" or any other of the words that belong to primitive life? If we admit communal authorship in our language, is it not even more probable in such an intangible matter as music?

However, it is not necessary to prove the communal origin of folk-song in order to argue in favour of its communal growth. It is yell known that when a rumoured fact or story becomes spread about it soon is circulated in various altered forms and this in spite of the fact that everyone who repeats the story is anxious to repeat it correctly. How much more then will a song become altered by oral repetition when each new singer is bound only by his artistic predilections? If he thinks he can improve the song, why should he not do so? If he finds it too difficult why should he not simplify it? Thus a folk-song evolves gradually as it passes through the minds of different men and different generations.

Nor will this gradual change ever be a process of deterioration, because those versions of the tune which are distasteful to others will die a natural death. Here then is a clear case of the survival of the fittest. A tune which has been handed down from father to son through many generations will represent the united imaginations of thousands of men and women through hundreds of years of evolution.

This then is the much discussed "communal growth" theory, and it is borne out by the facts. Collectors know well that numerous variants of the same tune have been found in different parts of the country and, conversely, that tunes have been found which are quite distinct from each other, but at the same time have features that point to a common stock. Thus Grimm's famous apophthegm "a folk-song composes itself" is not, after all, a piece of misty emotionalism but represents the hard common-sense facts of the case. (R. V. W)

Cowboy Songs.—The ballad spirit, common to all peoples and particularly active in European nations and their descendants, survived until recent years and under exceptionally friendly conditions in the section of the United States lying west of the Mississippi river. Here a fairly large group of men, almost all of Anglo-Saxon descent, were removed from easy contact not only with printed matter but with entertainment of any sort. Each man spent many hours entirely alone when on night herd or when range riding, engaged frequently in work that absorbed only a part of his attention; and he and his small group, about the chuck wagon or in going up the trail, spent long terms with only such social amusements as they could provide for themselves. Situated thus. the ballad-making instinct revived. with the result that there came into being a considerable body of folk-songs which have been preserved and perpetuated by oral tradition, and have been designated loosely for present purposes *Cowboy Songs*.

These songs are interesting chiefly as human documents, for the light that they throw on the conditions of frontier life. and for their reflection of the old time cattle baron and his crew. The whole cycle of the cowboy's experience—its monotony, its fun, its heroes. its love affairs, its dangers. and the epics of the long drives overland from Texas to Montana—is set forth in the songs made and sung by the men themselves. Further, the material offers to students of folk literature a picture of folk-songs in the process of manufacture and transmission. In a strict sense the songs of the cowboys are not ballads, yet, in the method of production. preservation and distribution. they show points of kinship to the accepted ballads of the Child collection. For example, the refrain of the ballad form is often present, adapted at times to common cattle cries: there are occasional instances both of simple and incremental repetition; some songs are introduced by the stereotyped "Come all ye." Also, a majority of the songs are without known authorship; some of them bear indication of communal composition, probably around the evening camp fires or the larger gatherings of the general roundups or in song contests, where the champion of one ranch "sang down" the champion of another ranch by the process of singing a greater number of songs. Some are adaptations of songs already well known, changed to fit a new environment; all, of whatever origin, existed for a number of years in oral literature, each singer feeling the freedom of an author, introducing his personal experiences, amending the phrasing, and giving that breath of real life that is present in true folklore.

During the time of their highest popularity these songs were not in print except in an occasional newspaper, but later a few small books, now out of print, appeared containing the words of some of the songs along with original verses by the local poet sponsoring them.

The best known of the real cowboy songs were widely distributed over the entire western United States, with 30 versions of the same song coming into the hands of a single collector from locations as far removed from each other as Idaho, California and Texas. In all, some hundreds of genuine cowboy songs were current among the frontiersmen, springing up as naturally, as unobtrusively, as did the prairie grass; and destined, except for the interest of scholars, to perish as noiselessly and as completely. As might be expected some of the cowboy's best poetic effort was expended on songs not suitable for publication.

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FOLLEN, AUGUST (or, as he later called himself, ADOLF) **LUDWIG** (1794–1855), German poet, was born at Giessen on Jan. 21, 1794, the son of a district judge. He studied at Giessen and Heidelberg, and after leaving the university edited the Elberfeld *Allgemeine Zeitung*.

Suspected of being connected with radical plots, Follen was imprisoned for two years in Berlin. On his release in 1821 he went to Switzerland, where he lived until his death at Berne on Dec. 26, 1855.

Besides a number of minor poems Follen wrote *Harfengrüsse aus Deutschland und der Schweiz* (1823) and *Malegys und Vivian* (1829), a knightly romance after the fashion of the romantic school. The series of sonnets entitled *An die gottlosen Nichtswüteriche,* aimed at the liberal philosopher Arnold Ruge, started a violent literary quarrel.

Follen's best-known work is a collection of German poetry entitled *Bildersaal deutscher Dichtung* (1827).

FOLLEN, KARL (1795–1840), German poet and patriot, brother of A. L. Follen, was born at Romrod, Hesse-Darmstadt, on Sept. 5, 1795. He studied at Giessen, and after a year's service in the army (1813) began the study of jurisprudence, and in 1818 established himself as *Privatdocent* ("unpaid but official lecturer") of civil law at Giessen. Suspected of political intrigues, he removed to Jena, and thence, after the assassination of Kotzebue, fled to France. After the political murder of the duc de Berry (Jan. 14, 1820), Follen was regarded as suspect, and took refuge in Switzerland; but the Prussian authorities imperatively demanding his surrender, he sought in 1824 the hospitality of the United States. There he taught German at Harvard in 1825, and in 1830 was appointed professor; but he forfeited his post in 1835 by his antislavery agitation, and became Unitarian minister at Lexington, Mass. (1836). He perished at sea on the night of Jan. 13–14, 1840.

Follen was the author of several celebrated patriotic liberal songs. The best is perhaps *Horch auf, ihr Fürsten! Du Volk, horch auf!* It was published in A. L. Follen's collection of patriotic songs, *Freie Stimmen frischer Jugend.*

His wife Elisa Lee (1787–1860) published after his death his lectures and sermons, with a biography written by herself (5 vol., Boston, 1836).

FOLSOM, an early American Indian culture named after the town of Folsom, N.M., near which the first artifacts were found. There, in 1926, a stone point was discovered in direct association with the remains of a giant extinct bison *(Bison antiquus figginsi,* at that time classified as *Bison taylori)* by an expedition from the Colorado Museum of Natural History, led by J. D. Figgins. The acceptance by archaeologists and paleontologists of this association of Folsom culture remains with an extinct Pleistocene bison required a new interpretation of the problem of the peopling of the new world. Previously the earliest Americans were thought to have arrived three or four millenniums prior to European contact. Early estimates of approximately 10,000 years for the age of the Folsom culture (which, however, by no means represents the earliest culture in the new world), based primarily on geological dating methods, are supported by later estimates based on the radiocarbon analysis of bone and shell samples from a site near Lubbock, Tex., containing Folsom artifacts.

The single type of artifact most characteristic of the Folsom culture is a thin lanceolate stone projectile point with a deeply concave base and a long narrow flake removed lengthwise from its two flat surfaces. This gives the Folsom point a fluted or "hollow-ground" appearance. Folsom points seem to represent a relatively late refinement of the fluting technique, which may have been in use in North America as early as 12,000 years ago. They are believed to have been used on a thrusting spear.

The Folsom culture is best known from excavations by a Smithsonian institution field party in 1934 and 1935, under the direction of F. H. H. Roberts, Jr., at the Lindenmeier site in northeastern Colorado. There a deeply buried Folsom campsite had been partially exposed by erosion. Excavation of the uneroded portion yielded an extensive inventory of nonperishable tools associated with hearths and the remains of extinct bison and camel. Characteristic stone tools from the Lindenmeier site include snub-nosed scrapers, end scrapers, side scrapers, drills, gravers and various types of knives. There are also sandstone shaft polishers and rubbing stones, some bone punches or awls and several bone fragments of problematical use decorated with engraved lines. The kinds of tools and the condition of the animal bone at the Lindenmeier site indicate that the Folsom people subsisted primarily by hunting large bison, and that they were not dependent to any great extent on wild plant foods. While Folsom remains have been found in localities as widely scattered as southern Alberta, Can., and southern Texas, the centre of activity of the Folsom culture was the southern high plains region, particularly the eastern portions of what are now Colorado and New Mexico. The distinctive culture of the Folsom hunters appears to have been replaced by the Plano hunting cultures before 8,000 years ago. *See* also ARCHAEOLOGY: *Prehistory: The New World Prior to Urban Civilization;* INDIAN, NORTH AMERICAN: *Prehistory.*

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FONBLANQUE, ALBANY WILLIAM (1793–1872), English journalist, was born of a French Huguenot family. His father was an Equity barrister and M.P. for Camelford. Fonblanque began journalistic work in 1812, and attracted attention by the boldness of his opinions and the superiority of his style to the ordinary work of the day. In 1830 he became editor of *The Examiner,* and remained in control until 1847. Fully maintaining the level of political independence set by the Hunts, he inspired the admiration even of his opponents by his wit, and *The Examiner* was the standard of literary merit in the journalistic world.

See the *Life and Labours of Albany Fonblanque,* ed. by his nephew, Edward Barrington de Fonblanque (1873).

FOND DU LAC, an industrial city, seat of Fond du Lac county, Wis., U.S., is located at the south end of Lake Winnebago in a dairy farming and resort region, 150 mi. N.W. of Chicago.

Platted by speculators in 1835, Fond du Lac attracted many German immigrants. Sawmills and wood product manufacturing prospered before the pine forests were removed. The town was incorporated as a village in 1847 and chartered as a city in 1852. A council-manager form of government mas adopted in 1957. (For comparative population figures *see* table in WISCONSIN: *Population.*)

Principal products include machine tools. refrigerators and outboard motors. Recreation centers on the lake where motorboat races attract entries from many states. The Episcopal Cathedral Church of St. Paul, with its wood carvings from Oberammergau, is a famous institution. One-third of the children attend parochial schools. A vocational school and an extension of the University of Wisconsin provide education beyond high school. (W. D. W.)

FONDI, a town of Lazio, Italy (anc. *Fundi*), province of Latina, 12 mi. N.W. of Formia, and 69 mi. S. of Rome by rail. Population (1957 est.) 21,529 (commune). It lies 25 ft. above sea level at the north end of a plain surrounded by mountains, which extend to the sea. It occupies the site of the ancient Fundi, a Volscian town, belonging later to *Latium adjectum*, on the Via Appia, still represented by the modern high road which passes through the centre of the town. It is rectangular in plan, and portions of its walls are preserved. The gate on the northeast still exists, and bears the inscription of three aediles who erected the gate, the towers and the wall. In the neighbourhood are remains of ancient villas. and along the Via Appia still stands an ancient wall of opus *reticulatum*, with an inscription. in large letters, of one Varronianus, the letters being at intervals of 25 ft.

The modern tonn is still enclosed by the ancient walls. The castle on the south-east side has some 15th-century windows with beautiful tracery. Close by is the Gothic church of S Pietro (formerly S. Maria), the cathedral until the see was united with that of Gaeta (1818). In the Dominican monastery the cell which St. Thomas Aquinas sometimes occupied is shown.

The ancient city of Fundi in 338 B C. (or 332) received (with Formiae) limited, and in 188 B.C. full citizenship, because it had always secured the Romans safe passage through its territory. This was strategically important for the Romans, as the military road definitely constructed by Appius Claudius in 312 B.C., still easily traceable by its remains, and in part followed by the high-road, traversed a narrow pass. which could easily be blocked, between Fundi and Formiae. The family of Livia, the consort of Augustus, belonged to Fundi During the Lombard invasions in 592 Fundi was temporarily abandoned, but it came under papal rule by 754. Pope John VIII ceded it with its territory to Docibile, duke of Gaeta, but sometimes it appears as an independent countship. though held by members of the Caetani family, who about 1297 returned to it. In 1504 it was given to Prospero Colonna. In 1534 Khair-ed-Din Barbarossa tried to carry off Giulia Gonzaga. countess of Fondi. and sacked the city. In 1721 it was sold to the Di Sangro family, in nhich it still remains. Its position as a frontier town between the papal states and the kingdom of Naples, just in the territory of the latter—the Via Appia can easily be blocked either north-west at the actual frontier called Portclla or south-east of it—affected it a good deal during the French Revolution and the events which led up to the unification of Italy.

The Lago di Fondi, in the middle of the plain, and the marshes surrounding it, compelled the Via Appia to make a considerable détour. The lake was also known in classical times as *lacus Amyclanus,* from the town of Amyclae or Amunclae, founded, according to legend, by Spartan colonists, and probably destroyed by the Oscans in the jth century B.C.; the bay was also known as *mare Amunclanum.* The ancient Speluncae (mod. *Sperlonga*) on the coast also belonged to the territory of Fundi. Here was the imperial villa in which Sejanus saved the life of Tiberius, who was almost crushed by a fall of rock. Considerable remains of it, and of the caves from which it took its name, still exist 1 m. S.E. of the modern village. Wine of the *áger Caecubus,* the coast plain round the Lago di Fundi, was praised by Horace. The plain of Fondi is the northernmost point in Italy where the cultivation of oranges and lemons is regularly carried on in modern times.

See T. Ashby, in *English Historical Review,* xix. (1904) 557 *seq.* for a notice of Italian works on the subject. (T. A.)

FONSAGRADA, a town of N.W. Spain, in Lugo province; 38 mi. E.N.E. of Lugo by road. Pop. (1950) 14,584 (mun.). Fonsagrada, over 3.000 ft. above sea level, is the market for the agricultural and dairy produce of the fertile valleys in the surrounding mountains, but its trade is mainly local, owing to the lack of communications beyond the Lugo-Rivadeo road. Insurgents captured the town early in the civil war of 1936–39.

FONSECA, MANUEL DEODORO DA (1827–1892), professional soldier and first president of Brazil. was born in Alagoas (Marechal Deodoro) on Aug. 5, 1827. The son of an army officer. Fonseca s-as trained from childhood for a military career. He distinguished himself for personal valour and military prowess in the Paraguayan war (1864–1870) and rose rapidly in the army thereafter. His rise to prominence occurred during a period of increasing political activity by army officers. many of whom favoured a republic. Although Fonseca was not an ardent republican, he defied the emperor, insisting that his fellow officers had the right to express their political views publicly even when they opposed the empire. The imperial government, severely weakened by other problems, could not withstand the direct military challenge to its authority. On Nov. 1j. 1889, Fonseca led the bloodless *coup d'état* that toppled the empire and set up the republic. He served as provisional president until Feb. 1891, when he was elected president by the constituent assembly. Arbitrary and autocratic. Fonseca lacked the capacity for political compromise. Unable to work harmoniously with his ministers or the congress, he resigned in Nov. 1891 and retired from public life. He died at Rio de Janeiro on Aug. 23, 1892.

Despite Fonseca's personal limitations as a political leader. his short regime established the institutional framework within which the republic functioned for nearly 40 years. Under his leadership a constitution patterned somewhat after that of the United States was issued (Jan. 1891); the highly centralized government of the empire was replaced by a federal system in which the states enjoyed almost complete political and economic autonomy; and the army was confirmed as a major element in the Brazilian political process. (R. E. P.)

FONSECA, GULF OF (GOLFO DE FONSECA), a sheltered inlet of the Pacific ocean in Central America, shared by Nicaragua on the south, by Honduras on the east and northeast and by El Salvador on the north and northwest. The gulf is about 50 mi. long and about 30 mi. wide at the mouth between Amapala and Cosigiiina points; it is regarded as one of the world's finest natural harbours, being protected from the winds and waves of the Pacific by the islands of Conchagüita, Meanguera and the rocky Farallones. It is surrounded by volcanic shores with huge sugarloaf islands, some of which are under cultivation, dotting the surface, and receives the Choluteca. Goascoran and Estero Real rivers and the Rio Negro. The chief ports are La Unión (*q.v.*), Amapala and Puerto Morazán (on the Estero Real. Nicaragua). The Gulf of Fonseca was discovered in 1j22 by Gil Gonzalez de Avila and was named by him after his patron, Archbishop Juan Rodriguez de Fonseca, persecutor of Columbus. Under the Bryan-Chamorro treaty (1916) with Nicaragua, the U.S acquired a perpetual option to the site of an interoceanic canal in Nicaraguan territory; at this time Nicaragua also granted the U.S. the right to establish a naval base on Corn Island if and when the Nicaraguan canal should be constructed. However, both Honduras and El Salvador protested to this latter grant, asserting that the waters of the gulf were not open sea but the joint property of El Salvador, Honduras and Nicaragua. (L. WE.)

FONT, the vessel used in churches to hold the water for Christian baptism. In the apostolic period baptism was administered at rivers or natural springs, Lat. *fons* (cf. Acts viii. 36), and no doubt the primitive form of the rite was by *immersion* in the water. *Infusion*—pouring water on the head of the neophyte—was early introduced into the west and north of Europe on account of the inconvenience of immersion, as well as its occasional danger; this form has never been countenanced in the Oriental churches. *Aspersion,* or sprinkling, was also admitted as valid, but recorded early examples of its use are rare *(see* BAPTISM). These different modes of administering baptism have caused corresponding changes in the receptacles for the water. After the cessation of persecution, when ritual and ornament began to develop openly, special buildings were erected for administering the rite of baptism. This was obviously necessary, for a large *piscina* (basin or tank) in which candidates could be immersed would occupy too much space of the church floor itself. These baptisteries consisted of tanks entered by steps (an ascent of three, and descent of four, to the water mas the normal but not the invariable number) and covered with a domed chamber *(see* BAPTISTERY).

By the 9th century, however, the use of separate baptisteries had generally given place to that of fonts. The material of which these were made was stone, often decorative marble; as early as 524, however. the council of Lerida enacted that if a stone font were not procurable the presbyter was to provide a suitable vessel, to be used for the sacrament exclusively. which might be of any material. In the Eastern Church the font never became an important decorative article of church furniture.

Few if any fonts older than the 11th century survive. These are all of stone, except a few of lead; much less common are fonts of' cast bronze (a fine example, dated 1112, exists at the Church of St. Barthelemy, Liege). The most ancient are plain cylindrical bowls, with a circular—sometimes cruciform or quatrefoil—outline to the basin, either without support or with a single central pillar; occasionally there is more than one pillar. The basins are usually lined with lead to prevent absorption by the stone. The church of Efenechtyd, Denbigh, possesses an ancient font made of a single block of oak.

Fonts early began to be decorated with sculpture and relief. Arcading and interlacing work are common; so are symbol and pictorial representation. A very remarkable leaden font is preserved at Strasbourg, bearing reliefs representing scenes in the life of Christ. At Pont-8-Mousson on the Moselle'are bas-reliefs of St. John the Baptist preaching, and baptizing Christ. Caryatides sometimes, take the place of the pillars, and sculptured animals and grotesques of strange design not infrequently form the base. Most remarkable is the occasional persistence of pagan symbolism; an interesting example is the very ancient font from Ottrava, Sweden, which, among a series of Christian symbols and figures on its panels, bears a representation of Thor *(see* G. Stephens' brochure, *Thunor the Thunderer*).

In the 13th century octagonal fonts became commoner, and in the 14th and succeeding centuries they became the rule. In England no fonts can certainly be said to date before the Norman conquest, although it is possible that a few very rude examples, such as those of Washaway, Cornwall and Denton, Sussex, are actually of Saxon times; of course we cannot count as "Saxon fonts" those adapted from pre-Norman sculptured stones originally designed for other purposes, such as that at Dolton, Devonshire. On the other hand, Norman fonts are very common, and are often the sole surviving relics of the Norman parish church. They are circular or square, sometimes plain, but generally covered with carving of arcades, figures, foliage, etc. Some of the best examples of "Norman" fonts in England (such as the notable specimen in Winchester cathedral) were probably imported from Belgium. Fonts of the Perpendicular period are very common, and are generally raised upon steps and a lofty stem, which, together with the body of the font, are frequently richly ornamented with panelling. It was also the custom during this period to ornament the font with shields and coats of arms and other heraldic insignia, as at Herne, Kent.

In 1236 it was ordered by Edmund, archbishop of Canterbury, that baptismal fonts should be kept under lock and key, as a precaution against sorcery. The ordinary position in the church was and is near the entrance, usually to the left of the south door.

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FONTAINE, PIERRE FRANÇOIS LÉONARD (1762–1853), French architect and decorator, who supervised work on the Louvre for many years. was born at Pontoise on Sept. 20, 1762, and died in Paris on Oct. 10, 1853. Several of his family were distinguished architects.

In 1779 Fontaine went to Paris to study under Peyre the younger, and won the second Grand Prix de Rome in 1785. With this grant he went to Rome. After the French Revolution he was employed by Napoleon for the restoration of the palace of Malmaison, and thereafter executed the principal architectural works in Paris for Napoleon I. Louis XVIII and Louis Philippe. He was employed with his collaborator. Charles Percier. on the arch of the Carrousel, the restoration of the Palais-Royal. the grand staircase and several wings of the Louvre and the project for the union of the Louvre and the Tuileries.

The neoclassical Expiatory chapel (1815–26) in Paris is considered by many authorities the outstanding work of Percier and Fontaine. Together they published *Palais, maisons, et autres édifices de Rome moderne* (1802); *Descriptions de cérémonies et de fêtes* (1807 and 1810); *Recueil de décorations intérieures* (1812); *Choix des plus célèbres maisons de plaisance de Rome et des environs* (1809–13); *Le Parallèle des principales residences des soverains d'Europe* (1833).

A history, *L'histoire du Palais Royal,* was published by Fontaine alone.

See M. Fouché, *Percier et Fontaine* (1905).

FONTAINEBLEAU, a town of northern France, capital of an *arrondissement* in the *de'partement* of Seine-et-Marne, 37 mi. S.E. of Paris by rail. Pop. (1954) 17,218. It stands in the forest of Fontainebleau, nearly 2 mi. from the left bank of the Seine. The Tambour mansion, and a portion of the cardinal of Ferrar's house, both of the 16th century, are still preserved. Fontainebleau is the seat of a subprefect and has a tribunal of first instance.

The town has quarries of sand and sandstone, sawmills, and manufactories of porcelain and gloves. It is a summer resort, and the president of the republic frequently resides in the palace, one of the largest of the royal residences of France, situated to the southeast of the town.

The exact origin of the palace and of its name (Lat. *Fons Bleaudi)* are unknown, but the older château was used in the latter part of the 12th century by Louis VII. Francis I caused most of the buildings of the Cour Ovale to be erected. After Francis I. Fontainebleau owes most to Henry IV, Louis XIII, Napoleon I, Louis XVIII, Louis Philippe and Napoleon III. The park covers about 200 ac. and is traversed by a canal dating from the reign of Henry IV. On the north it is bordered by a vinery producing white grapes.

The forest of Fontainebleau is one of the most beautiful wooded tracts in France, and has been for generations the haunt of landscape painters. It covers 42,200 ac., with a circumference of 56 mi. Nearly a quarter of this area is of a rocky nature, and the quarries of sandstone supplied a large part of the paving of Paris. Oak, pine, beech, hornbeam and birch are chief trees.

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FONTAN, LOUIS MARIE (1801–1839), French man of letters, was born at Lorient. He wrote a number of plays, of which *Perkins Warbec* (1828), written in collaboration with Halévy and Drouineau, was the most successful. He was repeatedly in trouble with the authorities under the Restoration and spent some time in prison before the revolution of 1830 brought him release.

Fontan's *Jeanne la folle,* performed in the same year, gained a success due perhaps mainly to sympathy with the author's political principles. A drama representing the trial of Marshal Ney, written in collaboration with Charles Dupenty, *Le Procès d'un maréchal de France* (printed 1831), was suppressed on the night of its production.

Fontan died in Paris on Oct. 10, 1839.

A sympathetic portrait oi Fontan as a prisoner, and an analysis of his principal works, are to be found in Jules Janin's *Histoire de la littérature dramatique,* vol. i.

FONTANA, DOMENICO (1543–1607), Italian architect who worked on St. Peter's cathedral and other famous buildings of Rome and Naples, was born at Melide (Mili) on Lake Lugano in 1543, and died at Naples in 1607. For Cardinal Montalto (afterward Sixtus V) he erected a chapel in the church of Santa Maria Maggiore and the Villa Negroni, Rome. On the election of Sixtus V, Fontana became his chief architect.

Among his works were the Laleian palace, the palace of Monte Cavallo (the Quirinal), the Vatican library and other buildings, executed in the baroque style. With Giacoma della Porta he completed the dome of St. Peter's cathedral (1585–go) from Michelangelo's model.

In the course of building an aqueduct, Fontana came across remains of the ancient city of Pompeii (*q.v.*), which was excavated many years later. His most famous undertaking was the removal of the Egyptian obelisk (brought to Rome in the reign of Caligula) from its place in the circus of the Vatican and its erection in front of St. Peter's in 1586.

Fontana was accused of misappropriating public money, and was dismissed from his post in 1592 by Clement VIII. He then became architect at Naples to the viceroy, the count of Miranda, and built the royal palace.

Fontana's projected new harbour and bridge were carried out after his death.

FONTANA, LAVINIA (1552–1614), Italian portrait painter, was the daughter of Prospero Fontana (*q.v.*). She was greatly employed by the ladies of Bologna, and, going then to Rome, painted the likenesses of many illustrious personages. She enjoyed the patronage of the family (Buoncampagni) of Pope Gregory XIII. The Roman ladies, from the days of this pontiff to those of Paul V, elected in 1605, showed no less favour to Lavinia than their Bolognese sisters had done. In her subject pictures she was not so successiul.

Examples of her work are to be seen at Bologna, Rome, Florence, Venice! Milan; the "Virgin Lifting a Veil From the Sleeping Infant Christ," in the Escorial, Madrid; and the "Queen of Sheba," a group of the Mantua courts, in the Dublin museum. Two self-portraits are at the Pitti, Florence, and one in the Academy of St. Luke, Rome.

Her husband, whose name is given as Paolo Zappi Giovanni of Imola, belonged to a distinguished family. He studied painting with Lavinia's father, and is said to have painted the draperies in many of Lavinia's pictures.

She was elected into the Academy of Rome, and died in that city in 1614.

FONTANA, PROSPER0 (1512–1597), Italian painter of the Mannerist school, was born in Bologna, and became a pupil of Innocenzo Francucci da Imola. He later worked 'for Giorgio Vasari and Perino del Vaga in Genoa, Florence and Rome. He has left a large quantity of work in Bologna where he lived after 1540. A representative work of his early period is the "Entombment" in the Bologna Pinacoteca, painted under the influence of his first master and comparatively careful in execution. To his later period belongs the "St. Alessis Distributing Alms," in S. Giacomo Maggiore at Bologna (1576), with many figures in architectural setting, in the mannered style of Vasari's pupils. He died in Bologna in 1597.

In portraiture Fontana was outshone by his daughter and pupil, Lavinia Fontana (1552–1614; *q.v.*). She was greatly employed in Bologna and in Rome. She enjoyed the patronage of the family of Pope Gregory XIII and painted the likenesses of many illustrious personages.

FONTANE, THEODOR (1819–1898), German poet and novelist, was born at Neu-Ruppin on Dec. 30, 1819. He made repeated visits to England, interesting himself in old English ballads, and as the first fruits of his tours published *Ein Sommer in London* (1854); *Aus England, Studien und Briefe* (1860) and *Jenseit des Tweed, Bilder und Briefe aus Schottland* (1860), and a volume of ballads *Männer und Helden* (1860). Fontane ranks with Uhland as one of the great ballad writers of the 19th century. He drew his material from English, Scottish and above all Prussian sources; sometimes, as in *Die Brück'am Tay* from contemporary events. Among the most famous are *Archibald Douglas, Schloss Eger,* and one on "der alte Dessauer." Fontane was particularly attached to his native Mark of Brandenburg: the fascination which it had for him may be seen in his delightfully picturesque *Wanderungen durch die Mark Brandenburg* (1862–82, 4 vols.). In 1870 he was for three months a prisoner of war at Vaucouleurs. His fine historical romance *Vor dem Sturm* (1878) was followed by a series of novels of contemporary life: *Irrungen, Wirrungen* (1888); *Stine* (1890); *Unwiederbringlich* (1891); *Effi Briest* (189j); *Der Stechlin* (1899), in which Fontane adapted the realistic methods and social criticism of contemporary French fiction to the conditions of Prussian life. He died on Sept. 20, 1898 at Berlin.

Fontane's other works include: *Kriegsgefangen, Erlebtes 1870* (1871); *Drr Krieg gegen Frankreich 1870–71* (1874–76). Fontane's *Gesammelte Romane und Erzählungen* were published in 12 vols. (1890–91, 2nd ed., 1905). For his life *see* the autobiographical works *Meine Kinderjahre* (1894), and *Von Zwanzig bis Drrissig* (1898), also *Briefe an seine Familie* (1905). *See* also monographs *by* F. Servaes (1900), Zillman (Stuttgart, 1919), Wandrey (Munich, 1919), and K. Hayens (London, 1920).

FONTANES, LOUIS, Marquis de (1757–1821), French poet and politician, was born at Niort (Deux Sevres) on March 6, 1757. He wrote a number of poems, including a version of Pope's *Essay on Man.* Fontanes drew up the protest of the citizens of Lyons against Collot d'Herbois, and was for some time in hiding. On the fall of Robespierre he was made professor of literature in the *École Centrale des Quatre-Nations,* and he was one of the original members of the Institute. He was exiled by the Directory and made his way to London, where he was associated with Chateaubriand. He soon returned to France, and his admiration for Napoleon, who commissioned him to write an *éloge* on Washington, secured his return to the Institute and his political promotion. He was president of the legislative chamber from 1804 to 1810. Fontanes has been accused of servility to Napoleon, but he remonstrated with him on the judicial murder of the duc d'Enghien, and as grand master of the university of Paris (1808–1815) he supported monarchical principles. He was made a marquis in 181j. He died on March 17, 1821, in Paris.

See his *Oeuvres* (2 vols. 1839), ed. Sainte-Beuve.

FONTENAY-LE-COMTE, town of western France, capital of an *arrondissement* in the *département* of Vendée 30 mi. N.E. of La Rochelle by rail. Pop. (1954) 7,995.

Fontenay existed in the time of the Gauls. The affix of "comte" was added when it was given to the count of Poitou, under whom it became capital of Bas-Poitou. Ceded to the English by the treaty of Bretigny in 1360 it was retaken in 1372 by Bertrand du Guesclin. It sufiered repeated capture during the Religious Wars of the 16th century, was dismantled in 1621 and was occupied both by the republicans and the Vendeans in the war of 1793. From 1790 to 1806 it was capital of the department of Vendée. A straggling town, it is situated on both banks of the Vendée, at the head of navigation. The church of Notre Dame (15th–18th cent) is rich in sculpture, and there are several old houses. The Hôtel de Terre Neuve (1595–1600) contains collections of furniture and tapestry. The Fontaine des Quatre-Tias, given to the town by King Francis I., commemorates the birth of many prominent men. Fontenay-Le-Comte is the seat of a subprefect and has a tribunal of first instance. It manufactures felt hats, oil and soap; timber-sawing, flour-milling and tanning are also carried on. There is trade in grain, fruit, horses, mules, timber, etc.

FONTENELLE, BERNARD LE BOVIER DE (1657–1; 57), French scientist and man of letters, described by Voltaire as the most universal mind produced by the era of Louis XIV. Fontenelle was born at Rouen on Feb. 11, 1657, of middle-class parents. his father being an advocate and his mother a sister of Pierre and Thomas Corneille; he was educated at the local Jesuit college. proceeded to study law. made an unsuccessful start as a barrister and thereafter devoted himself to literature and philosophy. Two of his early publications mere libretti for tragic operas (*Psyché,* 1678; *Bellérophon,* 1679), and despite later preoccupations he still nrote occasionally for the theatre in the 1730s and

1740s. Though he visited Paris in his youth he did not settle there until he had passed 30, by which time he had become famous. His literary activity during the six years 1683–88 won him a great reputation. The *Lettres galantes* (1683; expanded edition 1685) contributed to this, but the *Nouveaux Dialogues des morts* (1683; 2nd part, 1684) enjoyed a greater success and are more interesting to a modern reader. Conversations, modeled on the dialogues of Lucian, between such figures as Socrates and Montaigne, Seneca and Scarron, serve to place in circulation new philosophical ideas. The work of popularization was carried further by the *Histoire des oracles* (1686; critical edition by L. Maigron 1908; reprinted 1934), based on the Latin treatise *De oraculis ethnicorum* of the Dutch writer Anton van Dale (1683). Here Fontenelle uses a technique later to become popular with the 18th-century *philosophes:* it is to make criticisms of pagan religions in such a way that the reader will inevitably turn them against Christianity. The same antireligious bias is seen in his amusing satire *Relation de l'ile de Bornéo* (published in the Dutch periodical *Nouvelles de la République des Lettres,* 1686), where the civil war between the anagrammatic princesses Mréo and Eénegu symbolizes the dissensions between Catholics (Rome) and Calvinists (Genève-Geneva).

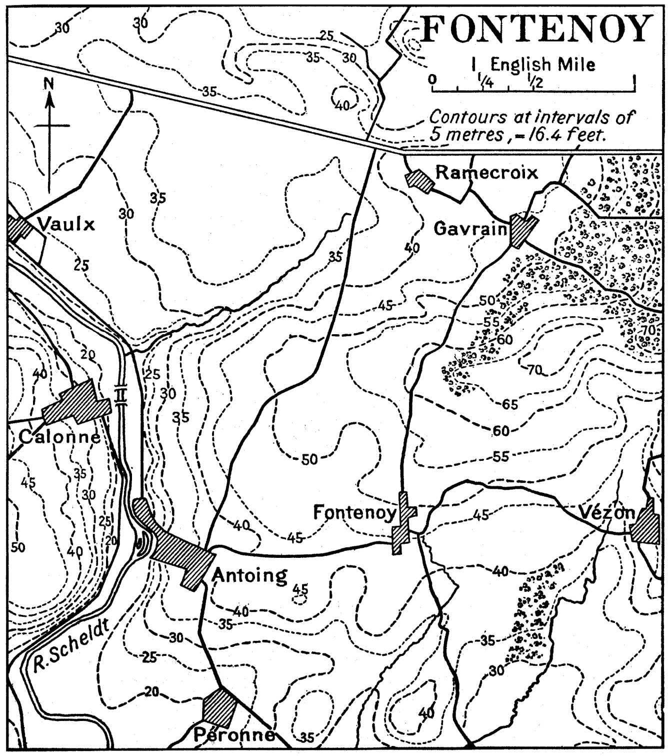
Fontenelle had not abandoned belles-lettres. His *Poksies pastorales* (1688) contains an interesting "Digression sur les anciens et les modernes," in which he shows himself an unashamed supporter of the moderns even to the extent of regarding many of Descartes's ideas (though not his method) as superseded. It was as a nholehearted Cartesian, however, that Fontenelle had published his most famous work, the *Entretiens sur la pluralité des mondes* (1686; critical edition by R. Shackleton, 1955). It is not an exaggeration to say that these charming and sophisticated dialogues were more influential than any other work in securing popular and fashionable acceptance of the Copernican system, still far from commanding universal support in 1686. Fontenelle's basis of scientific documentation was meagre: his main authority nas Bishop John Wilkins' *The Discovery oj a World in the Moone* (1638), and some of his figures were wildly erroneous even by the standards of his own day. He was unfortunate in the moment of his publication: the Cartesian theory of vortexes, on which his nork was based, was refuted the next year in Newton's *Principia.* But the *Entretiens* were nevertheless exceedingly successful. Their author was elected to the Académie Française in 1691 and became perpetual secretary to the Académie des Sciences in 1697. He was also elected to the Académie des Inscriptions in 1701.

The secretaryship of the Académie des Sciences became in Fontenelle's hands a highly influential office and afforded him his main occupation for the rest of his life. It mas his duty to publish the memoirs presented to the academy and to write its history, nhich he did (sometimes tendentiously) in his *Histoire de l'Académie royale des sciences,* covering the years from 1699 to 1740 in a series of volumes that appeared annually from 1702. His account of the earlier years, from the foundation of the academy in 1666, did not appear in the series till 1733; but his *Histoire du renouvellement de l'Académie* nas published separately in 1708. Initially quite undistinguished as a scientist, he later became highly competent, though without ever being original. He frequently revised and amended his *Entretiens;* he kept abreast of new developments in all branches of science and corresponded with scientists in most European countries. He developed his talent for lucid popular exposition so that in some of his obituary notices read to the academy (notably those of Newton and Leibniz) it reached almost the point of genius.

Fontenelle lived meanwhile a gay social life. Having knonn the salon of Madame de Sévigné, he lived to grace that of Madame Geoffrin. He was a close friend of Montesquieu, whom he introduced into Parisian society. He was well knonn to Voltaire, who mocked him in his *Micromégas.* He was witty, good-humoured, inclined to cynicism and exceedingly cautious, perhaps as a result of having been denounced to Louis XIV's government as an atheist after the publication of the *Relation de l'ile de Bornéo.* Many of the characteristic ideas of the Enlightenment are found in embryonic form in his works. His most original contribution is in his approach to historiography, shown in his *De l'origine des fables* (1724; critical edition by J. R. Carré. 1932), where he argues for the polygenesis of fables and tentatively addresses himself to comparative religion. He attended a ball at the age of 98 and died on Jan. 9, 1757. a month short of his century.

Bibliography.—The most serviceable collected editions of the *Oeuvres de Fontenelle,* 3 vol. (1818), and 5 vol. (1825), do not include the *Histoire de l'Académie royale des sciences.* *See* also L. Maigron, *Fontenelle, l'homme, l'oeuvre, l'influence* (1906); J. R. Carré, *La Philosophie de Fontenelle, ou le sourire de la raison* (1932). (Rt.S)

FONTENOY, a village of Belgium, province of Hainaut, 4 mi. S.E. of Tournai, pop. (1955 est.) 684; the scene of the battle of Fontenoy, in which on May 11, 1745, the French army under Marshal Saxe defeated the Anglo-Allied army under the duke of Cumberland. The object of the French (*see* also Austrian Succession, War of the) was to cover the siege of the then important fortress of Tournai; that of the Allies, who slowly advanced from the east, to relieve it. Informed of the impending attack, Louis XV., with the dauphin, came with all speed to witness the operations, and by his presence to give Saxe, who was in bad health and beset with private enemies, the support necessary to enable him to command effectively. Under Cumberland served



PLAN OF THE BATTLE OF FONTENOY. MAY 11TH, 1745

the Austrian field-marshal Konigsegg, and, at the head of the Dutch contingent. the prince of Waldeck.

The right of the French position (*see* map) rested on the river at Antoing, which village was fortified and garrisoned; between Antoing and Fontenoy three square redoubts were constructed; and Fontenoy itself was put in a complete state of defence. On the left rear of this line, and separated from Fontenoy by some furlongs of open ground, another redoubt was made at the corner of the wood of Barry and a fifth towards Gavrain. The infantry was arrayed in deployed lines behind the Antoing-Fontenoy redoubts and the low ridge between Fontenoy and the wood; behind them was the cavalry. Marshal Saxe himself, who was suffering from dropsy to such an extent that he was unable to mount his horse, slept in a wicker chariot in the midst of the troops. At early dawn of May 11, the Anglo-Hanoverian army with the Austrian contingent formed up in front of Vézon, facing towards Fontenoy and the wood, while the Dutch on their left extended the general line to Péronne. The total force was 46,000 against 52,000 whom Saxe could actually put into the line of battle.

It was resolved that the Dutch should attack the front Antoing-Fontenoy, while Cumberland should deliver a flank attack against Fontenoy and all in rear of it, by way of the open ground between Fontenoy and the wood. A great cavalry attack round the wood was projected but had to be given up, as in the late evening of the 10th the Allies' light cavalry drew fire from its southern edge. Cumberland then ordered his cavalry commander to form a screen facing Fontenoy, so as to cover the formation of the infantry. On the morning of the 11th another and most important modification had to be made. The advance was beginning when the redoubt at the corner of the wood became visible. Cumberland hastily told off Brigadier James Ingoldsby to storm this redoubt which, crossing its fire with that of Fontenoy, seemed absolutely to inhibit the development of the flank attack. At 6 A.M. the brigade moved off, but it was irresolutely handled; and after waiting as long as possible, the British and Hanoverian cavalry rode forward and extended in the plain, becoming the target for a furious cannonade which drove them back. Thereupon Sir John (Lord) Ligonier, whose deployment the squadrons were to have covered, let them pass to the rear, and pushed the British infantry forward through the lanes, each unit on reaching open ground covering the exit and deployment of the one in the rear, all under the French cannonade. This went on for two hours, and save that it showed the magnificent discipline of the British and Hanoverian regiments, was a bad prelude to the real attack.

It was now 9 A.M., and while the guns from the wood redoubt battered the upright ranks of the Allies, Ingoldsby's brigade was huddled together, motionless, on the right. Cumberland himself galloped thither, and under his reproaches Ingoldsby lost the last remnants of self-possession. To Ligonier's aide-de-camp, who delivered soon afterwards a bitterly formal order to advance, Ingoldsby sullenly replied that the duke's orders were for him to ad ance in line with Ligonier's main body. By now, too, the Dutch advance against Antoing-Fontenoy had collapsed.

But on the right the cannonade and the blunders together had roused a stern and almost blind anger in the leaders and the men they led. Ingoldsby was wounded, and his successor, the Hanoverian general Zastrow, gave up the right attack and brought his battalions into the main body. Meantime the young duke and the old Austrian field-marshal had agreed to take all risks and to storm through between Fontenoy and the wood redoubt, and had launched the great attack, one of the most celebrated in the history of war. The English infantry was in two lines. The Hanoverians on their left, owing to want of space, were compelled to file into third line behind the redcoats, and on their outer flanks were the battalions that had been with Ingoldsby. A few guns, man-drawn, accompanied the assaulting mass, and the cavalry followed. The column may have numbered 14,000 infantry. All the infantry battalions closed on their centre, the normal three ranks becoming six. (If the proper distances between lines were preserved, the mass must have formed an oblong about 500yd. × 600yd.).

The duke of Cumberland placed himself at the head of the front line and gave the signal to advance. Slowly and in parade order, drums beating and colours flying, the mass advanced, straight up the gentle slope, which was swept everywhere by the flanking artillery of the defence. When the first line reached the low crest, the fire became a full enfilade from both sides, and at the same moment the enemy's horse and foot became visible beyond. A brief pause ensued, and the front gradually contracted as regiments shouldered inwards to avoid the fire. Then the French advanced, and the Guards Brigade and the Gardes Françaises met face to face. Captain Lord Charles Hay, lieutenant of the First (Grenadier) Guards, suddenly ran in front of the line, took off his hat to the enemy and drank to them from a pocket flask, shouting a taunt, "We hope you will stand till we come up to you, and not swim the river as you did at Dettingen," then, turning to his own men, he called for three cheers. The astonished French officers returned the salute and gave a ragged counter-cheer. Whether or not the French, as legend states, were asked and refused to fire first, the whole British line fired one tremendous series of volleys by companies. Fifty officers and 760 men of the three foremost French regiments fell at once, and at so appalling a loss the remnant broke and fled. Three hundred paces farther on stood the second line of the French, and slowly the mass advanced, firing regular volleys. It was now well inside the French position, and no longer felt the enfilade fire that swept the crest it had passed over. Spasmodic counter-attacks on its flanks were repelled but these gained a few precious minutes for the French. It was the crisis of the battle. The king, though the court meditated flight, stood steady with the dauphin at his side—Fontenoy was the one great day of Louis XV.'s life—and Saxe, ill as he was, mounted his horse to collect his cavalry for a charge. The British and Hanoverians were now at a standstill. More and heavier counter-strokes were repulsed, but no progress was made; their cavalry was unable to get to the front, and Saxe was by now thinking of victory. Captain Isnard of the Touraine regiment suggested artillery to batter the face of the square, preparatory to a final charge. The nearest guns were planted in front of the assailants, and used with effect. The infantry led by Löwendahl, fastened itself on the sides of the square. On the front, waiting for the cannon to do its work, were the Maison du Roi, the Gendarmerie and all the light cavalry. The left wing of the Allies was still inactive, and French troops were brought up from Antoing and Fontenoy to support the final blow, about 2 P.M. In eight minutes the square was broken. As the infantry retired across the plain in small stubborn groups all attempts to close with them were repulsed by the terrible volleys, and they regained the broken ground about Vézon, whence they had come. Cumberland himself and all the senior generals remained with the rearguard.

The losses at Fontenoy were exceedingly severe in the units really engaged. Eight out of nineteen regiments of British infantry lost over 200 men, two of these more than 300. The Hanoverian regiments suffered as heavily in proportion. The total loss was about 7,500, that of the French 7,200.

Fontenoy was in the 18th century what the attack of the Prussian Guards at St. Privat was in the next. a *locus classicus* for military theorists. But the technical features of the battle are completely overshadowed by its epic interest.

FONTEVRAULT-L'ABBAYE (Lat. *Fons Ebraldi*), a town of western France, in the *département* of Maine-et-Loire, 10 mi. S.E. of Saumur by road, near the confluence of the Loire and Vienne. Pop. (1954) 1.296. The interest of the place centres in its abbey, which in 1811 became a convict prison. The church (12th century) has a beautiful nave formerly covered by four cupolas destroyed in 1816. There is a fifth cupola above the crossing. In a chapel in the south transept are the effigies of Henry II of England, of his wife Eleanor of Guienne. of Richard I of England and of Isabella of Angoulême, wife of John of England—Eleanor's being of oak and the rest of stone. Cloister, refectory and chapter-house date from the 16th century. The second court of the abbey contains the Tour d'Évrault (12th century), long called *chapelle funéraire,* but in reality the old kitchen. Details and diagrams will be found in Viollet-le-Duc's *Dictionnaire de l'architecture*. There are three stories, the whole being surmounted by a pyramidal structure.

The *Order of Fontevrault* was founded about 1100 by Robert of Arbrissel. The establishment was a double monastery, containing a nunnery of 300 nuns and a monastery of 200 monks, separated completely so that no communication was allowed except in the church; there were, moreover, a hospital for 120 lepers and other sick, and a penitentiary for fallen women, both worked by the nuns. The basis of the life was the Benedictine rule; the abbess ruled the monks as well as the nuns. At the beginning the order had a great vogue, and at the time of Robert's death, 1117, there were several monasteries and 3,000 nuns; afterwards the number of monasteries reached 57, all organized on the same plan. The institute never throve out of France; there were attempts to introduce it into Spain and England: in England there were three houses—at Ambresbury (Amesbury in Wiltshire), Nuneaton, and Westwood in Worcestershire. The nuns in England as in France were recruited from the highest families, and the abbess of Fontevrault, who was the superior-general of the whole order, was usually of the royal family of France.

See P. Hélyot, *Hist. des ordres religieux (1718)*; Max Heimbucher,

Orden und Kongregationen (1907); the arts. "Fontevrauld" in Wetzer and Welte, *Kirchenlexicon* (ed. 2), and in Herzog-Hauck, *Realencyklopadie* (ed. 3); Edouard, *Fontevrault et ses monuments* (1875); for the later history *see* art. by Edmund Bishop in *Downside Review* (1886).

FONTEYN, MARGOT (DAME MARGOT FONTEYN DE ARIAS) (1919–), English prima ballerina of the Royal Ballet. London, was born at Reigate, Surrey, on May 18, 1919. She studied as a child in Hong Kong and later in London with Serafima Astafieva and at the Sadler's Wells school. Her debut was with the Vic-Wells ballet in 1934. The following year she took over many classical roles from Alicia Markova, among them *Giselle*. In 1939 she danced Aurora in a revival of *The Sleeping Beauty*. Apart from the classical repertoire she created many roles in ballets by Frederick Ashton, among them *Horoscope,, Symphonic Variations, Daphnis and Chloe, Ondine,* and has given outstanding performances in revivals of Fokine's *Firebird* and Petrouchka. Her dancing stands out for its exceptional musical quality; she is able to combine minute detail into a perfectly integrated whole. In 1955 she married Roberto Emilio Arias. Panaman ambassador to Great Britain. She was created dame of the British empire in 1956, and had become president of the Royal Academy of Dancing in 1954.

(A. L. HL.)

FOOCHOW (FU-CHOU, MINHOW), former treaty port and capital of Fukien (*q.v.*) province, China. Pop. (1953) 553,000; (1957 est.) 616,000. It is 35 mi. above the mouth of the Min Chiang near the head of a narrow delta, on the north bank of the river. The Min is the largest of the many Fukien drainage basins, and Foochow is the natural outlet for the area. The hinterland is rough and hilly with no good passes through its ranges and the Min is navigable by small boats only. Foochow is thus oriented to the sea, with a long history of coastal and foreign trade. The Foochow dialect is not intelligible beyond the Min river valley.

Foochow was one of the original five treaty ports and was opened in 1861. It became the chief centre of the China tea trade during the mid-19th century. and exported the noted black bohea tea which was grown inland. The former foreign settlement of Nan-t'ai was established on an island in the river. and is linked to the south commercial riverside suburb by the Wanshow ("ten thousand ages") and Kiangnan bridges. The decline of the tea trade. after 1880. commenced the decline of Foochow as an international port. Later the decrease in lacquerware exports and the loss of a good share of the camphor trade caused a further weakening of Foochow's commercial position.

Sand bars at the mouth of the Min Chiang prevent entry of large ships and shallows below the city caused the port proper to be located about 10 mi. downstream at Pagoda anchorage. Foochow remains a significant coastwise trading centre, but it cannot compete with deepwater ports having a large hinterland. Foochow's trade patterns continue to revolve around the exports of tea, timber products, lacquerware and leather products.

A rail connection to the Amoy–Ying-t'an line was under construction in the late 1950s, and Foochow is a highway transport centre for the Fukien region. The Chinese Communists, after 1952, began developing major industrial activities in Foochow, augmenting existing manufacturing. (J. E. SR.)

FOOD, the general term for what is eaten by man and other creatures for the sustenance of life. The scientific aspect of human food is dealt with under DIET AND DIETETICS; NUTRITION. *See* also FOOD PREPARATION and the different staple foods dealt with under their own headings; also the articles which follow.

FOOD, CARE AND STORAGE OF (IN THE HOME). The prevention of food spoilage has always been one of man's major problems. Effective food care is based on recognition of the two primary causes of food deterioration: decomposition brought about by bacteria, molds and yeasts; and chemical changes within the food resulting from the action of enzymes normally present. Efficient methods of food care begin with the judicious selection of food. after which must be provided environmental conditions that will maintain optimal food qualities for as long as possible.

Temperature is the cardinal factor influencing the storage life of food, all deteriorative changes being decreased by lowered temperatures. Home refrigerators maintain temperatures of approximately 50° F., a temperature at which food storage life is almost tripled as compared with that at 70° F. Moisture content also is a critical factor. It is necessary to exercise extreme care to keep microbial contamination to a minimum. Air around stored food should be kept to the minimum, to reduce chemical changes. Foods whose pigments are sensitive to light should be held under light-restricted conditions. Fresh fruits and vegetables are best stored under refrigeration. Thorough washing (with clean water) of leafy and firm-textured vegetables and fruits is essential. These should be placed in moistureproof containers or bags and stored in the refrigerator. Berries should be spread out and held at cool temperatures; they should not be washed until just before using, since they are subject to mold growth.

Newly purchased meat cuts such as steaks, chops and poultry should be wiped with a clean, damp cloth, loosely rewrapped in a nonmoisture-absorbing material and refrigerated. The more extensive the area of cut surface, the shorter the length of storage life. Raw ground meat should not be held longer than one to two days in a refrigerator; thick roasts and steaks refrigerate well for six to eight days. Fresh fish should be cleaned, wrapped in a moistureproof, vapourproof covering and refrigerated. Storage of fresh fish or shell fish should not exceed two days.

Butter should be refrigerated in a vapourproof container to prevent the absorption of odours from other foods. Milk and cream are best stored in the delivery containers, kept covered and held at 40°–50° F. Cheeses should be kept in tightly covered containers in the refrigerator.

Shell eggs should be cleaned, if necessary, placed large end up in a covered container and stored in the refrigerator.

Frozen Foods.—The initial freezing of food is carried out at temperatures of 0° to −10° F.; after the food is frozen it should be stored at 0° or lower. Fluctuation of temperature in the freezer cabinet should be avoided. Packaging materials for frozen foods are designed to be as nearly moistureproof and vapourproof as possible. Aluminum foil. or the plastic films which are moistureproof, vapourproof and adhere tightly to food, provide protective covering.

Frozen fruits and vegetables may be stored in the freezer as purchased, in their original containers, for up to one year. In storing meats, poultry and fish it is essential to use moisture and vapour-resistant packaging material that adheres tightly to the food. Vacuum sealing is desirable, since it greatly retards the development of rancidity. Butter may be wrapped in nonpenetrative wrappings, frozen and held in frozen storage for six to eight months. Firm cheeses, packaged in moistureproof cartons, may be held in freezer storage for one to two years.

Canned and Bottled Foods.—Transparent glass containers should be stored in a darkened area. Canned food is best stored in a cool. darkened room at temperatures of 4j° to jj° F. If the entire contents of a can or bottle are not needed at one time, the unused portion may be saiely left in the container at refrigerator temperatures.

Baked Foods and **Leftovers.**—Maintenance of good quality in baked products is dependent upon retaining the moisture in the food. These products should be carefully wrapped in moistureproof wrappers, such as aluminum foil, and kept at cool temperatures.

Leftover dishes containing vegetables, eggs, cheese, milk, meat or fish require fastidious care. They should be carefully covered in tight containers, held at refrigerator temperatures and stored for only short periods of time.

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FOOD, MINISTRY OF: *see* WAR CONTROL OF FOOD.

FOOD, PURE: *see* HEALTH AND SAFETY LAWS.

FOOD AND AGRICULTURE ORGANIZATION. The FAO. first of the permanent specialized agencies of the United Nations to be founded after World War 11. came into formal being in Oct. 1945 with the signing of its constitution at a conference held in Quebec, Que. The immediate factor leading to its foundation, was, the Conference on Food and Agriculture convened at the request of Pres. Franklin D. Roosevelt at Hot Springs, Va., in 1943.

The ideas underlying foundation of the new organization came from two sources. First was the International Institute of Agriculture (*q.v.*), founded in Rome in 1905, a forerunner whose functions FAO took over soon after its first conference. The IIA was designed to protect farmers against the effects of sudden slumps and gluts, thus being concerned with information about market trends and agricultural statistics. Second was the League of Nations, which in the period immediately before World War II had been interested in problems of nutrition and their relationship to health. Both the IIA and the League, however, had been principally concerned with the more advanced countries, whereas in the foundation of the FAO several of the new and so-called "underdeveloped" countries took great interest and played an active part.

Since FAO was in part an answer to the question of feeding vast populations in the countries whose economies had been seriously disrupted by World War II, it was natural that the first few years should be devoted to trying to help bring about a rapid increase in the world's over-all supplies of food (see also FOOD SUPPLY OF THE WORLD). At the same time, the member countries had an eye on the possible emergence of surpluses of some commodities in certain countries, should the distribution system break down or should needy governments not be able to pay for the food they required. Finally, an appreciation of the rapid rise in population in virtually all parts of the world in the immediate postwar period added urgency to the organization's work.

Sir John (later Lord) Boyd-Orr of Great Britain was the first director-general of FAO, 1945–48. His proposal, for a world food board of wide powers, though not accepted by governments, resulted in establishment in 1947 of the Council of FAO, originally seen as a World Food Council, which subsequently became an interim governing body of 24 governments elected by the conference. During the following administration of Norris E. Dodd (U.S.), 1948–53, a proposal for an international commodity clearinghouse failed of approval. Dodd was followed by Philip V. Cardon (C.S.), 1953–1956, and following his resignation for ill health, by B. R. Sen (India).

In 1951 the organization was transferred from its temporary headquarters, Washington, to a permanent seat provided by the Italian government in Rome. A regional office for North America remained in Washington; other regional offices were set up in Cairo (for the near east); Bangkok (far east), with a suboffice in New Delhi; and Santiago (Chile), Rio de Janeiro and Mexico City (for western, eastern and northern Latin America respectively). There was also a suboffice in Geneva, principally concerned with economics and forestry work, and an office in New York for special liaison with United Nations headquarters.

In its early years FAO sent advisory or exploratory missions to such countries as Poland, Greece and Venezuela. Certain funds and related agricultural projects remaining from the operations of UNRRA were handed over to FAO, including campaigns for the introduction of American varieties of hybrid corn (maize) into Europe, and for the eradication of rinderpest in Ethiopia. The hybrid maize campaign in particular was regarded as one of FAO's notable successes; it was eventually handed over, except for central co-ordination, to the various member countries.

With the creation of the United Nations Special Fund for Technical Assistance, further extrabudgetary sums became available for FAO's field operations and from 1950 onward an increasing number of countries received technical assistance from FAO under the terms of that fund. The range of projects covered all of FAO's activities in agriculture, nutrition, forestry, fisheries and economics.

Most of the experts working under the technical assistance program were on individual assignments, advising governments concerned on specific problems. FAO also helped its member governments through regional projects, including widespread plant and animal disease control schemes, such as the desert locust control program in the Arabian peninsula; projects for the eradication of rinderpest already referred to; and creation of a European commission for the control of foot-and-mouth disease. A broad educational program was also in continual operation, with training centres and seminars in many subjects and a fellowship program run in connection with the assignment of technical assistance experts.

These programs were implemented by various publications and reports of a technical nature. including the Plant Protection Bulletin, comprising the work of a world reporting service on plant diseases and quarantine regulations. A parallel informational service for animal diseases included an annual over-all summary of developments in the subject field as well as periodical reports. The FAO-sponsored monthly bulletin of agricultural statistics and allied yearbooks on production and trade in agriculture, fisheries and forest products were standard works in their fields.

Member nations met in full conference every second year, when the budget for the following two years was decided on. To this sum was added FAO's share of the UN technical assistance fund, varying from year to year but being of the same order of magnitude as the regular budget, the latter amounting to $17,000,000 for the biennium 1958–59. (P. B. Cs.)

FOOD POISONING, BACTERIOLOGICAL. The concept that illness may result from eating spoiled and putrefying food is an old one. To explain this concept numerous theories have been formulated (for example, that of ptomaine poisoning propounded by Francesco Selmi in 1870). Spoilage and putrefaction are not in themselves harmful. Instead, they often enter into the making of cheese, wines and sauerkraut and the aging of meat. It is equally clear, however, that illness may result from eating food containing any of a number of harmful agents. Such agents may be inorganic chemical substances, poisonous plants and animals, certain animal parasites and microorganisms, including bacteria, or their toxic products. Of these agents, bacteria and their products are undoubtedly responsible for the greatest proportion of food poisoning. The resulting diseases, nhich comprise several different types of illness, may conveniently be divided into tno classes: (1) infections, in that living bacteria are necessary for the development of disease. and (2) intoxications, in that products produced by the bacteria are responsible.

FOOD POISONING CAUSED BY LIVING AGENTS

Salmonella.—Salmonella is a generic name applied to a group of bacteria, of more than 200 types or species, commonly known as the paratyphoid bacteria. Some of these organisms were implicated in outbreaks of food poisoning as early as 1888. The bacteria comprising the salmonella group resemble the typhoid bacterium in size, shape. staining properties. physiology. immunology and habitat in the intestine. They are not limited to man but live and grow in the intestinal tracts of animals as well.

Some of the salmonella group produce a typhoidlike febrile disease in man which can be diagnosed only by isolating the specific organism. Others commonly produce the more usual gastroenteritis. It is knonn that they have to be living to cause either of these diseases, since bacteria-free filtrates of cultures or heat-killed organisms have failed to produce illness when fed to human volunteers. Typical food poisoning is initiated within 7 to 72 hours after ingesting the organisms and is characterized by nausea, vomiting, abdominal pain and diarrhoea. It may start with a headache and a chill or with varying degrees of abdominal pain accompanied by diarrhoea. Therefore. the stools are usually foul-smelling and may be watery. In severe cases the temperature rises, prostration, muscular weakness, faintness and thirst are present, and the white blood cell count Increases. The severity of the disease differs in different outbreaks and among various individuals in the same outbreak. Convalescence usually is rapid and may vary from a few hours to a neek.

Salmonella food-poisoning outbreaks have been described in civilized countries throughout the world. The number occurring annually cannot be estimated since all are not reported. The foods involved are often derived from infected animals or are contaminated during their preparation or storage by infected animals or men. Contaminated foods have no abnormal odour or flavour.

Salmonella infections may be treated with such antibiotics as streptomycin and chloromycetin. Care must be used in administering the latter drug since a few cases of aplastic anaemia have followed its use. Meat from animals ill with salmonella infection is condemned by government inspection at abattoirs in the United States where meat is sold in interstate commerce. Milk from infected cows may be rendered safe by adequate pasteurization, which kills salmonellae. Uncooked animal products may be contaminated with salmonellae, since healthy animals may be carriers. The salmonellae are probably present only in small numbers under such circumstances, and if food is properly refrigerated and cooked. no ill effects follow. Foods should be stored in places inaccessible to mice and rats, which may carry salmonellae.

Streptococcus **Faecalis.**—An alpha-type streptococcus was implicated in outbreaks of food poisoning in 1924 and was occasionally reported thereafter. If it were more generally sought in specimens of food during outbreaks, it might possibly be found more often. This streptococcus, identified as *Streptococcus faecalis,* is a bacterium commonly found in the intestinal tracts of healthy humans and animals. On the surface of blood agar plates it produces pin-point colonies surrounded by a greenish-coloured zone caused by chemical changes in the haemoglobin of the blood. Whether other related streptococci produce food poisoning still remained undetermined in the early 1950s.

The symptoms of this type of food poisoning are usually mild. They are characterized by nausea and sometimes by vomiting, colicky pains and diarrhoea, which begin within j to 18 hours after eating the contaminated food. Recovery usually occurs within 24 hours.

Experimental animals, with the possible exception of cats, are usually not affected after being fed living cultures. Human volunteers, on the other hand. have been made ill by living cultures but not by heat-killed cultures or sterile filtrates from unheated cultures. The foods involved are numerous and include dairy products, meats, poultry and cream-filled bakery goods. In some outbreaks. the contaminating bacteria were found to have had time to grow because the food was stored at warm temperatures for several hours. No specific treatment had been found at mid-20th century. The control of streptococcus food poisoning requires sanitary methods in handling foods and adequate refrigeration of perishable foods.

Other Infectious Agents Transmitted by **Food.**—Many infectious agents may occasionally and more or less accidentally cause food poisoning by being transmitted in food. These include the causative agents of typhoid fever, bacillary dysentery, amoebic dysentery, scarlet fever, diphtheria, brucellosis, trichinosis, Weil's disease, infectious hepatitis. poliomyelitis and a number of other animal parasites. *Clostridium perfringens* and *Bacillus cereus* have been found in large numbers in foods implicated in outbreaks where the symptoms were mild, resembling those for *Streptococcus faecalis.* In addition, many bacteria have been incriminated possibly as the cause of food poisoning because they have been found in the stools of patients, but convincing proof of their role is lacking.

FOOD POISONING CAUSED BY TOXINS OF MICROORGANISMS

Staphylococcus.—Staphylococci are common in the air, in soil, on the skin and in the nose and throat. These small. spherical bacteria grow in grapelike clusters. and the toxin produced by some of them is responsible for the food poisoning.

Staphylococci multiply under conditions which tend to kill such bacteria as typhoid bacilli. For example. they grow abundantly in concentrations of salt and sugar which kill or prevent the growth of typhoid bacilli. Therefore, a food partially preserved with a curing solution containing salt and other ingredients may not be a good medium for spoilage germs but may be an excellent one for food-poisoning staphylococci. The growth of staphylococci in food nith or without the production of toxin is not detectable by taste or smell.

Newspaper accounts of outbreaks of staphylococcus food poisoning usually refer to them as "ptomaine poisoning" outbreaks. This. however, is a meaningless term because the word "ptomaine" does not represent a chemical entity. Staphylococcus food poisoning is probably the most frequent type of food poisoning (nearly every adult has suffered attacks of nausea and vomiting), but no reliable statement of its prevalence may be made because: (1) it may not be reported because it is mild or affects only one or a few persons; (2) it may be erroneously attributed to other causes.

The foods involved have increased in number. Those already incriminated are milk, cheese and other milk products, custard-filled bakery goods. gravies and meats. including cured meats. The symptoms usually appear suddenly within one to five hours after eating contaminated food. They may begin and end with nausea, vomiting, abdominal cramps and diarrhoea. In severe cases the patient is weak and prostrate. his vomitus or stools may contain blood and he may even go into shock. Only rarely does a patient die, and ordinarily recovery occurs in a few days. There is usually no fever or other sign of infection such as occur in salmonella food poisoning. A few resistant persons do not become ill after eating food contaminated with staphylococci.

The toxin responsible for staphylococcus food poisoning is formed in food before it is eaten. Under experimental conditions toxin has withstood boiling for as long as 30 minutes. Food has to be subjected to the following conditions to become contaminated: (1) to be contaminated with a toxin-forming staphylococcus; (2) to contain favourable nutritive requirements, such as the proper amount of moisture and degree of acidity or alkalinity; (3) to be maintained at a temperature suitable for growth of the staphylococci; and (4) to be kept under these conditions long enough to permit the organisms to grow and form toxin.

The treatment of severe staphylococcus food poisoning is important. Since vomiting and diarrhoea are present, it is unnecessary to remove unabsorbed poison from the gastrointestinal tract by emptying the stomach or by giving cathartics; but saline solutions should be given subcutaneously or intravenously because of the acute prostration and symptoms of shock with loss of fluids and disturbances in salt balance. No specific drug or serum therapy is of value. Prevention of staphylococcus food poisoning depends upon adequate refrigeration of perishable foods since contamination itself cannot be prevented. Staphylococci do not grow at temperatures maintained in mechanical refrigerators, but grow slowly at room temperature (68° F.) and rapidly at body temperature (98.6° F.). In the cold months of the year they can grow in heated kitchens and buildings. In five hours on a summer day (82°–86° F.), they produced sufficient toxin to cause illness in human volunteers.

Botulism. — This disease is caused by the production of a toxin in food by the botulinum microorganism. *Clostridium botulinum.* This organism is rod-shaped and ordinarily lives in the soil. It will not grow in the presence of free oxygen on agar surfaces which support the growth of many bacteria and! hence, is called anaerobic. It produces spores that are resistant to heat, so that they succumb only to prolonged boiling. Five types (A, B, C. D and E) of *Cl. botulinum* have been described. Each type produces a specific toxin but causes similar symptoms in man or animals or both. Antitoxins which are usually specific may be produced by immunizing animals. For example, type A antitoxin will neutralize only type A toxin and not any of the other types. Types A and B, rarely type E, *CL. botulinum* have been found in outbreaks of food poisoning involving man. Type C has been found in naturally occurring outbreaks in wild waterfowl and in outbreaks on mink farms, and type D has been associated with poisoning in horses and mules in South Africa. The outbreaks of type E botulism in man have been associated with canned fish products. The toxin for type A *Cl. botulinum* has been crystallized and is a protein. The toxins are readily inactivated by heat and are destroyed in less than one minute at the temperature of boiling water (212° F.).

In the United States, underprocessed canned foods are responsible for outbreaks. The commercial canning industry early recognized the dangers of botulism and took steps to control its processing of foods to avoid this disease. By mid-20th century there had not been an outbreak of botulism from this source since

1925. Most botulism in the United States is caused by home-canned foods, usually by the cold-pack method, in which the processing time and temperature have been inadequate to destroy the spores of *Cl. botulinum.* The pressure-cooker method, on the other hand, if operated according to the directions which come with the cooker, successfully destroys the spores and is especially recommended for preserving low-acid foods.

Of 483 outbreaks of botulism occurring between 1899 and 1949, 98 outbreaks were traced to string beans, of which only 3 were commercially packed in the United States. Next in importance were corn (49 outbreaks), spinach or chard (24) and beets (24). With regard to meat products, there were five outbreaks from ham, six from sausage and five from other meats. Fish and sea foods resulted in seven outbreaks from tuna, eight from salmon, five from clams and four from sardines. Five outbreaks were attributed to home-canned cheese and two to commercially packed canned milk. In the U.S.S.R. outbreaks have been reported from eating salt herring, salt salmon, smoke-dried herring, dried sturgeon and smoked sturgeon. Shallots raised and canned in Naples, It., were responsible for some cases of botulism in the United States, where the food was marketed.

Most outbreaks of botulism are dramatic in that symptoms may appear suddenly and progress rapidly to death. Symptoms usually appear within 12 to 36 hours after ingesting the toxin, although as short a period as 2 to 4 hours is mentioned in the literature. In one outbreak one individual was active for eight days before hospitalization and died on the tenth day. Typical symptoms, involving the nervous system, are double vision, difficulty in swallowing and in speech, and laboured breathing. Death usually results from respiratory paralysis. In addition, patients may develop acute digestive disturbances with nausea and vomiting. These disturbances may be related to the degree of spoilage and to the amount of contaminated food consumed.

Experimental work has shown that spores of *Cl. botulinum* heated to destroy the toxin may be fed to susceptible animals without producing ill effects. Apparently spores living in the soil are toxin-free, since soil and dust contaminating fresh fruits and vegetables with their content of botulinum spores cause no ill effects when eaten by man.

The treatment of botulism is unsatisfactory. Damage done by the toxin, which is evident when symptoms are well advanced, cannot be repaired by the administration of antitoxin. It is advisable, however, to give combined type A and type B botulinum antitoxin to all patients to prevent further damage to the tissues. Antitoxin should also be given to those who have eaten food containing the toxin, even though they may not have developed symptoms, when the disease is discovered in others. The mortality varies for different outbreaks but the average is 65%.

The control of botulism obviously rests on adequately processing canned foods to destroy the spores of *Cl. botulinum.* Fortunately, foods in which *Cl. botulinum* has grown have an abnormal odour and taste and the cans containing it are sometimes swollen. Foods, therefore, which exhibit these characteristics or are in swollen containers should be discarded. *(G. M. DK.)*

FOOD PREPARATION. Persons using recipe books printed on the other side of the Atlantic should note that, while the British pint is equal to 20 fluid oz., the U.S. pint is only 16 fluid oz. Since American recipes usually give amounts by volume and British recipes give amounts by weight, knowledge of these differences is important. Also, the same word may have a different meaning (*e.g.,* biscuit) and, in some instances, there' are considerable differences in the type of ingredients used or in the methods of preparation (*e.g.,* cake making), or both.

METHODS OF COOKING

Boiling and Simmering.—Water is the principal cooking medium in boiling and simmering. Boiling is cooking in water in which bubbles rise continually and break on the surface. At sea level, water boils at 212° F. (100° C.), but at higher altitudes water boils at lower temperatures, the decrease in boiling temperature being approximately 1 degree C. for each 1,000 ft. Water-soluble substances, such as sugar and salt, raise the boiling point of the water. Simmering is cooking in a liquid somewhat below the boiling point, 180°–211° F., when bubbles form slowly and break below the surface.

Steaming.—Steaming, or cooking in steam, may result from added water or from water present in the food itself; in the latter case, the term waterless cooking sometimes is applied. The temperature of steam is equal to that of the liquid from which it is evolved. If the steam is confined, as in pressure cooking, the temperature rises and, at sea level, temperatures of 228°, 240° and 250° F. are possible in a pressure saucepan or cooker at pressures of 5 lb., 10 lb. and 15 lb. respectively.

Broiling and Baking.—Air is the principal cooking medium in broiling and baking or roasting. Broiling is cooking by direct heat; the term grilling sometimes is applied to the same procedure. Baking is cooking by dry heat, as in an oven; roasting is the same process as baking but the term usually is applied specifically to meats. Nearly all oven cooking is done at temperatures between 250" and 500° F., 350° F. being referred to as a moderate oven temperature

Frying.—Fat is the cooking medium in frying. The amount of fat varies from a small amount in sautéing or pan-frying to enough to cover the food in deep-fat frying. The cooking temperature is not limited by a boiling point but by the smoking temperature of the fat; *i.e.,* the temperature at which the fat decomposes and fumes become visible. Because the decomposition is irreversible and reduces the usefulness of the fat, heating a fat to its smoking point is best avoided. Temperatures of 350°–390° F. are used in deep-fat frying.

Braising.—In braising, food such as meat is first browned in a small amount of fat in an open pan, then is cooked further, often on a bed of vegetables, with the pan covered. A small amount of liquid may be added after the browning is completed. The term fricasseeing may be applied to the making of a stew by braising small pieces of poultry, rabbit or veal. The braising of a large piece of meat sometimes is called pot-roasting.

Electronic Cooking.—In electronic cooking, radiant energy in the form of high-frequency radio waves causes molecular activity which generates heat within the food. Because the heat is produced within the food itself, rather than being transferred from a warmer source, interior heating is complete before exterior browning and crust formation occur. Many electronic ranges combine this rapid type of heating with a final browning under a broiler unit.

Other Heating Processes.—Some processes involve heating but are not in themselves methods of cooking. These include:

Blanching, a boiling-water or steam treatment followed by plunging into cold water, used to preserve the colour of vegetables and white meats, to remove excess salt and to aid in removal of skins from nuts and fruits.

Blazing, pouring an alcoholic beverage over a food and igniting it.

Caramelizing, heating sugar until a brown colour and characteristic flavour develop.

Glazing, treatment of the surface of a food to present a lacquerlike finish

Parboiling, boiling a food until partially cooked, preliminary to completion of cooking by another method.

Rendering or trying or trying out, heating a fatty food to separate the free fat from the other tissue.

Scalding, either heating milk or other liquid to just below the boiling point or pretreatment of vegetables with boiling water before freezing.

Scalloping, baking pieces of food with a sauce or other liquid and a topping of crumbs.

Steeping, allowing a substance to stand in liquid below the boiling point in order to extract flavour, colour or other components.

Toasting, browning by direct heat.

APPETIZERS AND SOUPS

Appetizers.—Small portions of highly seasoned food served before a meal to stimulate the appetite are called appetizers; *e.g.,* fruit or vegetable juices; fruit cocktails consisting of various combinations of fruit; and sea food cocktails in which pieces of shellfish are served with a sauce. Hors d'oeuvres and canapés are also served as appetizers. An hors d'oeuvre can be selected from a large number of dishes, typical examples being various kinds of cold dressed vegetables, anchovies, sardines, smoked herrings, cubes and balls of cheese, stuffed eggs and other dainty relishes.

Canapés, which are eaten with the fingers, consist of small crackers or pieces of bread, either plain, toasted or fried, spread with various combinations of butter, cheese, smoked meats and fish, etc., and decorated and glazed.

SOUPS.—The foundation of all good soups, whether thick or thin, should be a well-made stock, the basic ingredients being meat and/or meat bones, vegetables, seasoning and water. White stocks are made without first frying the ingredients, brown stocks by frying before adding the liquid. Bouillon is a plain clear soup, usually unclarified beef broth, while a consommé is a clear soup which has been clarified by the use of egg white. Consommé can be served hot or chilled, in the latter case usually jellied.

Thick soups range from plain vegetable purée soups to rich cream soups. Vegetable purée soups are made from fresh or dried vegetables and may be served with or without additional thickenings. Flour or some other starchy material, such as rice flour, is used for thickening soups and may be added at the beginning of the process, with butter or other fat, or toward the end, when it is blended with milk or other liquid. Potato and lentil soups are examples of thickened vegetable soups. Thickened meat soups include kidney, oxtail and some curry soups such as mulligatawny. Cream soups are made by adding cream or egg yolk and thin cream to the soup just before serving. Some cream soups tend to curdle, particularly those with a relatively high acid or tannin content, such as tomato and onion respectively, but the presence of starch and precautions taken when adding the milk help to prevent this occurrence. Tomato, mushroom and chicken are examples of popular cream soups.

Many soups are served with appropriate garnishes, the most usual being croutons (small cubes of bread either toasted or fried), tiny dumplings, grated cheese, lemon slices, shredded nuts, chopped hard-cooked egg, sieved egg yolk, cooked egg custard, thin strips or cutouts of vegetables and tiny meat balls.

ENTREES

Meat.—The animal flesh consumed by man consists largely of muscle tissue A muscle is made up of bundles of fibres, each fibre, bundle of fibres and muscle being surrounded by connective tissue, the amount and kind of which influences the method of cooking a piece of meat. Fat is deposited around, between and within muscles and produces a mottled effect, called marbling, which contributes to juiciness and flavour of the cooked meat. The term cut or joint is applied to a piece of muscle tissue with the accompanying fat and bone. The large wholesale cuts into which a carcass is first divided are subdivided into the retail cuts which the consumer buys. In general. divisions are made in such a way as to separate tender from less tender parts. Composition of meat varies, with protein constituting 15%–20% of the edible portion and fat 5%–30%. The carbohydrate content is not appreciable.

During cooking most of the constituents of meat are changed. Pigments are decomposed, causing a change in colour. Proteins in the muscle fibres are coagulated by heat, causing a progressive increase in firmness. Some of the connective tissue, collagen, is changed to gelatin, allowing easy separation of muscle fibres. Another type of connective tissue, elastin: is relatively unchanged. Fat melts and some liquid evaporates which, together with changes in protein, causes shrinkage. Flavour is changed through volatilization of some constituents of meats and through changes in others because of surface browning.

Tender cuts, those containing a minimum amount of connective tissue, may be cooked by dry heat, less tender cuts by moist heat. Dry-heat methods include roasting, broiling or grilling, pan-broiling and frying. Roasting is cooking by radiated heat in an uncovered container in an oven or, less commonly, on a spit over a source of heat, and is used for relatively large cuts. A layer of solid fat may be placed on top of a very lean roast to prevent drying, or strips of fat (larding) may be forced into the muscle. Salt may be added either before or after the cooking. If a meat thermometer is used, the bulb should be centred in the largest muscle. A temperature of 300°–350° is usual, as higher temperatures cause excessive shrinking and toughening. Searing or sealing, the use of a preliminary high temperature to "seal in" meat juices, has been found to increase, rather than decrease, cooking losses, but the method is still preferred by some because of the additional flavour and crispness produced.

The time required for roasting depends upon oven temperature, the initial temperature, weight, shape and composition of the meat and the desired degree of doneness. The most accurate means of determining doneness is measurement of internal temperature with a meat thermometer, but time-weight tables are useful guides in scheduling meal preparation. Broiling is a dry-heat method in which smaller tender cuts, such as steaks and chops, 1–2 in. thick, are cooked by direct heat, as under an electric unit or a flame (grills). Pan-broiling is cooking in a hot, uncovered heavy skillet or frying pan and pouring off the fat as it accumulates. Cuts which are less than an inch thick are frequently either pan-broiled or fried. Moist heat methods include braising and cooking in water. Braising is used for large, less tender cuts; pot roasts; and for smaller cuts, such as chops. The meat may be floured or coated with egg and crumbs prior to browning if a thick crust is desired, and the liquid added after browning may be water, milk, cream, meat stock, tomato juice or sour cream. Cooking is continued until the meat is tender. Overcooking in a moist atmosphere may change so much connective tissue to gelatin as to cause the meat to fall apart into stringy fibres. For cooking in water, more water is used than for braising. Stews are made by this method, and the meat may be browned before the liquid is added if a brown stew is desired. After the liquid is added, cooking is continued at a simmering temperature because boiling causes stringiness of the meat, which is usually either from a less tender cut or from a thin irregular piece of meat. A relatively large amount of liquid is used in the preparation of clear soups or in the cooking of certain cured meats as corned beef.

Differences in methods of preparing meats from different animals are due to their distinctive characteristics. Beef is roasted or broiled to rare, medium or well done (internal temperatures of 140°, 160° and 170" F., respectively). Veal, obtained from the calf, is treated somewhat differently because of its lack of fat and relatively high proportion of connective tissue; in order to prevent excessive drying and to soften connective tissue, braising, rather than broiling, is recommended for small pieces. Fat from another source may be added to roast veal to compensate for the fat deficiency and to supplement the mild flavour. Long, slow cooking is especially important in order to soften the connective tissue and, for this reason, veal is roasted at a temperature not exceeding 300° F. and is not served rare. Fresh pork is cooked well, both for sterilization and for development of the full flavour. Although sufficiently tender and low in connective tissue to be broiled, small cuts are more successfully braised because slow cooking develops more flavour than does rapid cooking. Cured pork can be cooked to a somewhat lower internal temperature than fresh pork. Because of the tenderness of lamb, parts of the carcass which for other kinds of meat are cooked by moist heat may be cooked by dry-heat methods. Lamb roasts and chops are prepared either well or medium-cooked. The fell (the paperlike membrane covering the lamb carcass) usually is left on a leg during roasting. Mutton is stronger in flavour and less tender and moist-heat methods are therefore preferable.

Such special parts of the animal as edible organs and glands, oxtail and pigs' feet are termed variety meats or offal. Brains and sweetbreads, which are particularly tender, are precooked in acidulated water for increased firmness. Heart and tongue, the least tender of the variety meats, are simmered in water for relatively long periods. Most liver is tender enough to be fried or broiled and also may be braised.

For meat pies and puddings, *see* below, *Desserts*.

Poultry **and** Game.—Fowl or poultry may be cooked by all the methods described above. A large bird may be eviscerated, stuffed and roasted, provided it is not old and tough. Halves or quarters of very young chickens may be broiled. Pieces of young birds frequently are fried. Braising is used for pieces of practically any fowl. Large. less tender birds may be cut into pieces and simmered for stew or for stock.

Wild game also is cooked by the same methods. Venison, a dry meat which needs to be prepared with added fat, is improved by marinating, and braising is preferable to broiling. Rib and loin cuts may be roasted, provided they are from a rather young animal and the roast is overlaid with fat. Ducks and geese usually are stuffed and roasted. Pheasant and quail have a tendency to be dry-fleshed and frequently are braised. Squabs and partridges are broiled, roasted or braised.

Fish.—Fish are classified as to source, fresh water or salt water; as to general type, finfish or shellfish; as to oiliness of the flesh; or alternatively as roundfish, flatfish, crustaceans, mollusks and miscellaneous. In nonoily fish. fat is localized in the liver rather than scattered throughout the flesh as in oily fish. Because of extreme perishability, fresh fish should be chilled as quickly as possible after being caught and kept cold until used, which should be as soon as possible.

Finfish.—Fresh finfish can be purchased whole, in large unboned, unskinned pieces, in crosswise slices (steaks) and in boned lengthwise pieces (fillets). Because the connective tissue of fish is readily softened, tenderness is characteristic and cooking periods should be short. Cooking methods are substantially the same as those described in the section on meat. Broiling or grilling can be used for pieces of any type, except large, whole fish, the distance from the surface of the fish to the source of heat being varied according to the thickness of the piece. Fish is so easily broken that it is commonly broiled in a flat container rather than on a broiler rack and need not necessarily be turned during cooking. Baking is particularly satisfactory for a whole medium-sized fish or for pieces of large fish, as these may be stuffed. It is advisable to remove the backbone before stufling the fish to facilitate serving, and the open edges of the fish can be sewn or held together with toothpicks. Fillets can be stuffed by spreading and rolling and then baked, or they can be cooked in an uncovered baking dish together with suitable ingredients such as sliced onion or other vegetables, sour cream and wine. Small, whole fish are frequently fried and pieces of large fish can be dipped into milk or egg and coated with flour or bread crumbs, or dipped into a batter mixture before frying, if a thick crust is desired. Marinating fish in French dressing before frying provides additional flavour. Cooking fish by poaching involves gently simmering in salted water or in a court bouillon, which should be prepared before the fish is placed in it. In its simplest form it consists of sufficient water to cover the fish, a tablespoon of white wine or wine vinegar, a bay leaf, a sprig of thyme, a little parsley, an onion pierced with a clove and a carrot sliced in two. These ingredients are simmered together for $\frac{1}{2}$ to 1 hr. and strained before use. Because of the tendency for the fish to fall apart, it can be wrapped in cheesecloth or held in a frying basket or in a special rack during poaching. Steaming is similar to poaching except that the fish is held out of the water and cooked by circulating steam. Planking is a variation of either baking or broiling when the fish is cooked on an oiled hardwood plank and, during the last few minutes of cooking. may be surrounded by mashed potatoes.

Shellfish.—Shellfish, like finfish, are toughened by overcooking. Lobsters are purchased alive, dropped into boiling, salted water and then simmered until the lobster is just tender. The cooked lobster is then split through the centre from head to tail and the intestinal tract removed. The meat can be removed and combined with other foods in a variety of dishes or it can be served hot in the shell with melted butter. Lobsters also can be split and broiled. Hard-shelled or mature crabs arc cooked and used similarly; soft-shelled crabs are broiled or fried. Clams and oysters often are served raw, with sauces: as well as cooked in a variety of ways. Oysters can be fried in deep fat, cooked in milk. baked with crumbs and butter or broiled in the shell, while clams can be steamed in the shell. New England clam chowder contains chopped clams, together with potatoes. onions, milk. fat and seasonings; Manhattan clam chowder contains no milk but consists of clams. tomatoes or tomato juice and celery and spices. Scallops are fried frequently or broiled or stewed and served in a cream sauce. Fresh shrimp can be cooked in the shell but the black intestinal vein running the length of the body is most easily removed before the shrimp is cooked. Shrimp can be simmered, fried in deep fat or sautéed.

Lemon butter, wedges and butterflies of lemon, parsley sauce and tart sauces, such as hollandaise and tartare, are common accompaniments for fish.

Stuffings and Gravies.—Variety can be introduced into everyday meals through the use of stufiings containing interesting combinations of ingredients. Stuffings may be classified most conveniently according to their basic ingredients, of which bread is the most commonly used. Bread stufiings contain crumbs or small pieces of dry bread, seasonings, liquid and fat. Ingredients such as chopped celery, onions, sausage, bacon, oysters, giblets, mushrooms, nuts and fruits commonly are used and corn bread is a modification. Bread stuffings are used for poultry, game birds, fish and thin pieces of meat which are rolled with stuffing, such as flank steak and breast of mutton. Rice, brown or white, may form a basis for a stuffing for green peppers or various rolled meats. An excellent stuffing for game birds is of wild rice and mushrooms, and chestnut stuffing, either with or without bread, is a favourite for turkey. Mashed potato stuffings are sometimes used for goose. Mixtures containing meat may be used for stuffing vegetables, such as marrow, squash and tomatoes, as well as for accompanying other meats. These mixtures usually are called forcemeats.

Gravies are served with meat and potatoes and are made from meat drippings, added liquid and thickening. Gravy is best made in the pan in which the meat has been roasted, provided the drippings have not been allowed to burn and excess fat is removed. The amount of liquid used depends upon the drippings available for flavour, and the amount of thickening depends upon the kind of meat the gravy is to accompany; *e.g.*, thin gravies are served with beef and thicker gravies with mutton and lamb. Fat and flour: approximately equal in amount, are blended with the drippings and allowed to brown if a dark gravy is desired. Browned flour has slightly less thickening power than unbrowned flour. The liquid, preferably meat stock or vegetable water, is then stirred in gradually and boiled for several minutes to cook the flour and dissolve the hardened meat drippings. Separation of fat from a gravy indicates too high a proportion of fat to liquid. If separation is caused by excessive evaporation of water, it may be corrected by replacement of the water.

Sauces. which often are served instead of gravies, are rich and concentrated in flavour and are usually thickened. The liquid used may be milk. cream. sour cream. stocks and/or wine. Mushrooms, herbs and other seasonings can be added to give a variety of flavours.

VEGETABLES AND SALADS

Vegetable **Cookery.**—Vegetables are cooked primarily to make them more digestible and more palatable. Softening of the cellulose and modification of the starch granules and pectic substances cause a change in texture; and collapse of the cellulose causes a decrease in the bulk of green leafy vegetables. Succulent vegetables containing a high proportion of, water require very little added water, a-hereas vegetables which tend to absorb water, such as those with relatively high starch content, require a larger amount of added water.

Pigments in vegetables may be green, yellow, white or red. Since a vegetable may contain more than one pigment, the cooking method which best preserves the colour depends upon the pigment which predominates. The yellow pigments are insoluble in water and relatively stable under ordinary conditions of cooking: thus. the colour of carrots is retained easily. Red pigments. which predominate in red cabbage and beetroots, are red in an acid solution and blue to blue-green in an alkaline solution; they are very water soluble. Red cabbage can be cooked with a slice of apple for preservation of the colour. White pigments become yellow in an alkaline medium but remain white in an acid solution: the addition of a small amount of cream of tartar or other acid to the cooking water helps to preserve the colour of. *e.g.*, onions and cauliflower. The predominating pigment in green vegetables is not water soluble, but is intensified in alkaline solution and changed to olive green in an acid solution. In spite of the effect of alkali on the green colour, bicarbonate of soda (baking soda) should not be added to green vegetables during cooking as it adversely affects texture, flavour and nutritive value.

Excessive loss of aromatic compounds through volatilization and loss through solubility in the cooking water of other flavour components causes a general weakening of flavour. Sulfur-containing aromatic compounds responsible for the distinctive flavours of strong-flavoured vegetables, such as cabbage, decompose during cooking, with a strong disagreeable flavour resulting when these vegetables are overcooked. The sulfur compound in onions and leeks merely volatilizes during cooking, with a weakened flavour resulting.

Preparation before cooking varies according to the type: root vegetables are washed and usually peeled or scraped; green vegetables are washed and crisped in the refrigerator if necessary and frequently shredded; the others are prepared variously.

Suitable methods for cooking vegetables are boiling, steaming, baking, panning and frying. The following are general rules for boiling vegetables: (1) The smallest possible amount of water should be used; an exception is the occasional recommendation that a larger amount of water be used for strong-flavoured vegetables. (2) The salted water should be brought to the boil before the vegetable is added. (3) Green vegetables should be cooked in fast-boiling water and cooked only till tender and not oversoft. Root vegetables should be cooked in gently boiling water, as these tend to break up rather easily. As a rule the pan should be covered to promote rapid cooking and minimum loss through volatilization. Desirability of cooking vegetables whole rather than in pieces depends upon the type, upon the amount of water and whether this is used later. The advantage of smaller pieces is that cooking time is shortened, thus canceling out the disadvantage of increased surface area from which loss of soluble nutrients could occur. Steaming is suitable for cooking root vegetables and some of the miscellaneous group, but not for green vegetables, as the colour will be affected adversely. A steamer made for the purpose has a lower portion for the boiling water and one or more perforated upper portions for the food. Alternatively steaming may be carried out in a saucepan with a rack. Steaming at a high temperature in a pressure saucepan shortens cooking time and is very useful for vegetables which require a relatively long cooking period and are not susceptible to undesirable colour changes, such as potatoes. In baking, water-soluble nutrients are well retained, but the relatively long cooking period required is damaging to the colour of green vegetables. Potatoes and squash are particularly satisfactory for this method. A few vegetables such as potatoes and parsnips are suitable for roasting. Panning is cooking in a small amount of fat in a tightly covered pan. Finely shredded green vegetables. such as cabbage, can be cooked by this method, since the very short cooking time required does not permit development of a strong flavour. The conservative method is similar, except that a little liquid is added as well and the cooking may be in a pan on top of the stove or in a casserole in the oven. Root vegetables are either sliced or shaped in small pieces when cooked by this method. Sautéing is a quick method using a little fat, but usually without covering the pan; mushrooms are frequently sautéed. A few vegetables are fried, the most popular being potatoes, which when deep-fat fried are called chips. Tomatoes are sometimes shallow-fat fried and are one of the few vegetables which can be broiled.

All vegetables should be seasoned carefully with salt and sometimes pepper. Depending upon the method of cooking, some vegetables can be served without any further additions, but others are improved by the addition of butter or other fat. A few vegetables are served with or in white sauce. while others can be served with such sauces as hollandaise or cheese sauce.

Salads. — A salad may occupy any one of four positions in a meal. It can be served as the first course, in which case it functions as an appetizer. This type of salad is frequently a fruit salad and sharp in flavour, fresh fruit being preferable to canned fruit. As a main dish, a salad can be served for both luncheon and supper: it is frequently served with or contains pieces of cold meat, fish, hard-cooked egg or cheese, together with raw or cooked vegetables. A salad served as an accompaniment to the main course is smaller and less substantial than a main-dish salad and should emphasize tartness of flavour rather than sweetness. Such salads often are tossed in a French dressing. A dessert salad is made from a selection of fruits.

Great variety is possible in salad making. Green salads can be made with lettuce, water cress, fresh spinach, escarole or chicory, endive and other suitable ingredients, either singly or in combination, and usually are tossed. Other raw vegetables frequently used are: cabbage, carrots, cauliflower, celery, cucumber, onions, peppers, radishes and tomatoes. A typical mixed salad has a basis of lettuce with spring onions, radishes, cucumber, tomatoes and cooked beetroot. Single items, such as tomato, or a combination of two or three, for example, tomato and chicory, can be sliced and dressed. Besides beetroot, cooked vegetables commonly used in salads include: asparagus, beans, carrots, cauliflower, peas and potatoes. Potato and Russian salads are made predominantly from cooked vegetables with the addition of suitable dressings. Fruits used in salads may be fresh, frozen or canned. Both fruits and vegetables can be combined with gelatin mixtures and molded, while fruits occasionally are used in frozen salads.

Many dressings can be made to add to and accompany salads, most of them being variations and modifications of two classical recipes, French dressing and mayonnaise. The basic ingredients of French dressing are oil, wine vinegar, salt and pepper, while in mayonnaise oil is emulsified with egg yolk, and vinegar and seasonings added to taste.

BREADS

Yeast Breads. — The dough for yeast breads requires a fermentation or rising period prior to baking, during which the yeast cells grow and produce the leavening gas. Essential ingredients are flour, liquid and yeast: flour provides structure and enzyme activity; liquid assists the flour in the development of structure, holds other material in solution and makes possible the best consistency for yeast growth; and yeast provides the leavening agent. Salt is an important additional ingredient, as it helps to control fermentation and contributes to the production of an acceptable flavour. A small amount of sugar often is added as it slightly shortens fermentation time, and shortening, when added, has a tenderizing effect and improves keeping quality, but these are not essential. Characteristics of yeast breads may be varied through the use of flours other than refined wheat flour, *e.g.,* whole-wheat, soy, rye; through the use of different liquids, *e.g.,* water or milk or a mixture of the two; by use of different forms of sweetening, such as molasses or honey; and through the addition of nonessential ingredients, *e.g.,* eggs, caraway seeds. dates and raisins. Variations in the handling of the dough also affect the characteristics of the final product.

During the mixing or kneading, protein in the flour is hydrated by the liquid and forms the elastic network which gives structure and permits retention of the leavening gas. The dough then is set aside until double in volume, at which stage the dough is punched down or knocked back to expel excess gas and to equalize distribution of yeast cells and their food. In the making of loaves of bread, one further fermentation period is usual before shaping the loaves. Yeast rolls can be shaped after either the first or the second fermentation. After shaping the dough, another fermentation or proving period completes the preparation for the oven. During baking. the gas expands, protein is coagulated by heat, thus giving a permanent structure. the yeast cells are destroyed. the starch is cooked and the surface of the product is browned.

Temperature is important throughout the entire breadmaking process. Care must be taken during mixing to prevent premature destruction of yeast cells by excess heat, and for satisfactory fermentation the dough should be kept in a slightly warm place, about 80° F.. free from draughts. The optimum baking temperature varies with the ingredients, ranging from 400° to 475° F.

Biscuits (American), Scones and Other Quick Breads. — All these use a source of leavening other than yeast. Most are leavened by carbon dioxide produced chemically from baking powder or baking soda and a form of acid, but popovers are leavened by the action of steam.

Biscuits.—American biscuits are made from flour, shortening, liquid, salt and baking powder. The dough for rolled biscuits frequently is lightly kneaded in order to increase the volume, develop a cylindrical shape and a "flaky" or layered interior. After it is rolled, the dough is cut as desired and baked at 425°–450° F. Dough for drop biscuits contains more liquid than that for rolled biscuits and is simply dropped on a baking sheet.

Scones.—These are the English equivalent of the American biscuit and are very similar. They usually are slightly sweetened and are better if not kneaded after mixing. Seedless raisins (Sultanas), dates or cheese are added for variation.

Other Quick Breads.—Other quick breads are corn bread, griddle cakes, muffins, popovers and waffles, all of which are quickly made and often served hot.

DESSERTS

Cakes.—Cakes are of two general types, shortened and unshortened, the former containing fat.

American cakes usually are made by one of three methods. In the conventional method the sugar and fat are creamed together, the egg added and a mixture of flour, salt and baking powder mixed in alternately with the liquid, beginning and ending with dry ingredients. In the quick, dump or one-bowl method, all the ingredients except the leavening agent are put into a bowl and mixed vigorously, preferably with a power mixer, the leavening agent added and mixing completed. As a modification of the method, the eggs and part of the milk may be added as a separate stage. The muffin method involves adding the combined liquid ingredients to the combined dry ingredients but, although rapid and easy, this method unmodified produces a cake which tends to be coarse-textured and to have poor keeping quality. Chiffon cake is made by a modification of the muffin method in which the egg white is beaten separately and blended with the other mixed ingredients. Shortened cakes made by these methods can be baked in flat layer pans, in loaf pans or in individual cups and can be baked at oven temperatures of 350°–400° F.

English cake recipes using fat are of two main types. The rubbing-in method can be used for most mixtures where the amount of fat is not more than half the amount of flour by weight: the fat is rubbed into the sifted flour, salt and leavening agent until the mixture is like fine bread crumbs; sugar and other dry ingredients such as dried fruit are added next, followed by beaten eggs together with any other liquid in the recipe. The ingredients must be mixed thoroughly without beating or overmixing for satisfactory results. The creaming method is used when the proportion of fat to flour is half or more by weight, thus producing rich cakes: the fat and sugar are creamed well together, the egg beaten into this mixture and the sifted flour and salt, together with raising agent if necessary, folded carefully in, followed by dried fruit and any iiquid in the recipe. Baking temperatures vary from 290° F. for very rich fruit cakes to 425° F. for small buns.

Spongecake and angel food cake are examples of unshortened mixtures. These cakes depend largely upon incorporated air for leavening and, unless modified recipes are used, chemical raising agent is not necessary, sufficient air to produce a light product being incorporated by whisking the eggs. In angel food cake, only the white of egg is used, beaten with cream of tartar, which is acidic and tends to stabilize the egg white foam; the blended flour, sugar and salt then are gently folded in and the desired flavouring added. A portion of the sugar may be beaten with the egg whites. When making spongecakes, two methods are possible: in the first, the unseparated eggs are whisked with the sugar and any flavouring and the sifted flour is then cut and folded into this thick light mixture; in the second, the egg yolks are beaten with lemon juice and all or part of the sugar and the egg whites are beaten separately with or without part of the sugar, the flour and salt being added to the yolk mixture and the whole combined with the beaten whites. Baking temperatures for unshortened cakes range from 300° to 450° F. .the higher temperatures being used for thin products such as Swiss rolls. Cake or pastry flours give lighter, finer-grained and more tender cakes than do stronger flours, which are used for breadmaking.

Cookies (English Biscuits).—These usually are mixed by the creaming, quick-cake or rubbing-in methods and are of four general types. Drop cookies are made from a dough that is too soft to be rolled out on a board and is therefore dropped on to a baking sheet by spoonfuls. These cookies tend to be somewhat cakelike in texture. Rolled cookies are made from a stiffer dough which can be rolled out, cut and transferred to a baking sheet. This type of cookie tends to be crisp. Refrigerator cookies are made from a stiff dough formed into a cylindrical shape and chilled to facilitate slicing. These mixtures produce very crisp cookies. Bar cookies are made from mixtures which are baked in a continuous thin layer and cut into bar-shaped pieces after baking. Cookies are baked at temperatures of 350°–400° F.

Shortbread.—Shortbread is sufficiently distinctive to stand in a class by itself. The ingredients—butter, fine sugar and flour or a mixture of flour and rice flour—are worked together without addition of any liquid and the result, if correctly made, is a very short product.

Pastry and Pies.—Pastry.—Plain pastry (similar to short-crust pastry) is made of flour, shortening (fat), salt and liquid. The fat is cut into the dry ingredients in pieces, or cut and rubbed in until the mixture looks like fine bread crumbs. The liquid then is blended gradually either into all the mixture, with a minimum of mixing, or into a part of the mixture; this paste is blended in turn with the remaining fat and flour. If liquid fat is used, it is added to the dry ingredients with the other liquid. Soft flours, such as pastry and cake flours, give a shorter pastry than the stronger, all-purpose flour. Shortness is directly proportional to the amount of fat used and indirectly proportional to the amount of water added and the amount of manipulation involved. Flakiness is an internal layering obtained by leaving the fat in pieces and by using the maximum amount of water possible without producing toughness; the use of a minimum amount of water or the use of oil or melted fat tends to produce a pastry which is short but mealy rather than flaky. After the dough is mixed, it is rolled until gentle pressure with the fingers dents it only slightly and then placed in position with care to avoid stretching; otherwise the crust will shrink during baking. Pastry which is to be baked as a single shell for later filling is pricked with a fork before baking so that steam can escape. Plain and short-crust pastries can be modified by the addition of egg yolks, sugar and ingredients such as sesame seeds and chopped nuts.

The making of flaky and puff-type pastries, in which the proportion of fat to flour is high, involves special methods for the incorporation of the fat. In order to obtain the maximum amount of flakiness and rise, most of the fat is added to the dough during the rolling process, thus forming alternate layers of fat and dough. Careful manipulation and cool conditions are essential for good results. Hot-water crust is made by boiling the fat and water together and nhipping this mixture into the flour. The action should be as quick as possible as the paste must be molded while it is soft. Strong flours should be used for flaky, puff and hot-water pastries.

Dessert Pies.—Pies for dessert are of two general types. single-crust and double-crust. A single-crust pie frequently consists of a baked pastry shell filled with a starch-thickened mixture and topped with meringue: the crust is baked at a temperature of 425°–450° F. until dry and slightly bronned. and the cooked filling is added to the cooled shell. Typical fillings are chocolate, lemon and vanilla flavoured mixtures. A meringue, consisting of beaten egg white, sugar and flavouring, is then spread over the filling and browned slightly in the oven. Another type of single-crust pie has an uncooked filling, in which case a baked shell is filled with a mixture containing some gelatin and the pie chilled until the mixture has set. These mixtures frequently contain fruit. Chiffon pies are those filled with gelatin mixtures to which whipped cream or beaten egg white has been added. Custard and pumpkin pies are examples of single-crust pies in which crust and filling are baked simultaneously. For minimum soaking of the crust, baking of such pies is begun at a relatively high temperature, *e.g.*, 425° F., and then finished at a lower temperature, 350° F. Single-crust pies also can be made in a deep dish with a top crust. Raw fruit, the filling generally used, is put into the dish with layers of sugar, a little water is added and the whole covered with short-crust pastry. The pastry is pricked or slit to allow steam to escape and then baked. Such pies usually are served with a sprinkling of sugar on the crust, added after cooking. In two-crust (usually fruit) pies an unbaked shell is filled with fruit, a thickening agent, sugar and spices or other flavouring; a flat piece of pie dough then is laid over the filling and the two crusts are sealed together. The top is pricked to allow for the escape of steam during baking. If this is not done, sufficient internal pressure may develop during baking to cause the fruit juice to boil out. A lattice-work of pastry strips may be used in place of the continuous top crust.

Pies can be made with a single crumb crust in place of pastry. Crumbs of crackers or cookies or breakfast cereal are mixed with butter, pressed into a piepan and either baked or chilled. Starch-thickened or gelatin mixtures are typical fillings. Crumbs also may be used to add variety as toppings for fruit pies and in deep-dish desserts, such as apple crunch or crumble.

In Great Britain, a dish with a bottom layer of pastry, with or without a top crust, is usually called a tart. Specific examples are apple, with a double crust; jam, which is baked open or nith a lattice finish; and bakewell tart, which has a cake mixture-type filling.

Meat Pies. — Meat pies are either deep-dish or raised. In both cases, the pastry has to withstand a comparatively long cooking period, and flaky pastry and hot-water crust are the two most commonly used. Flaky pastry is used for deep-dish meat pies, such as steak and kidney, veal and ham, and chicken pies. The usual procedure is to put the pie into a moderately hot oven to cook the pastry and then to cover the pastry with wet greaseproof paper, lower the oven temperature and continue cooking until the meat is cooked. If cooked meat is used, as in chicken pie, the pie should be ready when the pastry is cooked. These pies can be served hot or cold. A raised pie is a meat or savoury pie in which the filling is encased with pastry without requiring a dish for support. Hot-water crust is suitable for these pies, since it can be molded by hand if used quickly after making. Pork and game are well-known examples of such pies, usually served cold. With both types of pie, it is usual to decorate with pastry leaves and glaze with egg before cooking.

Puddings. — Most of the products which can be classified as puddings have a farinaceous substance as one of the main basic ingredients and are oftener served hot than cold. The majority are suitable for the dessert or sweet course of a meal, but a few are not sweet and are served as or with the main course. Puddings can be subdivided into four main classes: those made with (1) suet as the form of shortening; (2) milk and eggs; (3) a cake mixture; and (4) cereal and milk. Depending upon the type, puddings are baked, boiled or steamed.

Suet puddings are of two main kinds: those with a suet crust and a filling, usually fruit, and those made of a suet mixture. The crust is made of flour, suet, salt, leavening agent and water rolled out and used to line a pudding basin. Uncooked, prepared fruit is then packed into the basin with layers of sugar and the top covered with a remaining piece of rolled dough. The pudding is steamed 2–3 hr. and turned out onto a dish. Puddings with suet crust and dried fruit sometimes are baked. The second type of suet pudding, in which all the ingredients are mixed together, ranges from the very rich variety such as Christmas or plum puddings to plain leavened mixtures which are served with sauces, such as treacle or ginger puddings. Bread crumbs often are used instead of flour to give a light product. Long cooking is essential for these mixtures, which usually are boiled or steamed in basins.

Puddings made primarily from eggs and milk include batter puddings, which can be served with fruit or jam; pancakes and various fruit fritters; and custard-based dishes such as queen of puddings and bread-and-butter pudding. Most of this group are baked or fried.

A wide variety of puddings are made with a cake-mixture base and frequently are cooked with jam, syrup and/or fruit; *e.g.,* steamed jam pudding, pineapple upside-down pudding and Eve's pudding. Usually steamed or baked, many are served with sauces.

Milk puddings vary from very plain recipes containing just milk, sugar, cereal and flavouring, to quite elaborate dishes which may have eggs and cream added and be topped with meringue. The richer puddings usually can be served hot or cold, while the plain varieties frequently are served hot with stewed fruit or jam. These puddings can be cooked in a double saucepan or baked.

Meat puddings are of the suet crust type and are made in the same way as fruit puddings, beefsteak and kidney being the most common filling. Dumplings, cooked and served with boiled beef and some soups, are made from a plain suet mixture and Yorkshire pudding is made from a batter and baked, usually as an accompaniment to roast beef.

Cold Sweets. — Fruit desserts are those predominantly or wholly composed of fresh or cooked fruit; *e.g.,* mixed fruit compote, fruit salad, stewed fruit and fresh fruit. Gelatin, an important ingredient in many well-known desserts, *e.g.,* jellies of fruit juice and fruit, and cream mixtures, such as bavaroise, is also often added to such desserts as cold souffles, mousses and ice cream to give additional structure and smoothness. Eggs are used both as a thickening agent in custards and creams and as a foaming agent to give lightness in soufflés and similar dishes. Custard, a mixture of egg, milk, sugar and flavouring, may be either a stirred sauce or baked or steamed to form a set dish, caramel cream or custard being a well-known example of the latter. Egg whites often are used separately; *e.g.,* in hard meringues, which consist of beaten egg whites, sugar and flavouring, baked very slowly until dry and then filled with fruit and/or cream.

Starch of various kinds is an important thickening agent in many desserts and blancmange, made from cornstarch, milk, sugar, butter and flavouring, depends entirely on starch for its structure. Starch-thickened mixtures, or mixtures thickened with both starch and egg, are also used as fillings for cream puffs and eclairs, while whole grain cereals such as rice can be creamed and served with fruit or other flavouring.

Many popular desserts are combinations of several individual items, trifle and charlotte russe being good examples.

Chilled Desserts. — Many of the types of desserts mentioned above can be chilled to advantage. Whipped cream, beaten egg whites and gelatin are common constituents of such desserts, but various combinations of fruits, nuts, coconut, cookie crumbs and other ingredients also can be used. In frozen desserts, firmness is produced by ice crystals; smoothness and other characteristics, by the ingredients and the method of preparation. This group consists mainly of ices. The simplest form is the water ice consisting of fruit juice or other flavouring, water and a sweetening agent. A sherbet is modified by the addition of gelatin or beaten egg whites to give increased smoothness of texture and may have milk or cream substituted for water. A sorbet (frappe in the U.S.) is a soft water ice with fruit or liqueur flavour and only half frozen. The usual basis of an ice cream is either cream or custard or a mixture of the two; flavouring, such as fruit purée or chocolate, sugar and often a little gelatin (to give additional smoothness) are added. A half-frozen ice cream is usually known in Great Britain as a frappé. Both ices and ice creams are stirred during the freezing process. Desserts that are frozen without stirring are mousses, parfaits and cold souffles, which are light ice cream preparations made from custard, cream, fruit or sirups, whisked egg whites and flavouring. *Bombes* and ice puddings are combinations of at least two different frozen mixtures packed in a mold and refrozen.

Confections. — Homemade candies or s eets are of two general types, crystalline (*e.g.,* fondant and fudge) and noncrystalline or amorphous (*e.g*., caramels, taffy, brittle and all kinds of toffee).

Crystalline. — In the making of crystalline candies, sugar in crystalline form is dissolved in excess water, combined with chocolate or other ingredients and cooked until properly concentrated. The degree of concentration may be checked either by taking the temperature of the sirup or by testing the sirup in cold water. During cooling of the concentrated sirup, the amount of sugar that can remain in solution decreases. Thus, at a temperature only slightly higher than body temperature, beating initiates recrystallization of so much of the sugar that a solid mass is formed. Vigorous beating during crystal formation tends to keep the crystals small and the texture of the candy smooth. Certain added ingredients also contribute to smoothness by interfering with crystal formation, *e.g.,* cream of tartar and other materials that act chemically; if used to excess or if allowed to act too long, as in very slow cooking, acids may interfere with crystallization to such an extent that the candy fails to harden. Butter and other fats and corn sirup act mechanically to keep crystals small. If a crystalline candy is cooked to or beaten at too high a temperature, a grainy product is likely to result, but this can be redissolved in water, cooked to the proper end point and finished satisfactorily.

Noncrystalline.—Noncrystalline candies are cooked at higher temperatures and the sugar solidifies so rapidly during cooling that crystals are not formed. These candies are not beaten and high proportions of substances which interfere with crystallization are sometimes added, *e.g.,* caramels are not agitated after cooking and have a high proportion of fat and of milk solids. Taffy is pulled when it is cool enough to be handled and this incorporates air, thus lightening the colour. Brittles are not manipulated except that they are sometimes stretched during cooling in order to make them as thin as possible.

Other confections include glazed apricots, prepared by cooking dried apricots slowly in a heavy sirup, glazed nuts, similarly prepared, and marzipan, a sweetened, flavoured paste of ground almonds frequently tinted and shaped for use as a decorative confection. Fondant can be used, with or without nuts, as stuffings for dates, prunes and apricots and also can be shaped and dipped in a special chocolate coating. It also can be melted, flavoured and tinted and either poured out in small amounts to form flat, round mints or used as a dip for balls of firm fondant.

BEVERAGES

Coffee.—Coffee is available in four forms: powdered, frozen liquid concentrate, whole bean and ground. Powdered coffee and the frozen concentrate are dissolved in hot or boiling water; coffee beans are ground and then used as ground coffee. The beverage may be prepared from ground coffee by several methods but, regardless of the method used, the aim in coffee-making is extraction of the desirable flavouring substances with a minimum amount of the tannins and other bitter-tasting substances. Subboiling temperatures are preferable to boiling because (1) the desirable flavour constituents are volatile and thus easily lost during boiling and (2) the bitter components of coffee are increasingly soluble in water as the temperature rises. Caffeine, the stimulating substance in coffee, is soluble in hot water and therefore extracted with the other constituents, but decaffeinated ground coffees are available. There are three general methods of making coffee. Steeping requires no specialized equipment, the coffee being heated with water in a coffeepot or a covered saucepan and kept just below boiling point until the desired strength is obtained. In a percolator a small amount of water is forced upward through a tube and then filtered downward through the coffee grounds; the process is repeated until enough water-soluble material has been extracted to give the desired strength and colour. In the drip method boiling water is poured onto the grounds and allowed to filter through the coffee into a serving pot. Fineness of grind is important in this method as the water is in contact nith the grounds only once and for a short time. In vacuum-type coffee-makers, coffee is made by a variation of the drip method or by a method in which the extraction takes place as steam is forced up through the grounds. Automatic electric coffee-makers are either percolator or vacuum in type. After-dinner coffee usually is served very strong in a small cup called a demitasse.

Teas.—Green, black and oolong teas differ because of their different treatment during processing. Black tea is subjected to a fermentation process not used for green tea, resulting in a mildness of flavour as compared with the pungent flavour of green tea. Oolong is partially fermented and its flavour compromises between those of green and black teas. Terms such as pekoe and orange pekoe are grade designations based on size of leaf, the smaller leaves being graded higher. The only general method for making tea is steeping: boiling water is added to the tea leaves, which are allowed to steep for approximately three minutes, after which the tea bag or ball is removed or the infusion is poured off the leaves. If a very strong beverage is desired, it is best obtained by using more tea leaves rather than by steeping for a longer time, as longer steeping results in the undesirable extraction of more tannin. Iced tea is made by pouring freshly made tea over ice: because of the dilution by melting ice, a particularly strong infusion of tea is used. However, if the infusion is too strong or if it is prepared by long steeping, the chilled product may become cloudy because of precipitation of tannins, which are less soluble in cold than in hot water. The stimulant in tea, theine, is the same as caffeine in coffee and is found in green and black tea in similar amounts.

Milk Beverages.—Cocoa and chocolate beverages contain milk and usually are served hot. Since cocoa contains starch, the mixture should be cooked for several minutes at some stage in the preparation, unless the precooked variety is used, in order to avoid a raw flavour and a sediment in the finished product. Cocoa and chocolate contain theobromine, a stimulant similar to caffeine.

Other milk beverages include *café* au *lait,* a mixture of strong coffee and hot milk, and numerous cold mixtures of milk and fruit juices.

CHEESE, EGGS AND FRUIT

Cheese.—Characteristics of various cheeses, the most pronounced of which are caused by differences in moisture content and methods of ripening, affect their use in food preparation. Moisture content may be as high as 75% for a soft cheese, as cottage cheese, or as low as 30% for a hard cheese, as Parmesan. Ripening may be brought about by acid-forming bacteria, as in Cheddar, by gas-forming bacteria, as in Gruyère, or by mold, as in Roquefort, and it is during ripening that the characteristic flavour and texture develop and that the cheese becomes easier to blend with other ingredients in cooking.

When cheese is heated, the fat melts and, as the temperature increases, the protein coagulates and the fat tends to separate; heating above 160° F. tends to toughen the protein and cause stringiness. In the preparation of a cheese sauce, grated cheese is mixed into a white sauce which has been cooled to approximately 125° F.; if the cheese fails to melt, the sauce may be heated over hot water until the cheese is blended. In the preparation of baked cheese mixtures, such as macaroni and cheese, high temperatures and overcooking should be avoided.

Eggs.—In addition to adding colour, flavour and nutritive value, eggs also contribute thickening, as in custards; structure, as in chou paste (cream puffs) and to some extent cake mixtures; leavening, as in angel food cake and sponges; emulsification, as in mayonnaise; and binding, as in croquettes and meat loaves.

Eggs are frequently used alone, either poached, fried, scrambled or cooked in the shell. Poached eggs are broken into simmering water and cooked until the white coagulates; fried eggs are broken into a skillet and cooked in fat. For scrambling, the eggs are broken and slightly beaten, a little milk and seasoning added and the mixture heated slowly with a little butter and stirred gently until just coagulated. Boiled eggs are cooked in the shell in simmering water until the required degree of coagulation is obtained. The formation of a dark ring around the yolk can be prevented by not overcooking and by immediately placing hard-cooked eggs in cold water.

The changes which occur during the cooking of eggs are largely due to the coagulation of protein at relatively low temperatures, 140°–160° F. in the case of undiluted egg and a little higher with diluted egg mixture, such as custards. Overcooking eggs causes overcoagulation, with the result that the protein is toughened and liquid and solid separate in custards or other mixtures in which liquid has been added.

Fruit.—The changes which occur during the cooking of fruits affect texture, flavour and colour. Alterations in texture are due to several factors: softening of cellulose, the substance of which plant cell walls are composed; changes in the pectic substances which bind the cells together; cooking of the starch which is present in some fruits; and changes in moisture content. Flavour is due to the presence of sugar, organic acids, aromatic compounds and mineral salts, and the loss of aromatic compounds through volatilization is an important problem of fruit cooking. Losses of sugar, acid and salt are mainly the result of their solubility in cooking water.

The colour of fruits is due chiefly to a group of yellow pigments, carotenoids, and to red pigments, anthocyanins: the yellow pigments are so stable that their preservation during cooking is no problem, but the red pigments, although maintaining their colour in the presence of acid, are water-soluble and tend to leach out into the cooking water and, in some cases, to form blue or black compounds with tin and iron. Another group of compounds, tannins, also found in fruits but not classified as pigments, may react with iron to form dark-coloured compounds and therefore iron knives and pans of tin, iron or chipped enamel should not be used in the preparation of fruits.

Fruits can be cooked in water or a sugar solution, baked, broiled or fried. The amount of water used in cooking fruit depends upon the kind used; *e.g.,* berries require less added water than apples since they have a higher natural water content. Cooking fruit in a sugar solution tends to make it lustrous but, if the sugar solution is too concentrated, sufficient moisture may be drawn from the fruit to cause shriveling; on the other hand, if the sugar solution is very dilute or no sugar is added to the cooking water the fruit may become mushy. If the fruit is to be sieved, as for applesauce, it should be allowed to become mushy by cooking in water and the sugar, if needed, added after sieving, but if the fruit is desired for garnish, as in the case of coloured and spiced pieces of apple, a sugar sirup should be used. Fruits cooked in a sugar sirup are usually referred to as stewed or coddled fruits. Fruits which are sometimes baked include apples, bananas and pears: apples are frequently cored, stuffed with a mixture of sugar, butter, seasonings, raisins and nuts and baked whole; bananas and pears are halved, dotted with butter and sprinkled with fruit juice and cinnamon or other seasoning. Some fruits can be broiled; *e.g.,* grapefruit, canned and fresh pineapple rings and canned peach halves. Apples and bananas are sometimes fried and also made into fritters.

Cooked fruit can be used in a variety of ways during a meal: as an appetizer, *e.g.,* broiled grapefruit; as part of the main course, *e.g.,* fried apples; as a garnish, *e.g.,* cinnamon apples; or as dessert, *e.g.,* baked fruits and various fruit puddings.

The principal goal in the cooking of dried fruits is the replacement of water removed during drying. Rehydration can be achieved satisfactorily by slow cooking of the fruit in water or by a short soaking period followed by slow cooking. Sugar, if needed, should be added when the fruit is nearly done. Long soaking of the fruit prior to cooking tends to produce an undesirably watery product.

HERBS AND SPICES

Seasoning is an extremely important part of food preparation: real skill in the seasoning of foods requires experience, imagination, discrimination and restraint, for overseasoning can be even more serious than underseasoning. Herbs and spices provide an endless means for enhancing the natural flavours of food.

Herbs. — Herbs are plants with succulent, distinctly flavoured leaves, which can be used fresh or dried, preferably in a finely divided form and always in small amounts. Meat dishes, vegetables, salads, soups, sauces, fish, poultry and egg dishes may all benefit from additions of herbs. The following are some of the more commonlv used herbs.

Basil, an aromatic potherb whose leaves have a strong flavour resembling cloves, is always included in the making of turtle soup.

Bay leaves, from a species of laurel tree, are used in soups, with meats and fish and one or part of a bay leaf is always included in the *bouquet garni* and in court bouillon.

Chervil, whose delicate flavour resembles both parsley and fennel, is used in salads, soups, sauces and meat dishes and sometimes in the fresh green state.

Chives, related to onions and similar in flavour, are used in salads and soups.

Dill is commonly used in pickling as well as in meat and vegetable dishes, soups, salads and sauces; the leafy tops are used as well as the dried fruit, usually known as dill seed.

Fennel, related to the parsley plant and with a flavour similar to aniseed, is commonly used for flavouring fish sauces, soups and salads.

Marjoram is one of the sweet herbs which, when dried, are included in mixed herbs for flavouring stews, meat dishes and soups, etc.

Mint is mainly used when fresh but sometimes in a dried form; the serving of mint sauce with lamb, hot or cold, is an English custom, as is the addition of mint leaves to the cooking of new potatoes and green peas.

Oregano is widely used in meat dishes, with eggs, beans, cheese dishes and fish, and is essential to Latin cookery.

Parsley, a lacy green herb with a slightly sharp flavour, is used as a garnish, in sauces and salads, can he fried and is used fresh to a greater extent than dried.

Rosemary is a mint-flavoured herb used with lamb and other meats and in stuffings.

Sage, a commonly used seasoning in bread stuffings for poultry and other meats, is also used in soups and sauces.

Sorrel is an essentially French herb used for making sorrel soup and for flavouring omelets and sauces.

Tarragon is used fresh in salads and for flavouring in chicken dishes, omelets, sauces and stews, as well as in tarragon vinegar.

Thyme, a pungently flavoured herb widely used in stuffings, sauces, soups and meat dishes, is traditionally used in the preparation of jugged hare.

Mixtures of herbs can be bought, such as poultry seasoning with sage usually predominating and mixed herbs, usually consisting of thyme, sage, marjoram and parsley.

Spices. — Spices are aromatic parts of plants, mostly tropical, which are dried and used in food preparation either whole or in a pulverized form. A spice may represent the root, bark, fruit, flower, bud or seed of the plant.

Allspice is the dried fruit of the pimento tree, its name being derived from the similarity of its flavour to that of a mixture of cinnamon, cloves and nutmeg and is used primarily in baked cakes and cookies.

Anise (aniseed) is an extremely small seed, the oil of which is used in confections, sauces, creams, sweet puddings and cakes, as well as pickling.

Whole *caraway* seeds are used in breads, cakes, meat dishes, salads and in some cheese.

Cardamon seeds resemble anise in flavour and are used similarly, and in curry.

Celery seeds are used in pickling and in soups, as well as in fish and meat dishes.

Cinnamon, the bark stripped from young branches of the cinnamon tree, is available either in the ground form or in rather large pieces and is used extensively in cookies, cakes and with fruits.

Cloves are the unopened flower buds of the clove tree, available either whole or ground, and are used for flavouring soups, stocks, meats and desserts.

Powdered *coriander* seed is used mostly in pickling and is a constituent of curry powder.

Cumin seed is ground and used in soups and meat dishes and is a constituent of curry paste.

Ginger is an example of a spice obtained from the rhizome of a plant and is available both in pieces as stem or crystallized ginger and in the ground form; it is used in baked products such as cakes and cookies, in certain meat dishes and in oriental cookery, being a common ingredient of curry powder and pastes.

Mace is the covering of the nutmeg, with a similar delicate flavour, and is used for flavouring the same kind of products as is the nutmeg, as well as in preserving.

Mustard seeds are of two varieties, black and white (yellow); the ground form is used mainly for making a condiment or relish, although it is also used in flavouring meat and cheese dishes.

Nutmeg is available either ground or as whole seeds and is used widely in the preparation of desserts, soups, beverages and baked products.

Both black and white pepper are obtained from the same plant, black pepper from the dried immature fruit and white pepper from the dried mature fruit with the hull removed; pepper is used as a condiment and as a seasoning in all savoury dishes.

Saffron, the dried stigma of a plant related to the crocus, is used occasionally for flavouring and colouring of special type cakes.

Sesame seeds are small, light-coloured seeds with a nutty flavour, and are used in breads and confections.

Turmeric (curcuma) is another example of a dried rhizome or root and is from a plant of the ginger family; the yellow powder is used extensively in curry powder and in prepared mustard.

Vanilla, obtained from the dried pod of a plant, is a very delicate flavouring that can be used for all kinds of sweet dishes.

Others.—Curry powders and pastes are made up of various combinations of many spices and herbs, each combination varying considerably in flavour. Curry, as a dish, is of immemorial use in

India.

TRO important sources of flavour which cannot be classified as either herbs or spices are garlic and horse-radish. Garlic is the bulb of a plant, the small sections of which are known as "cloves" of garlic, and is used extensively in flavouring meat and vegetable dishes and salads, but needs to be used with care and discrimination. Horse-radish is a root with a somewhat peppery taste used grated and usually served as a cream sauce, particularly with roast beef.

See also FOODS, NATIONAL.

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FOOD PRESERVATION. As foods in their natural state remain sound and edible for only a comparatively short time, food preservation has engaged the attention of mankind from the earliest times. Prehistoric man preserved his cereals by parching, vegetables and fruits by drying, milk in the form of fermented products or as cheeses, and fruit juices as cider or wines; and the hunter learned to dry or salt his game or fish. The ever-increasing spread of man over different parts of the world, into widely different climates, and still more the increase in urban populations, have rendered the development of efficient methods of preservation a matter of vital necessity. For many centuries the art of preservation was at a standstill or developed only slowly and was purely empirical, fermentation, drying, smoking or curing with salt being the principal methods. As the biological causes of food spoilage became better understood, rapid advances followed and appropriate methods were soon developed for dealing with the causative agents.

Since most foods either carry or eventually acquire bacteria, molds or yeasts, microorganisms are the major cause of food spoilage. Other factors leading to deterioration or spoilage are the enzymes (ferments) naturally present in some foods, and various chemical reactions, particularly oxidation. Some factors which lead to spoilage in one food might be regarded as desirable in another instance and may be, indeed, essential for the protection of certain foods. For example; yeasts are applied in making wine, bacteria in the manufacture of sour milk and pickled products and molds in cheese making. Enzymes are used in both cheese making and in brewing, and the browning of roasts and bread crust is a type of chemical reaction that in many other foods leads to deterioration and spoilage.

There are several major processes for food preservation. The growth of microorganisms (and enzyme activity) in foods may be retarded by cooling or almost entirely prevented by freezing. Since water is necessary for the growth of microorganisms, dried (dehydrated) foods will keep for long periods. Or the enzymes and microorganisms present in foods may be completely or almost completely destroyed by the application of heat as in thermal processing (canning). In canned foods reinfestation by microorganisms must be prevented, hence the need for hermetically sealed containers. Finally, both enzyme action and microbial growth can be prevented by the addition of certain chemicals or through chemicals produced in fermentations. Smoking, salting and candying are the age-old examples of this type of food preservation, but the use of chemical preservatives and inhibitors, including antibiotics, is more important today. The preservation of food with ionizing radiations ("cold sterilization") will doubtless be added to this list when the principles involved and the operational details are sufficiently developed to allow large-scale commercial application. Often several of the principles are applied in combination. For instance, cabbage is preserved as sauerkraut in the presence of salt and by the chemicals produced by the microorganisms during fermentation: and much of this product is later marketed in cans after heat sterilization. Some frozen food products are heated before freezing in order to inactivate the enzymes or to reduce the number of viable organisms present. A combination of dehydration and freezing is used in the processing of dehydro-frozen foods.

The modern objective of food preservation includes more than the mere prevention of spoilage. Quality. economy and convenience are in most instances important in the production and marketing of processed foods. Colour or appearance, flavour, texture or consistency and freedom from defects are the major quality factors. Nutritive value has also come to be recognized as a quality factor. Most countries have detailed and exacting requirements governing food processing from the standpoint of sanitation and quality, but the extent to which such regulations are enforced varies greatly. However, quality requirements for any food are also firmly ingrained in the consumer's mind and thus will govern his purchases. Therefore, quality must be retained by the processed food during preservation and in the period between its manufacture and consumption. Naturally, the emphasis given to quality factors will depend on the cultural and economic state of development and is more important where there is high purchasing power and an abundance of food allowing a choice. Yet quality requirements (or "conforming to common usage") exist even in the most primitive cultures. In hardly any other field of'human activity does tradition play as important a part as in our choice of food.

Convenience is a factor in food processing which has gained much importance. Whereas, not many years ago; most canned and otherwise preserved foods represented starting materials for the preparation of meals, today it is common for some or most of the preparation and compounding into the final complete dish to be done by the food processor. It is clear that the modern food processor, with his scientific control, large-scale operation and use of raw materials in their prime, has many advantages over the cook or housewife. Such preserved, partially prepared or complete dishes, or even complete meals, offer in the home easy preparation in a short time. Although price is still a major consideration in determining the marketability of a processed food, the gradual increase in the world-wide standard of living and the employment of a large proportion of the population (including women) in many countries tend to increase the consumer's willingness to pay the processor for some of the preparation and cooking. In spite of some of the early objections to processed foods it is now generally conceded that the increasing availability and use of processed foods has had a profoundly beneficial effect on the diet pattern in many countries; and that in most instances it has led to substantial improvements in the national nutrition. This is particularly true where fresh fruits and vegetables are available only during part of the year or where foods transported from long distances make up a significant part of the diet. (See FOOD SUPPLY OF THE WORLD.)

Drying and Dehydration. — Desiccation or drying is nature's major method of preservation. Prehistoric man must have observed that dry cereals, berries and nuts kept well, and that meat and fish, when dried, could be kept for extended periods without spoilage. Many traditional sun-dried products are still used today, and the storage of dry cereals was a major factor in stimulating urbanization and the development of civilizations. "Drying" usually ,indicates a sun-dried product, whereas "dehydration" is used mostly for foods from which the water has been removed by artificial means. However, there are exceptions to the use of this terminology, particularly where artificial drying is used to supplement sun drying.

Food preservation by drying and dehydration depends on the fact that microorganisms cannot grow on dry materials and that enzyme action and various other deleterious chemical reactions are similarly retarded or prevented when the water content of a food is low. Previously it was thought that a moisture content of about 10% was sufficiently low to prevent both spoilage and deterioration of foods. But of late the upper limit of moisture content has been gradually reduced for most dried foods. This change was due, to a large extent, to the increased emphasis on quality retention, and was made possible by the development of more efficient means of artificial drying. The amount of permissible residual water is different for various products. The temperatures to which the product will be exposed during storage and the length of time between manufacture and consumption are major factors in determining the maximum permissible moisture content of a dehydrated food.

With the exception of eggs and milk, dehydrated foods were never as important in the United States as in Europe. During World Wars I and II, great efforts were made to increase production and to improve the quality of dehydrated foods, since they offer great economy both in tin requirements and in storage bulk and shipping weight. Considerable activity in research and development after World War II continued in the United States and elsewhere and resulted in many new and improved dehydrated products.

Sun drying is used with many fruits such as apples, pears, plums, peaches, apricots, figs, currants and various raisin grapes. In order to prevent excessive darkening, most of these fruits are treated with sulfur dioxide before drying, most of the chemical being lost from the fruit during the subsequent processing. Some fruits, such as figs, must be fumigated with chloropicrin, ethylene oxide, methyl bromide or other agents in order to prevent infestation by insects. The water content of most dried fruits is in the range of 5% to 15%, with different requirements for various fruits. Meat is not now sun-dried in western Europe and the United States but this ancient method of preservation is still used in many other parts of the world. The sun drying of fish is common all over the world, and usually is done in conjunction with salting, brining and smoking, in various combinations.

Artificial drying (dehydration) depends on the efficient transfer of water vapour into a stream of air or other gases that are not saturated with water vapour. Thus the volume, temperature and relative humidity of the drying gas and the surface of moist material exposed to it will govern the drying efficiency. The design of food drying equipment is a highly specialized branch of engineering. Since every food particle has a different and typical attraction to moisture, most types of dehydrating equipment will be suitable for a limited number of products only. Cabinet dryers are drying chambers usually divided into several compartments, each holding several stacks of trays mounted on carriages. The cabinets are commonly heated by steam coils. In the old-fashioned kiln dryer or "evaporator" (still used with apple pomace, hops, etc.) the product to be dried is placed in an upper room which has a slatted floor and a current of hot air is supplied from below. Tunnel dryers are extensively used—the drying takes place in tunnels 30–50 ft. long and about 6 ft. square. The material to be dried is loaded on slatted wooden or metal trays stacked on carriages which fit the tunnel snugly so that the air passes between the trays. The carriage loaded with the fresh material is introduced at one end of the tunnel and the dry material is removed at the other end.

Belts of stainless steel are sometimes used instead of trays and carriages. Drum dryers are commonly used for drying milk, pulped fruit, potato flour, mixtures for prepared foods and other products. In the most common type of double horizontal drum dryers the material to be dried is placed in the top "well" between two identical, closely placed, heated drums 3 to 6 ft. in diameter. The drums are slowly rotated so that the material to be dried is picked up by the drums and carried toward the outside. The drying is completed by the time the material on the drum reaches the scraper or "doctor blade" which shaves off the product. The material to be dried may also be fed from a pan under a single drum or sprayed on the drum.

Spray dryers are extensively used in the large-scale drying of milk and other dairy products, whole eggs, egg yolks, fruit and vegetable juices, purees, soluble coffee and tea and many other foods. This method of drying often allows economical large-scale production with the least damage to flavour. The material to be dried is finely atomized, usually into the top of a large cone-shaped chamber in which heated air or gas is circulated. The water in the droplets evaporates in the heated air and the solid particles are trapped by a collector which usually consists of a smaller cone-shaped structure. Spray drying is the quickest means of drying but the method is applicable only to a limited number of foods and the installation costs are high. Vacuum dryers provide rapid drying at lower temperatures and may be of the tray or continuous belt type. A specific form of vacuum drying is freeze-drying (lyophilization), which was developed for purposes other than food production during World War II but is now used for foods to a limited extent. Here the product is dried by sublimation of the water without raising the product temperature, a point of much importance in the food processors' effort to preserve flavour. Both vacuum drying and freeze-drying are expensive in comparison with other methods of dehydration and therefore are applied mostly to food products of special requirements or of high price.

Often it is most expedient to use a combination of various drying procedures. For instance, some vegetables are most economically dehydrated in tunnel dryers which remove the bulk of water. This is followed by drying in cabinet dryers, and lastly by removing additional moisture in bins through which air, dried in silica gel, is circulated. For storage and distribution, many dehydrated products are packed in cans in an inert atmosphere or under vacuum. The use of in-container dehydration by small packets of moisture-absorbing agents placed in the container with the dehydrated product allows attainment of new and hitherto impractically low levels of moisture content.

Salting and Pickling.— Salt is one of the oldest preservatives used for enhancing the keeping quality of fish, meat and vegetable foods. However, the preservative function of salt is not the same for all food products and some of the principles involved are not yet entirely understood. (See FISH CURING; PICKLING.)

Meat and fish are treated directly with dry salt crystals or are soaked in a strong brine. Salt is almost universally used for enhancing the keeping quality of butter, the proportion applied (in the U.S. and Canada) being in the range of 2.0% to 2.5%. Salt is used extensively in the manufacture of various types of cheese. In the preservation of vegetables the main function of salt is to govern the type of microorganisms which will grow in the product and the extent of the changes which the growing microorganisms will be able to produce. The effectiveness of salt in the control of microorganisms has been explained by a number of somewhat contradictory theories. Whatever may be its action, the fact remains that salt, particularly in combination with acids, has a selective action on microorganisms. This effect is extensively used in the manufacture of pickles, sauerkraut, cured olives and many other products. Pickles and sauerkraut are typical of foods stabilized by directed fermentation. Other examples in this classification are meat, buttermilk, yogurt, cheese and the many foods which in their original forms were susceptible to spoilage before the advent of food processing and therefore were allowed to be fermented by the ever-present yeasts. Honey beer (mead), the common malt-hop beer and the innumerable types of fermented fruit juices and wines are in this category.

Smoking.— Preservation by smoking is applied almost exclusively to meat (particularly ham) and fish and is often used in conjunction with other methods of preservation. The preserving action of smoking arises from the drying action of heat as well as from chemicals (*e.g.,* wood creosote) deposited on the food during smoking. However, increased palatability is undoubtedly the major reason for the smoking of fish and meat in countries where other methods of food preservation are easily available. Smoke usually is produced by the slow burning of sawdust from such hardwoods as hickory, maple and birch.

Chemical Preservatives.— The use of chemicals is an old and well-recognized practice in both household and commercial preservation of foods. A large number of chemicals having real or supposed preservative properties have at different times been added to foods. This subject is inseparable from the problems presented by food adulteration and from the occurrence in foods of the toxic residues from chemical agents used to protect plants or animals against pests and diseases. Whereas in most countries willful adulteration has come to present less of a problem, the complications introduced by the multitude of protective chemicals necessary in agricultural production are serious.

Chemical food preservatives are substances which. under defined conditions, delay the growth of microorganisms without necessarily destroying them. Since the concept of food preservation now includes retention of quality as well as prevention or delay of spoilage, a distinction has to be made between the use of chemicals which will prevent deterioration of quality during manufacture and distribution on the one hand and those added for preventing microbial spoilage on the other. The first group includes some natural food constituents such as ascorbic acid (vitamin C), which is added to frozen peaches to prevent brouning, and a long list of chemical cumpounds foreign to foods and classified as antioxidants. bleaching agents, acidulants, neutralizers, stabilizers, firming agents, humectants, etc. The second group again includes some natural food constituents which, when added to foods, will retard or prevent the growth of microorganisms. Sugar is used partly for this purpose in making jams, jellies and marmalades and in candying fruit. The use of vinegar in pickling and of alcohol in brandying is in this category as is the use of salt. Finally there is the group of chemicals foreign to foods and added strictly to prevent the growth of microorganisms, the chemical preservatives.

Sodium benzoate and other benzoates are among the principal chemical preservatives. The use of benzoates in certain products and in prescribed quantity (usually not exceeding 0.1%) is permitted in most countries, some of which, as the United States, require a declaration of its use on the label. Since free benzoic acid actually is the active agent, benzoates must be used in an acid medium in order to be effective. The ability of cranberries to resist rapid deterioration is attributed to their high benzoic acid content. Benzoic acid is more effective against yeasts than against molds and bacteria. The effectiveness of benzoic acid can be increased by the introduction of a side chain or by other modifications of the molecule. Other organic compounds used as preservatives include vanillic acid esters, monochloroacetic acid, propionates, dehydroacetic acid and glycols.

Sulfur dioxide and sulfites are perhaps the most important inorganic chemical preservatives. Although special laws forbidding the use of sulfur compounds were passed as early as 1400, a more tolerant view is now taken. Sulfites are more effective against molds than against yeasts and are widely used in the preservation of fruits and vegetables. Sulfur compounds are extensively used in wine making and. as in most other instances when this preservative is used, much care has to be exercised to keep the concentrations low in order to avoid undesirable effects on flavour. Sodium sulfite has been used as a preservative for meat although there is some doubt about its effectiveness. However, when incorporated with chopped meat which is in an incipient state of decomposition, it serves to bring out a red color thus tending to make the meat appear fresh. Oxidizing agents such as nitrates and nitrites are commonly used in the curing of meats.

Most governments attempt to control the addition of foreign substances to foods and the occurrence of toxic residues in foods. In the United States, the federal, state and city governments have regulations concerning this matter, but it is the Federal Food. Drug and Cosmetic act of 1938, amended and extended from time to time, which regulates the application of chemical preservatives in foods. Regulations concerning the use of food additives, including chemical preservatives, change frequently as new compounds become available or as the desirable or undesirable properties of agents in use become better understood.

The period after World War II saw an increasing use of antibiotics in food preservation; some European food preserving agents presumably containing antibiotics appeared on the market in the late 1940s. The use of antibiotics was given legal approval in the United States for the temporary preservation of poultry. and ice containing antibiotics was successfully applied in the cooling of fish. When the mode of action and absence of deleterious effects of residues and decomposition products are better understood, antibiotics may be more extensively used in food preservation.

Thermal Processing. — In thermal processing (called canning in the United States) the food is packed in hermetically sealed containers and heated sufficiently to destroy all living organisms or, at least, to assure that the conditions inside the container are such that no growth of residual organisms will occur. Many hundreds of different products are preserved by thermal processing in cans or tins and in hermetically sealed glass containers. In nonacid products the temperature must reach 240° F. inside the container and be maintained for several minutes. Even more extensive heating is required in some instances. Cured meats with salt and nitrate can be processed at somewhat lower temperatures, while for canned fruits the temperature of boiling water suffices. The flavour of some products, particularly liquid foods, is often detrimentally changed by heat sterilization and in such instances pasteurization is used since it involves only sufficient heat to destroy pathogenic bacteria without altering the flavour; pasteurization also will reduce the number of other organisms present sufficiently to enhance the keeping quality of the product. A common heat treatment is 145° F. for 30 min. or 160° F. for 15 sec. Milk is one of the most important foods pasteurized in large quantities. In the pasteurization of fruit juices, wine, beer, etc., treatment at different temperatures and for other periods of time is effective on account of the presence of alcohol and acids, which in combination with the heating prevent the growth of microorganisms.

(See CANNING, COMMERCIAL.) (Z. I. K.)

Cold Storage. — The only method by which fresh foods may be preserved for a considerable period in the raw state is by subjecting them to as low a temperature as possible without causing damage by freezing. Storage at temperatures above freezing, in the neighbourhood of 35° F., is known as cold storage. Storage at such temperatures makes possible the holding in good condition of many fresh foods for considerable periods, and their shipment to distant markets and consumers. This has helped immeasurably to improve the variety and quality of foods in the markets of many parts of the world, notably in Europe and the Americas. Some cold storage is accomplished by means of ice which, in most cases. is produced artificially in ice-making plants. The great majority of cold storage is accomplished by the direct use of refrigerants in one or another of the mechanical or chemical refrigerating cycles, as in household refrigerators. Cold storage equipment ranges from the smallest of home refrigerators to marine, rail or motor truck refrigerated transportation and commercial warehouses.

Freezing. — It has been found that many varieties of foodstuffs can be preserved for considerable periods with excellent results when frozen and kept in low-temperature cold storage. Under proper conditions the original flavour, appearance, nutritive value and texture of many foodstuffs are preserved more truly than by any other method of preservation. The remarkable similarity of the preserved product to the fresh or unpreserved food makes this method one that is most desirable. Coupled with this is the advantage that there is somewhat less labour involved in the preservation of foods by this method than by any other, especially in the case of home preservation in relatively small quantities.

History. — Freezing, as a method of preservation of foodstuffs, is not new. It has been used probably for as long as man has inhabited arctic regions where fish, game and other meats obtained in cold weather could be frozen and kept in that state for weeks and even months by natural means.

As early as 1842 a patent was granted to H. Benjamin in England for freezing foods by immersion in an ice and salt brine. Other patents followed at intervals during the century, both in the United States and in Great Britain, covering the freezing of meats and fish by special applications of ice and salt mixtures, either by direct or indirect contact. Indirect contact was obtained by placing the ice and salt in pans over the product to be frozen or by placing the products in tightly closed metal containers which were immersed in the ice and salt mixture.

It was not, however, until the development of mechanical refrigeration that it became possible to apply this method of preservation extensively. Mechanical refrigeration first made possible the freezing and transportation of meats over long distances, chiefly by sea. The first shipment of meat from Australia to Great

Britain, about 1880, by refrigerated ship was not frozen before loading, nor was it intended that it be frozen. However, it did freeze and the results led to freezing as a standard practice.

Early in the 20th century attempts were made to preserve foods other than meats and fish by freezing. H. S. Baker, Sr., is credited with freezing fruits in Colorado about 1908. Large crops that could not be immediately marketed or processed by the commercial canners presented a potential waste unless they could be held and processed gradually over an extended period. Freezing part of the crop for use later appeared to be a solution, and experiments showed that this could be done. Only certain fruits were frozen at first by what was known as the cold-pack method. These were chiefly strawberries and cherries. The method consisted of placing alternate layers of berries and sugar in large barrels or smaller metal containers which were then placed in cold storage rooms where the temperature was maintained at $-10°$ or $-15°$ F. Held at this temperature (or slightly higher) fruits kept well and later, after thawing, could be used for making preserves or directly in desserts such as ice creams, pies, etc.

Some experimental work was done by scientists in Europe on the freezing preservation of foods. In 1916, R. Plank, E. Ehrenbaum and K. Reuter are credited with showing in Germany the advantage of quick freezing; *i.e.*, freezing in a few hours as contrasted with several days. After that developments were rapid both in Europe and the United States. Most of the early investigations and development of procedures for freezing were carried on by the United States department of agriculture, the state colleges of Washington and Oregon and the growers and packers of the American northwest. Much credit can be given to Clarence Birdseye for the development of methods of freezing foods in small containers suitable for the retail trade. He began his work about 1917, but it was not until 1929, after much experimental work had been done by General Foods corporation, that the first Birds Eye commercial pack was placed on the market. This experimentation included work on vegetables as well as fruits: and it was found that many vegetables were admirably adapted to preservation by this method. Many obstacles were in the way of the acceptance of frozen foods by the public at large, chiefly the lack of adequate facilities in the retail market for handling frozen foods, coupled with a lack of knowledge on the part of the prospective consumers of the desirability of such foods and of how to use them.

Types of Frozen Foods. — Meats, including game and fish, were the first foods to be frozen for preservation. Dairy products, such as butter and cream, probably followed, except for possible isolated experiments. Early work on the freezing of fruits and vegetables indicated that, almost without exception, fruits and vegetables could be frozen and kept in storage in the frozen condition for considerable periods. On thawing it was found, in fruits and vegetables more than in meats, that the cell structure was broken down, causing a reduction in greater or lesser degree of the firmness or crispness of the fresh foodstuff. This structural change makes for rapid spoilage after thawing. making it necessary to hold such foods in the frozen state until nearly the time for using. However, when properly prepared and frozen, fruits and vegetables are much like the fresh product, even after months of storage, while there are some claims that meat is improved by being frozen; this, if true, is a result of the tenderizing effect.

Following World War II there appeared a new kind of frozen food product in the form of prepared dishes in considerable variety. Such dishes, requiring only to be thawed and heated before serving, gained ready acceptance. By the mid-1950s more than 500,000,000 lb. of such dishes were being frozen annually in the United States. and consumption increased thereafter. With the increasing production of frozen fruits and vegetables there was an intensified effort to develop new varieties which would be more desirable for freezing from the standpoints of growing, processing and acceptability as foods.

Processing of Foods for Freezing. — Meats in general require no special treatment prior to freezing. In the case of beef and venison a period of several days of aging in a room chilled to about 35° F. prior to freezing may improve the favour and tenderness. With most other meats and poultry it is desirable that they be frozen as quickly as possible after slaughtering. Chilling to about 40° F. before cutting the meat for freezing is desirable, as it facilitates the cutting and helps to preserve the meat in the best possible condition. The reason for haste in freezing such meats is that the process causing rancidity of the fatty tissues sets in shortly after slaughtering. If rancidity starts even imperceptibly prior to freezing, it will rapidly become evident in the taste of the fat. as freezing and storing at 0° F. retards its development but does not completely inhibit the process. The table shows the periods during which different meats and dairy products, as well as other foodstuffs, may be stored with reasonable expectation of good results. Many cases are on record of foods stored satisfactorily over much longer periods than those indicated in the table.

Safe Storage Periods for Various Food Products

Foodstuff	Approximate storage period (months)		
	At 0° F.	At 5° F.	At 10° F
Beef, fruit juices	—	10 to 12	6 to 8
Fruits, vegetables, veal, venison		8 to 10	3 to 6
Lamb, poultry, rabbits, game birds, eggs	8 to 10	t o	3 to 4
Fresh pork, ham, creamery butter, cheese	6 to 8	4 to 6	2 to 3
Ground meat (unsalted), lean fish, cottage cheese	4 to 6	3 to 4	1 to 2
Beef liver, fatty fish, slab bacon, cooked foods	2 to 4	2 to 3	1 to 2

Courtesy of J. D. Winter and A. Hustrulid, "Freezing Foods for Home Use," *Extension Bulletin 244*, University of Minnesota, revised June 1945.

In the case of fruits it is important that the maturity of the product when harvested for freezing be that which is best for eating the fruit fresh and that only fruit uniformly ripe and free from blemishes be frozen. It is also important that a minimum of time elapse between harvesting and freezing, as deterioration sets in and develops rapidly at room temperatures. Harvesting in the cool of the morning is advantageous as the fruit is then naturally cool and does not deteriorate rapidly after being picked.

Fruits may be frozen in a sirup or a dry sugar pack. Sirups for this purpose are most easily made from sugar and water in concentrations of from 20% to 65% sugar, depending on the acidity of the fruit to be preserved and the taste of the individual. When the fruit has been prepared as for serving, it is placed in containers and cold sirup added in sufficient quantity to cover the fruit. This is to exclude air and prevent both oxidation and desiccation. Dry sugar may be used in place of a sirup when the fruit is sliced or cut so that the sugar will draw out enough juice to form a sirup and coat the fruit thoroughly. The handling of the fruit should be as rapid and as careful as possible, especially in the case of fruits that oxidize rapidly. Oxidation is evidenced by discoloration and is also accompanied by a somewhat unpleasant flavour. Browning of fruits, such as peaches and apples. before, during and after freezing may be prevented by treatment with a small amount of ascorbic acid.

The same precautions should be taken with vegetables as with fruits in the choice of quality. maturity, variety, harvesting, speed in handling and prevention of oxidation and desiccation. After preparing the vegetables as for cooking for the table they must be blanched or scalded in boiling water for from 1 min. (for peas) to as much as 10 min. (for corn on the cob).

The purpose of blanching is to inactivate the enzymes by heat, so preventing the deterioration which would take place even at very low temperatures were the enzymes to remain active. It is possible to freeze and store most vegetables for a short period without blanching; but for normal periods of storage at 0° F. blanching is essential. Without it all vegetables soon acquire a haylike flavour and deteriorate in colour. With proper blanching. however, frozen vegetables retain their colour, flavour and general appearance remarkably well.

Methods of Freezing. — There are several methods by which foodstuffs can be frozen. Essentially the problem is that of removing heat in a relatively short time. and lowering the temperature of the product below its freezing point, commonly to 0° F. or somewhat lower, which is the recommended storage temperature for frozen foods.

One of the earliest methods of freezing foods was by immersion of the product either directly or within a container in a mixture of ice and salt or a brine chilled by mechanical refrigeration. A method known as the "Z process" was developed in Europe for freezing fish by M. T. Zarotschenzeff. This consisted in passing the foodstuffs either packaged or unpackaged through a chamber in which they come in contact with an atomized, secondary liquid refrigerant, such as a brine. In the United States, R. B. Taylor and L. H. Bartlett developed a method for freezing foodstuffs naturally small in size or cut in small pieces, such as berries, peas, sliced peaches, cut beans, etc. Their method consisted in immersing'the foods directly in a solution of glucose, sucrose or sodium chloride or combinations of the three. The disadvantage of direct immersion in brine is that brine tends to penetrate into the foodstuff. The Taylor and Bartlett method tends to eliminate this effect or to produce a pleasing result in spite of some penetration.

With development of mechanically refrigerated cold storage, foodstuffs were at first simply placed in rooms at low enough temperatures to freeze them in due course in the still air. Still-air freezing is the slowest of all methods for any given temperature, because of the poor heat transfer that exists where the only circulation of air is that caused by natural convection currents. Fans placed in such rooms will help the air currents and improve the freezing rate somewhat. A systematic use of air in motion is obtained in numerous freezers developed chiefly between 1930 and 1940. Blowers are used to circulate air over refrigerated coils which chill the air, then over the foodstuffs and back to the blower to repeat the cycle. With velocities of 500 ft. per minute or more the rate of heat transfer is increased and freezing can be accomplished in a much shorter time than in still air. This is known as blast freezing.

Contact freezing is obtained by placing the foodstuffs either in packages or loose in metal trays on refrigerated surfaces: which may be either pipe coils made in the form of shelves, or refrigerated plates. Here the heat transfer by conduction through the metal surfaces is much better than that through air; the method is effective in proportion to the area of the foodstuff in contact with the refrigerated surface.

Storage *of Frozen* Foods. — Generally speaking it has been found that the lower the storage temperature the better and longer mill foodstuffs keep in the frozen state. Deterioration takes place in the forms of oxidation, desiccation and enzymic action even at very low temperatures. However, it has been found that for most foodstuffs a temperature of 0° F. (−17.8° C.) is satisfactory for normal periods of storage. Many foods will keep for several years very well at this temperature if properly processed and packaged before freezing. Therefore, 0° F. has become accepted commonly as a satisfactory storage temperature, though much storage of commercially frozen foods is at lower temperatures. However, the lower the temperature the more costly the storage, both from the point of view of the insulation of the space and the power to maintain that temperature.

An important factor in the proper storage of foodstuffs is the packaging, which must be such as to resist injury during the period of storage and which must also be of a vapourproof nature to prevent as far as possible desiccation and oxidation of the foodstuff within.

Locker Plants. — Plants or concerns devoted to the storing of frozen foods for individuals for private use and in relatively small amounts came to be known in the L.S. and Canada as locker plants. This enterprise began when farmers and hunters started early in the 20th century in the American northwest to store game or meat slaughtered on the farm in low-temperature cold-storage plants where it froze and kept quite well over extended periods As this practice gren it became necessary for the cold-storage operators, nho rented space for this type of storage, to make provision for separating the produce of one patron from that of another. For this purpose boxes were first used, and later locked closets or simply lockers, which gave the industry its name. Before long fruits and vegetables were being stored along with meats and the trade grew to the point where it was recognized as a business distinct from cold storage in the usual sense. In the late 1920s, it is believed, though there are no accurate records, the first locker plants were established to cater to this trade exclusively. The earliest growth of the locker plant industry in the L.S. was in the northwest, and from there it spread to the mountain states and on into the midwest where it grew rapidly in the heavy meat-consuming communities. During World War II public interest in frozen foods increased and the demand for locker plant facilities grew far beyond the supply, and in the years following the war expansion of the locker plant industry was rapid. However, in this same period a vigorous competitor for locker plants appeared in the form of the home freezer, similar in principle to the refrigerator for fresh foods, but maintaining the necessary 0° F. temperature. As the number of home freezers grew, the demand for locker space fell off so that after the mid-1950s the number of locker plants diminished increasingly.

Transportation.—Along with the growth of the frozen food industry and the wide-spread distribution of frozen products came the problem of transportation. This was solved satisfactorily by refrigerated railway freight cars and refrigerated motor trucks. In the former, ice with salt has been widely used, although some cars are equipped with self-contained, completely automatic, diesel-powered refrigerating systems. Most motor trucks for frozen food transportation have self-contained refrigerating systems, powered mostly by gasoline engines, but many carry tanks containing some salt solution whose freezing point is around −5° F. The solution in these tanks is frozen by electrically driven refrigerating systems on the trucks that are connected to power sources when the trucks are at their bases, or by refrigerant supplied from a stationary system through demountable hose connections. Low-temperature refrigeration is thus provided until the solution is once more thawed.

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FOOD PRESERVATION (IN THE HOME). Food preservation, or the prevention of food spoilage, is of importance in providing adequate supplies throughout the year and making possible the transport of foods from areas of production to centres of need. Home food preservation makes it possible to save locally produced foods and provide more and a greater variety of foods.

The causes of food spoilage fall into two major classes: changes brought about by reactions normal to the food and changes due to outside sources. The first group includes such factors as the sprouting of grain or potatoes, development of a woody or starchy texture in vegetables, liquefaction of fresh meats or eggs and softening of fruits. These are caused by the continuance of certain chemical reactions promoted by enzymes normal to the particular product. The second class is comprised largely of microorganisms which are present everywhere and which are divided into three classes: yeasts, molds and bacteria. In a favourable situation they are in the actively growing or vegetative stage. When the environment becomes unfavourable, many types change to the spore or resting form and are much harder to destroy. The procedures used in home food preserving are based on inactivation of enzymes and destruction of microorganisms.

Yeasts are one-celled plants which live chiefly on solutions of sugars and other carbohydrates. Their growth is favoured by moisture and warmth and is usually shown by production of gas bubbles. Though this fermentation is desirable when making wines, in preserves it can cause development of undesirable flavours and odours. Yeast growth slows or stops entirely at temperatures below 37" F. (3° C.) or when the moisture content of the food is reduced sufficiently, and the cells are destroyed at high temperatures, 150°–180° F. (65°–82° C.), although some spores are more resistant to heat.

Molds reproduce by spores which are carried in the air. The different species can grow on a wide variety of organic materials. The spores develop into actively growing colonies, forming fuzzy, coloured patches or clumps which are easily seen and can be removed from the surface of the food. However, if growth has continued for some time unpleasant flavours will have permeated the food. Like the yeasts, molds are inhibited by low temperatures and most of them are destroyed by heating to 150°–180° F. (65°–82° C.), though one species found in Great Britain can withstand temperatures up to 212° F. (100° C.).

Bacteria are the most difficult to control and the most dangerous. Yeasts and molds cause souring and off-flavours, but some bacteria can cause illness and possibly death. Bacterial growth may or may not produce visible signs and many bacteria cause spoilage without any readily apparent change in the food. Bacteria can grow over a much wider temperature range than yeasts and molds. Most of them grow at temperatures of 60°–100° F. (16"–38" C.) but psychrophilic or cold-loving bacteria can grow at considerably lower temperatures, while thermophilic or heat-loving bacteria can grow at temperatures as high as 160° F. (71° C.). The vegetative cells are killed at the boiling point of water (212° F., 100° C.) but some spores require temperatures as high as 240° F. (116° C.) maintained for more than 30 minutes for their destruction.

BOTTLING AND CANNING

Canning refers, in Great Britain, to preserving food in metal containers, while bottling is used for similar preservation in glass jars or bottles; in the United States canning refers to both. Since glass containers are used much more frequently than metal cans for food preservation in the home, the term bottling will be used in this article and will include canning unless otherwise stated. Bottling depends on heating the food to inactivate enzymes and destroy microorganisms and on hermetic (airtight) sealing to prevent recontamination. In bottling the jars are sealed while hot and, provided that no air can enter while the jars are cooling, the pressure inside the cold jar will be less than that of the surrounding atmosphere so that the lids will remain firmly in place. Metal cans, however, are sealed before processing.

Foods for Bottling.—A very wide variety of foods can be preserved successfully by bottling but, since the method itself includes cooking, any food ordinarily eaten or preferred in the raw state cannot be preserved in this way. Also, the amount of heating necessary to sterilize some foods causes serious overcooking and the development of off-flavour and mushy texture. Foods selected for bottling should be fresh, clean and sound and of the proper variety and maturity. Certain varieties of fruits and vegetables, as well as certain kinds of protein foods, yield a more palatable bottled product than others.

Two essentials in the selection of an adequate processing procedure are that the temperature be high enough to destroy any microorganisms present that can grow in the food being preserved, and that this temperature be attained throughout the entire mass of food being bottled. Foods may be divided into two general classes in selecting processing methods: fruits, most of which are acid in reaction, and vegetables and meats, fish and poultry, most of which are neutral or nearly so. Not only are microorganisms more easily destroyed in an acid medium than in a neutral one but the acid prevents any dangerous bacteria from developing, so that acid foods require less heat and lower temperatures for safe processing than do neutral or nonacid foods. Another important factor is the consistency of the food. Products which are bottled as distinct pieces surrounded by liquid will heat through to the centre of the container more rapidly than foods which pack down and fill the container solidly. In the same way, larger containers will take longer to heat through to the centre than smaller ones.

Processing Methods and Equipment.—The temperatures used in bottling depend chiefly on the acidity and the consistency of the food. Acid liquid foods, such as fruit juices, need only be processed at 140° F. (60° C.) for 30–40 minutes or for a correspondingly shorter time at a higher temperature. Low temperatures are particularly useful for fruit juices in which the flavour may be changed by high temperatures. With the exception of fruit juices and similar products, all foods should be heated at least to the boiling point. In acid products, this is sufficient to destroy any microorganisms present. Nonacid foods require long holding at the boiling point (more than five hours) or, preferably, temperatures above boiling to be sure that the products are sterile. It is particularly important to destroy any spores of *Clostridium botulinum,* which can produce a deadly poison. These spores are very resistant to boiling in a nonacid medium but are killed by heating for approximately 10 minutes at 240° F. (116° C.). In an acid food they are destroyed more readily by boiling and any survivors will fail to develop. It should be borne in mind that altitude has a considerable effect on the temperature attained in processing; water boils at sea level at 212° F. (100° C.). At higher altitudes the boiling point of water is lower; the decrease amounts to approximately 2° F. or 1° C. for each 1,000 ft. of elevation. This may be compensated for by increasing the processing time or by raising the boiling point of water; *e.g.,* by using a pressure cooker. A pressure cooker, or pressure pan, is a heavy pan which can be sealed so as to retain steam under pressure. The lid has a pressure indicator or control, a pet cock or vent which can be opened and a safety plug to prevent the pressure from rising above safe limits.

The temperature obtained is calculated on the basis of steam pressure, not air pressure, and the air in the cooker must therefore be replaced by steam to obtain the correct temperature. The pressure should be kept constant during processing, thus reducing loss of liquid from the bottles.

Various methods of processing fruit can be used. The prepared fruit may be heated sufficiently to kill the microorganisms, then put into sterile containers and sealed. This method is adequate for acid foods and may be more convenient with solid fruits, softening the structure so that the pieces fit into the containers more readily. The containers and lids must be very carefully sterilized, filled with boiling hot fruit and sealed immediately so that the contents will not be contaminated. More frequently the food is placed in the container before processing, fruit being covered with sugar sirup or water and vegetables with dilute brine. Foods may be raw or partially cooked before being placed in the container.

In most cases the processing time required for a given hot-packed food is essentially the same as when raw-packed. In fact, in foods which soften during preheating to the stage where a more solid pack is obtained in hot-pack than in raw-pack, the processing time for the hot-pack will be longer than for the raw-pack. However, when dealing with large, solid pieces or highly starchy foods, preheating does reduce the time required for the material in the container to attain the correct processing temperature.

When the food is placed in metal cans, which are sealed before processing, a small free space should be left at the top to allow room for the expansion of the food during heating. Any empty spaces between the pieces of food should be filled with liquid. If the cans are to be processed above 212° F. (100° C.), provision must be made for exhausting, *i.e.,* driving out most of the air, before they are sealed.

Bottled fruit may be processed in a water bath or a pressure cooker. A water bath is recommended for fruit processed in metal cans. Nonacid foods should be processed under pressure in order to increase the temperature above 212° F. (100° C.).

Storage and Use of Bottled and Canned Foods.—Bottled or canned foods should be stored in a cool place as high storage temperatures lead to more rapid loss of vitamin content and deterioration of flavour.

Glass containers should be stored in the dark to avoid fading of the food colours.

Acid foods may be used cold straight from the can if desired. Nonacid foods should be heated thoroughly before consumption, as the botulism toxin is destroyed by boiling for 20 minutes.

Some loss of nutritional value occurs during canning, mostly of vitamins which are destroyed by heat and/or oxidation. However, if the containers are properly vented to remove air, oxidation will be kept to a minimum. Many vitamins and minerals are water soluble and a large part of the original amount in the food will be in the liquor surrounding the solid food. If this liquid is used, total nutrient losses from properly processed foods will not usually be greater than those caused by normal cooking procedures, with the exception of greater loss of thiamine (vitamin B_1).

FREEZING

Freezing as a method of food preservation depends on the marked reduction in rate of most chemical reactions at low temperatures. When food is frozen the low temperature and solid state of the water entirely inhibit the natural ripening processes or markedly reduce their rate. Growth of microorganisms ceases for the same reason. Some of the microorganisms will be killed by freezing but the products cannot be regarded as sterile since others survive and are capable of multiplying when the food is thawed. Foods can be preserved by freezing in a state close to that of the natural raw product. With the exception of vegetables, foods do not need any heat treatment before freezing, thus shortening the time required for preparation.

Since frozen foods must be held at a much lower temperature than canned foods, however, frozen storage is more expensive. The cost of suitable freezing cabinets seriously limited this as a method of preserving foods at home in Great Britain. There is little danger of food poisoning or food-borne illness from frozen foods, provided they have been properly handled. However. the growth of microorganisms when the food is thawed may be even more rapid than it would have been in the original fresh material as the formation of ice crystals during freezing tends to break up the structure of the food, softening the texture and making possible a more rapid penetration of microorganisms. For this reason foods should be kept solidly frozen until desired for use, then thawed and used immediately.

Guides for Success.—Only foods of high quality should be frozen. Unless the starting material is fresh, sound and adapted to freezing, the final product will not justify the time. effort and money. Some softening of the texture or firmness of the food will occur due to the nature of the freezing process and this should be kept in mind in any further preparation or cooking before the food is eaten.

Foods for freezing should be handled quickly and in small amounts so that they can be frozen as soon as prepared. The freezing capacity of the unit must also be kept in mind. The number of packages frozen at one time should be small enough to allow each package space for air circulation and contact with a primary freezing sarface (in contact with the coils carrying the refrigerant). If the unit is filled with unfrozen food the rate of heat transfer from the centre of the load is so slow that foods in the centre may spoil before they freeze. All foods should be wrapped in moisture-vapour-proof materials and sealed tightly. The low temperature in the freezer produces a very dry atmosphere and unprotected foods mill dry out rapidly, leading to a condition known as freezer burn. However, moisture-vapour-proof must not be confused with waterproof; many waterproof materials will hold nater in the liquid stage, but are not impervious to the passage of water in the vapour or gaseous phase. Packages should be made as solid as possible as oxygen in the air leads to undesirable changes in flavour and colour and loss of some nutrients. However, nhen foods are packed in rigid containers some head space must be allowed since water increases in volume as it freezes.

Products should be frozen and stored at 0° F. (−18° C.) or lower; higher temperatures materially shorten the storage life of the food. Variations in temperature should be kept to a minimum. Every time the temperature rises slightly the food loses a little moisture which, as the temperature falls again, does not re-enter the food but freezes inside the package. This leads to in-package drying, with eventual loss of desirable colour, flavour and texture.

Frozen foods should be used while still in excellent condition. Each type of food has a definite period of storage life during which it will remain of high quality; if stored beyond this time the food may become inedible due to development of off-flavours and odours, destruction of colour and deterioration of texture.

Foods for Freezing.—Most foods can be frozen successfully with the exception of those high in starch, those usually eaten raw for their crisp texture and those containing emulsified fat. Starchy foods tend to become sticky or gummy. Crisp raw foods and those high in water content become limp and soggy due to rupture of the cell walls by ice crystals and collapse of the tissue with excessive loss of fluids on thawing. Freezing usually breaks emulsions so foods containing emulsified fat may curdle and separate.

Fruits may be frozen either with or without added sugar or sirup. In many cases, however, the addition of sugar or sirup improves the retention of the fresh flavour and natural colour of the fruit. Light-coloured fruits which tend to turn brown when cut require treatment to prevent discoloration. Effective measures include a light blanching or scalding of the cut fruit, dipping the pieces in a solution containing sulfur dioxide, or addition of vitamin C (ascorbic acid) to the liquid in which the fruit is packed.

Vegetables should be blanched or scalded, then cooled thoroughly, before packaging. The activity of the enzymes in vegetables is decreased but not stopped by freezing. Scalding is necessary to inactivate the enzymes, or the vegetable colours deteriorate and undesirable flavours develop.

Whole egg meats and egg yolks require treatment to avoid gelling of the yolk material. Egg yolks contain lecithoproteins which coagulate at low temperatures and should therefore be mixed thoroughly with a small amount of sugar or salt before freezing to prevent this.

Many prepared and precooked foods may be frozen. Good foods for freezing are those that require long preparation, little more work when prepared in quantity than when prepared in small amounts and little attention between the freezer and the table. Mixtures should be seasoned cautiously, as some seasonings intensify or increase in flavour in frozen storage while others tend to disappear.

Frozen foods which have been carefully prepared and properly wrapped, frozen and stored will retain a large part of the nutritive value of the original food. However, some vitamins and minerals may be lost during washing and scalding of vegetables and excessive length of storage will lead to loss of nutrients as well as decreased eating quality.

JAMS AND JELLIES

Jams, jellies and other conserves depend on heat and high sugar concentration for preservation. Since they are made from fruit and are therefore acid foods, the boiling required to prepare them is sufficient to produce a sterile product. The high sugar concentration usually found in this type of food will prevent the growth of most microorganisms, although some can thrive in such an environment.

All the various kinds of jams and jellies are made of fruit and are characterized by a thick or gelled consistency which makes them relatively solid although still soft enough to spread easily. Jams contain crushed or pieces of fruit while jelly is made from the strained fruit juice; marmalades consist of slices of fruit and peel, usually citrus, suspended in jelly; preserves or conserves are whole or large pieces of fruit; while butters and cheeses are made from mashed or sieved fruit pulp.

Ingredients.—The traditional methods of making jam and jelly depend on the presence of three ingredients—pectin, sugar and acid—in addition to water, and on the balance among these four. Pectin. the primary gelling material, is present in varying amounts in all fruits and must usually be extracted by heat. Slightly underripe fruits contain a larger amount of pectin than do ripe fruits, while in overripe fruits most of the pectin has been converted to pectic acid, which has no gelling power. The pectin deteriorates if the fresh fruit is cut up or crushed and left in a warm place. Commercial pectins are also available and their use reduces the amount of cooking necessary to reach the gel stage and increases the amount of sugar that can be added to a given amount of fruit.

Sugar is added in relation to the amount of pectin in the fruit. The mixture of fruit and sugar is usually cooked to a sugar concentration of 60%–65%, indicated by a temperature of 219°–223° F. (104°–106° C.), to ensure good keeping quality. A gel may be obtained from a fruit very rich in pectin with a lower sugar concentration, but this may not have good keeping qualities unless hermetically sealed while hot. The sugar usually used is sucrose from sugar cane or beet. When purified, the sugar from these two plants is identical and can be used interchangeably. When sucrose is boiled with acid it is gradually converted into a mixture of equal parts of two different sugars, glucose and fructose, together often called invert sugar. This is an advantage, as there is less tendency for the sugar to crystallize out during storage when there is a mixture of sugars present than when any one predominates. Prolonged boiling of jam or jelly made from a very acid fruit may produce too much invert sugar; this usually separates out without any definite crystalline form. Separation of sucrose, which forms crystals like granulated sugar, is likely to occur when a fruit low in acid is added to a high proportion of sugar and boiled only for a very short time.

Acid is the third major ingredient. Both sugar and acid are necessary to change the pectin from a liquid to a semisolid. The majority of fruits used for jam making contains sufficient acid but if more is required it is often added in the form of lemon juice or citric or tartaric acid.

Preparation and Storage.—Jams are usually made in two stages. In the first, the prepared fruit is cooked slowly, with sufficient water to prevent burning, while the skins are softened and the pectin extracted from cells; in the second, sugar is added and the mixture boiled to evaporate excess water until the gelling point is reached. This occurs most readily when the sugar content is about 65%; roughly 5% of this will come from the fruit, the remainder from the added sucrose. This means that for maximum setting quality, the yield will usually be about 10 lb. for each 6 lb. sugar used. Even if a high proportion of fruit to sugar is used, a satisfactory gel can be obtained with a lower sugar concentration. A rough test for the gel stage may be made by pouring some of the boiling jam from a spoon. If the drops run together on the edge of the spoon and break off as a "sheet," rather than running off as a thick sirup, the product should set when cold.

Jellies are usually made from fruits that have good setting qualities and form a clear bright product. The fruit is cooked slowly with water and strained. A test that can be used in the home to estimate the amount of pectin in the extracted fruit juice is to mix a small amount of juice with an equal volume of alcohol. The formation of a solid clot indicates abundant pectin. Sugar is added in relation to the amount of pectin that the juice contains. A juice containing ample pectin can be mixed with an equal volume of sugar; one lower in pectin should have less sugar added. Boiling the jelly mixture results in evaporation of water and increased concentration of pectin and acid as well as sugar. This is the reason for adding less sugar to a juice containing less pectin; longer boiling will be required to reach the proper amount of sugar and the pectin will be concentrated sufficiently to gel the product. The gel stage can be tested as for jams. Jams and jellies can be made without cooking but the resulting product is not sterile so must be kept in a refrigerator to prevent spoilage.

Marmalades are made in the same way as jams, but as most citrus fruits are rich in pectin a smaller proportion of fruit to sugar is normally used and extra acid is required except for lemon, lime or bitter orange marmalade. Citrus fruits need thorough cooking to soften the peel before the sugar is added and so more water is required than in jams. Cooling the mixture to 176° F. (80° C.) before pouring it into glasses or jars helps to prevent the pieces of fruit from rising to the top of the containers.

Fruit butters are made by cooking the sieved or puréed fruit with sugar until thick and clear; spices are sometimes added. Fruit cheeses are made in the same way and boiled to give a cheese-like consistency when cold.

After these preserves have been cooked to gel stage, they should be poured into clean jars. Those with a high sugar concentration may be covered by pressing a prepared tissue on the hot surface, or by sealing with melted paraffin, and covering the containers to keep out dirt, insects and microorganisms. Those with lower sugar concentration need covering while very hot with an airtight seal, otherwise they may ferment in storage. Fruit cheeses and sometimes jellies are put into containers suitable for turning them out before serving.

A wide variety of fruits and other plant materials may be used in making products of a gelled consistency. They are usually used to add variety and interest to more staple foods rather than by themselves. Success can be achieved by careful following of directions and by experience, since many of the factors governing the gelling of these products are not easily measured.

PICKLING

Food preservation by pickling depends on the presence of acid or salt, or both, in the mixture. The growth of harmful microorganisms is usually inhibited by a sufficient concentration of acid or salt. Either vegetables or fruits may be made into pickles but the methods and type of finished product are quite different.

Vegetables used for pickling are usually high in water content, some of which must be removed. This is achieved by the addition of salt, since the salt solution will be more concentrated than the vegetable cell sap and some of the water will be drawn out of the vegetable to equalize the concentration. When natural fermentation is desired, as in making sauerkraut, salt is added in amounts of 2%–4% of the weight of vegetable. This amount of salt will check the growth of undesirable bacteria but allow the multiplication of acid-producing bacteria. When the acidity becomes high enough the product will keep in a cool place if protected from molds and yeasts. A fermentation process continued for several months is used commercially in the curing of vegetables prior to packing them in vinegar. In the home a quick brining process is generally preferred. The prepared vegetables are usually held for 12 to 48 hours in a 10% brine or sprinkled with salt and subsequently rinsed to remove any excess of salt. To produce a clear pickle, the drained vegetables are packed in jars and covered with spiced vinegar. In a mustard pickle or piccalilli the vegetables are mixed in a sauce containing vinegar, mustard and turmeric. In fruit pickles, preliminary brining is not necessary and the prepared fruit is heated with sweetened spiced vinegar.

Whereas in pickles the fruits or vegetables are kept in recognizable pieces, in chutneys they are cooked to a pulp. The main ingredient is usually a fruit, with onions, garlic or similar vegetables for flavouring. Vinegar forms the chief preservative with sugar, salt and spices. Chutneys are cooked slo ly to a smooth, jamlike consistency.

Sauces are made from essentially the same ingredients as chutneys but are sieved and should be of a pouring consistency.

Pickles, chutneys and sauces should be stored in jars or bottles and sealed to prevent evaporation. The covers used must also resist attack by acetic acid. Some of the sweeter pickles and sauces contain insufficient acetic acid to prevent spoilage and should be processed in a water bath and hermetically sealed while hot. Pickles, chutneys and sauces, like jams and jellies, are usually used to give variety and flavour to a meal. In general, their nutritive value tends to be rather low, especially in the water-soluble vitamins and minerals.

SIRUPS

Fruit sirups can be made from soft fruit that is too ripe to be used for most methods of preservation. The juice is extracted, with the minimum addition of water, sugar is added and the resulting sirup is preserved by means of heat or with chemical preservatives. Black currant, rose hip and citrus-fruit sirups may be useful sources of vitamin C.

CANDIED FRUITS

Candied fruits are made by cooking whole fruits or fairly large pieces of fruit in sirup until the fruit is clear and plump. To avoid shrinking the fruit the sugar concentration must be increased gradually. If the fruit is put directly into a heavy sirup, the water in the fruit will be drawn out because of the difference in concentration of the solutions inside and outside the fruit and the fruit cells will collapse, shriveling and toughening the pieces. Finally, the pieces are drained from the thick sirup and dried slowly until no longer sticky.

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Numerous bulletins and pamphlets are also available from government agencies, educational institutions and manufacturers, on specific foods, equipment and processes suitable for home food preservation.
(P. C. P.; B. A. CR.)

FOODS, NATIONAL. There are many similarities in indigenous foods and therefore in prepared dishes among different countries and cultural groups. All countries use frying, baking, grilling and steaming; combinations of meat and vegetables for main dishes are popular all over the world; custards are universal; and every country has sweet cakes and flaky pastry; yet each individual dish is distinctly different from the others. The idea of a foreign food may be said to be attributed mainly to the particular combination of ingredients and the use of unfamiliar flavouring, but also to the variety of fruits and vegetables and the treatment of food materials.

The eating patterns of countries may vary considerably and are influenced by economy, geographical location and religious beliefs. Thus lack of refrigeration enforces greater emphasis on salted or dried foods where production is seasonal; a preponderance of cereal grains is inevitable in the diet of overpopulated and underdeveloped areas; and access to the sea encourages the use of sea foods. So-called typical dishes may alter with new knowledge and facilities, changing economy and the advent of other culture groups. On the other hand, some dishes continue throughout changing times because of high palatability.

UNITED STATES

In the mainly urban population highly developed, competitive food industries market every conceivable item with few seasonal restrictions. Food may be bought partly or totally prepared, packaged flour mixes abound and canned and frozen precooked foods need only heating.

Among meats. beef is the most popular, although large amounts of fresh and cured pork are used; other meats are of minor importance. Cooking of meat is generally plain; grilling. broiling and roasting being the usual methods, but less tender cuts are often braised or stewed with vegetables. Juicy grilled or broiled steaks and medium-rare rib roast of beef are well liked but are relatively expensive; ground beef is used in a great variety of ways and grilled hamburgers compete with "hot dogs" (wieners or frankfurters) for the most popular lunch. Roast turkey with cranberry sauce is the traditional Thanksgiving main course, with pumpkin pie for dessert; chicken and turkey — particularly chicken —are served around the year. Fried chicken is thought of as a typically southern dish but is common throughout the country; with the widespread use of charcoal and other broilers, broiled chicken became popular. Barbecued beef — often but not necessarily cooked over an open fire—is a typical western food. Fish is used in only limited quantity but certain dishes are associated with certain parts of the country — for example, clam chowder and lobster with New England and various shrimp dishes, including shrimp creole, with the south Atlantic and Gulf states.

The commonest bread is commercially baked of white flour, the loaf being very white and soft with moist cakelike qualities, but other types are available in almost all grocery stores. Among hot breads, corn bread, made of ground corn (maize), is thought of as southern but is served throughout the nation. Milk and eggs are used a great deal. Among breakfast combinations, ham and eggs are frequently thought of as the one typically American dish but bacon and eggs are commoner. Prepared cereals are frequently served for breakfast; griddle cakes and waffles are popular but are more likely to be served for special occasions. Unripened curds and aged cheddars head the list of cheeses; cheddars are often softened by processing. Fruits of all types abound and fresh citrus is popular for breakfast. Vegetables are mainly cooked in water and seasoned only with butter. Boston baked beans are well known. Salads of fruits and vegetables are endless in variety and range from a simple accompaniment to a meal to the main course itself, especially for the midday meal. Ice creams in a great variety of flavours and apple pies are popular desserts. Black coffee of medium roast is the main beverage. The U.S. also has a rich heritage of national foods from other countries, and restaurants specializing in Italian and Chinese foods, for example, are common in all larger cities.

GREAT BRITAIN

Cooking is generally simple with the emphasis on roasting and baking and few seasonings or sauces detract from the natural flavour of foods.

Breakfast is traditionally of fried bacon and eggs, followed by toast with butter and marmalade, but smoked haddock and herring (as kippers) are popular alternatives.

The midday meal is frequently of roast meat with boiled vegetables and a dessert of fruit pie and custard. Roast beef with Yorkshire pudding is famous, the latter being made from a thin batter baked in a little hot fat often around the meat. Except in Yorkshire, where it is eaten first, it is served with the meat and roast potatoes. A variation of Yorkshire pudding is called toad-in-the-hole, when sausages are baked with the batter to form a main dish. Roast lamb is served with mint sauce, roast pork (stuffed with sage and onion forcemeat) with applesauce. Grilled lamb chops, rump steak, steak and kidney pie and steamed steak and kidney pudding are other favourites. Many counties are well-known for their special dishes, including Lancashire hot pot—lamb or mutton chops stewed in a casserole with layers of sliced potatoes, onions and mushrooms — Cornish pasties and Melton Mowbray pork pie. Popular are boiled cod with parsley sauce and fried fillets of fish, especially plaice — indeed, "fish and chips" (fried fish and fried potatoes) has become a byword, particularly in northern England.

Both white and whole meal brown breads are eaten and there are many types of richer yeast doughs; *e.g.,* Bath buns, Sally Lunns, Yorkshire teacakes, Chelsea buns, lardy cake and bara brith, the national bun loaf of Wales. Fruit pies and plate tarts, particularly made with apples, are common for dessert, and so are steamed puddings. The plum pudding traditional at Christmas time is a rich steamed pudding with dried fruit, currants, sultanas, raisins, suet and brown sugar. The Christmas cake is a rich fruit cake first covered nith almond paste and then white icing. Buttered scones are popular for afternoon tea and in Scotland they are baked on a griddle or may be dropped scones such as small thick pancakes which are buttered without splitting.

Oatmeal is used frequently in Scotland, where porridge, oatcakes and haggis (*q.v.*) are particularly famous. Herrings are split open and dipped in oatmeal before frying. Scotch shortbread is a rich biscuit of butter, flour and sugar.

Potatoes and cabbage appear often in Irish cooking. Irish stew consists of mutton cooked with potatoes, onions and stock until almost all the liquid has been absorbed. Mashed potatoes replace flour for scones baked on a griddle, which are split open, buttered and eaten hot. A common country dish is boiled bacon or pig's cheek with cabbage. Carrageen moss is an edible seaweed made into a sweetened jelly and eaten with cream.

Throughout Great Britain tea with milk is the most popular beverage. The midmorning habit of "elevenses," consisting of coffee and biscuits, appears to have originated there.

THE BRITISH COMMONWEALTH

Australia and New Zealand. — English cooking combined with indigenous foods characterizes the dishes, together with both

American and Chinese influences.

In Australia cooking is plain with plenty of meat, a variety of vegetables and few sauces. Bacon and eggs for breakfast are popular and so is the roast beef of Great Britain. Fish is plentiful and shellfish, crayfish, lobster, prawns and oysters are favourites. The barramundi, a fish from Queensland, is stuffed with prawns and crayfish and baked in wine and butter for a special occasion. Oysters with steak are not unusual and a carpetbag steak consists of a two inch thick steak cut to form a pocket and stuffed with oysters and mushrooms. A fried egg is also often served with grilled steak and roast pork with cloves and pineapple is another favourite dish.

There are plenty of salads and vegetables all the year round. Salads, which are often combinations of vegetables and fruit, are eaten either as a main course or with the main dish. *Aubergines* ("eggplant") capsicums and pumpkins are well liked, the latter being used as both a vegetable with meat and as a filling for a dessert pie.

World-famous among sweets is Pavlova: a meringue shell, crisp on the outside and like marshmallow inside, filled with whipped cream and fruit, often passion fruit; it is a typical festive dish. Apple blossom pie is also a national dish: a sweet pastry crust is filled with three layers, first a mixture of apples and passion fruit, then a layer of condensed milk, egg yolk and lemon juice, and topped with pale pink jelly whipped with beaten egg white and decorated with whipped cream. Sponge cakes filled with whipped cream and raspberry jam and chocolate cakes with fudge frosting are popular at tea time and lamingtons (sponge squares dipped in chocolate icing and rolled in dessicated coconut) are well-known favourites. In New Zealand the national skill is particularly displayed at tea time in the scones, fruit or nut loaves, biscuits and cakes. Cakes and biscuits are frequently made with whole meal flour, while nuts, dried fruit, brown sugar and treacle are common ingredients. Typical are the crisp round biscuits called anzacs, and a light sponge filled with cream and passion fruit pulp is also very popular.

Canada. — Both French and American as well as British cooking has influenced the national dishes, with original salad mixtures, fish dishes, crisp cookies and maple sirup as a characteristic flavouring. Gammon rubbed with mustard and brown sugar and baked in pineapple juice is a popular meat dish, as is roast turkey with chestnut stuffing. Salads are often sweet and savoury mixtures; *e.g.*, oranges and tomatoes mixed with tomato sauce and orange juice, or celery, pears, peanuts and capers dressed with mayonnaise and lemon juice and served on lettuce leaves. Blueberry, pumpkin and lemon chiffon pies are popular desserts. Popovers are made from a light batter baked in small tins, sometimes with fruit, and are served with butter and maple sirup. Both maple and pumpkin sirups often accompany pancakes and waffles. Maple nut cakes, coconut cookies and brownies are typical.

South Africa. — Many of the national dishes are of Afrikaans origin or developed from those brought from Malaya by early settlers. *Sosaties* consists of cubes of lamb grilled on a skewer, but first soaked in a marinade of browned onions, curry powder, vinegar, chutney, orange or lemon leaves and seasonings, which is afterward strained and served as a sauce with the meat. Boiled rice and chutney are accompaniments. In another dish, *bobotie,* minced cooked meat is flavoured with onions, chopped almonds, raisins and curry powder, covered with an egg and milk mixture, and baked. *Koesisters,* plaits of pastry dough fried in deep fat and soaked in chilled sirup, are eaten as biscuits with coffee. A delicious sweet is *melktert,* a thickened cinnamon flavoured custard baked in a pastry crust.

EUROPE

France. — The French above all have developed cookery into an art. Herbs, spices and wines are delicately blended to give subtle, tantalizing flavours and sauces are often used to enhance the natural flavour of foods.

Specialities of the soup course are broths and bisques. A clear, well-flavoured stock, devoid of fat as in a consommé, is typical of the broths which are served with crisp croutons of fried bread; the famous French onion soup consists of onion rings, cooked in butter, in a well-flavoured stock. Shellfish are widely used for bisques, which are often enriched by folding in whipped cream immediately before serving. The classic Mediterranean fish soup, bouillabaisse, prepared to perfection in Marseilles, is made from eight or more different fish.

A substantial white bread loaf with a crisp crust is often baked in a characteristic long shape. *Croissants* (sweet crescent-shaped flaky rolls) are eaten at breakfast and often with hot chocolate.

A frequently used meat is veal that combines well with ham, mushrooms and other vegetables or elaborate sauces, whereas escalopes of veal can be quickly and simply prepared by coating in egg and crumbs and frying in butter. Veal, chicken or fish may be cooked in their own juices in parchment paper; seasonings and often herbs are added to the individual portions, which are securely wrapped for cooking and then served still in the covering. Typical of the popular grilled fillet of beef are *tournedos,* small fillets of about three ounces served on rounds of fried or toasted bread, which absorb the juices, and accompanied by a particular sauce or garnish which gives the dish its name. Stews are numerous and varied, red and white wine being used as well as stock.

Salads are very popular and generally consist of a single vegetable with a vinaigrette, oil and vinegar, dressing. Plain dressed lettuce is always served with poultry and game. Salads with mixtures of raw and cooked vegetables and also meat, poultry and fish salads are also found. Vegetables are varied and often served as a separate course, young tender vegetables being cooked quickly and flavoured with browned butter. Potatoes are cooked in numerous mays, including mashed with butter and milk to give a typical soft purée, cooked, sliced and fried with onion rings. Potato duchess, made by adding egg, butter and seasoning to mashed potatoes, is used to garnish meat dishes by piping the mixture through a bag with a star pipe and then browning in the oven.

Pastries and cakes are artistic and often require considerable skill. The puff pastry for fruit or cream tarts begins with a thin pastry dough which is rolled out and spread with a layer of softened butter; the process is repeated several times and cases of various shapes are cut before baking. The French dessert course is of a light and airy nature. Soufflés are numerous and so delicate in texture that they must be served directly from the oven. Éclairs and tiny profiteroles are made from a rich *roux* into which eggs are beaten and which is piped through a plain pipe in a bag and then cooked in a hot oven. They are then filled with cream and coated with icing or sweet sauce. **A** rich spongy yeast dough with currants is used to make babas, often round cakes which are soaked in rum sauce for serving. Caramel is a popular flavour and cream caramel custard a favourite dessert. Crepes suzette are rich thin pancakes spread with sweetened orange-flavoured butter, rolled up, covered with liqueur and set alight just before serving. *Petits fours* may be tiny decorated cakes, crystallized fruits or bonbons.

The French excel in using eggs in many ways, frequently as a main dish, but milk is not used extensively except for making cheeses, of which there are several hundred kinds. Roquefort, a salty cheese made originally from ewe's milk and treated with a greenish-blue mold, originated in France; soft-ripened Camembert is another typical cheese.

Coffee and chocolate are the favourite beverages. Strong coffee may be diluted with an equal quantity of hot milk to produce the familiar *cafe' au lait.* The origin of the use of bitter roasted chicory is attributed to the French, although it is not used consistently.

The Netherlands. — A characteristic of Dutch cookery is that typical dishes are based on nourishing ingredients; this is probably because the evening meal is generally the one liot meal of the day. Cheese and boiled eggs are eaten for breakfast with a variety of breads and butter and jam. The midday meal is of a sandwich type; *e.g.,* breads and rusks topped with liver sausage, ham or rare-cooked beef, to which a fried egg or an omelette may be added. Dinner is of three courses: (1) soup, of which those made with eels, beans and peas are all famous; (2) a main dish of meat or fish with potatoes and several vegetables; and (3) a sweet or fruit. Methods of cooking are simple, so that food takes little time to prepare, but the former Dutch possessions overseas have influenced national dishes in the use of rice and spices.

Vegetables are cooked by steaming with butter and are often flavoured with spices, particularly nutmeg and cinnamon. Dried peas and beans—staple articles of diet—are soaked overnight in water, then simmered gently until tender; they may be served with fried bacon, fried onions or gravy. Among other popular vegetables are beetroot served with apples and nutmeg, stuffed cabbage, endive with a nutmeg-flavoured sauce and red cabbage with apples and nutmeg. Much fish is eaten, particularly herrings and plaice. Salted and smoked herrings are famous and uncooked smoked herrings are a national dish. Beef, often cooked rare and sometimes eaten raw, pork and veal are the preferred meats, of which joints may be stuffed or boned and rolled. Small fritters made of yeast dough served hot with melted butter and sugar are frequent features at fairs and carnivals. Pancakes filled with jam or served with treacle or brown sugar are well liked. A popular pudding called John in the sack is made from a yeast dough mixed with milk and egg, with raisins, currants and citrus peel added. It is then put to rise before being wrapped in a cloth and boiled. This is served with butter and brown sugar or treacle. Dutch Edam and Gouda are mild smooth-textured cheeses which may be flavoured with carraway seeds or cloves. Tea without milk and coffee with cream are the main hot beverages.

Belgium.—Although influenced by French and Dutch cuisine Belgium has a number of typical national dishes. One of these is the *waterzoie,* a chicken broth which includes dry white wine. A similar soup is also made with several different kinds of fish. The *carbonnade flammande,* one of the best known Belgian dishes, is essentially a beef stew cooked in a brown sauce made with beer and served with plain boiled potatoes, so that the sauce can be appreciated fully. The popular fricandels are minced meat balls made nith fresh pork which, after frying. are poached with potatoes in white wine. beer or stock. A typical dish from the Ardennes is rabbit with prunes: the meat is steeped in a marinade of red wine vinegar and herbs and simmered in red wine with previously soaked prunes. Chicory, asparagus and hop shoots are favourite vegetables. Chicory is often eaten raw as a salad. or cooked slowly in the oven in a covered dish with butter and seasoning. Cooked heads of chicory are also wrapped individually in a slice of ham and covered with cheese sauce to make a main dish. Among the desserts are rich waffles made from yeast dough enriched nith eggs, butter and cream, and a flaky pastry tart with a sweet filling of cream cheese, sugar, butter and eggs. Brown spicy biscuits (cookies) cut in animal shapes and iced in white and pink are traditional for the feast of St. Nicholas.

Germany.—Characteristics of German cooking are the use of sweet sauces and garnishes for meat and poultry, substantial beer soups. many kinds of sausage and fermented cabbage (sauerkraut), consisting of layers of shredded white cabbage sprinkled with salt and carraway seeds and pressed down in a special kind of tub for three to four weeks. Plenty of bread, particularly pumpernickel, a dark whole meal rye bread. is served at all meals.

Weissbiersuppe consists of a light-coloured beer flavoured with cinnamon and lemon and thickened with potato flour. A favourite fish dish is carp cooked in beer. Both fresh and salt herrings are used a great deal. Rollmops are filleted raw herrings spread with chopped shallots, capers and sliced gherkins, rolled up and skewered. They are put in a jar with a few mustard seeds and peppercorns and covered with wine vinegar, and are ready to eat in a few days. Pork, beef and veal are the favourite meats, pickled pork with sauerkraut being a famous dish; pork chops with plums, stewed in mine, or roast loin of pork stuffed with prunes are also typical. Roast goose is stuffed with apples, chestnuts and raisins, mixed with the liver and giblets. An orange cake with rum icing is popular, and a rich sweet pastry mixed with eggs is used for an open tart with apple purée and chopped almonds. Cinnamon, nutmeg and almonds are used to flavour small cakes and biscuits. Cheeses include the strong-smelling Limburger and also Tilsiter. Light beer, frequently drunk with meals, and medium roast coffee are the usual beverages.

Austria.—Austrian soups are rich and substantial and often a meal in themselves, with the addition of forcemeat balls, dumplings, rice sausages and vermicelli or noodles. Beef broth with liver dumplings is typical. Fresh-water and salt fish are both popular. Dishes, of which paprika is a frequent ingredient, are often highly seasoned. Pork, veal and venison are eaten extensively and veal or beef goulash is popular. A favourite dish is Wiener schnitzel: very thin slices of veal from the fillet or leg are floured, coated in egg and white bread crumbs, fried quickly and served at once with a garnish of lemon slices. Goose is commoner than chicken and a characteristic dish is *kalte Gans,* cold roast goose with cucumber salad flavoured with chopped dill or caraway seeds. These two flavourings are used in many dishes and sauces. Pheasant *Zigeunerart* is stuffed with previously cooked snipe, fat salt pork and truffles.

Austrian pastries are world-renowned, with *Apfel strudel* the particular speciality: a plain pastry dough is pulled to paper thinness on a floured cloth, covered with fried bread crumbs, sliced apples, currants, sugar and cinnamon, then rolled up and baked before cutting into slices. Other fruits are used as well and also sour milk or cream with eggs, sugar, raisins and currants. Yeast doughs are used for sweets and cakes. *Gugelhupf* is made in a special fluted tin and served with coffee or chocolate topped with sweetened whipped cream.

Hungary.—The use of paprika to give the characteristic bright red colour to soups, fish and meat dishes. is typical of Hungarian cookery. So too is the use of fresh green and red peppers, sour cabbage and sour cream. Hungarian goulash is a national dish which may be either a soup or a stew. As a stew equal quantities of beef and onions are cooked slowly with a liberal sprinkling of paprika, very little liquid, tomato purée and a flavouring of caraway seeds. This is served with potatoes, rice or very small dumplings. Chicken paprika is a similar and another characteristic dish. Cherry cake and a poppy-seed cake are typical sneets. Lipto (Liptauer) cheese is made from sour milk and flavoured with capers, anchovies, onion and paprika.

Poland.—Among the Slavonic nations Poland has a distinctive cookery of its oun dating back for many centuries. Basically Slavonic, it is tempered by a sense of balance and proportion common to western cultures. There is a choice of soups of which the cold *chlodnik* (a salt cucumber soup with sour cream) is perhaps the most original. Fresh-water fish are prepared in many ways, the most popular being *karp po polsku* (carp stuffed with veal forcemeat). *Potrawka z rakow* is a tasty dish of crayfish with groats or rice, flavoured with dill. Beef, pork and venison are the commonest meat dishes; *zrazy z kasza* (rolled and stuffed filet steaks with buckwheat groats) and *bigos* (sour cabbage with meat. game, mushrooms, apples and tomato *purée*) are perhaps the most popular. *Flaki popolsku* (tripe prepared with dumplings, grated cheese, paprika and marjoram) is a delicacy. There is a great choice of vegetables, desserts and pastries. Black coffee or China tea (without milk) are the hot beverages.

Italy.—Italian cooking is varied. each region or province often having its onn specialities or variations of a national dish; *e.g.,* in Bologna spaghetti is served with a rich sauce of minced beef, tomatoes and mushrooms.

Among soups is the famous minestrone: made with fresh young vegetables, it is very thick and served either hot or cold, sprinkled with grated Parmesan cheese.

Pastas made from eggs nith either flour, semolina, maize or potato flour appear in many shapes—shells, spirals, tubes and noodles, for instance. The name often varies with the thickness or length of the paste. Pasta is properly cooked *al dente* (literally "to the tooth"), not sticky or mushy. and may be served with cheese alone, or with some kind of tomato or meat sauce. Ravioli are small cushions of broad noodle paste either plain or filled; *e.g.,* with spinach and forcemeat. Rice is used for *risottos,* the best-known perhaps being *alla Milanese,* when the rice is cooked in butter with beef marrow, stock, wine and saffron and served with grated cheese.

Vegetables are important in the menu and include globe artichokes, asparagus, beans, peas, small marrows, sweet peppers or capsicums (yellow, red and green) and also celery and *aubergines*. Fennel1 and oregano are herbs frequently used. Raw salads with oil and wine vinegar are served as an hors d'oeuvre or antipasto. Potatoes are used in soups and gnocchi.

The Neapolitan dish pizza may be either savoury or sweet: bread dough ¼-in. thick is covered with tomatoes, crisscrossed with anchovy fillets and baked, then sprinkled with cheese and browned. As a sweet, short or puff pastry is used and one version is spread with honey, spice and nuts and rolled before baking.

Fish of all kinds are used, including eels, lobster, crayfish, scampi, crabs, scallops, clams, oysters and mussels. The fish dishes of Venice have been famous for centuries.

Beef, veal, lamb, chicken and pork are generally roasted, grilled or fried.

Sweets are not usually served, fresh fruits being more popular, but *zabaglione* is a famous dish made from egg yolks, sugar and Marsala wine beaten together over hot water to form a light and frothy mixture.

There are many varieties of cheeses, notable among them being mozzarella, a soft creamy cheese made from buffalo milk, the well-known Gorgonzola and bel paese.

Coffee is the favourite hot beverage, an unusually dark roast producing a distinctive flavour.

Spain.—Spanish food is characteristically rich, colourful and highly seasoned. Oil is used a great deal for frying and baking and garlic, chili peppers, paprika and cumin are common seasonings. Mixing many foods into one dish is illustrated by the well-known paella which may consist of chicken, lobsters, crabs, mussels, clams, scallops, scampi, globe artichokes, french beans, peas and rice, flavoured with garlic and saffron. Colour is added to dishes by using tomatoes and sweet red and green peppers.

Substantial soups with many ingredients, mainly vegetables, are common and may be thickened with rice and vermicelli. A typical soup has little forcemeat balls added to a good meat stock. Another, la fabada, which is a meal in itself, includes salt beef, ham, black pudding, haricot beans and special local sausages, the meat and sausages being served separately after the soup. Chicken, pork, lamb and mutton are common meats. Salads are very popular, including both raw and cooked vegetables, *e.g.,* pimentos and *aubergines,* tomatoes and runner beans, as well as crisp leaves of lettuce or endive with an olive oil dressing. A great many olives are also eaten. Sweets for dessert often are not served but sweetmeats such as all sorts of crystallized fruits and *turrón* (a kind of very sweet nougat flavoured with vanilla and nutmeg) are universal. Churros, which are eaten for breakfast with chocolate or coffee, are fritters made of chou paste piped into hot fat, where they puff up into long curls; they are sprinkled with sugar for eating.

Portugal.— The food is similar to that of Spain, but simpler and less exotic. Eggs, fried, scrambled and as omelets, are staple food and fresh raw fruit such as oranges, watermelons and many varieties of grapes are eaten as dessert.

Mexico.—Mexican cookery is often considered synonomous with that of Spain, but the food is more highly spiced with hot chili peppers and dishes are frequently made from tortillas. The tortilla, the bread of Mexico, is a thin unleavened cake cooked quickly on a hot ungreased griddle. The flour is made from finely ground lime-treated corn or maize but white flour also may be used. Enchiladas are rolled tortillas filled with minced beef, chopped onion and grated cheese and baked in a spicy tomato sauce. Another popular use of the tortilla is a *tostado,* a crisp envelope made by sautéing the tortilla in a little hot fat and folding once to hold a mixture of lettuce, green peppers, onions and cooked meat. Tamales are also very common; they are made of cornmeal mixed with minced meat and seasoned with chili peppers, small portions of which are wrapped in cornhusks and steamed. Butter beans and rice are mainstays of Mexican cookery. Beans are often just boiled, mashed and sautéed, or may be baked in a casserole with bacon, onions, tomatoes and treacle. *Verdulagas* (vinelike greens) and *nopales* (prickly pear cactus), wild plants indigenous to Mexico, are chopped and cooked in water, which is discarded; bacon fat, garlic and onion are then added and the mixture simmered in a tomato sauce, which may be enriched with eggs. Chili peppers range from very mild to peppery hot; one dish is of stuffed long mild chilis dipped in batter and fried. A popular salad is made of mashed avocados mixed with chopped raw tomato and onion. Mango and papaya are common fruits often eaten at breakfast. Chocolate is a popular beverage, characteristically flavoured with cinnamon. Typical candies are made from cactus and sweet potato.

Scandinavia.— Cooking is influenced by the cold climate and short growing season, particularly in the north, and by accessibility to the sea.

Norway.—Quantities of fish and salted meats are eaten. Fish are frequently bought alive so that they are eaten very fresh. Smoked meats are also common, particularly smoked mutton which is eaten both raw and cooked. Smoked reindeer tongues are a delicacy. Chicken is stuffed with butter and parsley for roasting.

Many varieties of hors d'oeuvre are served with rye bread, including salted herrings, smoked salmon, anchovies and shellfish. This is not unlike the smörgasbord of Sweden which characteristically consists of a variety of both hot and cold dishes eaten with bread and butter and intended as a prelude to the main course.

Sweden.—Herrings are a basic food, eaten salted and raw with a dressing of vinegar. The crayfish season in August is a good reason for kraftor parties, at which these miniature lobsters are eaten and schnapps is drunk. Dill is a frequent flavouring herb, dill sauce being popular with fish and lamb. A typical Swedish jam is made from lingonberries, which resemble cranberries. The characteristic Swedish limpa bread, a yeast dough with a cakelike consistency, contains a high proportion of rye flour and is flavoured with treacle and orange peel.

Denmark.—Soups are substantial enough to form a complete meal; *e.g., gule arter* made with pork and yellow split peas. Flour dumplings and forcemeat balls are often added. A sweet buttermilk soup is made with ground rice, lemon, cinnamon and chopped almonds. Much fish is eaten, particularly cod, which is boiled and served with mustard sauce, and also mackerel, plaice, salmon and shrimps. Beef, veal and lamb are roasted and stewed, and pork, chicken, duck and goose are also common: duck is stuffed with apples and prunes and roast goose, served with stewed red cabbage, is traditional on Christmas Eve. Stewed rhubarb and red currants are common with hot meats and poultry. Among vegetables caramel potatoes are outstanding. Potatoes are boiled in their skins, peeled, rolled in sugar and fried in butter. For salads cucumber and beetroot are well liked. A favourite summer sweet is rodgrod, a fruit jelly made with fresh currants and raspberries and thickened with potato or corn flour. Other sweets are apple cake, pancakes and doughnuts. The world-famous Danish pastries consist of a yeast dough, enriched by rolling in butter as for flaky pastry, formed into different shapes with fillings such as almond paste, vanilla *crème* or prunes, and then baked. They are often eaten for breakfast. Danish blue cheese is well known and other distinctive varieties include Danbo, Fynbo, Elbo and Samsoe. In Denmark cheese is always cut in very thin slices.

The Danish *smørrebrød* are open sandwiches with hundreds of different toppings on thickly buttered bread, usually of rye. Typical is the Andersen sandwich of buttered dark or light rye bread with a topping of crisp fried bacon, liver paste and tomato slices, garnished with horseradish and jellied consommé. Another is tartar med aeg, chopped raw steak spread on buttered bread, in the centre of which a raw egg yolk is circled by a ring of raw onion.

Greece.—Lamb is the favourite meat and grilling the usual method of cooking. At Easter whole animals are roasted. Small pieces of meat (souvlakia) are marinated in oil with onions and herbs, then placed on a skewer alternately with tomato, onion, mushroom and bacon before grilling. This is served with boiled rice. A famous national dish, *moussaka,* is made of alternate layers of minced meat, first fried in oil, and sliced vegetable such as aubergine or potato, covered with a cheese sauce and baked in the oven. A typical soup, *avgolemono,* consists of chicken stock in which rice is cooked, enriched with eggs and flavoured with lemon juice. Olive oil is the popular cooking fat. Baked fish, using bream or mullet with onions, tomatoes and garlic, is another national dish. Grilled eel, fried octopus or mussels and fish soups are also liked.

Rice dishes are popular, the pilafs being very like those of Turkey, whose cookery has obviously influenced that of Greece. Vegetables are stuffed with cooked rice and raw minced meat flavoured with herbs; vine leaves (dolmas), cabbage, lettuce, pimentos and courgettes are also prepared in this way. A salad of shredded white cabbage with olives, capers, beetroot and beans, dressed with a vinegar and oil dressing is frequently served with *souvlakia.* A shortbread, *kourabiedes,* is made from butter, flour and icing sugar worked together and baked very slowly, cut into fingers and coated in icing sugar. This is eaten on festive occasions. An unripened Fedde cheese is eaten with bread for breakfast and enclosed in pastry for snacks. Sweet black tea and Turkish coffee are the favourite hot beverages.

ASIA

Turkey and **the** Arab World. — In Turkey mutton, rice, vegetables and oil are characteristic ingredients. Kebab, a famous dish, consists of small pieces of fat breast of lamb marinated in vinegar with oil, onions, cloves and parsley, then grilled on skewers and served with pilaf (rice cooked so that it absorbs all the liquid and is quite dry with every grain separate). *Aubergines* are a popular vegetable and vine leaves or spinach stuffed with forcemeat of uncooked minced mutton, rice, herbs and spices are also favourites. Sesame seed paste is very popular. Tihini may be seasoned with lemon and served with fish or vegetables or sweetened for a spread on crackers. The well-known sweet halva is made of crushed sesame and sugar sometimes flavoured with chocolate and containing almonds. Two unique breads may be found. *Balady* bread, a mainstay of the Egyptian diet, is baked in small, round, very flat "loaves" which easily open into an envelope for filling. Fool *medames,* well-seasoned beans baked very slowly overnight. are the commonest sandwich filler. A similarly shaped loaf turns out to be a hollow ball of crisp texture. Baklava, a flaky pastry with almonds and honey, is a favourite dessert.

India. — The economy and religious practices of India preclude the use of much meat and therefore grains constitute the mainstay of the diet — particularly rice, dhal (a split pulse resembling lentils) and chapati, the bread of India. It is eaten with everything except rice and is made from wholemeal flour mixed to a stiff dough with water, rolled out thinly like a pancake and baked on a griddle. Other characteristics of Indian cooking are the use of ghee (clarified butter from buffalo milk) instead of oil, and the use of spices, especially the distinctive curry flavour. For best flavour the spices from which curry powder is made need to be freshly ground, the ingredients including turmeric, cummin and coriander seeds, ginger, pepper, cardamon, fennel, chilies, mace, cloves, mustard and poppy seeds in varying proportions. Curries may be made with meat and vegetables or vegetables only. Lamb and chicken are eaten extensively. beef by some groups. The large Dublin Bay prawns or Norwegian lobsters are a favourite fish. *Dopiaza* curries have a small quantity of rich sauce that has been reduced during the cooking; kofta curries are characterized by the forcemeat balls made from minced or pounded chicken, pork, lamb, beef or fish. Many kinds of vegetables are used for curries (chankees) and mashes (bhurthas), the chief ingredients of which are onions, green chilies and lemon juice.

Aubergines, yams, okra, capsicums. potatoes, beans and peas are popular vegetables and are frequently cooked in butter flavoured with cummin. Rice is always served with curry. as are side dishes of various fruit chutneys and Bombay duck, a small phosphorescent fish which is dried, salted and toasted and sprinkled over the curry dish. Milk is used a great deal for cooking, making sneets and yoghurt or soft cheese. Curds (*dahi*) are made from soured milk allowed to stand and may be served as a sweet with sugar or with salt and rice. Curds are mixed with sugar, ground almonds and butter, spread in a dish and decorated with lightly fried sliced blanched almonds. Tea and coffee are both taken as hot beverages.

U.S.S.R.—The distinction of Russian cookery is a combination of western and eastern (mainly Armenian, Georgian and Turkish) influences. There is a great variety of hors d'oeuvres (*zakuski*), the most famous, though expensive, being caviar; a typically Russian way to serve it is on hot *bliny* (buckwheat pancakes) with sour cream. The true *russki* salat comprises not only cold vegetables but also meat, poultry, game or fish; it is served with mayonnaise or *à* la *vinagrette.* Soups are traditionally Slavonic, the most popular being shchi (cabbage soup) and borshch (beetroot soup or meat stock with other vegetables) ; borshchok is a clear beetroot consommé served with piroshki (pancakes stuffed with forcemeat or chopped cabbage with mushrooms). Kulebiak is a roll stuffed with fish (salmon or sturgeon), or with cabbage and mushrooms. There are many game and meat dishes served with sour cream and a choice of vegetables, including pickled cucumber and sour cabbage.

The Russians drink mainly China tea without milk, often without sugar but with cherry or strawberry jam.

China. — Chinese cooking, whose subtle flavour can be compared to those of French art *culinaire,* is characterized by the generous use of rice, of the soybean such as bean sprouts, of bean curd instead of milk and as a sauce, of fresh root ginger, of many dried foods and by the fact that butter, milk, cream and cheese are never used. Spices and herbs are rarely found but garlic and onion are used for strong flavourings. Several dishes, often in multiples of eight, are accompanied by Auffy white rice, a little being taken from each dish in turn, with bites of rice in between.

All food can be eaten with chop sticks or a spoon and fork and a knife never appears at table, since the food is cut up during the preparation.

Chinese birds' nest soup is unique: a hardened gelatinous substance, regurgitated by certain birds in nest making, is softened by soaking and then cooking, and is added to a chicken broth, thickened with rice flour. Other typical soups are light and delicate in flavour, two may be served during a banquet to clear the palate. Fish is a favourite food, particularly fresh-water varieties and lobster and prawns. Pork, chicken and duck are the supreme meats, but beef, lamb and mutton also are sometimes eaten. Both fish and meat may be prepared in a sweet-sour sauce of sugar and vinegar with mixed fruits. The meat is often dipped in batter and shallow fried in peanut or soybean oil before being added to the sauce. Rice and noodles are staple foods and maize and millet are also used. Large quantities of vegetables are eaten. They are cooked quickly in a small amount of liquid and crisp vegetables garnished with slivers of meat form many main dishes. Mushrooms, particularly a large black variety, bamboo shoots, water chestnuts and bean sprouts are typical vegetables. Monosodium glutamate is frequently added to savoury dishes and this and soybean sauce, which replaces salt, are common flavourings. Peaches, pears, persimmon, mango and litchi are enjoyed among fruit.

Almond biscuits and almond paste soup served either hot or cold are typical desserts. as is a tart made of rich, very flaky pastry with a slightly sweet bean paste or other filling.

Shao hsing is Chinese yellow rice wine used in cooking as well as to accompany meals. Tea, either green or semifermented, is served at every meal. Jasmine tea, nhich contains the flowers as well as the leaves. is served in small handleless cups without milk or sugar.

Japan. — Cooking is plain and simple and grilling and baking are common methods. The Japanese excel in the artistic decoration of dishes and the utensils for serving add to the attractiveness of the table.

Many courses of small portions are served. Rice takes the place of bread and noodles made from flour and egg yolks accompany main dishes. Black noodles are made with soybean flour. Stock for soups is frequently made from dried tunny fish. A popular soup is made by adding well-beaten eggs to hot stock so that soft curds are formed. The Japanese are great fish eaters. one hot and one cold dish often being served at a meal. Dried fish is frequently used and some fish is eaten raw with a typical salad of brined sliced cucumber and lettuce.

Sukiyaki is known throughout the world as a Japanese main dish: it consists of beef and vegetables which are cooked at the *table over a spirit lamp.* Vegetables *such as thinly sliced spring onions, bamboo shoots and leeks are browned singly in a little fat, moistened with stock, covered with very thin slices of beef and simmered a few minutes. The dish is seasoned with* shoya*—a sauce made from soybean seeds, wheat and salt—and served with* tufu *(cubes of pressed soybean curd). Pork and chicken can be used instead of beef.*

Sake is the national drink and is made from rice by a fermentation process. Tea is drunk with all meals and the tea ceremony (q.v.), when a bowl of tea is offered to each guest in turn with sweet and salty biscuits, is an important custom.

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FOOD SUPPLY OF THE WORLD. *Since time immemorial, food production has been the chief occupation of mankind. It still engages more than half the world's labour force. Processing foodstuffs.their national and international exchange, transportation and retail distribution occupy many additional hundred millions of people. However, the proportion of labour engaged in food production is different in various countries at different levels of economic development, the proportion tending to decline with economic progress. Similarly, the share of expenditure for food in the budget of individual households declines with elevation from lower to higher* income *level.*

Income level is also one of the decisive factors in determining the per capita consumption of food both quantitatively, as measured by the average daily calorie intake, and qualitatively. as *characterized by the variety and proportion of protective* foods*—meat, dairy products, leafy vegetables, vitamin C-rich foods and others. Least elastic is the demand for cereals and root crops, while that for meat, dairy products, fruit and vegetables tends to increase with the rise in standard of living. Income level divides mankind into "cereal eaters" and "meat eaters."*

Nutrition *patterns in different parts of the world have developed around local food production, each people adjusting habits and tastes to domestically produced foodstuffs. In sheep-raising countries, such as Australia and New* Zealand, *the per capita consumption of mutton and lamb is many times greater than in the United States, while the per capita consumption of pork in the* U.S. *is many times greater than in those countries. In sparsely populated cattle-raising countries such as Argentina and Uruguay, meat consumption is among the highest in the world, while milk and dairy products predominate in Switzerland, the Netherlands, Belgium, Luxembourg and the Scandinavian countries—all areas with intensive husbandry. In regions where agriculture is concentrated on production of grains, cereals constitute the bulk of the diet.*

The over-all volume of food production in various parts of the world is determined by the abundance or scarcity of arable land in relation to population, fertility of the soil, climatic conditions and the level of agricultural techniques. Thus, in certain areas there are deficiencies in food production, and in others there are surpluses. (The terms "deficiency" and ,'surplus" are usually applied to staple foods such as cereals, roots and sometimes sugar, rather than to crops that can be raised only under special climatic conditions, such as tea, coffee, cocoa beans, southern fruits or various oil-bearing seeds and nuts.)

Staple crops are largely consumed within the producing areas. In underdeveloped countries with prevailing subsistence economy, a large part of the harvest is consumed directly on the farm without *passing through domestic markets. Only a comparatively small proportion of such crops reaches the international trade: about 15% of wheat, less than 10% of corn. 2%–3% of* rice*—about 5%–6% of all grains combined. Export rates (the ratio of export to output) for the more perishable foodstuffs such as staple vegetables, milk and meat are still lower. They are much higher for sugar (40%), coffee and tea (70%–75%) and cocoa (more than 90%).*

In international trade staple foods move from a few *surplus areas to deficiency regions widely spread over the world.* Wheat *and coarse grains are exported from the U.S., Canada, Australia and Argentina; rice, mainly from Burma. Thailand. Formosa and Indochina, with smaller amounts coming from the U.S. and Italy; meat, from Argentina, Denmark. Ireland. Australia and New* Zealand; *cheese and butter, from Denmark, the Netherlands. Australia and* New Zealand. *The main destination areas are Great Britain, the German Federal Republic and other countries of northwestern Europe, southeast Asia (India. Pakistan. Malaya, Ceylon). Japan and some countries of Latin America. Products of plantation agriculture—tea. coffee, cocoa, spices,* etc.—move *from the tropical zones of Latin America, Africa and southeast Asia to industrially developed areas in temperate zones. International trade in these commodities, as also in wheat, meat and dairy products, is primarily intercontinental and transoceanic. Trade in rice belongs chiefly to the intra-Asian exchange.*

Foodstuffs (including beverages and tobacco) represent approximately 25% of the value of foreign trade, but their importance in international balances of payment is much larger than is suggested by this rate. Even a small deficiency in foodstuffs represents a very serious problem for economically underdeveloped areas. On the other hand, cash crops are the foundation of local economy in certain areas: sugar cane in Cuba. Brazil, Puerto Rico *and Hawaii; tea in Ceylon, India and Indonesia; coffee in Brazil, Colombia. Guatemala, Venezuela and the Sudan, etc.; cocoa in Brazil, the Gold Coast, Nigeria and others; bananas in Central America; pineapples in Hawaii; and coconuts in Ceylon and the* Philippines.

THE WORLD'S LARDER

The food supply of the world *may be represented as a giant larder, from which people draw their everyday food while it is replenished by the never-ending* work *of the tillers of the soil in all parts of the world. Some stocks are replenished once or twice a year after the harvest; others come in continually. 4 part of the supply is carried over for periods longer than a year. Because of fluctuations in weather conditions and other factors, the annual world consumption of single food products is not necessarily equal to the annual output, but in the long run the two items tend to balance one another.*

However, *not all world supplies of foodstuffs are used as human food. Some amounts are needed for seed. and some are* wasted *in the process of storing, transporting and marketing on the long way from the farm to the ultimate consumer. A substantial part of food crops is fed to livestock; another part is diverted to industrial purposes. Of the former, only a fraction reappears for human* consumption *in the form of meat, fat and dairy products: about 10 lb. of grain go into the production of 1* lb. *of meat. For all these reasons, the actual net supply of foodstuffs available at the retail level for human consumption, including foodstuffs consumed directly by producers, forms only a part, though the largest and most important part, of the annual gross output of foodstuffs described here as the* world's *larder.*

This larder may be visualized as divided into three compartments for different types of foods. The largest and most important is that for cereals; next is a huge one for potatoes, other tubers and roots. sugar, pulses (legumes). oilseeds *and fruit; the third one is stocked with meat: poultry, dairy products and fish. For the distribution of the different types of food in the world's larder, see Table I.*

*TABLE I.—The World's Larder, 1954**

(In 000,000 metric tons)

Item	Quantity	Item	Quantity
Cereals	635	Animal foodstuffs	350
Breadgrains	172	Meat	55
Rice, paddy	162	Beef, veal, pork, mutton and lamb	45
Coarse grains	301	Poultry meat, offals	10
Other crops	500	Edible pig fat	3
Tubers and roots	300	Milk	255
Pulses	25	Eggs	10
Oilbearing crops	60	Seafood	27
Sugar	40		
Fruit	75	Total, approximate	1,500

*Excludes the U.S.S.R.

In round numbers, the annual amount of food produced in the world, which approaches and in some years exceeds 1,500,000,000 metric tons or approximately 3,000,000,000,000 lb.. would provide, on the average, a little more than 1,100 lb. annually or 3 lb. daily for each person in the world. These figures do not include tea, coffee, cocoa beans, various vegetables and fruit, and numerous other foodstuffs raised locally in comparatively small quantities for which statistics are not available. Nor do they take account of the loss from extraction for cereals or oilseeds, waste in storage and distribution, or the part of crops used for seed and industrial purposes. Furthermore, some of the crops listed in the first compartment of the larder are used for feed and so reappear, in much reduced amounts, in the tonnage of animal foodstuffs in the third compartment. There is also a great difference between the world per capita amount of available food and the quantity actually consumed by the population in different regions, individual countries and different income groups in each area.

Before discussing the output of different foodstuffs by region, we will briefly survey the shelves of the world's larder.

Cereals. — The most important cereals are rice and wheat, used chiefly for food, but also as feed for animals. In food, cereals are to some extent interchangeable and in feed almost completely so. Grains used for feed in economically advanced countries are consumed as food in underdeveloped parts of the world where cereals supply from 70% to 75% of the daily calories.

Rice is the staple food of the Asian peoples. almost half of mankind. Although Asia accounts for more than nine-tenths of the world's output of rice. it must supplement its production with imports, particularly in years of unfavourable harvest. Rice is an economical crop: it yields more food per acre than any other grain. and only 3% to 5% of the yield need be reserved for seed, as compared with from 8% to 15% for wheat. Indeed. Asia could not support its teeming millions with any other crop. In the history of Asia failure of the rice crop time and again has resulted in famine and starvation.

In contrast to rice, wheat is raised in all parts of the world, occupying a larger part of arable land than any other crop. Wheat enjoys an almost exclusive position among all grains because wheat dough raised with yeast retains large quantities of gases in the bread-making process. Rye. the only other bread grain, possesses this property to a lesser extent. Rye bread has not so fine a texture as wheat bread and is less digestible. Because of the general consumer preference for wheat. even in areas where it cannot be grown in sufficient quantity, the export rate of wheat is higher than that of any other grain. In the past century wheat invaded the areas where rye bread had predominated and made the latter a poor-man's bread. Rye is less exacting to grow, being much more winter-hardy, ripening earlier than wheat, and on low fertility soil yielding more than any other small grain. Because of these advantages and because rye can be raised as a cover crop and is also appreciably cheaper than wheat. it has more or less maintained its position in agriculture of Europe and the U.S.S.R.

Maize is the grain contribution of the western hemisphere to the old world. It ranks first in acreage in the Cnited States and is also important in Latin America. Asia. Africa and southeastern Europe. As direct food. it serves only 50,000,000 to 60,000,000 people but hundreds of millions consume it in the form of pork, beef or dairy products. Most of the corn produced on farms of the U.S. leaves them on the hoof. Processing of corn by animals is, hoaever, expensive: a bushel of corn consumed as whole corn meal meets the daily requirements of 23 persons for food energy and protein, but if consumed in the form of eggs meets the requirements of only 2 persons for energy food, and of 8 for protein.

Sorghum and millet can withstand long periods of dry weather by reverting to a dormant state and then growing again with the monsoons or as soon as the soil obtains enough moisture. Furthermore, these prolific crops have a short growing season and respond to the most primitive cultivation methods. All these characteristics have enhanced their importance in the monsoon area of Asia and the subtropical zones of Africa where they are consumed in the form of flatbread. grits, porridge and confectionery. While the chief use of sorghum and millet in other parts of the world is for feed, a bread variety of millet (proso) is staple food, eaten mostly as thick porridge. throughout the U.S.S.R.

Oats in the form of porridge ranks high among breakfast cereals in many countries of Europe, mostly in the north, and in the U.S. As a well-balanced feed, it has maintained its position in the world, though motorization of highway transport and mechanization of field work have reduced its use as staple feed for horses.

Other Food Crops. — Of other food crops, roots and tubers are the bulkiest. In their raw state they are largely composed of water and carbohydrates and contain only small amounts of protein and still less fat. They are highly perishable and therefore of limited transportability but constitute important energy food in many parts of the world. Also, when hunger arises the farmers often turn to these crops, since they can be raised in abundance rather quickly and at relatively low cost. They are also used extensively as feed for animals.

Potatoes, sweet potatoes and yams, and cassava predominate in this group. Though potatoes originated in the Andes, they are grown today in many areas but mostly in the cool, moist regions of northern and central Europe and the U.S.S.R. In the U.S. potatoes are harvested in some area during any of the four seasons. Sweet potatoes and yams are widely grown in Asia, particularly in China, Korea and Japan. In Japan they are one of the basic foods. Cassava is widely cultivated in Africa, Asia' and Latin America.

Dry beans, broad beans, dry peas, lentils and chick-peas are the main pulses. They contain more protein than the cereals or roots and tubers and can therefore serve as substitutes for animal proteins, particularly in the world's poor regions: less land and labour is required to raise pulses than to provide feed and maintain animals for the same quantities of protein. In the diet of people in North America. western Europe and Oceania they are used merely as vegetables to supplement meat courses. Though pulses have been raised for several thousand years in many parts of the world their nitrogen-producing quality was discovered only late in the 19th century. Because their decaying roots release nitrogen in the soil, pulses are often grown for rotation purposes and also for enriching poor soil.

Oil-bearing crops include oilseeds, nuts and some oil-containing fruit. They supply a wide variety of oils for both human consumption and industrial purposes, and their fat-free residues after extraction of oil provide valuable feed concentrates. The importance of edible oils varies from country to country. Being cheaper than animal fats, they are widely used in butter substitutes by low-income groups even in wealthy countries where preference for butter has become traditional.

Sugar. an essential energy food, is provided by the sugar beet and sugar cane. The former is a root crop grown in temperate climates and the latter is a tropical stalk crop. but in processed form both supply an identical product. Their relative position in the world changed several times during the 19th century, but after the 1920s sugar cane dominated the field. Because these crops contain a large amount of water and are therefore bulky. their processing is usually carried out in the growing area. In the case of the sugar beet, extraction and refining are carried out in a single operation. In contrast, raw sugar extracted from the cane is often shipped for refining to factories closer to consumer markets.

Animal Foodstuffs. — Meat is important in human diet because it contains protein of highest quality, many mineral elements (phosphorus, iron, copper and others), some of the vitamins, and fats. Moreover, it stimulates the flow of digestive juices in the stomach. Another important nutrition element, calcium, is provided mainly by milk. Since milk contains the greatest assortment of nutritive elements of any single food, it is considered a complete food in itself.

The number of domestic animals about equals the number of people in the world (2,400,000,000 and 2,700,000,000, respectively, in 1954). As there is such a large domestic animal population, man has had to assume the responsibility of feeding it. Thus a substantial part of the world's farm land is devoted to pasturage, and where the herds have outgrown the available pastures cropland is taken over for feedstuffs. In the United States, for example, about three-fifths of all land is used for hay and pasture, and two-thirds of all cropland for producing feed and forage crops. In such a densely populated country as the German Federal Republic permanent meadows and pastures occupy nearly 40% of all agricultural land. In New Zealand more than 95% of all agricultural land is in natural and sown pastures. Even in Argentina, with its vast open stretches, pastures compete with crop fields for land. Moreover. a considerable proportion of all crops raised in the world is fed to livestock. In Canada not only about 80% of the barley and 90% of the oats but also about half of the wheat is used for animal feed. In Denmark, only about 10% of all grain goes for direct human consumption. The rest, except for what is withheld for seed and industrial purposes or wasted, is used for feed. In contrast, in poor underdeveloped regions such as India, Pakistan or China, man cannot share with animals even the coarse grains and uses his harvest almost exclusively as food.

Seafood in general and fish in particular is a less expensive source of protein than meat and could therefore be a very important food. especially in areas generally deficient in animal foodstuffs. Yet because of the tenacity of food habits, perishability of fish, inadequacy of handling techniques and, most of all, lack of knowledge of marine resources and insufficient recognition of their food value, fish plays a secondary role in human diet except in a few countries, such as Japan, Thailand, the Philippines and the northwestern countries of Europe. For the world as a whole, fish represents only 2% of all foodstuffs consumed and **3%** of the proteins.

Fish is a unique food source in the sense that it replenishes itself without such efforts as are required to produce all other kinds of food. The distribution of fish on our planet depends, like that of plants, on climatic and physical conditions. The ocean offers a wide range of environmental conditions for vegetal and animal life, the most significant of which are temperature, salinity and currents. In the ever-moving waters, fish. too, are always moving, gravitating toward sources of food. Plankton, the small floating or drifting animal or vegetable matter which is the chief pasturage of the sea. is more abundant in cold waters than in warm, in shallow layers of water exposed to sunlight than in the depths and in coastal waters rather than in the open sea.

Fish find the most abundant and variegated plankton on continental shelves, and it is there that both marine life and fisheries are concentrated. The richest and most productive fishing grounds, supplying nearly 95% of the world's fish catch, are in the northern hemisphere. Since fishing is not limited by national boundaries and fish have no nationality until caught, fishermen of any nation can exploit the world's fishing grounds, no matter how far from their own land. The only limitation to foreign fishing is on coastal waters, usually a 3-to-12-mi.-wide strip. while a few small countries claim a zoo-mi. limit for their coastal waters. On the other hand, a fisherman has no exclusive rights on his customary fishing grounds as has the farmer on his land. He may arrive with all his gear at the fishing banks, only to discover the season's harvest nearly captured by others with faster equipment.

In contrast to the small use of fish as food, the world's demand for fish meal for livestock and poultry feed grew continually. Before the value of its highly concentrated protein was recognized, small fry and little-known species had been simply thrown overboard by the fishermen. This practice was not completely eliminated, but, increasingly, the industry used inedible species and the waste from processing the edible catch. Even a part of the catch previously consumed in fresh or canned form came to be diverted to fish meal production, which was also stimulated by improved reduction techniques. Whenever there is difficulty in marketing the edible catch, fish meal plants present a ready outlet.

OUTPUT BY REGION

Food Crops.—Though rice occupies far less of the world's land than wheat (the ratio is 7 to 10), the world's harvest of rice in normal years is slightly larger than that of wheat: in 1954, 162,000,000 and 152,000,000 tons, respectively. Next in line is maize, with other coarse grains, barley, millet and sorghum, and oats close runners-up. Among roots and tubers, potatoes tanked first, with 167,000,000 tons produced in 1954.

Asia accounts for about 40% of the total output of major food crops in the world (exclusive of the U.S.S.R.). Not only is it the almost exclusive producer of rice but it also raises nearly 70% of millet and sorghum, sweet potatoes and yams, about 60% or more of pulses and half the oilseeds. This huge output is not sufficient, however, to feed its vast population. Were it not for surplus production of rice in a few smaller countries within this region, the largest countries of Asia—China and India—would increasingly depend on food supplies from other continents.

Europe leads in the output of potatoes, with about 80% of the world total (exclusive of the U.S.S.R.. also an important producer), but it is deficient in many other crops and must import them in large quantities for both food and feed purposes. Wheat is the main European crop, the chief producers being France, Italy and Spain, followed by the German Federal Republic and Great Britain.

North America accounts for nearly 60% of the world's maize, more than half the oats and 25%–30% of the wheat. The U.S. ranks first in these crops. Canada is another important producer of wheat.

Some three-fifths of the world's sugar is produced in Europe (beet sugar) and Latin America (cane sugar). Chief European producers are Germany, France. Poland, Czechoslovakia and Great Britain. In Latin America. Cuba leads, followed by Brazil and Puerto Rico. (See Table II.)

*TABLE 11.—Output of Major Food Crops by **Region,** 1954*

(In 000,000 metric tons)

Crop	World*	North America	Latin America	Europe	Middle East†	Asia	Africa	Oceania
Cereals	635.6	160.0	37.6	117.9	30.2	256.7	26.9	6.3
Rice, paddy	162.2	2.9	5.3	1.7	2.3	147.2	2.7	0.1
Wheat	151.4	35.2	11.7	46.2	13.3	36.2	4.1	4.7
Rye	20.3	1.0	0.9	17.9	0.5	—	...	—
Corn	137.3	77.0	16.3	14.6	3.2	18.2	7.9	0.1
Barley	55.7	11.9	1.8	18.0	6.4	13.8	3.1	0.7
Oats	49.4	26.5	1.1	19.4	0.3	1.2	0.3	0.6
Millet and sorghum	59.3	5.5	0.5	0.1	4.2	40.1	8.8	0.1
Tubers and roots	296.2	11.9	25.6	138.0	1.6	68.6	49.7	0.8
Potatoes	166.9	11.1	5.5	137.8	1.5	9.6	0.8	0.6
Sweet potatoes and yams	69.6	0.8	2.5	0.2	0.1	47.4	18.5	0.1
Cassava	59.7	—	17.6	—	...	11.6	30.4	0.1
Pulses	24.5	1.1	2.7	2.9	1.4	15.4	1.0	—
Oilbearing crops	59.5	16.4	4.0	2.8	2.1	29.6	4.3	0.3
Oilseeds‡	54.6	16.4	3.9	1.9	2.0	27.1	3.3	—
Other§	4.9	—	0.1	0.9	0.1	2.5	1.0	0.3
Sugar	40.7	3.6	14.1	9.5	0.6	9.7	1.7	1.5
Refined	34.8	3.6	12.8	9.5	0.6	5.1	1.7	1.5
Crude	5.9	—	1.3	—	—	4.6	—	—

*Excludes the U.S.S.R.

†Includes the Sudan, Egypt, Somaliland, Ethiopia and Eritrea, Libya in Africa, and Iran, Iraq, Israel, Jordan, Lebanon, Saudi Arabia, Syria, Turkey, Afghanistan and small adjoining territories in Asia.

‡Cottonseed, rapeseed, peanuts, sesame and sunflower seed.

§Olives, copra, palm kernels.

Animal Foodstuffs.——North America and Europe were the main producers of meat, each accounting for about 30% of the world's total in 1954 (exclusive of poultry meat and edible offals). Asia and Latin America produced about equal amounts (14% to 15% each). The rest came from Oceania, Africa and the near east.

Half the meat produced in the world is beef and veal. which rank first in the meat output of the new world, Africa and Oceania. In Latin America, their share is about 75% of the total meat produced. Pork is next in importance, while mutton and lamb account for less than 10% of the aorld's meat output. Pork predominates in the meat output of Europe and especially in that of the far east.

Poultry meat is a comparatively expensive food for areas short of grain. In such areas—Asia and some European countries—chickens are kept chiefly for egg production. Stimulated by growing demand for lighter protein fare, the world output of poultry meat expanded from 3,100,000 tons before World War II to 5,200,000 tons in 1954–55. About 60% of it was produced in North America (58% in the United States) and about 17% in Europe.

Europe produces half the world's milk, North America three-tenths of it. The world's largest single producer of milk is the U.S. Considering the vast population of the far east, its output of animal foodstuffs and particularly of milk is pitifully low. Half of its milk comes from buffaloes; a little less than half from cows.

In countries with a well-developed dairy industry, the yield per cow has shown a steady increase. It is still very low in areas with poor and unproductive livestock breeds. The annual yield per cow ranges from 6,280 to 7,780 lb. in Switzerland and the Netherlands to 1,220 lb. in Egypt (1954).

While before World War. II half the milk produced in the world was used for butter and cheese production, consumption of milk in liquid form increased in postwar years. Production of powdered milk expanded more rapidly than that of condensed and evaporated milk.

World production of eggs is concentrated in North America (about 40%) and Europe (30%). Better breeding and feeding, a better selection of the laying strains and many improvements in the care of laying hens after World War II brought an increase in egg production of 50% in the world as a whole, 75% in North America and 25% in Europe. (See Table III.)

TABLE III.—*Output of Animal Foodstuffs by Region, 1954*
(In 000,000 metric tons)

Product	World*	North America	Latin America	Europe	Middle East†	Asia	Africa	Oceania
Meat	43.0	12.5	6.2	13.0	1.4	6.6	1.6	1.7
Beef and veal	22.1	7.2	4.6	5.7	0.8	1.7	1.1	0.9
Pork	16.8	4.9	1.1	6.4	—	4.2	0.1	0.1
Mutton and lamb	4.1	0.4	0.5	0.9	0.6	0.7	0.4	0.7
Other meat	9.0	4.0	‡	2.0	‡	‡	‡	0.1
Poultry	5.2	3.2	‡	0.9	‡	‡	‡	0.1
Offals, horsemeat	3.8	0.8	‡	1.1	‡	‡	‡	0.1
Edible pig fat	3.2	1.1	‡	1.1	‡	‡	‡	‡
Milk	253.2	63.8	17.4	114.0	11.6	28.8	7.0	10.6
Cow	225.2	63.8	16.7	109.0	6.1	13.4	5.6	10.6
Goat	7.7	—	0.7	2.9	1.9	1.3	0.9	—
Sheep	4.8	—	—	1.8	2.5	—	0.5	—
Buffalo	15.5	—	—	0.3	1.1	14.1	—	—
Eggs	10.3	4.3	0.7	3.2	0.3	1.4	0.2	0.2

*Excludes the U.S.S.R.
†Includes the Sudan, Egypt, Somaliland, Ethiopia and Eritrea, Libya in Africa, and Iran, Iraq, Israel, Jordan, Lebanon, Saudi Arabia, Syria, Turkey, Afghanistan and small adjoining territories in Asia
‡Information not available.

The Food and Agriculture Organization of the United Nations (F.A.O.) estimated the world's seafood catch at more than 27,000,000 tons for 1953. The major world producer of fish was Japan, followed by the U.S., Norway, Great Britain and Canada. In Japan, coastal fishing is carried on in numerous tiny villages, while deep-sea fishing is concentrated in a few ports equipped with the necessary facilities. The U.S., with its two coasts stretching over thousands of miles, has a greater variety of marine life than any other nation. Great Britain and Norway, where fishing is a traditional trade, have excellent fishing grounds off their coasts, efficient fleets and experienced fishermen. In Canada, particularly in Newfoundland, fishing is an important industry, and the entire economy of Iceland is keyed to fishing and export of fish.

Marine fishing supplies nine-tenths of the world's catch; the rest comes from fresh waters, of which about 70% originates in Asia. Cod, herring and related species constitute about 45% of the marine catch, the remainder consists of salmon, trout, tuna, numerous other species and variety of molluscs, crustaceans and other aquatic flora and fauna. Whales and other aquatic mammals are not included in the estimate of F.A.O.

About 45% of the world's live weight of total catch is marketed in the fresh or frozen state; about 25% is cured by salting, drying or smoking; about 7% is canned; and the rest, together with offals from dressing, is used for making fish meal. In international trade, fish products move in greater quantities than meats—2,800,000 and 1,500,000 tons, respectively. However, the value of fish in international trade is less than half that of meat.

POSTWAR CHANGES IN WORLD FOOD PRODUCTION

In 1945 the world found itself with a greatly reduced food production, yet with an increase in population of more than 200,000,000, in comparison with the prewar period. In war-torn countries agriculture was disorganized and beset with many difficulties. The soil needed reconditioning after years of inadequate fertilization, and livestock had been decimated for lack of feed. Obsolescence of equipment, lack of new machinery and parts, a shortage of fertilizer, quality seed, labour and draught animals, and other difficulties were aggravated by unsettled political conditions in many regions. Even in areas where there had been no direct fighting or enemy occupation, agriculture had suffered from such indirect effects of the war as cutting off of normal sources of supplies and outlets, shortage of manpower, lack of goods to offer farmers in exchange for their produce, etc. Food production expanded rapidly during the war only in North America, particularly in the U.S., despite the decline in the agricultural labour force. The uninterruptedly rising output of food crops in North America so far exceeded the growth of population that this continent became the world's chief supplier of grain.

With world agriculture out of balance, the problem of food supply became acute in the early postwar years. In 1946–47, when efforts in many countries were concentrated on the increase of food production, output of food in the world as a whole still lagged 7% behind the prewar level. There was even 15% less food per capita than in prewar years. Only international help through the United Nations relief, large direct shipments of food from the U.S., and rationing and price control in many countries staved off famines.

The problem of an insufficient food supply was attacked in various ways. Some countries continued or intensified the wartime policy of shifting from nonfood crops to those of high-calorie content, forbade the use of cereals for feed, raised the extraction and milling rates of grain, etc. In others, governments assumed control of agricultural production and distribution of foodstuffs. The policy of farm price support and subsidies to farmers for obtaining quality seed, fertilizer and equipment became widespread. Agricultural extension service was established in the majority of countries. The most important factor, however, was a broader application of science in agriculture.

New scientific methods revolutionized world agriculture, and while progress was particularly marked in advanced countries, especially in the U.S., gains were also made in underdeveloped regions. Arable land was expanded by bringing millions of additional hectares under irrigation in Asia, Latin America and the middle east. Commercial fertilizers were used in countries which had never used them before or had applied them only on export crops. Between 1938 and 1954–55, world consumption (exclusive of the U.S.S.R.) of nitrogenous fertilizers increased from 2,400,000 tons to 5,800,000; of phosphoric acid, from 3,500,000 tons to 6,700,000; of potash fertilizer, from 2,500,000 tons to 5,400,000. India, Pakistan and the Philippines built plants for domestic production of nitrogenous fertilizers. Power mechanization was increasingly applied to increase yields by more timely operations, to extend the zone of cultivation or to plow up land with deep-rooted weeds, as in India and some African territories. In the world as a whole, exclusive of the U.S. and the U.S.S.R. where tractorization was a feature of agriculture before the war, the number of tractors increased from about 400,000 in 1938–39 to more than 2,300,000 in 1954–55. In many underdeveloped countries, governments and co-operatives established tractor pools to bring mechanized farming within reach of villages.

Synthetic insecticides and pesticides, introduced during the decade after World War II, came into wide use not only in advanced countries but also in underdeveloped regions. Their general use greatly reduced the losses from pests and plant diseases and in some cases was responsible for sharply increased yields.

Perhaps most significant was the spreading use of high-quality seed. Plant breeding was not a new development, but the hold that it took on farmers in underdeveloped regions and the ever-increasing recognition of its potentialities everywhere were new. Where plant breeding had been concentrated before on export and industrial crops, it became centred on food crops. Rice received primary attention in southeast Asia, maize in Latin America. Hybrid corn, the great achievement of United States agriculture, caught the imagination of farmers in Europe and the U.S.S.R. Some provinces of northern Italy had up to 95% of their maize area under hybrids.

New agricultural methods also invaded livestock production and fisheries. Attack on chief animal diseases and internal parasites was carried out in many countries. For example, application of better and cheaper vaccines on a very wide scale achieved good results in the fight against rinderpest in the far east and Africa. Spraying with insecticides of a large area in southeast Africa nearly eliminated the danger from the tsetse fly. Artificial insemination was used in many underdeveloped regions, and use of antibiotics in animal feeding made great progress, particularly in the U.S. and Europe.

South and southwest Africa, Angola, Peru, Chile and several other countries emerged as considerable fish producers in the postwar decade. Much progress was achieved in better fish preservation, in equipment of fisheries, etc.

The list of technical innovations introduced in world agriculture in the decade could be extended, but even this brief enumeration may provide a picture of the changes in this sector of economy. Simultaneously, many institutional changes were made in land ownership, land tenure and land taxation, in order to raise farmers' income, encourage the improvement of holdings and stimulate intensification of production. Agrarian reforms, varying in extent, were carried out, fully or partly, in Japan, India, Burma, Pakistan, China and Formosa in the far east; in Turkey and Egypt in the middle east; in Bolivia, Guatemala and Puerto Rico in Latin America; in Finland, Italy, Spain and eastern European countries. These reforms involved changes in the tenancy system to provide security to the tenants, establishing the right to compensation for improvements, elimination of personal services to landlords, etc. Attack on excessive fragmentation of land, an old obstacle to the increase of agricultural productivity, was launched in many countries not only in Europe but also in Asia. In Japan, for example, nearly 20% of all cultivated land was consolidated by the end of 1954. India and Pakistan initiated an active policy against land fragmentation. Collection of taxes through intermediaries leading to exploitation and village poverty was abolished in such countries as Japan, India, Pakistan and Mexico, among others.

These and other measures revitalized world agriculture so that ten years after the end of World War II the food output of the world as a whole exceeded the prewar level by 20%; the increase was as large as 29% in the world, exclusive of the U.S.S.R., China and eastern Europe. Because of increased population, however, the output per person was only 1% higher than before the war.

The development was highly uneven. In many regions production did not keep pace with the growth of the population. Thus in

TABLE IV.—Index Numbers of Food Production by Region, 1946–55
(Prewar average= 100)

Region	1946–47	1950–51	1954–55
Total food production			
World	93	111	120
World, exclusive of the U.S.S.R., China and Eastern Europe	103	118	129
North America	138	139	145
Latin America	115	130	139
Western Europe	76	110	124
Middle East	103	120	138
Asia	91	100	109
Africa	107	128	142
Oceania	92	111	116
Food production per capita			
World	85	97	101
World, exclusive of the U.S.S.R., China and Eastern Europe	91	98	101
North America	124	116	113
Latin America	94	97	94
Western Europe	72	100	109
Middle East	91	99	106
Asia	80	83	86
Africa	93	105	109
Oceania	85	93	87

Latin America food production in 1954–55 was 39% higher than before the war but with the 45% increase in population, the per capita food production was 6% below the prewar level. The worst food situation was in Asia, where food supplies have always been very low and where the rapid growth of the population outstripped the modest advances in agriculture. Moreover, this continent faced much greater difficulties than other parts of the world in expanding its food production because of continuing political disturbances and lack of capital, equipment and technical knowledge. Though the index of per capita food production in 1954–55 was about the same in Oceania as in Asia (87 and 86, respectively, in comparison with prewar years), actual food conditions in the two areas are entirely different. *(See* Table IV.) Oceania's agriculture is highly developed and geared to export of large quantities of agricultural surpluses. The decline in per capita output of foodstuffs does not, therefore, affect the exceptionally high nutritional standards of this area; it only reduces surpluses available for export. On the other hand, food shortage in Asia presents Asian peoples with a dilemma: they must either make further cuts in their meagre diets or seek ways to increase production.

While food deficiency remains a grave problem for a large part of the world population, burdensome surpluses of foodstuffs, especially of grain, have accumulated in the United States and some other countries in postwar years. The traditional exporters of rice in Asia, Burma and Thailand became loaded with surpluses because domestic production of the importing countries began to satisfy the requirements for rice to a greater degree than before the war. For the same reason Latin America was faced with surpluses in sugar. The abnormality of such a situation was somewhat mitigated by the fact that most of the stocks were in the hands of governments trying to avoid dumping of surpluses on the world market in order not to cause a catastrophic drop in farm prices: the experience after World War I had taught the world that unorganized unloading of surpluses disorganizes world agriculture and ruins millions of farmers.

FOOD SUPPLY AND NUTRITIONAL PATTERNS

With due reservation for a considerable margin of error, the food balance sheets prepared by the F.A.O. for individual countries provide a telling picture of the net food supply available in each country at the retail level and can serve as a basis for comparing the nutritional patterns in different countries. These patterns may be measured in pounds and ounces of foodstuffs consumed, or in calorie value of different foods per person in average national daily diets, and characterized by the composition of the daily calorie intake.

According to the F.A.O. estimates, total daily calorie intake per person varies from country to country, ranging from less than 2,000 calories in some underdeveloped areas (the Philippines, India, Peru and others) to more than 3,000 in prosperous countries such as the United States, Canada, Great Britain, Switzerland, Denmark, Australia and New Zealand.

Apart from this general correlation between the level of prosperity, roughly measured by the per capita income and daily intake of calories, the pattern of nutrition in different countries depends on climate, composition of the population and national food habits. The daily number of calories per person in most countries with a per capita income of more than $500 either exceeds 3,000 calories or is very close to it (2,973 in Sweden; 2,928 in Belgium-Luxembourg). The unique position of Ireland in this group with its daily 3,483 calories per person is accounted for partly by the cool moist climate of the island and partly by the large proportion of starchy foods (potatoes) in its diet. Similarly, Uruguay with its very high consumption of livestock products consumes daily nearly 3,000 calories per person although its per capita income ($300) does not permit it to rank among the most prosperous nations. As one moves down the scale of per capita incomes, the daily food supply in terms of calories diminishes and, at the bottom of the scale, falls below the physiological requirements, as in the Philippines and India. *(See* Table V.)

More revealing than total calorie intake is the composition of national diets. The more prosperous a country, the less important are the cereals and starchy roots in its diet. The calorie content of meat and dairy products in the daily intake per person varies from more than 1,000 calories in New Zealand (1,163) and the U.S.

TABLE V.—*National Income and Net Food Supply in Selected Countries, 1954–55*

(Per capita of population)

Country*	National income, U.S. dollars	Calories in daily food supply							
		Total	Cereals and starchy tubers	Sugar and syrup	Pulses and nuts	Fruit and vegetables	Meat, milk and eggs	Fish	Fats and oils
United States	1,850	3,092	803	486	83	192	1,006	21	501
Canada	1,250	3,032	821	494	71	141	991	31	483
Switzerland	1,050	3,099	1,144	417	98	190	841	13	396
Sweden	1,000	2,973	941	457	30	103	882	72	488
Sew Zealand	950	3,289	958	472	46	140	1,163	13	497
Australia	925	3,040	944	560	54	113	963	11	395
United Kingdom	850	3,231	1,053	515	66	116	901	27	333
Norway	775	3,136	1,146	420	39	89	717	67	658
Belgium-Luxembourg	750	2,928	1,277	301	47	147	591	28	537
Denmark	750	3,298	1,103	496	49	155	832	44	619
Finland	625	3,102	1,443	377	19	36	760	43	424
France	525	2,783	1,263	306	56	150	676	24	308
Netherlands	525	2,925	1,082	418	45	101	593	23	663
Ireland	500	3,483	1,611	410	14	84	861	12	491
Western Germany	500	2,943	1,262	286	38	126	627	25	579
Venezuela	500	2,275	1,093	452	156	123	264	35	152
Israel	350	2,739	1,516	241	83	214	306	27	352
Italy	300	2,594	1,581	172	105	155	280	20	281
Uruguay	300	2,950	1,111	347	26	84	972	3	407
Union of South Africa	300	2,651	1,556	439	36	60	380	40	140
Austria	275	2,788	1,320	290	26	103	635	12	402
Argentina	27j	2,799	1,090	325	29	101	782	6	406
Chile	250	2,488	1,466	2j3	85	89	347	33	
Yugoslavia	200	2,711	1,939	85	84	86	292	2	
Japan	zoo	2,165†	1,545	138	53	63	38	55	49
Portugal	175	2,363	1,363	168	jg	214	150	74	335
Greece	175	2,536	1,469	114	160	162	248	25	358
Philippines	175	1,957	1,430	149	67	127	82	29	73
Turkey	150	2,669	1,924	3	137	146	159	8	157
Southern Rhodesia	125	2,651	1,556	439	36	60	380	40	140
Egypt	110	2,390	1,717	163	102	149	156	13	90
Brazil	100	2,342	1,216	354	231	158	216	8	159
Peru	100	2,077	1,356	213	83	75	198	7	145
Pakistan	60	2,025	1,464	127	73	62	208	2	89
India	60	1,837	1,303	105	215	30	108	3	73

*Countries are listed in the order of declining per capita income. †Includes calories from unreported sources.

(1,006) to 38 calories in Japan. These are the extremes on the international scale of consumption. But daily rations of meat providing 600 to 1,000 calories are quite usual in prosperous (or livestock-raising) countries. while rations of less than 200 calories are characteristic of primarily agricultural underdeveloped countries. The first group includes countries of northwestern Europe, Australia and the cattle-raising countries of Latin America (Argentina and Uruguay). The second group embraces almost all of Africa, the middle east and the countries of Asia for which statistics are available. A few small areas such as Israel have a slightly higher intake of livestock products than is characteristic of this group, but this does not change the general nutritional pattern of the vast region from the Atlantic coast of Africa to the China sea and the Pacific coast of Asia.

A large part of Latin America from the Rio Grande to the border of Uruguay and Argentina, southern and eastern Europe including Italy, Greece and Yugoslavia, and the southern tip of Africa form a middle group, with 200 to 600 calories from livestock products in their daily diets. In China and the U.S.S.R., for which no statistics are available, the former is among the countries with the lowest consumption of meat. The position of the U.S.S.R. is less certain: there are indications that its consumption of meat and dairy products is very low but it may be close to the borderline between the areas with less than 200 calories and those with 200–600 calories. (*See* map).

Because fish is cheaper than meat, its consumption within a country is usually larger in low-income groups than among the rich. But this correlation disappears when comparison is made among individual countries. The development of fisheries in certain areas has been determined by geographic and historical conditions. Sweden, one of the most prosperous nations in the world, has about the same number of daily calories from fish consumption as poorer Portugal—72 and 74 calories, respectively, New Zealand, with a per capita income of $950 a year, obtains 13 calories daily from fish consumption, as much as Egypt which has a per capita income of $110.

The role played by fruit and vegetables in human diet also depends on geographic conditions. It is greater in subtropical and tropical zones than in areas with temperate climates, but it is also correlated to some extent with the economic level, being much higher in prosperous countries than in the poor ones. In India, for example, less than 2% (30 calories) of daily intake comes from consumption of fruit and vegetables, as compared with more than 11% (141) calories in Canada.

ADEQUACY OF NET FOOD SUPPLY

Individual food requirements vary considerably depending on climate, age, sex, type of work performed and various other factors. The F.A.O. has calculated average physiological requirements for the population of different countries basing its estimates on specific climatic conditions in respective countries and the physical characteristics of their population.

According to these estimates, average daily food requirements in most countries of the temperate zone vary between 2,600 and 2,850 calories: about 2,840–2,850 for Sweden and Norway; 2,710–2,750 for Canada, Switzerland and Denmark; 2,600–2,670 for the United States, Belgium-Luxembourg, the Netherlands, Great Britain, Argentina, Australia and New Zealand. In countries with a warmer climate the requirements are estimated at 2,2jo–a,500 calories for Pakistan and India, and 2,440–2,j50 calories for Italy, France, Portugal, Turkey, Brazil, Mexico and Venezuela.

A comparison of actual daily intake per person with the estimated requirements reveals that average consumption of iood, in terms of calories, in prosperous countries exceeds the physiological requirements. while in other countries the net food supply available to the people at retail level is insufficient to provide them with the number of calories required for health and normal functioning of human bodies. Moreover, food supply is usually very unevenly distributed among different population groups within a country High-income groups may often consume more food than is good for their health, while at the other extreme many low income groups cannot obtain even the required minimum of calories in their daily diet.

After having established minimum food requirements for different countries, the F.A.O. estimated nutritional targets for respective countries for 1960. These targets represent a compromise between the net iood supply available per person at retail level in 1952–53, the physiological requirements and the economic feasibilities. In the case of such underdeveloped areas as many African territories, Japan, India, Paki-

TABLE VI.—*Daily Food Intake, Requirements and Targets in Selected Countries*

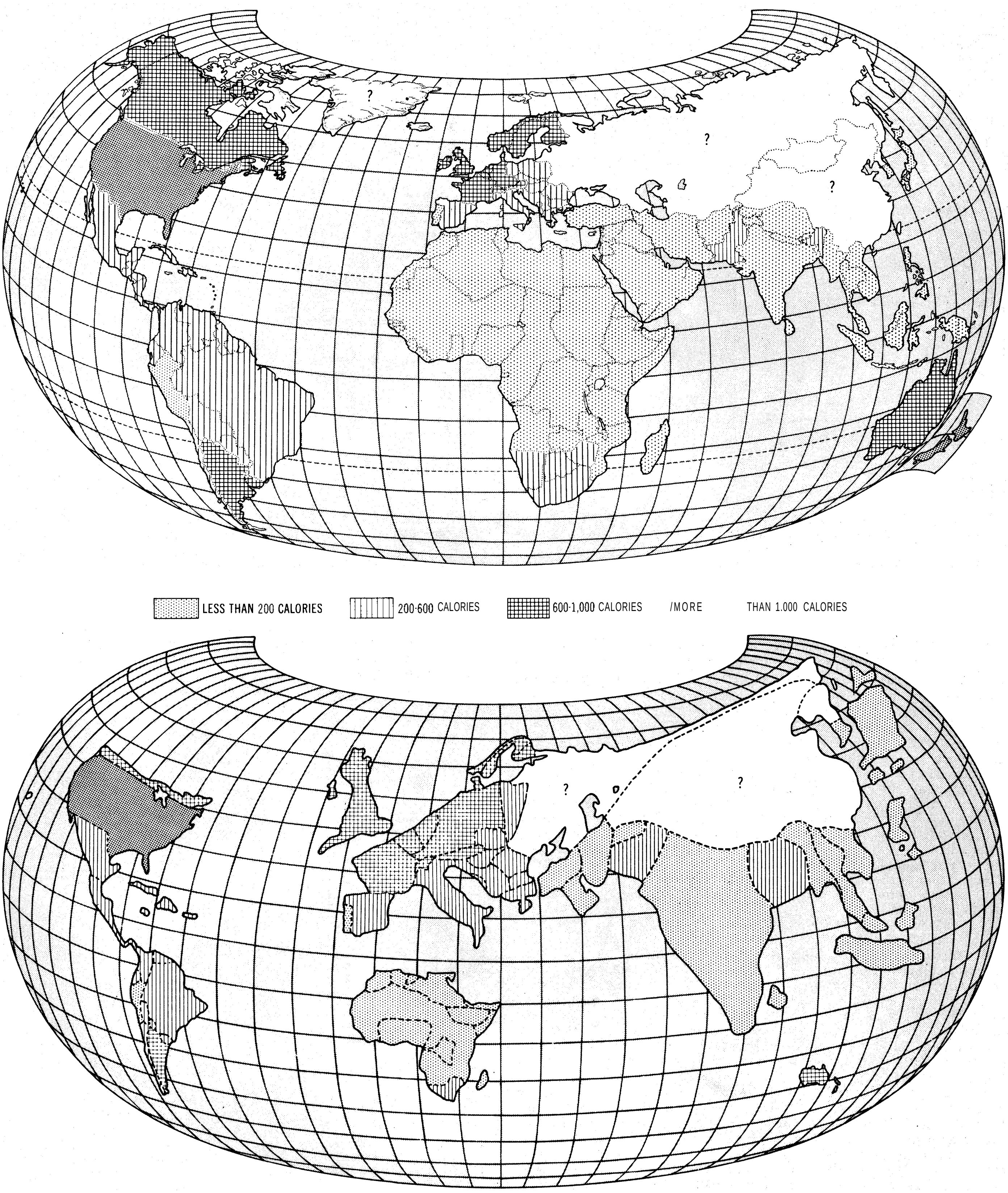
(Calories per capita of population)

Country*	Intake-1954–55	Requirements†	Target 1960
Norway	3,136	2,850	3,190
Sweden	2,973	2,840	3,120
Denmark	3,298	2,750	3,120
Switzerland	3,099	2,720	3,120
Canada	3,032	2,710	3,050
New Zealand	3,289	2,670	3,180
United Kingdom	3,231	2,650	3,120
Chile	2,488	2,640	2,600
United States	3,092	2,640	3,110
Finland	3,102	2,630	3,180
Netherlands	2,925	2,630	3,030
Australia	3,040	2,620	3,150
Belgium-Luxembourg	2,928	2,620	2,880
Argentina	2,799	2,600	3,170
Uruguay	2,950	2,570	2,720
France	2,783	2,550	2,890
Colombia	2,280	2,550	2,590
Peru	2,077	2,540	2,340
Mexico	2,050	2,490	2,420
Cuba	2,740	2,460	2,820
Portugal	2,363	2,450	2,730
Brazil	2,342	2,450	2,470
Italy	2,594	2,440	2,680
Venezuela	2,275	2,440	2,490
Turkey	2,669	2,440	2,580
French North Africa	1,920	2,430	2,290
Tanganyika	1,980	2,420	2,230
Union of South Africa	2,651	2,400	2,510
Greece	2,536	2,390	2,634
Egypt	2,390	2,360	2,390
Japan	2,165	2,330	2,210
Pakistan	2,025	2,300	2,230
Ceylon	1,970	2,270	2,200
India	1,837	2,250	2,000
Philippines	1,957	2,230	2,250

*Countries are listed in the order of declining requirements.
†For Cuba, Mexico, Ceylon, Tanganyika and French North Africa: 1949–51.
Source: Estimates of the Food and Agriculture Organization.

stan, Ceylon, Peru, Mexico and others, these targets fall still short of physiological requirements but come closer to the latter than actual consumption was in 1954–55. On the other hand, the F.A.O. targets were below the actual intake in 1954–55 in some countries such as in Denmark, Great Britain, Australia and others. *(See* Table VI.)

To meet these targets for the world's growing population a tremendous expansion of food production by 1960 was required: 19% more cereals, 47% more pulses, 30% more meat, 33% more milk, 39% more eggs, etc. What made the task even more formidable is that the largest increase in production would have to come in underdeveloped areas



BY COURTESY OF (TOP) ERWIN RAISZ

DAILY PER CAPITA INTAKE OF MEAT AND DAIRY PRODUCTS THROUGHOUT THE WORLD. TOP. CONVENTIONAL MAP SHOWING PER CAPITA INTAKE IN VARIOUS GEOGRAPHIC AREAS. BOTTOM DISTORTED MAP SHOWING THE PROPORTION OF THE WORLD'S POPULATION IN EACH CALORIC CATEGORY. AREAS ARE SHOWN IN SIZE PROPORTIONATE TO THEIR POPULATION where the need was greatest. According to the F.A.O., the increase in cereal supplies in Asia and Africa wouldhave to be twice as large as the expected increase in the population. Expansion in production of other foodstuffs such as pulses, meat, milk, eggs and fish would have to he proportionately still greater. As to the advanced countries, the targets called for an expansion of livestock production that would exceed the estimated population increase in order to raise the proportion of protective foods in their respective diets.

FOOD SUPPLY AND EXPANDING POPULATION

The challenge to world agriculture was twofold, quantitative and qualitative: to produce more food for the growing world population and to intensify production of protective foods—meat, dairy products, etc.

Agricultural experts were confident that, apart irom annual fluctuations depending on weather conditions, the world's iood supply would continue to increase in the years to come, more rapidly than the world population. There were still large areas of unused land capable of cultivation on all continents, and these were to be gradually brought under plough by irrigation, flood control, drainage, fertilization, etc. Yields per unit of land in underdeveloped regions might be expected to rise from their present low levels as a result of broader application of improved agricultural methods developed in advanced countries. Higher yields would cover the world needs for cereals and other starchy foods and release some land, now occupied by crops for human consumption, for pastures and feed crops. Such a development would favour the growth of a modern livestock industry and diversification of agricultural production.

These expectations were supported by the observation that there is a time lag between the improvements in agriculture and their effect: the results of improvements already accomplished or nearing completion in underdeveloped areas in the first postwar decade would become mare and more evident as time passed.

The main and most disturbing ieature of the world food supply at the beginning of the second decade after World War II was the great contrast between the surplus in food production in certain areas and food deficiency in other. There was little possibility of an automatic alleviation of this situation in the near future. Surpluses could hardly be eliminated by restriction on agricultural production in areas with overfilled storehouses, or by the normal growth of world population accompanied by a proportionate increase in demand for foodstuffs.

The equilibrium between production and consumption of food in the u·orld would depend, to some extent, on the outcome of plans for industrialization and economic development in areas where undernourishment of the population is a permanent feature. If and to the extent that these plans were successful, they would lead to a rise in per capita income and a higher standard of living. As income rose in poor countries, the first call of the people would be for more iood to satisfy hunger. Progress in domestic agricultural production might not be sufficient to meet the growing demand. Increased imports of foodstuffs from surplus areas might then become necessary—a logical movement of foodstuffs irom comparatively sparsely populated to overpopulated countries.

Along with measures for further economic development, the F.A.O. recommended measures designed to change food habits by teaching people about the advantages of a nutritionally balanced diet. A campaien of this kind, concerning the nutritional value of liquid milk, had resulted in a substantial increase in milk consumption in western countries. The F.A.O. believed that similar results might be achieved elsewhere.

Among other means for raising consumption of protective foods were measures to reduce production and marketing costs of such foods. This would bring them within the reach of large groups that cannot afford them now, not only in underdeveloped areas but all over the world.

In briei, the problem of food supply in the world is not simply a question of the race between the increasing population and the carrying capacity of the earth. Rather, this is a complex economic problem that appears in different forms in different areas and ultimately merges with the general problem of social and economic progress in the world. *See* also NATURAL RESOURCES.

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FOOL (JESTER), a simpleton whose imbecility, real or assumed, is utilized for entertainment. The origin of the professional fool is obscure. In Mohammedan and early Irish sources, madmen are mentioned who, inspired with poetic and prophetic powers, behaved as professional jesters; *e.g.*, Buhlul, who flourished at the court of Harun al-Rashid in the 9th century, and Mac-da-Cherda in 7th-century Ireland. Dwarf fools may have been kept for luck as well as for fun; in the belief that deformity can avert the evil eye and abusive raillery transfer ill luck from the abused to the abuser. The Asian Indian dwarf buffoon Vidusaka, whose name means "an abuser," appears in drama and society during the early centuries A.D. In the 19th century the buffalo sacrifice of south Indian villages was accompanied by the buffoon Raniga, who railed at everyone including the officiating priest and the earth-goddess, and the fool of European folk customs plays a similar part. His raillery and association with a mock king suggest that he was once a scapegoat substituted for a royal victim. E. K. Chambers (see *Bibliography)* finds traces of sacrificial *exuviae* ("garments") in the foxtail, calfskin, etc.. of the festival fool and in the coxcomb. eared hood, bells and bauble which, with the motley coat, formed the official costume of the household jester. At Christmas, particularly in France, medieval clergy celebrated a "Feast of Fools" derived from the pagan Kalendae. A mock bishop or pope was elected. ecclesiastical ritual was parodied, low and high officials changed places and masked clergy rioted inside and outside churches.

In imperial Rome, fools were kept in wealthy houses? and deformity and imbecility fetched high prices in the slave market. References to household fools reappear in the 12th and increase during the 14th and 15th centuries, particularly in French account books. Fools were attached to courts, private households, corporations, taverns and even brothels. During the Renaissance, interest was taken in famous fools such as I1 Matello, the pet of Isabella d'Este. marchioness of Mantua; Triboulet. who amused Louis XII and Francis I; Cardinal Wolsey's enemy Will Sommers; the French female fool Mathurine; the German Claus Narr and Kunz von der Rosen, the intelligent. loyal fool of Maximilian I. The last official French royal fool was the formidable L'Angely who, standing behind Louis XIV at table, terrified courtiers with his sarcasm until finally banished for impertinence. Archibald Armstrong, fool to James I and Charles I, made so much money that. after being "unfrocked" for insolence to Archbishop Laud, he became a landowner in Cumberland. His successor, Muckle John, an insignificant simpleton, was probably the last English royal fool. In the 18th century household jesters declined in western Europe but flourished in Russia, and offending courtiers were sometimes degraded into court jesters.

The fool also appears in drama. In 15th-century French mysteries. he clowns, addresses the audience and even makes satirical comments on God. while the role of the Vice in Tudor interludes is probably derived irom that of the domestic fool. who is thus connected with the English stage clown. When *As You Like It, Twelfth Sight* and *King Lear* were produced, the clown in Shakespeare's company was Robert Armin, who published an account of household fools.

From the late 15th century to the early 17th century, the suppressed Feast of Fools was continued by members of secular fool societies who, adopting the dress and licensed freedom of the domestic fool. satirized contemporaries in burlesque processions and in farces (soties). which culminated in disrobing the characters to display the motley coat beneath the learned gown. The theme of 15th- and 16th-century fool literature was the universality of folly and its satire was Christian satire: Sebastian Brant's *Narrenschiff* is packed with knaves in cap and bells. for the knave is a fool who buys temporal pleasure for eternal pain. On the other hand the fool. having no social standing, can see truth impartially and even symbolize the divine "foolishness" which is "wiser than men." These ideas all contribute to the ironies of Erasmus' *Praise of* Folly and Shakespeare's *King Lear*.

The fool is easily confused with the buffoon. The laughter-making parasites who gained free dinners in Greece and Rome. the itinerant tricksters n·ho contributed to the art of storytelling in medieval and Renaissance Italy and the madcap poets and friars who diverted Pope Leo X, all exploited their eccentricities for purposes of entertainment. Such characters attract stock jokes and may become mythical heroes of jestbooks, and many pranks of Till Eulenspiegel, John Scogan and Bertoldo were derived from the legend of the peasant Marcolf who outwitted Solomon. The buffoon resembles the fool in his irresponsible absurdity, but he is mischievous rather than insane, whereas the fool is essentially a real or pretended lunatic. See also CLOWN.

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FOOLS, FEAST OF, the name for certain burlesque, quasi-religious festivals which, during the middle ages, were the ecclesiastical counterpart of the secular revelries of the Lord of Misrule. (Lat. jestum stultorum, *follorum;* Fr. *fête* des fous.) The celebrations are directly traceable to the pagan Saturnalia of ancient Rome which, in spite of the denunciation of bishops and ecclesiastical councils, continued to be celebrated by the people with all their old licence. In the 11th century Bishop Burchard of Worms thought it necessary to fulminate against the excesses connected with it. The clergy set apart certain days as special festivals for different orders: the feast of St. Stephen (Dec. 26) for the deacons, St. John's day (Dec. 2;) for the priests, Holy Innocents' Day for the boys, and for the sub-deacons Circumcision, the Epiphany, or Jan. 11. The Feast of Holy Innocents became a festival of children, in which a boy, elected by his fellows of the choir school, functioned solemnly as bishop or archbishop, surrounded by the elder choir-boys as his clergy. (See BOY-BISHOP.) At first there is no evidence to prove that these celebrations were characterized by any indecorous behaviour; but in the 12th century such behaviour had become the rule. In 1180 Jean Beleth, of the diocese of Amiens, calls the festival of the sub-deacons festum *stultorum.* A young sub-deacon was elected bishop, vested in the episcopal insignia (except the mitre), and conducted by his fellows to the sanctuary. A mock mass was begun, during which the lections were read cum farsia, obscene songs were sung and dances performed, cakes and sausages eaten at the altar, and cards and dice played upon it.

This burlesquing of things sacred, though condemned by serious-minded theologians, conveyed to the child-like popular mind of the middle ages no suggestion of contempt, though when belief in the doctrines and rites of the mediaeval Church was shaken, it became a ready instrument in the hands of those who sought to destroy them. This naïve temper of the middle ages is nowhere more conspicuously displayed than in the Feast of the Ass, which under various forms was celebrated in a large number of churches throughout the West. Often the ass was a mere incident in the Feast of Fools; but sometimes he was the occasion of a special festival, ridiculous enough to modem notions but by no means intended in an irreverent spirit.

Celebration at **Beauvais.**—A singular celebration at Beauvais, which was held on Jan. 14, represented the flight into Egypt. A richly-caparisoned ass, on which was seated the prettiest girl in the town, holding in her arms a baby or a large doll, was escorted with much pomp from the cathedral to the church of St. Btienne. There the procession was received by the priests, who led the ass and its burden to the sanctuary. Mass was then sung; but instead of the ordinary responses to the Introit, Kyrie, Gloria, etc., the congregation chanted "Hinham" (Hee-haw) three times. At the close of the mass the priest, turning to the people, instead of saying, *Ite missa* est, brayed; the people, instead of Deo gratias, thrice responded Hee-haw, Hee-haw, Hee-haw.

Celebration at **Sens.**—At Sens the Feast of the Ass was associated with the Feast of Fools, celebrated at Vespers on the Feast of Circumcision. The clergy went in procession to the west door of the church, where two canons received the ass, amid joyous chants, and led it to the precentor's table. Bizarre vespers followed, sung falsetto and consisting of a medley of extracts from all the vespers of the year. Between the lessons the ass was solemnly fed, and at the conclusion of the service was led by the precentor out into the square before the church (conductus ad ludos); water was poured on the precentor's head, and the ass became the centre of burlesque ceremonies, dancing and buffoonery being carried on far into the night.

Various efforts were made during the middle ages to abolish the Feast of Fools. How little effect these had, however, is shown by the fact that in 1265 Odo, archbishop of Sens, could do no more than prohibit the obscene excesses of the feast, without abolishing the feast itself; the festival was, in fact, too popular to succumb to these efforts, and it survived throughout Europe till the Reformation, and even later in France; for in 1645 Mathurin de Neuré complains in a letter to Pierre Gassendi of the monstrous fooleries which yearly on Innocents' Day took place in the monastery of the Cordeliers at Antibes.

FOOL'S-PARSLEY, in botany, the common name for Aethusa *cynapium,* of the family Umbelliferae (*q.v.*), a common weed sparingly naturalized in the eastern United States and Canada and in cultivated ground in Great Britain. It is an annual herb, with a fusiform root and a smooth hollow branched stem 1 to 3 ft. high, with much divided (ternately pinnate) smooth leaves and small compound umbels of small irregular white flowers. The plant has a nauseous smell, and, like various other members of the family (*e.g.,* water hemlock), is poisonous.

FOOT, that part of the lower extremity on which the body rests when in an upright position, standing or moving. It articulates with the leg at the ankle joint. See ANATOMY, GROSS; SKELETON, VERTEBRATE.

The word is also applied to such parts of invertebrate animals as serve as a foot, either for movement or attachment to a surface. From the resemblance to the foot, in regard to its position, as the base of anything, or as the lowest member of the body, or in regard to its function of movement, the word is applied to the lowest part of a hill or mountain, to the plate of a sewing machine which holds the material in position, to the part of an organ pipe below the mouth, and the like. In printing, the bottom of a type is divided by a groove into two portions known as "feet." Probably referring to the beating of the rhythm with the foot in dancing. the word was applied in prosody to a grouping of syllables, one of which is stressed, forming the division of a verse. "Foot," (*i.e.* foot soldier) was formerly, with an ordinal number prefixed, the name of the infantry regiments of the British army. It is now superseded by territorial designations, but is used in the five regiments of the infantry of the household, the foot guards. As a lineal measure of length the "foot" is of great antiquity, estimated originally by the length of a man's foot (see WEIGHTS AND MEASURES). For the ceremonial washing of feet see MAUNDY THURSDAY.

FOOT, DISEASES AND DISABILITIES OF. The normal human foot is composed of 25 bones related to one another through joints, supported and stabilized by ligaments and controlled by muscles and tendons. (For its anatomy, see SKELETON. VERTEBRATE: *Appendicular* Skeleton: Lower Limb and JOINTS AND LIGAMENTS.) Its purposes are (1) to support the weight of the body and (2) to serve as a lever in propulsion of the body. Function of the feet depends upon anatomical integrity, joint stability, elasticity of the arches and good muscular tone. Anything disrupting any one of these factors will affect function adversely. Measures designed to preserve or improve these factors are basic to all programs of prophylactic or therapeutic foot care. Well-fitted supportive shoes, hygienic care, weight control and muscle-strengthening exercises are the most important.

Congenital Disorders.—Clubfoot and flatfoot, the two commonest congenital anomalies, are discussed in the separate articles CLUBFOOT and FLATFOOT.

A condition often mistaken for clubfoot is one in which the forefoot turns in, unaccompanied by downward flection or extreme rigidity. This is called metatarsus adductus. It is a condition ordinarily self-limited and self-correcting. Prolonged treatment is seldom necessary.

Bunions occur as a result of a congenital foot abnormality. This condition, hallux valgus, consists of an angulation outward of the first metatarsal bone with a compensatory deviation inward of the great toe. This results in a prominence of the medial aspect of the metatarsal head. Irritation by shoes results in an irritation of the soft tissues overlying the bone. The inflamed, tender bursa thus produced constitutes the bunion. Conservative treatment often suffices to control symptoms. Surgical reconstruction of the deformed foot gives the best long-term results in young patients.

Developmental Disorders. — Many of these overlap with congenital disorders. They may be subdivided into those produced by trauma and those produced by disease.

Metatarsalgia is basically an irritation of the soft tissues underlying the forefoot. When it is severe enough, weight bearing may be excruciatingly painful. Proper general foot care plus shoe corrections normally bring gradual relief. Other conditions of similar etiology are "policeman's heel" (calcaneal bursitis), inflammation of tendons (tenosynovitis) and of other bursae.

Disease may attack the feet as anywhere in the body — pyogenic infections. tuberculosis and tumours are not uncommon. Transient interruption of local blood supply to portions of certain bones produces aseptic necrosis, the local death of bone. Treatment is aimed at avoiding trauma until the body can replace this dead bone with living bone, limiting further deformity.

See also CORN; FRACTURES AND DISLOCATIONS; HAMMERTOE.

(J. DY.)

FOOT-AND-MOUTH DISEASE (APHTHOUS FEVER, EPIZOOTIC APHTHA, ECZEMA EPIZOOTICA) is a highly contagious disease affecting practically all cloven-footed animals. It is characterized by the formation of vesicles (blisters) on the tongue, lips and other tissues of the mouth, and on parts of the body where the skin is thin, as on the udder and teats, between the claws of the feet and around the coronary band above the hoof.

The disease appears suddenly and spreads very rapidly. The virus has an affinity for epithelium (the covering of the skin and mucous membranes of the gastrointestinal tract); it forms a primary vesicle where it gains entrance in the body. Within 24 to 48 hours it enters the blood stream, causing fever. During this phase, lasting 24 to 36 hours, the virus is excreted in the saliva, the milk, the urine and the faeces. The characteristic smacking of the lips then usually becomes prominent, ushering in the phase of the formation of secondary vesicles. These rupture in about 24 hours, leaving raw, painful surfaces.

Losses caused by foot-and-mouth disease are tremendous. The mortality in ordinary mild epizootics is only about 5%, but malignant forms of the disease have led to losses up to 50%. In those animals that survive, great losses in weight occur because the animals cannot eat. In surviving milk animals the flow is sharply diminished. Abortions and mastitis are common. Secondary infections are frequent, especially about the feet.

The diagnosis of foot-and-mouth disease is complicated by the existence of two other vesicular diseases, vesicular stomatitis and vesicular exanthema. Careful study is necessary to differentiate among the three. As is generally the case in virus diseases, an exact diagnosis can be made on the basis of animal tests. The horse is not susceptible to foot-and-mouth disease. The cow and the guinea pig are not susceptible to vesicular exanthema. When a fever, followed by characteristic vesicles, develops in swine, cattle and guinea pigs, but not in horses. a diagnosis of foot-and-mouth disease is justified. When all four of the animals develop vesicles, a diagnosis of vesicular stomatitis is justified. When lesions are seen in swine, but not in cattle or guinea pigs, and infrequently and to a mild degree in horses, a diagnosis of vesicular exanthema of swine is justified.

The virus of foot-and-mouth disease is the smallest known. Estimates indicate that the virus of smallpox is 10,000 times larger. In common with all viruses, living tissue must be used to cultivate it. It has been cultivated in tissue culture containing epithelium procured from guinea pig embryos.

The virus is resistant to destruction if the conditions are right. When contained in the epithelium of the vesicular coverings, it has been shown to remain active in hay for 30 days. In beef and pork carcasses kept at freezing temperature, the virus from the bone marrow was still active after 76 days. The virus is resistant for hours to such standard antiseptics as 0.1% bichloride of mercury, 5% phenol and 3.5% liquor cresolis compound, but 2% sodium hydroxide destroys the virus in a few minutes.

Immunity to foot-and-mouth disease is complicated by the existence of six known types of the disease virus. An animal recovering from foot-and-mouth disease is immune to the type of virus causing the disease but is susceptible to the other five known types. Further, the immunity is not permanent, many animals being susceptible to reinfection with the same virus type after one year. Immunization by vaccination is possible, but this confers immunity for only about four months. Adding to the complexity of the problem are variants of the disease virus within a type. There are recorded instances in which a virulent variant broke through the protection afforded by a vaccine of the same type.

Diagnosis of the type or types of virus is often important. This had been an expensive procedure until 1952, when the Foot-and-Mouth Disease Research institute at Pirbright, Eng., announced a test which determines the type of virus involved within a few hours.

Foot-and-mouth disease is reputed to be more than 2,000 years old, but not until the 17th and 18th centuries is there found trustworthy evidence of its presence. The disease is present in most countries of the world. In the early 1950s the only countries reporting freedom from it were the United States and its territories, Australia, New Zealand, Greenland, Iceland, Norway, Ireland, Northern Ireland, the Channel Islands, Central America, islands of the Caribbean and the West Indies.

The disease first invaded England in 1839 and quickly spread throughout Great Britain. There were 11 more outbreaks in Britain between 1839 and 1902, then none until after World War I. Each outbreak was stamped out as it occurred, but reinfection from other countries came with disturbing frequency.

Foot-and-mouth disease first invaded the United States in 1870 through cattle imported via Canada from England. Imported livestock were also responsible for outbreaks in 1880 and in 1884. After the latter outbreak, inspection, quarantine and rigid regulations prevented introduction of the disease with livestock. Other outbreaks occurred in 1902, 1914 and 1924 because of the importation of infected materials such as hay and garbage or imported smallpox vaccine. An outbreak occurred in 1929 because regulations were violated.

With the invasion of Venezuela (1950) and Colombia (1951), every country in South America had become victim to the plague. An outbreak which occurred in Mexico during 1946 caused grave concern to the United States. To fight it a Mexican-United States commission was formed that carried on an extensive campaign leading in 1952 to final elimination of the disease in Mexico. At the height of that campaign about 8,200 workers were employed, and more than $1,000,000 a month was spent. (NA. BR.)

FOOTBALL, the name given to a number of games in which each of two teams attempts to kick, carry or otherwise force a ball through a goal or across a goal line defended by the opponent. (For the U.S. game of soccer, *see* SOCCER.) This article, covering the major variations of football, is divided into the following sections:

I. EARLY HISTORY

The highly organized modern games grouped under the generic name of football all developed out of the *mêlées* or mellays of ancient and medieval Britain in which a round or oval object, usually the inflated bladder of an animal, was kicked, punched. carried or driven toward some goal. The immediate origin of the mellays is obscure in most cases. The real origin may well have been the child's apparently instinctive desire to kick any small object in its path, go on kicking it and keep it from other would-be kickers.

The Romans undoubtedly played a game called *harpastum,* the name being derived from the Greek word for "handball." An ancient writer says that the players were divided into two bands. each of which tried to force the ball beyond a line drawn behind its opponents; the game was started by throwing the ball up in the air in mid-field and in the course of the struggle there was much pushing backward and forward. It has not been proven that the Romans played *harpastum* in Britain during their occupation of the country, but it is extremely probable that they did, and in several cities and towns of Roman origin there are traditions of early games which might have been developments of *harpastum.* From early times there was a game of football annually on Shrove Tuesday at Chester, a town founded and named by the Romans. The shoemakers annually delivered a leather ball, to the value of 40d. or more. to the drapers, who played football with it between the hall of Rodehee and the common hall of the city; the tradition that the first ball used was the head of a dead Danish brigand may, however, mean that this game was not a child of *harpastum,* but the result of an indigenous method of celebrating victory over one's enemies. The game became so violent that it was stopped and replaced by a running match at Rodehee. Shrove Tuesday, a day of festival before a fast, became the day on which nearly all these medieval mellays, which seem to bear more or less resemblance to football, took place; among the more notable were those at Derby, Corfe Castle, Alnnick and Bromford, and the Cross of Scone and Midlothian, Scot.; in the last of these the married women of a parish used to play the spinsters and almost invariably beat them severely.

As their popularity increased among the humbler citizens these games were no longer confined to days of festival, and village greens became the scenes of practice matches at all times. Kings of England began to fear that the youth of the country was being distracted from the proper study of archery and that the efficiency of their armies would suffer. A Scottish writer reports that the Anglo-Scottish war which began in 1297 was not taken with a proper seriousness by either party; King Edward I's foot consisted of 2,500 levies from Cheshire and Lancashire, of whom the Lancastrians were old opponents of the Scots raiders and had to be restrained by orders to their commanders from playing football nith instead of fighting their hereditary enemies. Whether this is a true story or not, Edward III decided in 1365 to prohibit football for military reasons and further edicts were made by Richard II, Henry IV, Henry VIII and Elizabeth I; these prohibitions were no more effective in the long run than were those in Scotland against the playing of "gowffe." The festival matches became bigger and bigger, and Richard Carew in his survey of Cornwall, published in 1602, records that goals were set three or four miles apart and two or three parishes united to play two or three others "hurling over country." Most of these games had local names such as "hurling" or "camp ball," but between them they contained in embryo most of the characteristics of modern football with mellays or scrums and judicious passing and running. Joseph Strutt, a great historian of English sport, wrote in 1801 a description of a match at football which is easily recognizable: ". . . an equal number of competitors take the field and stand between two goals placed at a distance of 80 or 100 yards the one from the other. The goal is usually made with two sticks driven into the ground about two or three feet apart. The ball, which is commonly made of a blown bladder and cased with leather, is delivered in the midst of the ground, and the object of each party is to drive it through the goal of their antagonists, which being achieved the game is won. The abilities of the performers are best displayed in attacking and defending the goals; and hence the pastime is more frequently called a goal at football than a game at football. When the exercise becomes exceedingly violent the players kick each others' shins without the least ceremony, and some of them are overthrown at the hazard of their limbs."

So great. indeed, was the violence of the games in the 18th century that other historians report that broken shins, broken heads, torn coats and lost hats were among the minor casualties, and that a Frenchman watching a game at Derby exclaimed that if Englishmen called this playing it would be impossible to say what they would call fighting.

Origin of Rugby.—Football began to become more orderly and a regular pastime, as opposed to a periodic outbreak of legal (or illegal) violence, with the growth of the great English public schools, where the sons of the richer and more aristocratic families were cooped up together and for long periods could not take their sports individually as they had done formerly at home with rod, gun, horse or sword. They adopted in one form or another the rowdy games which had been played so long by workingmen but which still were regarded by the university authorities as boisterous, undignified and totally unsuited to gentlemen, particularly those headed toward scholarly lives.

No two schools seem to have had anything like the same rules; there was still no governing body for the game, and almost the only thing on which there seems to have been common agreement was that the ball must never be carried or passed by hand in the direction of the opponents' goal.

It was a famous violation of this rule on carrying the ball by William Webb Ellis at Rugby school in 1823 which led to the development of the basic feature dividing modern players into two parties, those who want to play with their feet alone and those who want to play with both hands and feet. At first Ellis' behaviour was condemned even at Rugby; but the school soon decided to permit running with the ball by players who received it by fair catch; next it mas permitted if the ball were caught on the bound, and finally all restrictions on running with it were abolished. Ellis was translated from a lawbreaker into a great hero, and a tablet on one of the boundary walls of the Rugby school ground bears the following inscription: "This stone commemorates the exploit of William Webb Ellis who with a fine disregard for the rules of football as played in his time first took the ball in his arms and ran with it, thus originating the distinctive feature of the Rugby game. A.D. 1823." It was at Rugby, too, that the players seem to have been posted in something like the modern Rugby positions in the field; Thomas Hughes records in his description of a Bigside game at Rugby in *Tom Brown's School Days* that the teams were divided into four groups—the forwards nho fought out the mauls or scrummages, the dodgers (rather like halfbacks), the boys in quarters (modern three-quarter backs) and the goalkeepers.

Codification of Rules.—Outside matches were not played by the schools at this time; indeed, it mould have been almost impossible to play them as each school had its own game and there were no independent clubs until the middle of the 19th century. Rugby school played its first outside match only in 1867 and did not meet another school until 1896. However, old boys of the schools began to feel the need for settled rules and organized clubs so that they might go on playing. Two old boys of Westminster founded an ill-fated old boys' club in 1846, and in the same year H. C. Malden and George Sault called a meeting at Cambridge university of representatives of all schools which drew up a code of rules; no copy of this code survived as the game did not achieve popularity at the university at that time; but it is known that the meeting took what it thought the best features of the various games and expressly prohibited running with the ball in the Rugby manner. In the next 15 years a number of independent clubs came into being; among them mere Guy's Hospital Football club (founded in 1843 according to one claim but probably a little later in fact), Sheffield (1855), Blackheath (1857. but reformed in 1862), Hallamshire (1857), Old Harrovians (1859) and Forest F.C. (1859 or 1860), later known as the Wanderers. There were still only a few rules in common; most clubs restricted teams to

20 a side and prohibited offside play; a player was considered off side generally if he was between the ball and his opponents' goal; a match was decided by a majority of goals and a goal was scored by kicking the ball between the sticks or posts defended by the other side and under a tape; the ball was a round inflated rubber "bladder," generally covered with cowhide. Only Blackheath stood firm for the Rugby running with the ball.

In Oct. 1863 football enthusiasts at Cambridge finally agreed upon a set of uniform rules and had them published. In the same month representatives of the various independent clubs met at the Freemasons tavern. Great Queen street, London, to draw up a set of rules. Cambridge had rejected the Rugby principle, but the independent clubs held many long debates on this point. Eventually they decided against carrying the ball and on Dec. 1 published a set of rules entitled *Rules of the London Football Association*, which prohibited carrying. Blackheath, which had once more led the Rugby party, withdrew from the association and went its own way. It was not long alone. for in the same year the Richmond Football club had been formed and supported carrying; the north of England was of the same opinion and had powerful clubs at Manchester and Liverpool; and in 1869 the Oxford University Rugby Football club was formed. Obviously there had to be Rugby rules, and on Jan. 26, 1871, representatives of 17 clubs and 3 schools met at the Pall Mall restaurant, Regent street, London, formed the Rugby Football union, drafted bylaws, appointed officers and instructed a committee of 13 to draw up the laws on the basis of the code in use at Rugby school. The actual drafting of the code was left to three Rugby alumni—A. Rutter, E. C. Holmes and L. J. Maton; they in turn deputed Maton as draftsman, who completed his work in good time, and saw the laws accepted as they stood by a special general meeting on July 24.

Both parties in football now had rules and a governing body; both still consisted almost entirely of old boys of the public schools; probably neither had the least idea that the industrial revolution and consequent collection of huge numbers of persons in the towns was to lead to the spread of their sports until association football (soccer) was the game of all the world and Rugby well known in all the British Commonwealth countries and a popular sport in France and elsewhere. Soccer and "rugger," as they became known popularly, were on the move. (L. M.)

II. U.S. FOOTBALL

A. U.S. College Football History

The Beginnings.—U.S. universities along the Atlantic seaboard had known football as an informal campus pastime from early in the 19th century. alternately frowning on it or tolerating it, as circumstances seemed to dictate. At Princeton in 1820 they played a form of association football called "ballown."

As in the British schools, football in the U.S. colleges varied from campus to campus, but all played fundamentally the kicking game. Intercollegiate contests were undreamed of in the middle of the 19th century.

The Harvard faculty banned football from the campus in 1860, and town authorities at New Haven, Conn., forbade Yale students to play it on the public green in 1858. Football nevertheless continued to grow in the colleges, and finally in 1867 the Princeton rules were drawn up, specifying 25 players to a side, and a Princeton team of that number engaged in a game with Princeton Theological seminary. It was then only a step to the first intercollegiate meeting, played by Princeton and Rutgers at New Brunswick, N.J., on Nov. 6. 1869, by sides of 2j men. Rutgers won by 6 goals to 4. The game, as played at the two colleges, was not timed by a watch, but was decided when one team scored six goals.

The teams used a round, rubber ball, and a goal was scored when the ball was kicked under the crossbar (rather than over it as in the modern game) and between the posts defended by the opponents. No running with the ball was permitted, but it could be batted with the hands as well as kicked. Under Princeton rules a player might make a fair catch and gain a free kick therefrom. The game at New Brunswick mas played under Rutgers' rules. A week later the teams met in Princeton, N.J., under Princeton's rules, with the special provision that eight goals were required for victory. Princeton won that game, 8–0. The faculties of the two colleges then joined forces to prevent the playing of the third game. scheduled for New Brunswick on Nov. 20.

Columbia joined the intercollegiate football family in 1870, suffering a 6–3 defeat by Rutgers at New Brunsmick on Nov. 12. Yale became a competitor in 1872. defeating Columbia at New Haven on Kov. 16 with 20 players on a side. The Harvard faculty lifted its ban on football in 1871 and the game began to reappear on the campus. Harvard, ho ever, played a carrying game. more like Rugby, called the "Boston game." This prevented the university from participating in the first intercollegiate rules convention in the United States because the other colleges—Yale, Princeton, Columbia and Rutgers—adhered to the kicking game.

At that convention, held in New York city on Oct. 19, 1873, uniform rules along association lines were adopted. The first Yale-Princeton game was played under those rules at New Haven on Nov. 15 of that year. Princeton winning 3–0. The same year Yale met a team from England calling themselves the Eton Players. They played with 11 men on a side and persuaded Yale to play with that number instead of 20. So Yale was to become the advocate of 11-man teams.

Harvard continued with its running game, which permitted a player to pick up the ball and, if pursued, to run with it. Lacking games with U.S. colleges because of differences in rules, Harvard scheduled two games with McGill university of Montreal, Que., in the spring of 1874. They were played in Cambridge. A third game was played in Montreal in the fall. The first of the two at Cambridge was played on May 14 under Harvard rules. Largely a kicking game despite the rules allowing running with the ball, it was won by Harvard 3 to 0. The next day the teams played under the rules of the Rugby Football union with an egg-shaped ball, and a scoreless tie resulted. Canadian Rugby rules allowed touchdowns (running with the ball across the goal line) as well as goals to count in the score.

The games with McGill had far-reaching importance in committing Harvard to the running Rugby game, and thus influencing the pattern of the U.S. game that was to evolve. Harvard adopted the Rugby rules and Harvard and Yale met for the first time on Kov. 13, 1875, in New Haven in a game that was largely Rugby. The desire for a contest between the two universities had led to a meeting of representatives at Springfield, Mass., on Oct. 16, 1875, where the "Concessionary Rules" were adopted. Yale conceded to the Rugby principle of running with the ball and tackling. Yale was won over to Rugby in that game. won by Harvard 4 goals to 0, and adopted the Rugby rules in 1876. That year Harvard conceded to Yale's request to play with 11 rather than 15 men on a side.

The 1875 game was witnessed by two Princeton players, W. Earle Dodge and Jotham Potter, who were so taken with Rugby that they called a mass meeting at Princeton in early Nov. 1876. By a narrow margin in a turbulent session it was voted to adopt Rugby and to invite Harvard, Yale and Columbia to a convention. Thus came about the important meeting of Nov. 23, 1876, at Massasoit house, Springfield, at which the Intercollegiate Football association was organized and the Rugby union code adopted with a change in the scoring. Rule 7, which read, "A match shall be decided by a majority of goals alone," was changed to "A match shall be decided by a majority of touchdowns. A goal shall be equal to 4 touchdowns, but in case of a tie, a goal kicked from a touchdown shall take precedence over four touchdowns."

The old round rubber ball was replaced by the egg-shaped leather Rugby ball and players were now initiated into the complexities of "off side" and "on side."

Yale went into the Springfield meeting convinced that Rugby could best be played by 11 men. When the convention voted against reducing the sides, Yale declined to become a full member of the league but readily became a playing member. Yale won the first championship by defeating Princeton and Columbia, each by two goals. The league code was made retroactive to include games played prior to the meeting, giving Yale credit for its victory over Harvard by one goal to nothing the week before the meeting was held.

Experiment With Rules.—Yale continued to attend meetings of the Intercollegiate Football association! being represented by Walter C. Camp of the class of 1880, who had made his football debut on the Yale Blue's 1876 championship team and whose name soon became almost synonymous with football in the United States. Though Camp continued to insist on a reduction of teams to 11 men, the league still refused to effect the change; Yale continued playing in the league while refusing to become a full member. It finally joined the league in 1879, and a year later the league reduced the sides to 11 men. The playing field was reduced from 140 yd. by 70 yd. to 110 yd. by $53\frac{1}{3}$ yd. in 1880, conforming to the British maximum length but dipping almost one-third under the British maximum width.

Next came another distinctive feature of the U.S. game, definite possession of the ball. Also, the quarterback made his appearance, along with a new method of putting the ball in play—by the holder snapping it back with his foot to the quarterback. In Rugby the forwards heeled it back in the scrurn.

This practice was legalized in 1880 when the U.S. scrum officially became a scrimmage and definite possession of the ball became an approved tactic. This was the first great change which sent the U.S. game along a path so divergent from that of Rugby. Thus begun, the tendency to change accelerated, and finally the game of U.S. football evolved.

Definite possession of the ball having been established, teams soon learned that, if they themselves could not score, superior opponents could be prevented from scoring if the team in possession of the ball refused to surrender it. No means had been devised to force surrender of the ball, and Yale and Princeton availed themselves of this oversight to the fullest. The two strongest teams in the association, Yale and Princeton played annually for the championship in the late 1870s and through the 1880s. Having respect for each other, they turned their games of 1880 and 1881 into farces by what became known ,as the "block game." The team receiving the kickoff would retain the ball for the entire half, without making any particular effort to advance it. The result was two dull scoreless ties, and a demand from the college public that something be done about it.

Camp solved this situation in 1882 by introducing the system of downs with a rule requiring a team to gain five yards or lose ten yards in three downs or else surrender the ball to the opponents on the spot of the third domn. In 1883 the distance to be lost was increased to 20 yd. This rule forced the attacking team to kick on third domn unless it seemed certain that sufficient yardage could be gained to retain the ball. The five-yard rule gave the U.S. football field its barred appearance, with white lines at intervals of five yards, and Ied to the term "gridiron" as a synonym for the football field.

The rule was the heart of the modern game. It led to the development of a plan of attack, strategy, and to Yale's abandonment of kicking as the predominant offense and the development of the running attack by short, hard rushes.

U.S. players developed the habit of touching the ball down "for safety" behind their own goal lines so as to be able to gain a free kick from the 25-yd. line. No penalty was attached to the safety touchdown until 1881, and it was the usual procedure for any team having possession of the ball nearer its own goal than 25 yd. to touch it down for safety and kick out. Public disapproval of the Yale-Princeton block game of 1880 led directly to the inclusion of the safety as a scoring play in 1881. It was a provisional scoring play in 1881, decisive only when the game otherwise was tied, but it had half the value of a touchdown in 1882. The touchdown was increased in value in 1881 and 1882. A touchdown and goal after touchdown were ruled to be superior to a field goal, and four touchdowns were made more valuable than a field goal.

The introduction of the safety as a scoring play and the new values assigned to the touchdown further complicated the scoring ratios, but still nobody thought of numerical scoring as the solution. The numerical idea was forced on the football world by the Harvard-Princeton game of 1882, in which Harvard scored a touchdown and a field goal and forced Princeton to make two safeties while the Tigers got a touchdown and goal. Referee R. W. Watson (Yale, 1881) ruled that Harvard had won, but the game aroused so much discussion that Camp decided that the time for numerical scoring had arrived.

Camp accordingly introduced these scoring values for the 1883 season: touchdown, 2; goal after touchdown, 4; goal from field: 5; safety by opponents, 1. In 1884 the touchdown was increased to 4 points and the goal after touchdown reduced to 2. The safety was set at 2 points to maintain its value as half that of a touchdown. Four other alterations were made in scoring values in the ensuing 28 years, each tending to give importance to the touchdown and causing it to overshadow the field goal. Scoring, nevertheless, was let alone more than anything else in the game and was not altered between 1912 and 1958. The touchdown was increased to 5 points in 1897 and the goal after touchdown (conversion) reduced to 1. The field goal was cut to 4 points in 1904 and to 3 in 1909. The touchdown was increased to 6 points in 1912. In 1958 the conversion became worth 2 points if the ball was carried or passed rather than kicked.

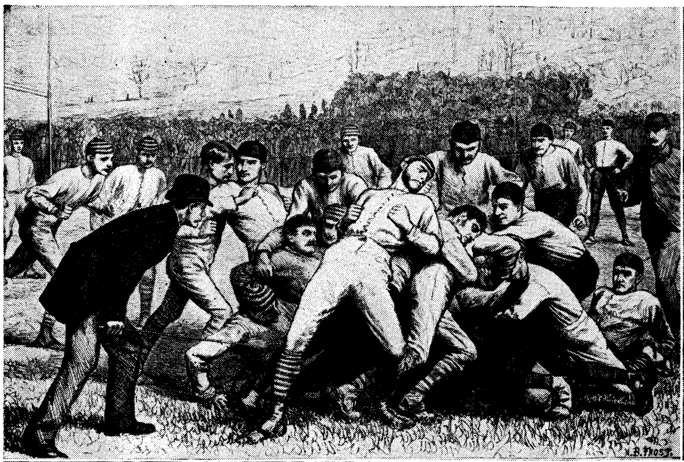
Assured of uninterrupted possession of the ball by the revision which established the U.S. scrimmage in 1880, teams soon began to devise signals to indicate to their players the particular play they intended to use. At first, these were spoken words or phrases. Within a decade words had been replaced by numbers. In the early 1920s the huddle was introduced by Robert ("Bob") Zuppke, University of Illinois coach, and soon was universally adopted. In the shouted signals, the quarterback invariably called the play, sometimes at the direction of the captain or the coach. In the huddle, any player may give the signal, or even call the play by name, with no fear that the opposition will be the wiser.

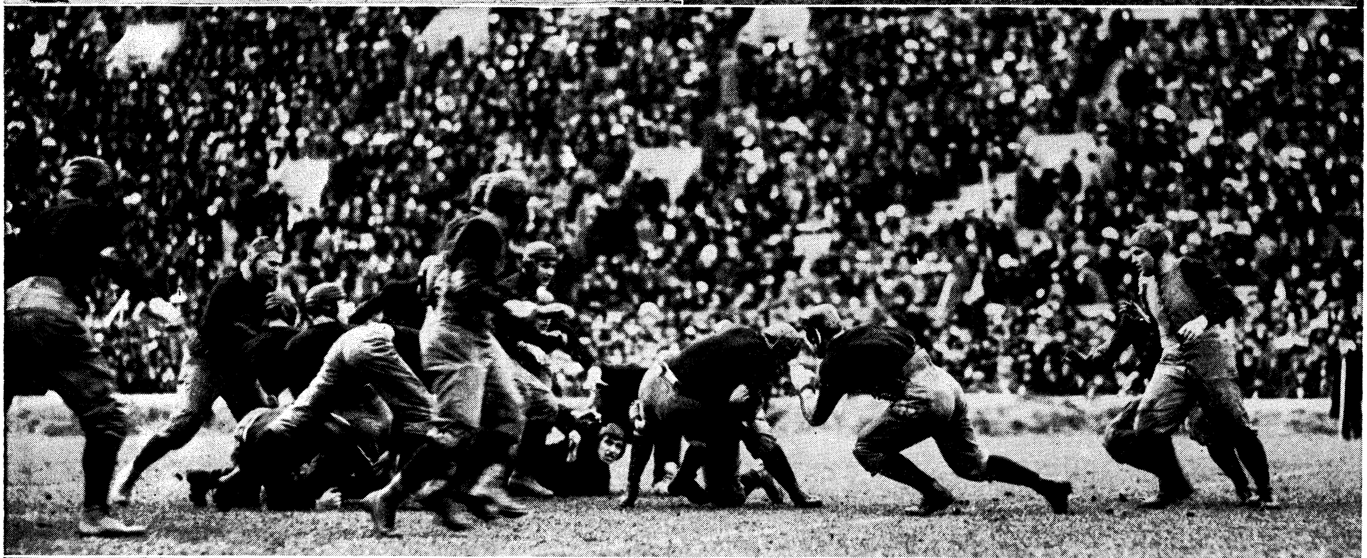
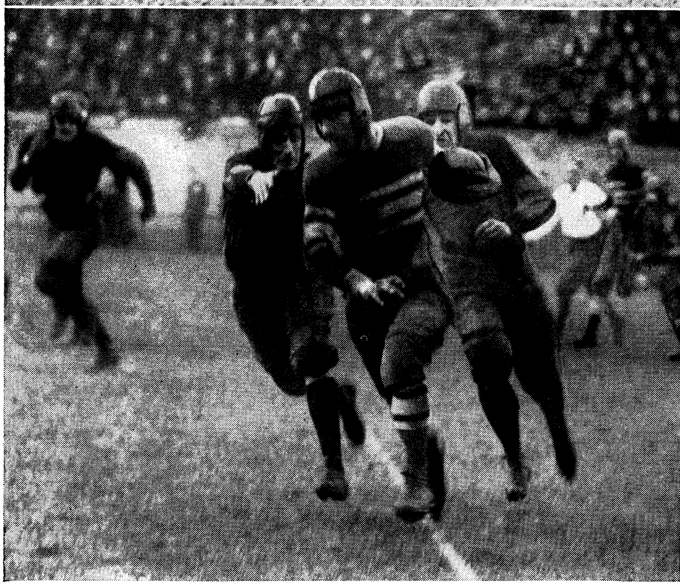
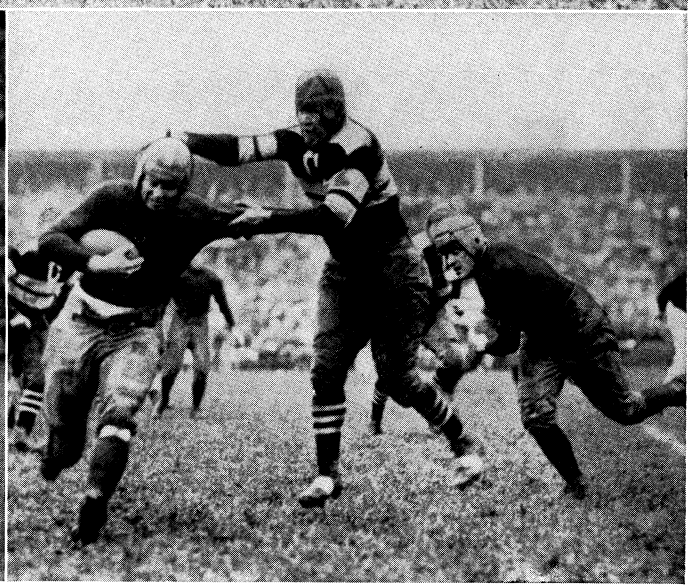
Alignment of the players in the U.S. game, after the establishment of uninterrupted possession of the ball and before the game was closed up, departed sharply from the practice in British Rugby. Instead of being locked in a scrimmage, U.S. forwards were widely spread across the field and the backs played at correspondingly wide posts, from three yards to five yards behind the line. Players in the line (linemen) earned, in the 1880s, the names by which they now are known—ends, tackles, guards and centre—though at the outset the end was known as the end rush and the centre as the centre rush. The centre rush heeled the ball back, or passed it with his hand, to the quarterback, who was not eligible to run with it. The quarterback, in turn, passed it. back to a halfback or the fullback.

Players still were prohibited from taking any part in a play if they were ahead of the ball, but backs soon developed a habit of running at the side of the ball carrier to fend off tacklers. It was only natural to progress from this to running ahead of the carrier and, while thus off side, to blocking intended tacklers out of the play. This infraction first was winked at and then was incorporated into the rules as a legal move. Interference for the runner thus was born and legalized, with Princeton a leader and George W. Woodruff and William W. Heffelfinger of Yale the most famous of the early blockers.

The zeal of interferers was matched by that of tacklers. The rules prohibited tackling below the waist, but inspired defenders began creeping down toward the knee. This practice also was winked at in its early years. Finally, in 1888, it was made legal, completing the final phase of the metamorphosis which had been begun in 1880 with the establishment of definite possession of the ball. At the same time, linemen were required to hold their arms at their sides instead of extending them. As the linemen, formerly spread across the field, mere brought in close, the backs came in close too for protection against the low tackle.

Thus came about the standard close formation, known as the T formation, and the end of the open Rugby game. The wide arc from which the attack might spring in the backfield was constricted. Wide passes and open play disappeared overnight. To plow through tacklers who were permitted to grasp a runner



PHOTOGRAPHS (TOP LEFT, TOP RIGHT) THE BETTMANN ARCHIVE, (CENTRE, BOTTOM LEFT) INTERNATIONAL NEWS PHOTOS, (BOTTOM RIGHT) UNITED PRESS

EARLY FOOTBALL IN THE UNITED STATES

Top left: Game between Yale and Princeton, Nov. 27, 1879, a scoreless tie played at St. George's Cricket club, Hoboken, N.J. From a drawing by A. B. Frost

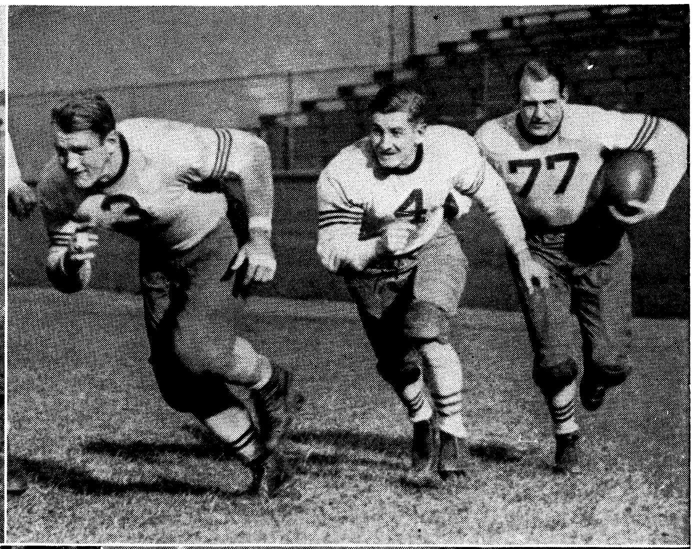
Top right: Photograph of about 1890 showing the "flying wedge" formation

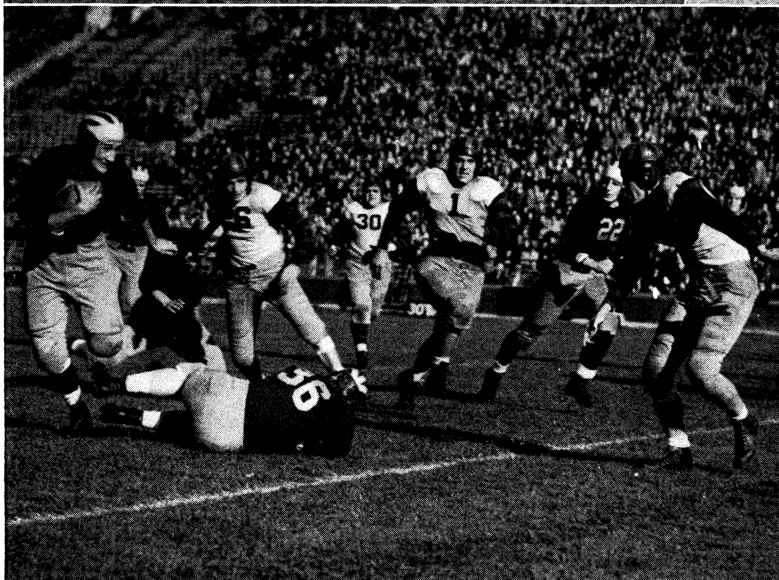
Centre: Harvard *v.* Princeton, 1912

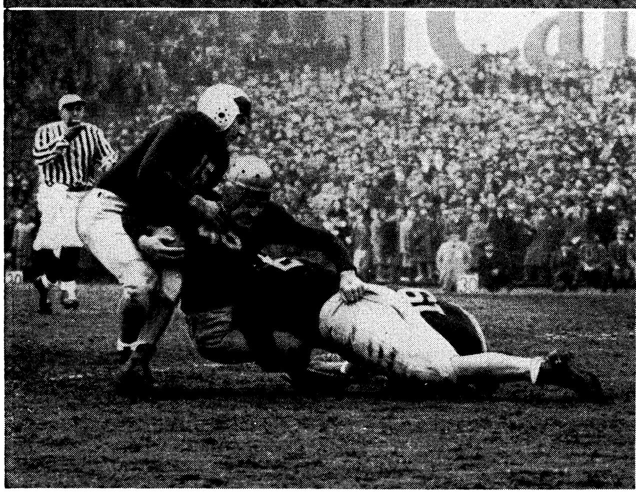
Bottom left: A. N. ("Bo") McMillin carrying ball for Centre college, Danville, Ky., as his team upset Harvard 6–0 in 1921

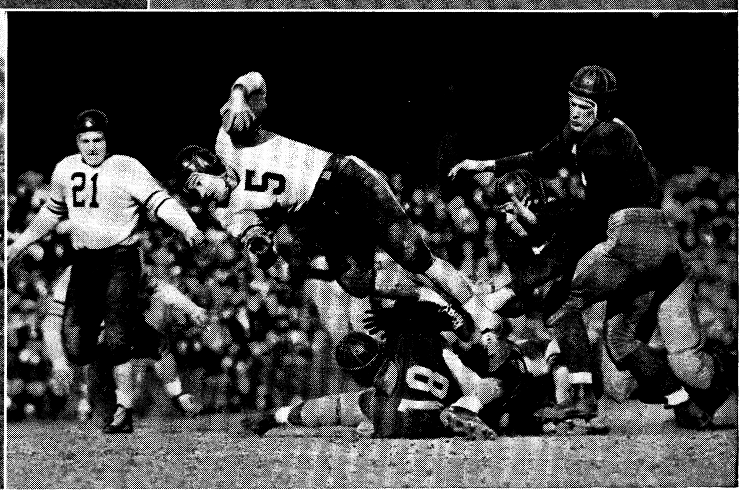
Bottom right: Jim Thorpe about to make a tackle in an early professional league game between the Canton Bulldogs and the Frankford Yellow Jackets

FOOTBALL









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UNIVERSITY AND PROFESSIONAL FOOTBALL, 1924–40

Top left: Coach Knute Rockne and the "Four Horsemen," outstanding Notre Dame backfield of **1924.** Left to right: Rockne, Harry Stuhldreher, Elmer Layden, Don Miller, Jim Crowley

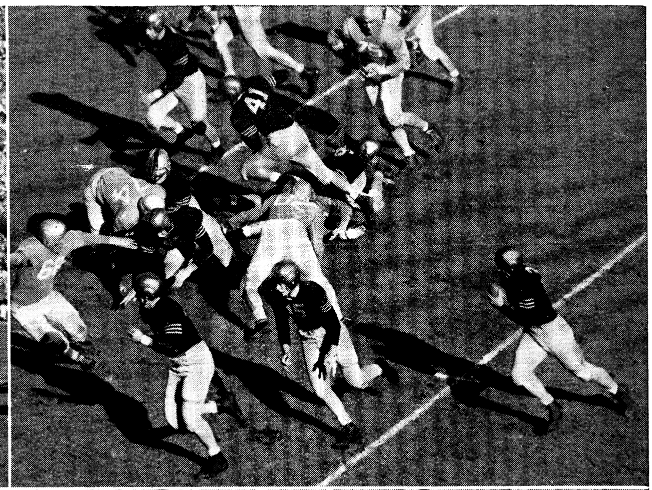
Top right: Bronko Nagurski, Keith Molesworth and Harold ("Red") Grange of the Chicago Bears as they practised for a game against the New York Giants in **1932**

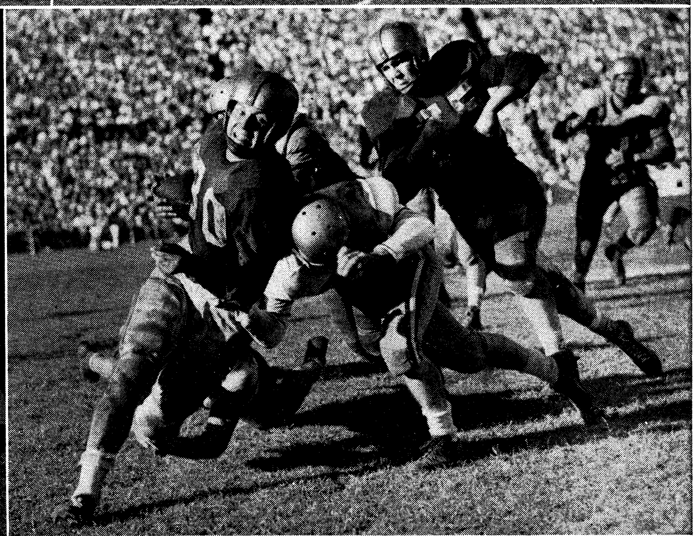
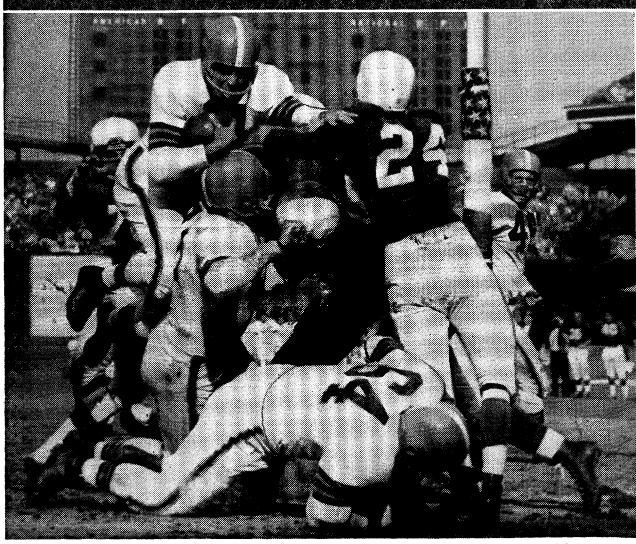
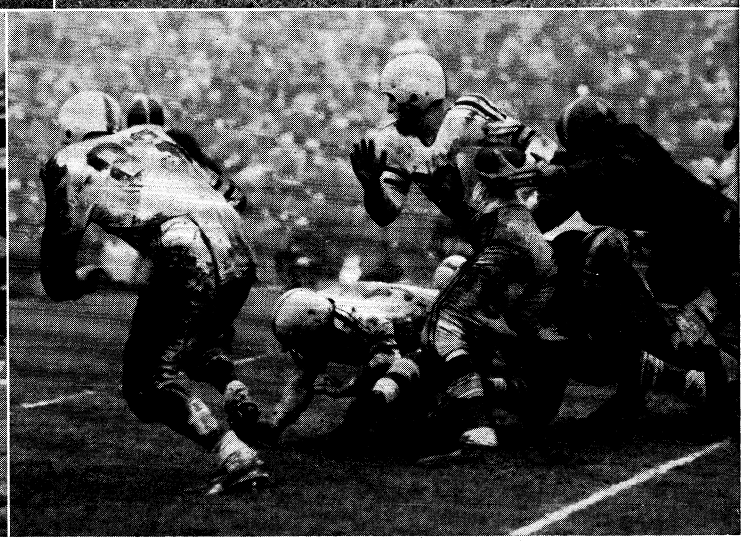
Centre left: Tom Harmon, Michigan, carrying the ball against Pennsylvania in game of **1938** won by Michigan **19-13**

Centre right: Cecil Isbell preparing to pass to a Purdue teammate in **1937** game won by Fordham **21-3**

Bottom left: Frank Maznicki, Boston college, brought down by three Georgetown players after 15-yd. gain. Boston won **19-18,** the first loss for Georgetown in **23** games, Nov. **16, 1940**

Bottom right: Halfback George McAfee of the Chicago Bears plunging over Washington Redskins' line in National Football league championship game of Dec. 8, **1940.** The Bears, using the newly developed **T** formation, won **73-0**

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SCENES FROM GAMES OF THE 1940s AND 1950s

Top left: Emil Sitko (left). Notre Dame back, taking a lateral pass for a 15-yd. gain against Southern California, Dec. 6, 1947, an undefeated season for Notre Dame

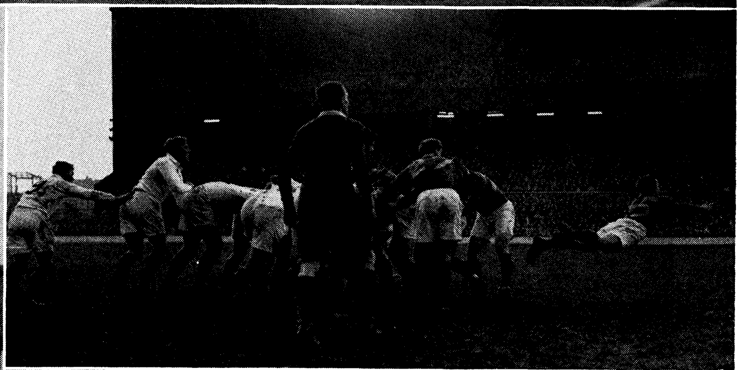
Top right: Felix ("Doc") Blanchard (right), Army, going around left end for 12 yd. against Columbia, Oct. 10, 1946. Blanchard and Glenn Davis led the Army team through undefeated seasons from 1944 to 1946

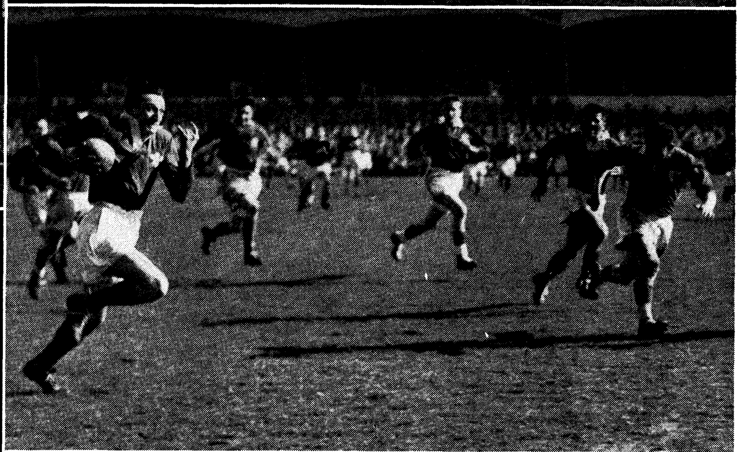
Centre left: Clyde Scott of the Philadelphia Eagles about to fumble in second quarter of the 1950 game against the College Ail-Stars, won by the Stars 17–7

Centre right: Orange Bowl game of 1952. Dick Parma, Baylor, running around right end against Georgia Tech. Georgia won 17–14

Bottom left: Otto Graham, Cleveland Browns auarterback, scoring in game against Chicago Cardinals, Oct. 24, 1954, ninth straight year in which Graham led the team to a division championship. In six of those years the Browns won professional league championships

Bottom right: Quarterback Dave Leggett carrying the ball through the Southern California line as Ohio State won the 1955 Rose Bowl game *20–7*





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RUGBY AND ASSOCIATION FOOTBALL IN GREAT BRITAIN

Top: Goalkeeper G. Merrick of England blocking a shot by S. Kocsis of Hungary during game of Nov. 25, 1953, at Wernbley. Hungary won, 6 goals to 3, England's first recorded defeat at home by a foreign team

Centre left: An attack by the Wolverhampton Wanderers broken up at the Charlton Athletic goal in game of April 10, 1954

Centre right, top: P. A. du Toit, South Africa, passing out from the scrum in rugby match against Combined Services at Twickenham, Dec. 26, 1951

Centre right, bottom: K. Jones, Wales, getting away with the ball to score a try as Wales defeated France in international rugby match at Cardiff, March 25, 1950

Bottom left: Cardiff player beating a Harlequin player to the ball by a finger tip in a lineout in a Rugby union game of Oct. 12, 1954

Bottom right: English (white jerseys) and New Zealand players charging for the ball in a game at Twickenham, Jan. 30, 1954 as low as the knee, backfield men had to charge low and hard and with tremendous interference. Football was no longer graceful and fast; it was lumbering and slow and very rough.

Spread of the Game.—From its cradle in the larger eastern colleges of the United States, football spread quickly through the east and then to other sections of the country. Pennsylvania, Wesleyan, Stevens, Amherst. Williams, Dartmouth, Brown, Cornell, Penn State, Lafayette, Lehigh, Trinity and many others took up the game in the 1870s and 1880s. In Canada, football already was well established at Toronto and McGill.

In the U.S. middle west, the University of Michigan became the pioneer. A team was organized as early as 1873, but Michigan could find no opponent until Racine college, Racine. Wis., was met in the park of the Chicago National league baseball club on May 30, 1879. Michigan won by one touchdown and one field goal to nothing, and went on to establish football on a firm foundation in the next few years. The Wolverines also pioneered in intersectional football in 1881, meeting Harvard, Yale and Princeton within five days on a single eastern trip. Michigan lost all three games but, nothing daunted, tried the same thing again in 1883, this time against Wesleyan, Yale, Harvard and Stevens. Michigan again lost all the games, but football was on its way at Ann Arbor and in the west. Minnesota, Iowa, Purdue. Northwestern and other middle western universities took up the game in the 1880s. Most significant addition of all, although comparatively unnoticed at the time, was that of Notre Dame, which made its debut by losing, 8–4, to Michigan on the Notre Dame campus in South Bend. Ind., on Nov. 23, 1887.

Football was introduced to the south in 1877, when Virginia Military institute played Washington and Lee. On April 9, 1880, Centre college of Danville. Ky., famed 40 years later for its "Praying Colonels," and Kentucky university (later Transylvania) played a scoreless tie in Lexington, Ry., but the game was destined not to catch on in the south until later. Eight years passed before Trinity (later Duke) defeated North Carolina by 16–0 at Raleigh. This game was played on Thanksgiving day of 1888. Football then spread quickly to Virginia, Vanderbilt, Auburn, Georgia and other south Atlantic and southern colleges. It also returned to the Kentucky colleges in the early 1890s, and soon afterward spread to the southwest, the Missouri valley, the Rocky mountains and the Pacific coast. By the turn of the century it had become the national academic game, but the power remained concentrated at the colleges which had pioneered in the game in the east—Yale, Harvard. Princeton and Pennsylvania. In the middle west, Michigan, Chicago, Minnesota and Wisconsin were beginning to challenge the supremacy of the east, but the westerners were about a decade away from gaining real equality.

Concentration on Power.—Speed and deception had been the prime requisites for success at the Rugby-style game played in the United States up to 1888. Legalization of knee-high tackling in 1888 had closed up the game and placed a premium on power. Winning requisites became power, speed and deception, with the first far outweighing the other two.

Inventive genius on the campuses remained the same as it had been in the years when young Americans first began making over the original Rugby game. Other youths began devising ways and means of getting greater power into the plays in order that massed defenders could be either crushed down or split asunder to give the runner free passage toward the enemy goal. The game was rough, but since it also was slow injuries were not so numerous as often supposed. Injuries nere destined to mount only when some semblance of speed had been regained. This speed was acquired when momentum, prior to the snap of the ball. was added to the mass game through the inventiveness of Lorin F. Deland of Harvard and Woodruff of Yale, who coached Pennsylvania to its first real football success in the middle 1890s.

An invention dating back to Rugby days served as the vehicle for the most devastating of these momentum mass plays—the "flying wedge." As early as 1884, strategists at Princeton and Lehigh (no one knons which thought of it first) discovered that nothing in the rules said that the ball had to be kicked to the receiving side on a kickoff. They learned that the rules could be satisfied if the kicker merely touched the ball with his foot. He then was free to tuck himself away within a wedge formed by his ten mates and go trotting along for what usually amounted to a handsome gain against opponents who were restrained by rule to a point ten yards removed from the kickoff. This became known as the "V trick" and was the standard means of putting the ball into play by all teams from 1885 until it was forced on the attention of the rules committee nine years later.

Deland, who never played football at Harvard but who was a master strategist, devised a means of adding momentum to the V trick in 1892. He grouped the ten men of his wedge not around the kicker on the 55-yd. line but near the side lines and back on their own 25-yd. line, five men on each side of the field. At a given signal, the two groups charged forward together, headed for the kicker. At the instant they converged on him, the kicker "babied" the ball with his toe and stepped within the wedge. The play was saved for the Yale game of 1892, and the result was devastating. Harvard failed to win the game, failed even to score with the play, but it did plow 45 yd. through amazed Yale defenders to the Blue's 10-yd. line. Yale later scored a touchdown and goal to win by 6–0, but the flying wedge was the sensation of the game. It spread to all points of the football map in 1893, and injuries from its use aroused widespread criticism.

Woodruff became coach of the University of Pennsylvania in 1892. He introduced the principle of flying interference by grouping two or three linemen in the backfield and having them start for ard, with the spare backs, before the ball was snapped. The carrier took the ball from the quarterback and took his place in this charging set of players, usually second in a group of four interferers or third in a group of five. It was necessary to get power behind the ball as well as in front of it, since interferers and carrier were permitted to run with arms interlocked about bodies, and pushing and pulling was entirely legal. From this mass momentum principle Woodruff, in 1894, invented a famous play known as "guards back," which enabled Pennsylvania to win undisputed championships in 1895 and 1897, its first two titles.

Prior to this Amos Alonzo Stagg, the most inventive of all football coaches and one of Yale's most famous graduates, had launched the fast-moving mass attack with his "ends back" formation of 1890–91 at the International Y.M.C.A. college at Springfield, Mass. (See below.) He followed it with the "turtleback" in 1891 (claimed by Harvard in 1893) and the "tackles back" in 1894 at The University of Chicago.

Meanwhile, the uproar against injuries resulting from mass momentum plays had increased. The universities themselves were at odds over it and over the eligibility of graduate students. Harvard and Pennsylvania, having large graduate departments and schools and an abundance of brawny material, advocated mass play and eligibility of graduate students, regardless of how long they had played football before taking up graduate courses. Yale and Princeton, being in the main undergraduate colleges and having few men other than undergraduate students on their campuses, insisted on a four-year eligibility rule and the minimization or even elimination of momentum from mass play. It never occurred to anyone then that mass play itself could be eliminated. The original Intercollegiate Football association was broken up by these disputed points after the season of 1893 and football was without a governing body. Chaos reigned, and criticism of the game was universal.

In this emergency, the University Athletic club of New York invited Yale, Harvard, Princeton and Pennsylvania to send representatives to a meeting at the club and draw up a code for the use of all colleges. Yale had just broken relations with Pennsylvania; Princeton and Harvard had not been competing for several seasons; Yale was on the verge of its break with Harvard; and Princeton was about ready to say good-by to Pennsylvania. But to save the game, representatives of what had come to be known as the Big Four subordinated their personal differences and agreed on reformations. In the sweeping rules revision the old Rugby kickoff was brought back. The Lehigh V, Princeton wedge and flying wedge were outlawed by a decree forcing the kicking team to kick the ball at least ten yards into enemy territory on the kickoff. Playing time was reduced from 90 minutes to 70 minutes, divided into halves of 35 minutes each, and a compromise mas reached on momentum. The rule makers decreed that no more than three men might group more than five yards behind the line of scrimmage for the purpose of launching a momentum mass play

These reforms accomplished much, but not enough to satisfy Yale and Princeton. These two colleges enlisted the support of Navy and broke with Harvard and Pennsylvania in the spring of 1895 to formulate separate rules of their own. Harvard and Pennsylvania took Cornell into their group and drew up another set of rules. The Yale-Princeton rules struck at momentum mass play by decreeing that seven men must be on the line of scrimmage of the team in possession of the ball and that only one offensive back might start forward before the ball was snapped. Harvard, Pennsylvania and Cornell retained their rules of 1894.

With two sets of rules in effect. the season of 1895 was not chaotic. but it was far from satisfactory to either camp. A compromise was reached early in 1896 and a permanent rules committee was set up. Proponents of momentum mass play yielded by agreeing that no player on the offensive side might take more than one step toward the goal of the defensive team before the ball was snapped without coming to a full stop. The Yale-Princeton group gave ground by permitting the offensive scrimmage line to be reduced to five players, with the other two forwards in the backfield to add power, if not momentum, to the plays. Momentum thus was reduced to a minimum, but the mass remained and football continued to be rough. Nevertheless it proceeded for another decade before being struck by another reform wave.

Chief tactical development of the 1890s, other than Woodruff's guards back, was the play along the same lines known as tackles back, worked out by Stagg, who was coaching at Chicago. It was just as rough and effective as guards back but was more mobile. It depended for its success on the power of interlocked interference, power behind the ball. It embodied the art, expounded for purposes of war by Gen. Nathan Bedford Forrest. of striking a given point with superior force before defenders had time to reinforce it or even realize the necessity of reinforcing it. It had greater deception than guards back. In 1899 Harry Lane Williams of Yale, coaching at Penn Charter school before launching his distinguished career at Minnesota, used the "tackle back," pulling one tackle back to line up behind the other. Camp introduced it at Yale in 1900

Birth of the Modern Game.--In the decade following the reform of the mid-1890s, football went on its course little changed. At the beginning of the 20th century, Fielding Harris Yost of West Virginia and Lafayette coached Michigan to pre-eminence, perennially challenged by Stagg at Chicago and Williams at Minnesota and by various coaches at Wisconsin, including Philip King of Princeton. A Yost pupil, Daniel Earl McGugin, lifted Vanderbilt from the ranks of ordinary elevens and set the pace for development all through the south. Yale let well enough alone in the east and went on winning regularly from Harvard and Princeton.

But football kept on injuring players, and the public outcry against the game became greater and greater. The middle western universities, organized for about a decade into the Western conference. heeded these protests by making drastic revisions following the 1905 season. Freshmen students were barred from varsity teams. and schedules were limited to five games. Transfer students were eligible only after one year's residence, and all players were limited to three years' participation in football. The Western conference was powerless. however, to effect any changes in the game. That authority was vested solely in the rules committee which had grown out of the reform wave of the mid-1890s.

In this emergency Pres. Theodore Roosevelt acted. Realizing the necessity for devising a more open and less brutal game if football was to survive, the president summoned representatives of Yale. Harvard and Princeton to the White House and urged them to take steps to save the game. Representatives of 28 colleges met in New York city and formed a committee that was the forerunner of the National Collegiate Athletic association. Led by Capt. Palmer E. Pierce of the U.S. army, it merged with the established governing body headed by Camp. The two groups formed the American Inter-Collegiate Football Rules committee and at a meeting on Jan. 12, 1906, adopted a reform program to make the game safer and more interesting.

From that conference grew the modern game of football. The prime demand was that the game be opened up. This was accomplished by the revolutionary legalization, contrary to all Rugby fundamentals, of the forward pass. Introduction of the forward pass in 1906 took rank with the legalization of the U.S. scrimmage in 1880 as one of the greatest steps away from parent Rugby toward a distinct U.S. game. Compared with these fundamental changes, other alterations through the years had been minor. Without definite possession of the ball, U.S. football still would have been Rugby. Without the forward pass, it still would have been mass football.

The forward pass, recommended to Camp by John Heisman of Penn as early as 1903, was sponsored strongly at the 1906 meeting by John C. Bell of Pennsylvania and Paul J. Dashiell of the U.S. Naval academy. It was adopted—but with severe restrictions, which were to be eliminated one by one through the ensuing few years. At the outset, the forward pass had to be thrown from five yards behind the scrimmage line and had to cross the scrimmage line at a point at least five yards out from the spot where it had been put into play. Eligible receivers were the players at the ends of the line of scrimmage and those behind it, excepting of course the thrower. Penalty for failure to complete a forward pass was 15 yd. from the point where the ball had been put into play, and loss of a down. With such restrictions, the forward pass was little used, particularly in the conservative universities of the east which had little to gain through the development of the pass and much to lose. Yale nevertheless defeated Harvard in 1906 on a long forward pass.

Other changes adopted included increase of the distance to be gained in three downs from five to ten yards, so that teams would be forced to abandon short-gaining line plays in favour of longer-gaining sweeps and slants. All players on both teams were ruled to be on side the instant any punt struck the ground. Hurdling was prohibited and centres, guards and tackles were forbidden to play in the backfield unless they were five yards back. The neutral zone was established, separating the teams by the length of the ball. Time of the game was cut from 70 minutes to 60, divided into halves of 30 minutes apiece. Like the other and more important changes made in 1906, however, the rule on the time was only the first step in a series of experiments which continued until 1912, when the modern game assumed its ultimate pattern.

In the mass game of 1888–1905 the defensive alignment amounted to a ten-man line. The two halfbacks backed up the tackles and the fullback backed up the centre, virtually on the line. The quarterback was stationed from 20 to 40 yd. back, depending on the down and the ability of the opposing punter. This arrangement was effective and satisfactory as long as the offensive team could not throw the ball forward. It could cope with the interlocked interference hurled at it. In introducing the forward pass in 1906, the rules committee neglected to outlaw interlocked interference. Necessity demanded that the defensive halfbacks withdraw from support of their tackles and play several yards back to be on guard against forward passes. Restrictions on the pass being what they were, this made little difference in 1906, but unsupported tackles took increasingly severe beatings through the next few years as one restriction after another was removed from the pass and as more and more men learned to throw the ball. The defensive halfbacks moved farther and farther away from the tackles and left them more and more open to being overwhelmed by interlocked attackers. Tackles frequently suffered serious injuries from this circumstance.

In 1907 the 15-yd. penalty for failure to complete a forward pass was removed, and in 1910 it no longer was necessary for the ball to cross the scrimmage line at a point 5 yd. out from where it had been put into play. In 1910 the pass could not be thrown more than 20 yd. beyond the scrimmage line and a punt, to put players of the kicking team on side, had to travel 20 yd. or more beyond the line—keeping both the umpire and the field judge busy measuring with their eyes. In 1912 the onside kick was eliminated (unless the kicking team had a man stationed behind the kicker, in ahich case he was on side without regard to the ball's striking the ground) and all restrictions were removed from the forward pass. except that only one such pass could be thrown during a single scrimmage, and it had to be thrown from five yards behind the line of scrimmage. Through these developments of the pass and experimentations with the onside kick. the running game, featuring interlocked interference. came more and more to overtax the capacity of tackles left unsupported by halfbacks who had more demanding chores to perform elsewhere. Matters came to a head in 1909 when at least half a dozen tackles, including Cadet Eugene Alexis Byrne of Army, were killed or fatally injured on the field of play. The solution which had been beckoning after 1906 was accepted; interlocked interference was outlawed, beginning in 1910. The offense was required to have seven men on the line of scrimmage.

Abolition of interlocked interference so weakened the offense in 1910 and 1911 that the balance of pomer passed to the defense and many scoreless ties resulted Teams of anywhere near equal strength were unable to carry out any sustained attack against each other. More often than not games were decided on the breaks or on field goals. This led the rules committee to untrammel the forward pass in 1912 and give the attacking team a fourth down in which to make its ten yards. The value of the touchdown was increased to 6 points in 1912 to enable a team scoring a touchdown and goal to defeat an opponent which had kicked two field goals. The length of the field was reduced to 100 yd. in 1912, but two end zones 10 yd. deep were established. In these end zones the attacking team was permitted to complete forward passes.

Development of the Modern **U.S.** Game.—The metamorphosis of football from the close-order game to the open game was accomplished by the rules changes effected between 1906 and 1912. The rules themselves were changed only by degrees from 1913 to the mid-1950s but tactics and strategy of the open game had hardly begun to take effect before 1913. Up to 1906 the team with the greater power always won. Large eastern elevens, as a consequence, were little disposed to experiment with any innovations in the open game wherein a physically inferior rival with fewer resources might not only score upon but even defeat one of the football mighty. The big teams included the pass in their repertoire of plays but chiefly because all major rivals might be expected to do the same. All used it with caution.

It remained for Coach Jesse Harper and his Notre Dame eleven to open the eyes of the east to the dazzling possibilities of the forward pass in the first Notre Dame-Army game at West Point on Nov. 1, 1913. Led by the forward pass combination of Charles E. ("Gus") Dorais and Knute Rockne, this unheralded Notre Dame team humbled Army by 35–13 that afternoon The result was not only defeat but progress for Army The progress developed when Cadets Vernon E. Prichard and Louis Merillat, Jr , obtained permission from Coach Charles D. Daly to use a forward pass play nhich those tno cadets had been experimenting with all summer, even as Dorais and Rockne had experimented with Notre Dame's pass. The result was a crushing defeat, by 22–9, of a favoured Navy team in Army's climactic game.

Football development continued apace until the entry of the United States into World War I, but it was not until after that war that the game reached its ultimate development by the spread of good material and good coaching to all major colleges and to all sections of the country. It nas not until after the mar that the forward pass reached its highest development and that Rockne led Notre Dame to unchallenged pre-eminence.

Robert C. Folwell of Pennsylvania, coaching at Washington and Jefferson, developed a short forward pass straight over the line and made it more effective by sending his tackles crisscrossing into the enemy backfield to take out the defensive halfbacks. then a legal move. Later. players ineligible to receive a forward pass were prohibited from coming into contact aith defenders.

Williams had developed the Minnesota shift in the years between 1906 and 1909 and had done extremely well with it, the Gophers having won or tied for the Western conference championship in 1909, 1910 and 1911. Heisman, coaching at Georgia Tech, had adapted the shift and improved it in 1910. With its help he won the championship of the south in 1916 and gained national recognition in 1917. Thomas L. Shevlin, called to help bolster a losing Yale eleven with late-season coaching in 1915, introduced the play in time for Yale to win from a highly favoured Princeton eleven, 13–7. Notre Dame used the shift nith conspicuous success under Rockne who credited Stagg with originating it. Stagg first used a line shift at Chicago in 1902 and the backs joined in in 1904. The success of the play resulted from the small momentum the attacking team gained as its linemen leaped into position at the snap of the ball. Some time after World War I the teeth were drawn from the play by requiring shifting linemen to come to a palpable halt before the ball could be put into play.

Erection of Stadiums.—More far-reaching in effect than anything which took place on the playing field in the years immediately preceding World War I was Yale's decision in 1913 to erect a concrete amphitheatre. Harvard had built a concrete stadium seating about 30,000 in 1903 and had added a colonnade on the rim and wooden seats in the open end several years later to increase the capacity to about 50 000. Syracuse had built its Archbold stadium several years later, seating about 35,000, and Princeton already was discussing plans for Palmer stadium, which eventually was sped to completion in 1914 and opened exactly four weeks prior to the dedication of the Yale Bowl. But none of these stadiums had captured the imagination of the public as the Yale Bowl was to capture it. (See also STADIUM.)

U.S. Football Prior to 1917–18.—From 1908 through 1916 Percy Duncan Haughton coached Harvard teams to outstanding victories. Harvard was undefeated and untied in 1912 and 1913, undefeated in 1908, 1910 and 1914 and defeated only once each year in 1909 and 1915. Power remained an essential to victory in the open game. but it was distinctly secondary to speed—and even the power had to be raced hurriedly into position ahead of the ball in the form of interference instead of being placed behind it in the form of "pushers" as had been the case in the old mass game. Haughton won at Harvard where others had failed because he was one of the first major coaches to realize that speed and power were. in themselves, relatively valueless unless properly masked by deception. Harvard played football only informally in 1917 and 1918, but returned to the field in 1919. The master coach had retired, but enough of his teaching and his impetus remained to carry Harvard through to the 1919 championship and a Rose Bowl victory over Oregon by 7–6; yet Harvard was nearing the end of its brief reign as a real football power.

Illinois under the mercurial Zuppke and Ohio State under John W. Wilce had taken prominent places in middle west football. Zuppke's victory over a mighty Minnesota team, 14–9, on Nov. 4. 1916, was still talked about years later as one of the greatest football upsets of all time. Illinois had won the Western conference championship in 1914 and had tied with Minnesota in 1915, but Minnesota was supposed to win as it pleased in 1916—and did everywhere except in the Illinois game. The upset of Minnesota enabled Ohio State to win its first championship in 1916 by what was largely regarded as a fluke. Wilce proved that this charge mas groundless by repeating with another championship in 1917. Michigan, which had withdrawn from the Western conference as a result of the upheaval following the 1905 season, returned to western competition in 1917 and was undefeated and untied in 1918, sharing the championship nith Illinois and Purdue, also undefeated and untied in conference play.

Post-World War I Boom.—Those close to football realized the game was to experience a boom in the years immediately following World War I. but not even the most extravagant estimates encompassed what was in store. The lesson Camp had taught college football managers by inspiring the building of the Yale Bowl was well remembered, and colleges throughout the land began rushing stadiums to completion. on borrowed funds more often than not and nith unfortunate results in some instances. In the main vast stadiums were confined to larger universities, those with larger undergraduate bodies and either large graduate bodies or large concentrations of townsfolk eager to see football games. and in these cases the building programs worked out very satisfactorily. The stadiums were paid for in due course and the earnings of the football teams were diverted to the provision of athletic facilities for the general mass of the students. In the case of Notre Dame, the greatest money-earning team in football, profits from the game also provided new buildings and academic improvements. Because Notre Dame played most of its big games away from home, the university was one of the last of the major institutions to build a modern stadium on its own campus. In colleges of minor football stature, however, the erection of stadiums beyond their needs brought financial disaster, even in boom times. With nobody but the public to dram upon, such colleges soon found that the public would not pay to see a loser. This led to recruiting of players by offering them inducements outside the amateur code, but sometimes not even this proselyting produced winning teams.

Rise of "Small" Teams.—Into this setting of prosperity arrived, in 1919, several so-called "small" teams which achieved sudden success and fame. The two most successful elevens in 1919 were Notre Dame and Centre. Also undefeated was Texas A. & M.. but that feat went largely unrecognized because sectional football developments were not considered, in 1919, to be of national importance. Notre Dame had produced undefeated and untied teams in 1912 and 1913 (without having attracted undue attention in the east, despite its 1913 victory over Army), and Centre college had produced several championship elevens in the south. Rockne mas becoming famous at South Bend, and "Uncle Charley" Moran of Tennessee was putting together another championship team at Centre which became known as the "Praying Colonels" because the players were said to kneel in prayer before each game.

Centre in 1919 attracted even more attention than did Notre Dame. West Virginia, beaten in an early-season game by Pittsburgh, upset Princeton by 25–0 on Nov. 1, but suffered defeat by Centre. 14–6, a week later as Princeton was coming back to tie Harvard. That circumstance forced the Praying Colonels into the consciousness of the football public, with far-reaching results. Harvard. with an undefeated but tied eleven and a Rose Bowl winner, failed to get the recognition which its graduates felt was its due, and agitation was begun to arrange a more difficult schedule for 1920. Urged by influential graduates. Harvard invited first Illinois, Western conference champion of 1919, and next Michigan to play at Cambridge in 1920. Each declined unless Harvard would return the visit in 1921. Harvard authorities then invited Centre to come to Cambridge for the big midseason game of 1920, and Centre accepted.

Camp in 1919 had chosen Alvin N. ("Bo") McMillin and James R Weaver, quarterback and centre respectively of Centre, for his All-America team. contrary to all precedent, and football enthusiasts in Boston were eager to see what manner of men these Praying Colonels, who had upset the accepted order in football, mere. As a result, Soldiers field. Boston, was filled to its capacity of 52,000 on Oct. 23, 1920. Although defeated by 31–14 Centre rewarded the curious by scoring more touchdowns in Harvard stadium in 1j minutes than Yale had scored there in 15 years. Harvard suggested another game in 1921. Centre accepted filled the date and the stadium and won by 6–0 when McMillin ran 32 yd. around right end for a touchdown. aided by the interference of All-American James M. ("Red") Roberts. Harvard naturally wanted revenge, so Centre was invited back for 1922. The Colonels again filled the stadium to its full capacity, but Harvard won by 24–10, and thus ended the series.

Soon after Centre had disappeared from football fame. Notre Dame came back on the scene with even greater achievements. Notre Dame had gone undefeated in 1919 and 1920, but had failed to repeat that success in 1921, 1922 and 1923. Rockne then produced his great 1924 team, which won all its games and went on to defeat Stanford by 27–10 in the Rose Bowl. This team had Elmer Layden at fullback, Harry Stuhldreher at quarterback and Don Miller and Jim Crowley at the halfbacks. When Notre Dame defeated Army by 13–7 at the Polo Grounds in New York on Oct. 18, 1924, Grantland Rice. writing in the *New* York Herald *Tribune,* described the backfield men as "the Four Horsemen," a sobriquet which endured and helped establish the team as one of the most famous in history.

Rise of Pacific Coast Teams.—Football came into its own in the far west simultaneously nith its rise at smaller colleges in other sections of the United States. The University of California had played football as early as the 1880s, and Stanford had adopted the game in 1891. Stanford and California met annually from 1892 (when both spring and fall contests were played) through 1905 in the "big game" of the Pacific coast. Washington, Oregon, Nevada, Idaho. Whitman, Washington Agricultural (later State) and Oregon Agricultural (later State) took up the game in the mid- or late 1890s, and were playing representative schedules, including games with Stanford and California, when the reformation of 1906 struck college football. Stanford, California and other California colleges dropped U.S football and adopted Rugby in that year, and from 1906 through 1915 the "big game" was a Rugby match. This opened the way for the colleges farther north to establish themselves in football, which they proceeded to do by organizing the Pacific Northwest conference in 1908. Coached by Gilmour Dobie, Washington dominated this group from 1908 through 1916, a nine-year stretch without defeat during which Dobie's teams won 58 games and tied 3. From 1909 through 1913 Washington went through five straight seasons without defeat or tie, and set a record for the longest string of that sort in major U.S. football. Washington won or tied for the Pacific Northwest championship in each of the seven seasons from 1908 through 1914, and then tied Oregon for the first Pacific Coast conference title in 1916. Washington and Oregon played a scoreless tie in their own game. but Oregon got the call to the Rose Bowl and defeated Pennsylvania by 14–0 on Jan. 1, 1917, in the third game in this bowl series.

Andrew L. Smith by that time was established at California, laying the foundations for his "wonder teams" of the 1920s. The lesser-known Melbourne C. ("Fighting Bob") Evans coached at Stanford in 1919, and sent an inspired eleven against California in the big game. California finally won by 14–10, but Oregon had a better record and captured the Rose Bowl assignment. No team went through the conference season undefeated, and Harvard added to western woe by winning in the bowl game by 7–6.

From that point onward Smith nas on his way. He won four straight championships from 1920 through 1923, and was undefeated but tied twice in 1924, when Stanford took the title and the assignment to the Rose Bowl (nhere Notre Dame's Four Horsemen won by 27–10). California crushed Ohio State. Western conference champion, by 28–0 in the Rose Bowl on Jan 1, 1921, and played a scoreless tie with Washington and Jefferson on Jan. 2, 1922. The Pacific Coast conference refused to send its champion team to the bowl following the seasons of 1922 and 1923.

Evans a San Francisco businessman, had no desire to remain in the coaching profession, and Stanford authorities began seeking the services of a well-known coach. After trying two temporary coaches. they decided. in 1922, on Glenn ("Pop") Warner. who after 191j had been building strong Pittsburgh teams. From 191j through 1918 Warner's Pittsburgh teams were undefeated by college opposition, ninning 23 major games and losing only to the Cleveland Naval Reserve eleven, 10–9, in the final 1918 game. He rated his 1916 team as the best of all the elevens he developed. Earlier, Warner had coached at Georgia and Cornell, his alma mater, and had won national fame as mentor of the famous Carlisle Indians. who included among their number Jim Thorpe, often considered the greatest player in football's history. The Stanford situation suited Warner exactly, but his commitment at Pittsburgh prevented his taking the post until 1924. In this emergency. Warner dispatched one of his assistants, Andrew Kerr of Dickinson, to Palo Alto to coach in 1922 and 1923.

Southern California meanwhile had joined the conference. and had high football ambitions. Trojan authorities engaged Howard Harding Jones, who had coached Yale in 1909 and Iowa in 1921 and 1922 to championship seasons before moving to Trinity of

North Carolina. Smith died in Jan. 1926 before this new triple rivalry of master coaches could more than get under way, and was succeeded by Clarence M. ("Nibs") Price. Washington. coached by Enoch Bagshaw, had won the 1925 championship, but Price, Jones and Warner fought for the next several titles. The style of play taught by Warner was due to vie with the game advocated by Rockne at Notre Dame for the favour of almost all the other U.S. coaches.

The Game in the South. — In all the years prior to U.S. entry into World War I, the supremacy of Virginia in the south Atlantic states and of Vanderbilt in the central south had never been seriously challenged. North Carolina or Georgetown or 1'irginia Polytechnic in some years would crowd Virginia closely, or even win, but in the main the Cavaliers were victorious. The supremacy of Vanderbilt in the deep south was even more marked. Sewanee, Centre or Auburn would win a championship here or there, or tie for one: Kentucky State (later Kentucky) and Central university of Richmond. Ky., had undefeated, untied elevens in 1898, but failed to meet each other and found Sewanee and Auburn, also undefeated and untied, owning shares in a championship split four ways as Vanderbilt experienced one of its rare losing seasons. Clemson, coached by Heisman, won in 1902 and shared the 1903 title with Vanderbilt and Sewanee, after Cumberland was narrowly eliminated. But for the most part Vanderbilt was on top. From the start of football at Vanderbilt in 1890 through the season of 1912, the Commodores dropped only 12 games to rivals in the central south, exactly half of them to their then archrival. Sewanee. In the nine seasons following the arrival of able Dan McGugin on the Vanderbilt campus in 1904, Vanderbilt lost only one game to a southern team. This was a 16-j defeat by the champion Sewanee eleven of 1909. Sewanee had held the Commodores to a 6-6 tie in 1908. Vanderbilt also proved the worth of southern football, or more properly its own football, in other sections in the 1904–12 era, playing several close games with Michigan, tying Yale, 0–0, at New Haven in 1910 and losing to the champion Harvard eleven of 1912 by only 9-3. Vanderbilt won or tied for the championship of the central south in 1904–07 and 1010–12.

Sewanee had its greatest success just before the turn of the century. The Purple Tigers cut into the four-way tie for the 1898 championship and had fine prospects for 1899. They engaged a capable coach in Herman M. Suter of Princeton. A trip into Texas to play Texas and Texas A. & M. grew into a junket in which five games were played in six days. Sewanee defeated Texas. Texas A. & M., Tulane, Louisiana and Mississippi in succession and held all opposition scoreless. The Tigers finished a perfect season with 12 victories. and saw their goal line crossed only by Auburn, which was defeated by 11–10 in Montgomery. Ala., on Thanksgiving day. Two days later, Sewanee defeated North Carolina by 5–0 in Atlanta, Ga. North Carolina was south Atlantic champion, and the Tigers thus won the championship of the entire south.

Heisman moved to Georgia Tech in 1904, but experienced many lean years before he began to challenge the supremacy of Vanderbilt. Through these years Heisman endeavoured to win by guile and craft, but he failed to make an impression with his Georgia Tech eleven until 1916, when he won the title. George Tech won all its games in 1917, defeating Pennsylvania by 41–0, Carlisle by 98–0, Vanderbilt by 83–0 (the Commodores' greatest setback), Auburn by 68-7, Tulane by 48–0 and Washington and Lee by 63–0.

Such was the status of southern football up to the end of World War I. The postwar years saw the rise of Centre and of Alabama, coached by William Wallace Wade. In Wade's second season he lost only to the champion Centre eleven of 1924, and in his third he completed a perfect campaign with a 20–19 victory over Washington in the Rose Bowl on Jan. 1, 1926, the first visit of a southern eleven to Pasadena. Alabama also won the championship in 1926 and climaxed its season with a 7–7 tie against Stanford in the Rose Bowl. Georgia Tech returned to power in 1927 and 1928, and sent its 1928 eleven to Pasadena to defeat California by 8–7 in the game made famous by the dash of California's Roy Riegels toward his own goal. Bernard ("Bernie") Bierman of Minnesota built Tulane into a feared and respected team before he went to Minneapolis to establish his own alma mater as the greatest eleven in football during the period 1934–41. Capt. (later Gen.) Robert Neyland was turning out great elevens at Tennessee, but the Volunteers seemed always to miss the championship by suffering one tie while some rival turned in an all-victorious campaign. Capt. Lawrence ("Biff") Jones of Army was engaged to build up the Louisiana State eleven, with which Bernard H. Moore of Carson-Newman won championships in 1935 and 1936 after Jones had moved to Nebraska.

Wade had another great year at Alabama in 1930, winning the championship, crushing Washington State in the Rose Bowl by 24–0 and winding up second only to the great undefeated and untied Notre Dame eleven, the last Rockne coached before he was killed in an airplane crash in Kansas on March 31, 1931. Wade then moved on to Duke where he continued to develop championship teams. Frank W. Thomas of h'otre Dame moved from Georgia to Alabama in 1931, and gave the Crimson Tide championship elevens in 1933, 1934, 1937, 1944 and 1945.

In the south Atlantic area, Virginia abdicated from the ruling seat in the early 1920s, but no new power rose to take its place. Virginia Military institute won the championship in 1920, sparked by a great back, James Leach; North Carolina produced great teams coached by the Fetzer brothers, Bob and Bill, winning the championship in 1922. North Carolina repeated in 1929 under Chuck Collins of Notre Dame. Wake Forest. meanwhile, defeated North Carolina in four straight games from 1924 through 1927, and won the south Atlantic title in 1924. But no team in the south Atlantic seemed to aspire to national football honours except Duke, which had not yet become a threat.

Other Sections. — Great teams were developed in the Southwest conference by such men as Dana Xenophon Bible. Ray Morrison, Madison Bell, Leo R. ("Dutch") Meyer, Homer Norton and others. Although southwestern teams failed to get a full share of national attention following World War I, they gave a good account of themselves everywhere in intersectional games. Favouring indiscriminate use of the forward pass, the Southwest conference became known as the "passer's league." From the conference came Sammy Baugh, later of the professional Washington Redskins, whose passing prowess made gridiron history. The southwest's chance for fame came after the 1935 season. when Stanford. hard pressed to choose a Rose Bowl opponent, decided that Texas was far enough "east" to qualify Southern Methodist as the "eastern" team in the classic. Stanford won by 7-0.

In the Missouri Valley conference, Nebraska long had been a power. The Cornhuskers mere strong enough to win their share of games from the great elevens of the Western conference, even before World War I, and they continued the pace in the years following the war. Nebraska continued to dominate its field even after the six leading teams in the Missouri Valley conference withdrew from the old organization in 1928 to form the Missouri Valley Intercollegiate Athletic association, popularly known as the Big Six (Nebraska, Missouri, Kansas. Oklahoma, Kansas State and Iona State). The league became the Big Seven in 1948 with the admittance of Colorado university, and the Big Eight in 1957 with the admittance of Oklahoma State.

The Rocky mountain teams play few intersectional games, and so receive little or no nation-side publicity. Utah, coached by Ike J. Armstrong, became a perennial power in that section. Colorado developed a championship team in 1937 under the coaching of Bernard F. ("Bunny") Oakes—a team made famous by Byron ("Whizzer") White, the greatest ball carrier developed in the Rocky mountains after Colorado college produced Earl ("Dutch") Clark. In 1938 Colorado, Denver, Colorado State. Wyoming, Utah, Brigham Young and Utah State withdrew from the Rocky Mountain conference and organized the Mountain States conference, leaving the older organization to the five "smaller" teams, one of which — Colorado college — soundly trounced one and all in the Rocky mountains in 1943.

New Strategy and Tactics. — The established major teams remained generally conservative in the first few years after World War I, but they changed after a few startling incidents such as the one "Bo" McMillin engineered on an astonished Harvard eleven in the first Centre-Harvard game in 1920. With the score tied at 7–7 in the second quarter, Centre had a fourth down on its own go-yd. line with 6 yd. to go. McMillin stood back for what even Centre supporters supposed would be a punt, but he did not punt. Instead he took the ball, faded back a few more yards, and defied every "don't" in the football book by sailing a high forward pass over the heads of Harvard defenders into the hands of Eddie "Cutie" Whitnell, 50 yd. away on Harvard's 30-yd. line. Whitnell raced over the Harvard goal line for the touchdown which put Centre ahead. Nobody gave McMillin credit for realizing how far and how accurately he could throw a football or for having the courage to throw one in the clutch. Four years later Princeton received Harvard's opening kickoff on the same field and immediately threw a forward pass from deep in its own territory. That one failed, but the Tigers promptly tossed another which succeeded—and then went on to crush Harvard by 34–0.

In the years preceding 1917 large eastern teams used the forward pass mainly as a threat to open up the defense in order that the running plays might work better. Its disuse could be traced to the absence of any passers of outstanding ability. Dartmouth used the air attack in 1924 and 1925 when Andrew J. ("Swede") Oberlander convinced Coach Jess B. Hanley that he could throw a football both accurately and far. With Oberlander passing to Myles J. Lane and George C. Tully, Dartmouth humbled all opposition in 1925 and claimed at least a share of the national championship.

The two most successful coaches in the years immediately following World War I were Rockne of Notre Dame and "Pop" Warner of Pittsburgh and Stanford. It was only natural that other coaches, even conservative easterners, should borrow their methods, that colleges everywhere should demand Rockne-trained or Warner-trained men as coaches. The methods of the tno men were at wide variance, but the results they obtained were similar. Both attacks were predicated on speed, but in the Warner scheme power was on a parity with speed. The Warner game could not be played without power and, if necessary. speed was sacrificed to power. The Notre Dame attack did assign two men to take out the defensive tackle, but otherwise it consisted of precision, speed and timing with man-to-man blocking.

In the first few years after World War I Notre Dame relied a good deal on the backfield shift, but the rule makers removed all advantage from the shift by requiring a full halt between the final jump and the snap of the ball, robbing the play of its momentum. This nullifying of the advantage of the shift led to Rockne's developing the "weak side" attack, thus discouraging opponents from overshifting on defense to the strong side, as had been their practice. Rockne always had his backs work behind a balanced line, with both guards racing out to lead interference. For this reason he required guards who could do more than hold their ground and withstand line drives of the opposition. Rockne needed and obtained (hatch-charm" guards, Notre Dame backs lined up in a T and shifted into an oblique box an instant before the ball was snapped. This arrangement was not unlike Warner's single wing formation, except that in the Notre Dame system the outer back's position nas about two yards inside his own end instead of one yard outside.

The entire Notre Dame attack was designed to produce long gains, to break a man into the open for a touchdown run from any part of the field. It has been said that every play in football would mean a touchdown if each offensive player carried out his assignment perfectly. Notre Dame men then, more often than players on other teams, did carry out their assignments to perfection. Rockne by no means scorned the pass, but he never had a superior passer. The pass therefore never overshadowed his running attack, but remained always a threat. Rockne much preferred to have his players catch passes thrown by other teams and run them back for touchdowns.

When the two defensive halfbacks first were forced away from their tackles by the introduction of the forward pass in 1906, the defensive setup of the backs was changed from an inverted T to a roughly shaped diamond. As passing developed, the points of the diamond were made equidistant. since many coaches believed this to be the best defense against both rushing and passing. As more and more teams began to remove the centre from the line and play him "loose" in support of the fullback (really an eight-man line nith six primary and two secondary defenders), the diamond defense was converted into what is known as the 2–2–1 defense. Rockne to the last preferred the diamond defense, although he did not invariably employ it.

The Warner game, in which defensive power is theoretically crushed by a greater concentration of offensive power, dissipates some of its power in the feints it calls for on sweeps and reverses, but both guards usually are in position to deal telling blows for the carrier on the ultimate development of the play. There is also the danger that the fullback will spin and, without having delivered the ball to some mate as seemingly was his intent, go plunging through the middle of the line, deserted by defenders.

The Warner system operates from an unbalanced line, shifted in either direction and nith both tackles lined up on the same side of the centre. This has the dual benefit of getting interfering power closer to the point of probable attack and of inducing the defense to overshift and leave the weak side vulnerable to a surprise thrust. The Warner single wing attack usually strikes the strong side, sometimes after a back has dashed nith the ball toward the weak side and then handed it to the weak side end moving in the opposite direction (a reverse), but it feints at the strong and then strikes around the usually unguarded weak side just often enough to keep the defenders uneasy. This weak side thrust folloning a feint at the strong side is the "naked reverse"

After Warner had gleaned many victories from the single ning back formation and had seen it copied the length and breadth of the land, he developed the double wing back, which he unveiled for the east in Yankee stadium in New York city on Dec. 1, 1928, to the acute discomfort of Army. Stanford won by 26–0 In the double wing, the fullback stands about four yards back of his centre in an unbalanced line, the quarterback is two yards in front of the fullback and slightly less than two yards to his right, and each of the two halfbacks is about one yard outside one of the ends and one yard to the rear of him. Reverses (nhich are deeper) are even more important in the double ning formation than they are in the single ning, but slants and plunges also are effective. Great physical superiority is required to make the double ning attack effective, and it is little used.

Other coaches modified Warner's single wing attack by pulling the tail or carrying back sufficiently to the rear of the offensive formation to enable him to throw a quick forward pass without being forced to fade backward in order to comply with the five-yards-back-of-the-line rule. As there nas always the possibility, in the minds of the defenders, that he might actually kick, this tended to spread the defense, thus opening the way for running plays. This style of play is called the single wing and short punt formation game.

In the decade preceding the outbreak of World War II, an increasing number of teams began to experiment with five-man lines on defense. These lines retained the eight-man principle of the line in the 6–2–2–1 defense, and further aided the defensive team by confusing the offensive team's blockers on their assignments Most young football players are decidedly upset if they have been taught to block a given defender on a given play and then suddenly discover that the foe is not there to be blocked. Coaches met this situation by drilling their players in two sets of blocking assignments, one for the five-man line and one for the six-man defense. A third set was required when any possibility existed that an opponent might go into the fast-disappearing diamond defense nith a seven-man line, but the variation in blocking between seven- and six-man lines was negligible. The centre could be out of the line without upsetting the offense. It was the disappearing guard or tackle who caused all the confusion. As soon as offenses mastered the five-man line defense its use began to disappear, except for nuisance purposes, although many teams peel down to a four- or even a three-man line to guard against passes in the closing minutes of a game when a beaten foe can do nothing but throw the ball in desperation, hoping for a completion and a score.

In the late 1930s George Halas. owner and coach of the Chicago Bears of the National Football league, departed from the accepted practice of employing either Rockne or Warner football. He revived an offensive formation which had come into being almost simultaneously with the closing up of the old Rugby-style game in 1888 but which had been generally abandoned before the start of World War I. The revived formation became known to the football world as the T formation because in it the backs line up in the form of a capital T. the halfbacks on either side of the fullback and all in a straight line from four to five yards back of the scrimmage line, with the quarterback "up under the centre." In the T formation, the ball is never passed directly to the carrier, but is always handled through the quarterback, who also is invariably the forward passer. Deception is increased by employing one of the halfbacks as a flanker or man in motion. Moving obliquely toward his own goal line in advance of the snap of the ball, this man in motion is a multiple threat to the defense. The T usually operates behind a balanced line. Its leading advantages are its deception and full utilization of speed. The attack breaks sharply and quickly through openings quickly made in the defensive line. With its brush blocking, it calls for less power than either the Rockne or the Warner system, and frequently enables teams of inferior physical ability to defeat, on sheer speed, foes using Warner or Notre Dame football.

Halas' Bears won tremendous victories with the T formation at Chicago. Clark Shaughnessy, while coaching at The University of Chicago, helped Halas develop the formation and install it as the system of the Bears. After The University of Chicago abandoned football folloning the 1939 season, Shaughnessy was engaged to coach Stanford, which had failed to win a single game on the Pacific coast in 1939. Shaughnessy installed the T formation at Stanford in 1940, and the Indians played through an undefeated season.

Coaches who had been hesitant about adopting the T then rushed to install it. Its spread was limited only by the ability of coaches to assimilate it and teach it to players who had spent their football careers working under either Warner or Rockne systems. At Notre Dame itself, Coach Elmer Layden had, quite naturally. been teaching Rockne football to his players after he became head coach in 1934. In March 1941 Layden resigned to become commissioner of professional football. Frank W. Leahy, then coach at Boston college, was engaged to take his place. Leahy adopted the T and developed one of his greatest teams in 1943. Earl Blaik at West Point also went over to the T and Army was invincible from 1944 through 1946 with Felix ("Doc") Blanchard and Glenn Davis in the backfield.

By the end of World War II, more than 60% of the major colleges had adopted the T, but new defense alignments were solving it and these .were countered, in the following years, by combinations of the basic T and single uing formations. resulting in the wing T; widespread linemen. flankers and a deceptive man in motion. The split T, originated by Don Faurot at Missouri in 1941, with wider spacing of the line and making a runner of the quarterback on the famous option play, achieved a great vogue. Oklahoma and Maryland, coached by Charles ("Bud") Wilkinson and James Tatum, who both had been Faurot's assistants during World War II at Iowa Pre-Flight, won national championships with the split T in the 1950s.

Wilkinson achieved great success from 1948, when he became head coach at Oklahoma, through 1958. Prior to this Blaik and Leahy had been the big "name" coaches, along with Fritz Crisler and Bennie Oosterbaan of Michigan. Leahy, after developing his great Notre Dame team of 1943, went into the navy, and Blaik was supreme with his all-conquering Army elevens of 1944 and 1945. Leahy returned from the war in 1946 to challenge Blaik, and their unbeaten teams played a scoreless tie. Michigan challenged Notre Dame for supremacy in 1947 and 1948, but in the latter year Wilkinson started Oklahoma on its climb from mediocrity.

After losing its opening game under Wilkinson in 1948, Oklahoma won 31 games in succession. It then lost to Kentucky in the 1951 Sugar Bowl and to Notre Dame in 1952. In 1953 Oklahoma lost its opening game to Notre Dame and was tied by Pittsburgh in the second game. Then began one of the longest winning streaks in the history of intercollegiate football. For 47 successive games Wilkinson's teams were invincible. The team that ended their winning streak in 1957 was Notre Dame, the same team that had last beaten them, in 1953.

The split T formation that Wilkinson used with such success began to lose some of its vogue in the late 1950s. The slot T, splitting an end wide and putting a back in the gap, off the line, mas introduced by the professional teams and taken up by the colleges as an effective forward-passing arrangement. The wing T, with variations, took on an increasing vogue. The double wing T appeared. and Army's "lonely end" formation, in which the flanker remained out of the huddle, originated by Earl Blaik in 1958 to stop the defense from packing in tight against the running attack, led to the general practice of splitting an end wide, as well as stationing a back far out on the opposite side as another flanker.

All-Star Teams. — Caspar Whitney, probably with the assistance of Camp, in 1889 established the custom of selecting all-star elevens at the close of each football season. His selections were called the All-America team. and they appeared in a magazine called *The Week's* Sport, as did those of 1890. The choices included only 11 first-string players, 4 line substitutes and 4 backfield substitutes. From 1891 through 1896 Camp and Whitney apparently collaborated on the selections. Their selections appeared in *Harper's* Weekly in Whitney's column and in the *Spalding* Football *Guide* under Camp's name. Whitney's own magazine had ceased publication. The 1891–96 selections also mere limited to a first team and eight substitutes, but the "honourable mention" list was introduced in 1891. Camp took over Whitney's column in Harper's in 1897. when Whitney was absent from the United States. Camp in that year introduced the practice of choosing first, second and third elevens and retained the honourable mention list. In 1898 Camp moved to Collier's, and his All-America selections appeared in that magazine through 1924. Camp died in March 1925, and Collier's engaged Grantland Rice to carry on the annual selection.

Even before the turn of the century, other football devotees began to make their own All-America selections. The number of such selectors increased as football grew, but Camp's choices always were accepted by the football public as "official." It seemed doubtful that anybody else could command universal acceptance of selections, since there were hundreds of good football players in the 1920s whereas there had been only dozens in the 1890s. More than 100 good teams mere in the field instead of perhaps 20. Obviously, no one man could possibly hope to see all the good teams or all the good players, much less choose the 11 best. Rice and Collier's met this problem by compiling their selections from the findings of a country-wide board of the American Football Coaches association, of which Rice served as chairman until his death in July 1954. He was as pre-eminent among sports writers as was Camp as a football leader. The three major U.S. news-gathering services, Associated Press, United Press and the International News Service (the latter two combined to form United Press International in 1958), also choose All-America teams annually on the findings of representatives scattered throughout the country, and these selections enjoy wide acceptance. A fifth major selection group was the All-America board, established by Christy Walsh of the Christy Walsh syndicate in 1924. Walsh's honour teams were chosen by "name" coaches whom he enlisted to perform this service. Original members of the board included T. A. D. Jones of Yale. Rockne. Warner and William A. Alexander of Georgia Tech. The Football Writers Association of America picks a team for Look *Magazine*.

World War **II** and the Postwar Years. — The effects of World War II on football and other college sports were not so immediate or so far-reaching as those of U.S. participation in World War I had been. Lessons learned in the earlier conflict enabled colleges to avoid mistakes made in 1917 and to maintain athletic competition for the remaining students. Action of the colleges was backed by the war and navy departments, which requested that athletics, particularly football, be continued, not only to train youths physically but also to bolster civilian morale.

The army and the navy soon began using facilities at most of the colleges of the country. This was projected as early as 1942, but was not carried out until after the completion of the 1942 football season, which progressed much as had any peacetime season, despite the fact that teams everywhere were weakened by loss of players who had entered the armed forces. Crowds remained large, although not quite so large as they had been in 1940 and 1941. Transportation shortages already had begun to be felt, but they had by no means become acute.

Before the 1943 season opened, trainees were in virtually full occupancy of all the colleges, and curtailment of travel had become a necessity. Few civilian players were left from 1942 teams, but the navy department made up for this in navy-trainee colleges by granting permission to use trainees on varsity elevens. The war department, however, forbade army trainees from taking part in varsity competition. This caused many army-trainee colleges to drop football temporarily. Others, however, carried on and some fabulous elevens were produced in the war years, notably the so-called "dream team" at West Point. But many colleges had only 17- and 18-year-old players available and the peacetime competitive balance was missing.

The last season of wartime football was 1945, but many of the colleges which had recently dropped the game were again fielding teams in 1944 and, with the return of draftees from the European front, competition was soon restored to prewar levels. The homecoming G.I.'s brought abundant manpower and talent to nearly all teams and the return of unrestricted auto and rail transportation filled the nation's stadiums with capacity crowds. It was boom time for football. A period of spectacular and record-breaking play followed. The Korean war caused few disruptions and schedules were completed throughout that conflict.

The wartime swing to offensive football continued. The attack was centred in the pass. More were thrown and the portion completed climbed above 60% for outstanding performers. On the ground, bewildering variations of wing and T formations with a man in motion became increasingly popular and increasingly effective. This mounting efficiency in attack led inevitably to more scoring by both of the teams in a game.

In 1948, the last season in which prewar players were eligible, both teams in 965 major games scored and only 2 major games in that season were 0–0 scoreless battles.

Platoons and **De-emphasis.**—The two-platoon system—an offensive and a defensive eleven for each team—was a popular postwar innovation. Introduced by Michigan in 1945, it developed highly skilled specialists and superior play in both offensive and defensive departments. But it also called for greatly increased squads and coaching staffs and, largely because of soaring costs, was eliminated in 1953 by a return to prewar substitution rules.

In the 1948–52 period a move to de-emphasize football gained momentum. The N.C.A.A. stopped mushrooming bowl games by sanctioning only those which allotted 80% of the gate receipts to the participating teams. The Ivy group (Brown, Coluinbia, Cornell, Dartmouth, Harvard, Pennsylvania, Princeton, Yale) and the Missouri Valley conference banned postseason games entirely and also banned spring practice. Steps were taken by the N.C.A.A. to curb excesses in the recruiting and subsidizing of athletes. Football coaches adopted an ethics code to eliminate unsportsmanlike practices.

The N.C.A.A. and some of the conferences, probably influenced by the example of the Ivy group in setting up strict faculty regulations of their athletics under the presidents' agreement of 1954, took punitive action against member colleges for recruiting and giving financial aid to athletes in violation of restrictions. Colleges in the Pacific Coast, Western (Big Ten), Southwestern, Southeastern, Southern, Missouri Valley (Big Eight) and Atlantic Coast conferences were disciplined. The penalties included probation for from one to four years, barring the school from N.C.A.A. championships and postseason (bowl) games, depriving players of a year of eligibility and, in one instance, the suspension of the coach for a year. The punishment meted out to four colleges in the Pacific Coast conference brought a strong protest from alumni groups and in 1959 the conference broke up and a new Big Five was formed.

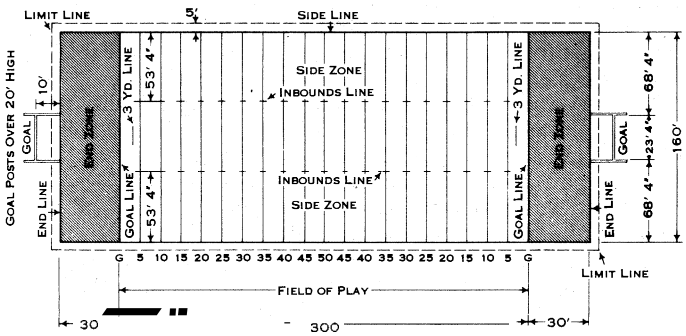
Postseason Games.—The postseason or "bowl game" idea was launched at Pasadena, Calif., on Jan. 1, 1902, when the Tournament of Roses committee of that city arranged the first tournament game between the national co-champion, Michigan, and a Stanford eleven which had not even been able to win the title on the Pacific coast. Michigan won by 49–0. No more games were played until New Year's day, 1916, when Brown was defeated by Washington State, 14–0. Except for a two-year hiatus in World War I (when service elevens were substituted), the Tournament of Roses (later Rose Bowl) game was an annual feature.

The East-West Shrine games for charity were started at San Francisco, Calif., in 1925. The Orange Bowl game was launched at Miami, Fla., in 1933; the Sugar Bowl at New Orleans, La., in 1935; the Cotton Bowl at Dallas, Tex., in 1937; and the 'Gator Bowl at Jacksonville, Fla., in 1946. All the major bowl engagements are played ordinarily on Jan. 1.

B. Rules and Fundamentals of U.S. College Football

Although U.S. football was born from Rugby, the game in the United States resembles its British parent only in the shape of the ball, which is an oval leather case covering an inflated rubber bladder. Its long axis measures 11 to $11\frac{1}{4}$ in., its short axis measures 6.73 to 6.85 in. and its weight is from 14 to 15 oz.

Number of Players.—Teams consist of 11 players: 4 backs (quarterback, left halfback, right halfback, fullback) and 7 linemen (left end, left tackle, left guard, centre, right guard, right tackle, right end). Players line up in various formations for offense and defense but, when a scrimmage begins, each team must be "on side"; any offensive lineman in the backfield must be at least five yards back, unless the change is permanent; and the offensive team must have at least seven players on its forward line.



BY COURTESY OF NATIONAL COLLEGIATE ATHLETIC ASSOCIATION

FIG I.—DRAWING OF U.S. COLLEGE FOOTBALL FIELD. SHOWING MARKINGS. ZONES AND MEASUREMENTS

Objective of Game.—Each team's objective is to score more points than its opponents. Points are scored for the attacking team only and the team having the most points at the end of the game is the winner. A touchdown (6 points) is scored when a player carries the ball across his opponents' goal line, completes a forward pass or recovers a free ball in his opponents' end zone. With each touchdown goes the privilege of trying for extra points. The ball is given to the scoring team on the defenders' 3-yd. line for one play. One point may be scored by a place or drop kick, two by a run or a pass. A field goal (3 points) is scored by drop-kicking or place-kicking the ball from scrimmage over the crossbar or directly over an upright of the opponent's goal. A safety (2 points) is scored when a play ends with the defenders in possession of the ball behind their own goal line, the defenders themselves having given the impetus which caused the ball to cross their goal line.

Playing time is 60 minutes divided into IS-minute quarters and go-minute halves. Time is taken out for various delays and the elapsed time for a game is uell over two hours. Between the first two and between the last two quarters, there is a one-minute interval when the teams exchange goals and the ball is relocated so that its position, as related to goal lines and side lines, is the same at the start of the ensuing quarter as it was at the end of the previous quarter. There is a 1j-minute intermission between the two halves during which both teams leave the field

Before each game, the referee tosses a coin in the presence of the two captains, asking one to call The winner of the toss gets his choice of goals or of kicking or receiving the first kickoff. The loser gets the same choice at the start of the second half.

Each half of the game starts with a kickoff—a place or drop kick from the kicking team's 40-yd. line and with the receiving team behind a line 10 yd. distant (*i.e.*, a "free kick"). Someone on the receiving team tries to catch the ball and run it back toaard the kicking team's goal as far as he can before someone on that team tackles and stops him. A tackle is made by grasping the runner's body with the arms and throwing him to the ground.

Following the kickoff and runback, the team in possession of the ball gets a series of four scrimmage downs during which it must either advance the ball a minimum of ten yards or forfeit possession of the ball to the defenders. Each down starts with the ball resting on the ground and with the teams separated by a neutral zone whose width is equal to the ball's length. The centre snaps the ball back between his legs to a back who may run with it himself or pass it to a teammate who runs with it. Opponents try to stop any advance toward their goal by tackling the runner or by batting down or intercepting passes in flight. Each down ends when the ball becomes dead. At the end of any down, if the attacking team has the ball beyond its line to gain (ten yards from where the series started) it gets a new series of four downs with a new line to gain. At the end of the fourth down. if the attacking team has the ball behind its line to gain, the ball is given to the defenders and they become and proceed as the attacking team. Scrimmage downs, in successive series for one team or the other, continue until a series ends in a score. Then comes another free kick and the same pattern (free kick—runback—scrimmage—score) is repeated until playing time for the current half expires. After a touchdown (and the try for extra points) or after a field goal, the defenders choose between kicking or receiving the ensuing kickoff. After a safety, the defenders get a free kick from their own 20-yd. line.

During any scrimmage down, the attacking team may, and often does, surrender the ball to the defenders by kicking it. When that is done the kicking team may not interfere with a defender's opportunity to catch the ball. A defender may gain added protection by signaling (arm aloft) for a fair catch. If he does so he must stand fast after a catch and the kicking team is prohibited from tackling him. The traditional privilege of making a free kick after a fair catch was abolished in 1950.

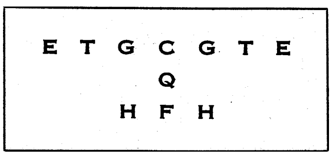


FIG. 2.—BALANCED LINE AND BALANCED BACKFIELD FORMATION
E, end; T, tackle; G, guard; C, centre; Q, quarterback; H, halfback; F, fullback

Three methods of kicking the ball are permitted: a drop kick, made by dropping the ball from the hands and kicking it as it touches, or is rising from, the ground; a place kick, made by kicking the ball while it is resting on the ground or a tee—the ball may be, and usually is, steadied by another member of the team; and a punt, made by dropping the ball from the hands and kicking it before it strikes the ground.

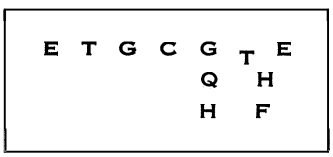


FIG. 3.—NOTRE DAME FORMATION

Systems of Play.—In the T formation. three of the backs (the left halfback, the fullback and the right halfback) line up from four to five yards behind the centre, just as they did in the early days of the game. The quarterback, now as then, plays close to and directly behind the centre. In the older game, the quarterback was required by rule to handle the ball before it could be touched by any other back except on a punt. In the modern T, he always handles it so as to prevent defenders from knowing just which back has received it. a deception less likely to succeed on a direct pass

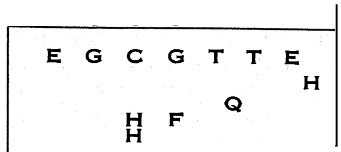


FIG 4.—WARNER SINGLE WING FORMATION

Rockne Notre Dame football, which enjoyed a big vogue in the 1920s and 1930s but was employed by few teams after World War II, also operates behind a balanced line (see fig. 3), but the backs are deployed differently, and the ball is aluays passed to them by direct pass from centre. The backs in the Notre Dame system first line up in a T and then, at a given signal, jump into the formation shown in fig. 3. They may also jump into the same formation toward the left The two forward backs are slightly more than 1 yd. behind the line; the two rear backs are about 4½ yd. behind it.

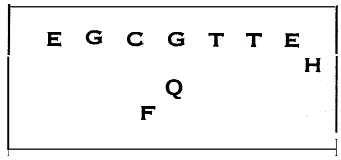


FIG 5—WARNER DOUBLE WING FORMATION

Warner or single or double wing football calls for an unbalanced line (see fig. 4 and 5) and a widely deployed backfield. The line usually is unbalanced by shifting a tackle. but some coaches choose to shift a guard instead. In the single wing (fig. 4), the forward halfback (wing back) stands one yard behind the line and up to one yard outside the end. The quarterback (blocking back) is placed about one-half yard to the rear of the wing back and about two yards inside the wing back position. The fullback (plunging back) is 1½ yd. behind and 1 yd. inside the quarterback. The left halfback (carrying back or tail back) is 1½ yd. to the rear and 1 yd. inside the fullback. In single wing, teams may shift to the left as well as to the right, depending upon the needs of the moment or the position on the field. In the double wing, rarely used

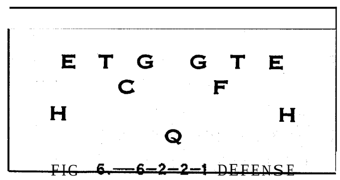


FIG 6.—6–2–2–1 DEFENSE

(fig. 5), each of the halfbacks (wing backs) stands one yard behind the line and one yard outside his end. The quarterback (blocking back) stands about two yards behind the strong side guard. The fullback (plunging back) is from 3½ to 43 yd. behind the centre, depending on what play has been called. The fullback is far more than a plunger in the double wing. He handles the ball first on most of the plays and is a key man in starting the delicately measured reverses.

Defense.—Defensive formations vary with the coaching systems and with the position of the ball on the field. A defense naturally must be much tighter when the attacking team has the ball near the defensive team's goal line than it would be near mid-field. This tightening has given rise to the term, "zone of intense resistance."

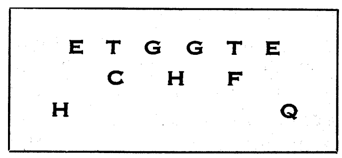


FIG. 7.—6–3–2 DEFENSE

The objective of the defense is (1) to recover the ball if an opponent fumbles it; (2) to throw the runner for a loss or limit him to as short a gain as possible; (3) to bat down or intercept any forward pass; (4) to block and try to recover any punt; or (j) to catch a punt and run it back toward the opposing goal line.

To accomplish these ends coaches employ various defenses. The commonest all-purpose defense is the 6–2–2–1 or 6–3–2 alignment (fig. 6 and 7). The offense must have, as noted, seven men on the line of scrimmage. The defense is free to get along with as few as it dares to leave there. In all defenses where only six men are left on the defensive scrimmage line, the centre, invariably a sturdy player, is the man withdrawn. Defenses calling for fewer than six men on the scrimmage line are used less often.

When the centre is withdrawn from the line of scrimmage to aid in defense back of the line. he shares with the fullback the duty of protecting the zone immediately back of the line. He and the fullback are called the "backers up" or "linebackers." Both stand about one yard back of the line. usually behind the defensive tackles. The line on defense is spread more widely than it is on attack and is shiited to meet offensive shifts.

E T G C G T E

FIG. e.— BOXDEFENSE

From iour to ten yards behind the backers up (in a 6–2–2–1 defense) are the defensive halfbacks. Their lateral spacing varies with different coaches. If they are too widely spaced: a forward pass may easily be completed between them in the "middle alley." If they are too close together, offensive backs may more easily run outside them or passes may be completed in the "flat zones." On an average, the defensive halfbacks stand no more than one yard outside their own ends.

E T G C G T E

FIG. 9.— DIAMONDDEFENSE

Back of the four forward defenders in this secondary defense stands the safety man. He is 20 yd. behind the scrimmage line on ordinary plays, but, if the attacking team is likely to kick, he is from 30 to 40 yd. back.

The 6–3–2 defense is used only when the offensive team is certain not to kick or when the offensive team is so close to the defending team's goal that no kick will be made except a drop or place kick in an attempt to score 3 points by goal from the field. In the 6–3–2 alignment there is no safety man. but there are three backers up.

The box defense (fig. 8) calls for a seven-man line, two backers up and two men in the secondary defense. The diamond defense (fig. 9), favoured by Rockne but now used only rarely, also calls for a seven-man line with one backer up, two defensive halfbacks and a safety man.

Defenses calling for the five-man line are used in part to confuse the offensive players on their blocking assignments. An offensive blocker cannot block a man who is not there to be blocked. The five-man defense invariably calls for three backers up—each a potential line defender if he is agile enough to plunge one yard forward to the threatened area of the forward wall.

The vogue of the T and especially the split T formations changed the defensive thinking. To stop these attacks coaches deployed their forces in ever-changing patterns. The rules favoured the defense in that it was not required to have any set number of men on the line of scrimmage. nor did the players on defense have to come to a pause in their forward movement before the ball was put in play.

The old standard defenses had difficulty in adjusting to the split T line spacing, creating gaps. It became necessary to put more men close to the line of scrimmage. Five-man lines became commonplace and the four-man lines ceased to be a novelty. The 4–5. 4–4, tight j, angling 5 and the Oklahoma 5 or corner defense (which does away with the old type of end play by bringing the ends in so close that they are no longer a force for containment) are among the arrangements used. They amount to eight- or nine-man lines. leaving two or three players in the secondary. The design is to create chaos by getting more men into the offensive backfield.

Along with these new deployments. coaches adopted the practice of keeping their deiense in a constant state of flux. Line backers pop in and out of the line. changing positions and switching assignments. This prevents the offense from taking a second look at the defensive setup before the ball is snapped and has a disconcerting effect upon the offense in carrying out blocking assignments.

Officials.—The playing of a game is supervised by a referee. an umpire, a linesman, a field judge and sometimes a back judge. Primarily the referee positions the ball, orders play started and stopped according to rule, inflicts all penalties, declares all scores and is in over-all charge. The umpire inspects and rules on equipment and conduct of players. The linesman locates the line to gain and keeps count of the downs for each series, notes whether players are on side when each play starts and marks the distance gained or lost by each play. The field judge keeps time. using a stop watch or a scoreboard clock operated by an assistant. and supervises downfield play which has passed his fellow officials.

Fouls and Penalties.— In addition to their primary duties, all officials have a joint responsibility for calling fouls; *i.e.,* infractions of the rules (fig. 10). Each one carries a marker which he tosses or drops when he calls a foul. At the end of the play he reports his ruling to the referee, who inflicts the prescribed penalty. Loss of yardage, loss of a down and forfeiture of the ball to the offended team are the penalties frequently inflicted. S o team, however, may be penalized more than half the distance between the enforcement spot and the goal line. Common fouls, with the penalty for each. are: off side (prematurely charging across a restraining line), j yd.; illegal use of hand or arm (holding an opponent), 15 yd.; ineligible pass receiver (in legal formation, any offensive lineman between the ends when a scrimmage starts) first touching a forward pass beyond the neutral zone, 1 j yd. plus loss of a down; unsportsmanlike conduct (side-line coaching, invalid fair-catch signal, illegal return of disqualified player to the game, rule violation during intermission), 1 j yd.; illegal position or procedure (less than seven men on the offensive scrimmage line at the snap, wing back less than one yard behind the scrimmage line at the snap, false start, illegal substitution), j yd.; illegal motion (by back or lineman at the snap), j yd.: illegal shift (failure to come to a full. one-second stop after shifting). 15 yd.; illegal return (re-entry of a player into the game before eligible under the substitution rule), 1 j yd.; delay of the game (taking more than 2 j sec. to put the ball into play. excessive time-out), j yd. (1 j yd. for delaying the start of a half); personal foul (piling on, hurdling. tripping, kicking an opponent, late tackling, etc.), 1 j yd., possible ejection of the offender from the game; clipping (blocking from behind), 1 j yd.: roughing the kicker or place-kick holder, 1 j yd.; intentional grounding of a forward pass (throwing a pass into the ground to avoid a loss). j yd.. loss of a down; illegal pass (two forward passes during one down. throwing from beyond the scrimmage line, handing ball forward illegally'), j yd.. loss of a down: interference with pass receiver, pass declared completed and offended team given first down on the spot of the foul; interference with pass defender, 15 yd.. loss of a down; interference with opportunity to catch a kick. 1 j yd.; batting or kicking a free ball or illegally touching a free kick, offended team's ball at the spot of the foul; crawling (attempt by a runner to advance the ball after any part of his person, other than a hand or foot, has touched the ground), j yd.; helping the runner or interlocked interference. 1 j yd. Although an incompleted forward pass does not call for a penalty as such. it does result in the loss of a down.

Any penalty may be declined by the offended team but a player who is declared ineligible because oi a personal foul must leave the game. A team will decline a penalty if the play, as completed, has given the team a greater advantage than would accrue to it by accepting the penalty. An example would be a team's declining a penalty on a play which ended in its scoring a touchdown.

On the same play. fouls by both teams offset each other and the resultant penalties cancel each other.

If, on a single play. a team commits two fouls: the offended team may accept either penalty or decline both.

(A. S. Bl.; W. J. Ch.; Xr. R. H.; A. Da.)

C. U.S. Secondary School Football

History.——Since football requires rather expensive equipment, its expansion in high schools was slow prior to 1920. By that time. ton-nship and community high school districts with larger taxing units were being iormed. Since more money was available for the purchase oi athletic equipment and ior the construction

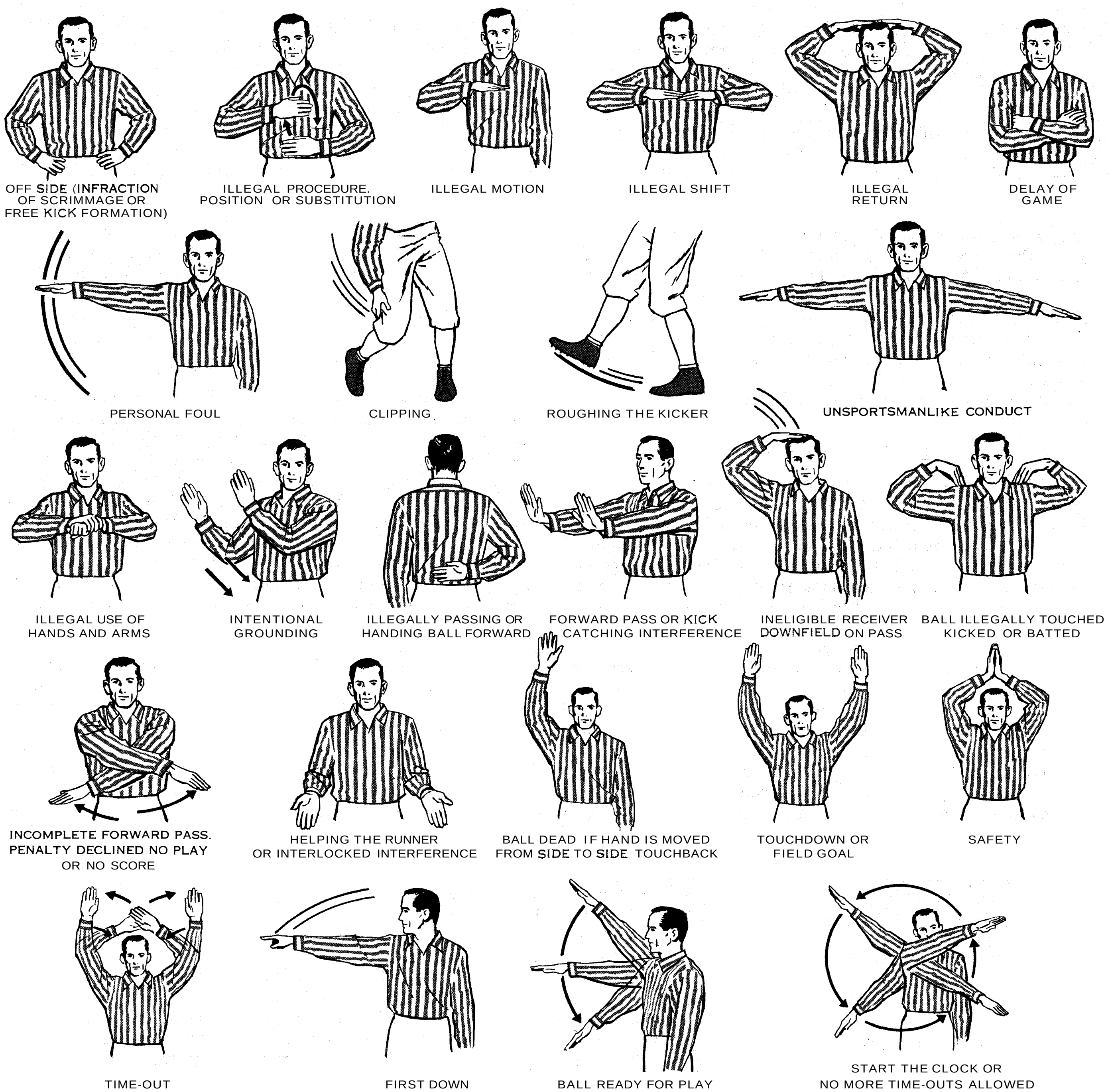


FIG. 10.—SIGNALS USED BY OFFICIALS ON FOOTBALL FIELD TO DESIGNATE PENALTIES AND OTHER DECISIONS

of adequate playing fields. high school football began to expand. About 1928 a high school in eastern Illinois (Westville) provided a lighting system for the playing of night football. This greatly increased the attendance. since it permitted working people to attend and permitted games to be played on Friday night as well as on Saturday afternoon. Approximately 50% of the high school games are now played at night.

Rules.—High school football is played under a code which permits a slightly more open type of game than that played by the larger colleges and universities. Significant features of the code include the following. When a scrimmage kick or a free kick touches anything in the receivers' end zone. the ball becomes dead and no runback is possible The high school game has 12-minute quarters (8-minute for junior high schools) and a 3-minute warm-up period is prescribed before the first and third quarters. More than one forward pass may be thrown provided each is thronn from behind the line of scrimmage; and a forward pass screen may be formed beyond the line of scrimmage if the pass is caught behind the line. Also a kick receiver may make a fair catch after which he may put the ball in play either by a snap or a free kick. The rules are the same for each of the three types of free kick; i e., the kickoff, the free kick after safety and a free kick after a fair catch. Any number of substitutes may enter when the ball is dead and there is no limit on the number of times any player may re-enter. During a time-out charged to either team, a player from each team may confer with his coach at a side line.

A carefully devised penalty system permits fixing the spot of enforcement without the necessity of making exceptions for special cases. This is commonly referred to as the "three-and-one" system of enforcement. This system provides that the penalty for any dead-ball foul is enforced from the succeeding spot (see Glossary, below), regardless of nhere, on or off the field. the foul occurs. If a foul occurs during a loose ball such as during a kick, pass or fumble, the basic spot for measurement is the previous spot. All measurements are from this spot unless the foul is committed by the offensive team and at a place behind the previous spot. In that case, measurement is from the spot of the foul. The same principle applies to a foul which occurs during a running play. In this case, the basic enforcement spot is the spot where the run ends.

High school football rules are made by a committee composed of one representative chosen by each state high school athletic association. This committee acts jointly nith the National Junior College Athletic association and the National Association of Intercollegiate Athletics. Safety and research committees operate during the entire season. All committee efforts are co-ordinated through the office of the National Federation of State High School Athletic Associations. Eligibility rules. regulations about scheduling games, the number of games which may be played during one season, the number of weeks of practice which must precede the playing of the first game and the opening and closing dates which mark the football season are administered in each state by its state high school association. No national or sectional championships are permitted and bowl-type games are not approved,

D. Six-Man Football

History. — Six-man football was originated in 1934 by Stephen E. Epler, athletic coach at Chester high school, Chester. Neb., who felt the need of a game that could be played by small secondary schools which could not produce enough players to build an 11-man squad plus an additional 11 for practice scrimmage and substitutions. Other considerations were the danger to young players in the 11-man game, the cost of equipment beyond the means of many small schools and the great distances between schools in states such as Nebraska.

The rules drawn up by Epler were such as to retain the essential factors of blocking, tackling, running and passing while opening the way to new possibilities for skill and strategy. This produced a sport with many characteristics of a new game rather than merely regulation football played by teams of six players each.

The first six-man game was played in the fall of 1934 at Hebron, Neb. The two teams, made up of players from four different Nebraska high schools, battled to a 19–19 tie. The game had an appeal for small secondary schools which had never attempted to compete in regulation football and to other schools whose athletic budgets had been reduced during the depression years of the early 1930s, and spread throughout the U.S. and to Canada. It was played by primary and secondary schools, boys' clubs and college intramural teams.

Rules. — The game is played by two teams of six men each. A team consists of a centre, two ends, a quarterback, a halfback and a fullback. The field of play is 100 yd. long and 40 yd. wide with two end zones 10 yd. deep. Three officials, a referee, an umpire and a linesman, supervise the play. The essential differences between the 6-man and the 11-man game are as follons. After the ball is snapped, a clear (backward) pass or a forward pass must be thrown before the ball can cross the scrimmage line. Violation of this rule is a foul and calls for a five-yard penalty; a hand-off is not considered a pass. Every player is eligible to receive a forward pass; during a series of downs, the team in possession must advance the ball 15 yd. or give it up to the opposing team. A field goal counts 4 points. The try after touchdown starts at the 3-yd. line with a successful kick scoring 2 points; a run or a pass scores only 1. Fair catches and return kicks are not used. Also, if at the end of the first half or during the second half a team acquires not less than 45 points more than its opponent, the game ends.

In nearly all other essentials the rules for 6-man football are the same as those for 11-man football.

Variations. — In the 1950s many schools changed from 6-man to 8-man teams, which played on the smaller field but under the 11-man rules. The team is made up the same as the six-man team with the addition of two linemen who, with the centre, are ineligible to receive forward passes. In a few areas, games are played by teams made up of five or nine players.

Touch and Tail Football. — Touch football may be played with little or no equipment by varying numbers of players. Either 6-man or 11-man rules may be followed. Body contact is kept to a minimum since the ball carrier need only be touched, usually with both hands, rather than tackled. Sometimes each player carries a handkerchief protruding from a hip pocket. In such cases the possession of the handkerchief is substituted for touching. This form of the game is known as tail football.

Other rules peculiar to touch football are: The ball becomes dead whenever it strikes the ground. A team which intends to punt must announce its intention before the down begins and must actually punt the ball, neither team being allowed to cross the line of scrimmage until after the kick. There is no try after touchdown. If a game ends in a tie the ball is taken to mid-field and each team is allowed one series of four downs. One point is scored by the team making the longest total advance during this overtime series. (H. V. P.)

E. U.S. Professional Football

Early History, 1895–1920. — The first professional football game to be officially recognized as such was played in the township of Latrobe, Pa., on Aug. 31, 1895. Latrobe beat a team from Jeannette, 10 mi. away, by the score of 12–0 and major league football had been inaugurated. For the next ten years, Latrobe fielded a powerful team which played whenever and wherever it could for uhatever returns it could earn.

John Brallier, who became a dentist in Latrobe, was recorded as the first "confessed" professional after he left the University of Rest Virginia team to play for Latrobe. Other college athletes, however, were earning expenses in scattered games of the time. Fielding Yost, later to become an outspoken opponent of professional football, played with the Greensburg, Pa., team. Walter Okeson of Lehigh, Walter Howard of Cornell and Thomas Trenchard of Princeton were heroes of many off-record contests. In 1897 the entire backfield of Lafayette college in Easton, Pa., played also for Greensburg.

During the next few years other professional teams appeared. In Pittsburgh, Pa., the Duquesne County and Athletic club mas created and its rosters listed some of the most famous college players of the day. Heffelfinger of Yale, Arthur Poe of Princeton, G. H. Brooke and P. D. Overfield of Pennsylvania, Fred Crolius of Dartmouth, Bemus and Hawey Pierce, the two magnificent American Indian athletes from Carlisle, all as prominent then as the All-Americans of a half century later, played for Duquesne.

Upper New York state folloned Pennsylvania into professional football soon after the start at Latrobe. There were teams in Buffalo, Syracuse, Watertown, Auburn, Corinth, Clayton, Oswego, Alexandria Bay and Ogdensburg. On Dec. 28, 1902, Syracuse, with "Pop" Warner and his brother Bill in the line-up along with Phil Draper, Williams college immortal, and the Pierce brothers, defeated the Philadelphia Nationals, 6–0, in the first indoor football game at Madison Square Garden, New York city. Thirty years later the Chicago Bears beat the Portsmouth Spartans, 9–0, in the Chicago Stadium. These two contests were the only major league games held indoors.

In 1902 Cornelius ("Connie Mack") McGillicuddy (1862–1956) organized a football team which he named the Philadelphia Athletics. In the line-up was George ("Rube") Waddell, the famous pitcher of Mack's baseball team. Mack claimed the "championship of the world" after his club vanquished a squad representing Pittsburgh which had Christy Mathewson, another great baseball pitcher, as its fullback. Mathewson had been a star during his college days at Bucknell. Again the Pierce brothers were on hand, playing for Philadelphia.

Like New York state, Ohio began to sponsor town teams. For 20 years leading to 1920, uhen the American Professional Football association (later the National Football league) was formed, there were teams in Canton, Massillon, Akron. Shelby. Columbus and Dayton. At Canton Jim Thorpe, the American Indian athlete, first played as an admitted professional after leaving Carlisle in 1912, the year of his triumph at the Olympic games in Stockholm. Thorpe ended his career in 1926, again with Canton after playing with Cleveland, Rock Island, the New York Giants and, in 1923, with a team of his own called the Oorang Indians made up entirely of Indians.

College stars of the time did not enter the professional game as eagerly as they did in the more prosperous years after World War II, but the early squads included such players as Willie Heston of Michigan, D. O. ("Tuss") McLaughry of Dartmouth, Charles Brinkley of Harvard, Herbert ("Fido") Kempton of Yale, Fritz Pollard of Brown. John ("Jock") Sutherland. Earle ("Greasy") Neale. Lou Little of Pennsylvania, the Horween brothers, Arnold and Ralph, of Harvard and many others.

One of the most unusual teams of history represented Columbus, O., in 1906 and for several years thereafter. Sponsored by the Pennsylvania railway and calling itself the Panhandles. this team had six brothers, the Nessers. who were railroad workers, in its line-up. These rugged men practised in their leisure hours after full days of railroad work. All of them—John, Ted, Frank, Phil, Fred and Al Nesser—were besieged with contracts from colleges and other professional teams but they preferred to stay on the job at home and play the bruising game "just for fun." Only Al accepted outside offers. playing with teams in Akron and Cleveland and with the New York Giants championship team of 1927. He completed 25 years of professional football in 1931.

The combination of World War I, a chance remark by Robert Zuppke, veteran coach of the University of Illinois, and the enthusiasm for football of George Halas of Chicago combined in 1918 to spark the beginning of the modern major league game.

Zuppke, at the postseason banquet of his 1917 Illinois team (on which Halas had been an outstanding end), said that it mas unfortunate that football players at the time when they were just beginning to learn something about the game were graduated from college and played it no more. A few weeks later, reporting for training at Great Lakes Naval Training station in Illinois, Halas found several recent college stars eager to continue playing. By New Year's day of 1919, a Rose Bowl championship match was held. in which Great Lakes upset a powerful Mare Island team.

On the Great Lakes squad were players who were to be the first stars of the future National Football league. John ("Paddy") Driscoll of Northwestern university (who succeeded Halas as head coach of the professional Chicago Bears 37 years later for the 1956 season) was one of the Great Lakes halfbacks; James Conzelman (later head coach of the professional Chicago Cardinals' 1947 championship team), Emmett Keefe, Harold Erickson, John ("Dutch") Lauer and Hugh Blacklock were other Great Lakes players.

Through this same period the pattern of football was developing and changing rapidly, with the professionals in large part leading the way. In 1906 the forward pass was legalized in an effort to refine and open up the game but it was not until 1913 that the passing game began to assert itself (see U.S. *College Football History,* above). For the next 25 years the pass play fermented, being used mostly as a desperation maneuver and often not successfully. Then came the explosion of the T formation as played by the Chicago Bears, with Sid Luckman at quarterback. In the championship game of 1940, the Bears defeated the Washington Redskins, 73–0. With this game, and the parallel performance of Sammy Baugh in the same era, the pass took its present place as almost half of each team's attack. (See below.)

Rockne, who was to become one of the immortals of football as a coach at Notre Dame, was one of the busiest and hardest-to-trace professional players of the 1914–20 period. He played as often as he could for whatever team was offering the best salary. One team claimed he played against them in six successive games in six different uniforms. He was one of the trickiest and hardest ends to stop.

The **Growing Years,** 1920–45.—As the early days ended with the organizing of the American Professional Football association in 1920, hundreds of unrecorded narriors of the gridiron faded from the scene. Scant records had been kept and the bruising battles of pickup games were lost forever. Even the glory of the individual stars dimmed, leaving only Jim Thorpe to live a few more years in sports pages. Unpadded, often unpaid, the pioneers played a vicious and smashing game of foothall, often for the full 60 minutes of each encounter unless crippled beyond the possibility of completing the game. A "big" squad of those days might have contained 1j players; the modern teams of more than 30 players, specialists and platoons were unknown.

Jim Thorpe was a superlative back. but his approach to the game was lighthearted and erratic. Despite contempt for the ordinary training rules, however. Thorpe could run in the open, crash the line and shatter the attack of his opponents. He ran like the later star, Harold ("Red") Grange, with swiveling hips, change of pace and extreme confidence. Defensively he broke up opponents with a lethal and "slightly illegal" special shoulder pad with an outer covering of sheet metal, nhich he was ordered not to wear when the league was formed. It mas said by those who had played with and against Jim Thorpe that he was one of the greatest football players of all time. Thorpe, who died in 1953, also excelled in other sports and was recognized by many as a great athlete. In his honour, the towns of Mauch Chunk and East Mauch Chunk. Pa., were joined and renamed Jim Thorpe.

Eleven league franchises at $100 each were sold when the American Professional Football association was officially formed on Sept. 17, 1920. Jim Thorpe was elected president and George Halas purchased a franchise for the Staley Starch company of Decatur, Ill., which had recently made him athletic director. The first 11 teams in the league were the Canton Bulldogs (Thorpe's team), Cleveland Indians, Dayton Triangles, Akron Professionals, Massillon Tigers, Rochester, N.Y., Giants, Rock Island, Ill., Muncie, Ind., Hammond, Ind., the Chicago Cardinals and the Staleys, who became the Chicago Bears in 1922.

The league had a perilous beginning that fall. Few games were played and there seemed little chance that the league would survive. However, in April 1921 the league elected Joe Carr, an experienced promoter, as its new president. Carr, who guided the National Football league until his death in 1939, created an immediate realignment of teams. Massillon, Muncie and Hammond dropped out; Green Bay, Wis., Buffalo, Detroit, Columbus and Cincinnati came in and a full schedule was completed with the Chicago Bears winning more games than any other team. Kot until 1933 did the N.F.L. play in two divisions with an annual championship game.

The appearance of the Green Bay Packers in 1921 was the beginning of a football saga. With a population of only 30,000 (growing to 50,000, 35 years later), Green Bay always gave the team more support than New York city gave its Giants. For more than a decade the National Football league survived with little support from the fans and even less from newspapers. Some franchises moved to other cities; new teams joined; some dropped out. By the 1960s only the Chicago Bears, Chicago Cardinals and Green Bay Packers had survived in the same place they had started. From 1921, 45 cities were the homes of N.F.L. teams.

The first trend toward prosperity began in 192j when "Red" Grange left the University of Illinois to play mith the Chicago Bears. Grange was the biggest name in the sports world at that time, and he was the spark that professional football needed. His debut against the Chicago Cardinals drew a capacity crowd of 36,000. Seven days later 68,000 jammed New York's Polo Grounds to see him play against the Giants. Grange and the Bears then went on a coast-to-coast tour that sowed the seeds of interest in the sport. Later, television helped complete the job of publicizing major league football. Grange established himself as one of the all-time stars of the N.F.L. before he retired in 193j.

Other factors were boosting the public interest. One was the T formation which was to startle the entire sports world in 1940; the other was a long list of brilliant players developed in the K.F.L. Most spectacular of all were two quarterbacks. Baugh and Luckman, beginning careers that stretched over many seasons. Baugh amazed experts through 16 years of competition.

Football's offense at this period was specializing in the single and double wing, with some plays being run from punt and short punt formation. The defense, as it always does, was catching up with these maneuvers, however, and the Chicago Bears' Halas, retired since 1930 as a player and spending his full time as head coach, was working on the T formation. Aiding and abetting these schemes to crush opponents of the future was Clark Shaughnessy, one of the top strategists of the game. In 1939 Luckman, a Columbia university star, joined the Bears and the T was ready.

In the championship game of 1940 against the Washington Redskins it was exploited, and a fine Washington team was the victim of a 73–0 massacre. The single wing and other formations, beginning in 1941, were eclipsed by the T formation in U.S. football.

Luckman's individual brilliance through his 12-year career with the Bears was helped by the outstanding ability of his teammates. Squads were built for years around the centre, Clyde ("Bulldog") Turner, one of the players who will be ranked with the best so long as U.S. football is played.

Baugh. joining the league with the Washington team in 1937, soon demonstrated his unprecedented ability as a passer. When Baugh finally retired in 19j3, he was acclaimed as a great offensive player as well as a sound defensive competitor and the league's leading punter through three seasons. He also led the league in interceptions one season besides being the top passer statistically through six. In 1945 Baugh threw 182 passes, completing 128 for a record .703 completion record. Only four were intercepted, also a record. Twice he tossed six touchdown passes in one game and by the end of his career he had attempted 2,983 and completed 1,689 for 18j touchdowns, all league records. His six-in-one-game record was beaten by Luckman, who fired seven in 1943 against the New York Giants.

During World War II, when 638 N.F.L. players served in the armed forces, 22 of whom died in action. the league continued. Some franchises were merged to provide better competition, and the sport continued to draw growing support of the fans. A strong factor in its fast gronth prior to World War II was the annual All-Star game in Soldier field. Chicago, promoted by the Chicago Tribune Charities fund and fielding the professional champions of each previous season against a picked squad of recently graduated college stars. Started in 1934, the series began to lose public interest in the early 1950s folloning several devastating defeats of the College All-Stars, but interest revived nhen the sponsors appointed professional coaches for the All-Star team in the 1954 game and thereafter.

The Modern Era.—In 1945 a rival league, the All America Football conference, n-as formed with eight clubs representing Brooklyn, Buffalo, Chicago, Cleveland, Los Angeles, Miami. Fla., New York city and San Francisco. Dan Topping, owner of the former Brooklyn N.F.L. team, transferred his entire squad to the A.A.F.C. There was considerable opposition among the N.F.L. owners against the new league, and four years of competition for support followed. When it ended before the 1950 season, professional football in general had come of age and the fans from coast to coast were aware of its existence. Under an agreement between the leagues, Baltimore, San Francisco and Cleveland moved their teams into the N F.L. and the balance of the A.A F.C. players were pooled and drafted by the 13 clubs in the N.F.L. After one season the league was reorganized into 12 clubs: the Baltimore Colts, Chicago Bears, Chicago Cardinals, Cleveland Browns, Detroit Lions, Green Bay Packers, Los Angeles Rams, New York Giants. Philadelphia Eagles, Pittsburgh Steelers, San Francisco Forty-Niners and Washington Redskins. Attendance records started to climb rapidly as the new era opened. Bert Bell, veteran player, coach and owner, was commissioner of the league from 1946 until his death in 1959. Pete Rozelle, general manager of the Los Angeles Rams, was named as Bell's successor in 1960. Annual attendance passed the 2,000,000 mark by the mid-1950s and television made the stars of the league well known nationally. In 1960 the Cardinals moved to St. Louis.

In 1959 a new American Football league was organized with Joe Foss, World War II air hero and former governor of South Dakota, serving as its first commissioner.

Rules.—The rules of professional football permit a more wide-open, high-scoring game than that played by the colleges, despite the fact that only one point can be scored after touchdown whether the ball is run, passed or kicked. Because the professional goal posts are on the goal line rather than at the back of the ten-yard end zone as in the college game, the professionals attempt and make more field goals than college teams.

In professional ball a member of the defensive team can run with a recovered fumble; the colleges call the ball dead at recovery. A professional ball carrier can rise and run if he falls to the ground unless he had gone down as the result of contact with an opponent; the collegian is down even though he slips and falls. The professionals have added a fifth official, the back judge, to the four who are standard in the college game. Substitutions are unrestricted in professional rules while the colleges moved toward the same system after the drastic antiplatoon ruling in 1953.

In professional football, divisional play-offs or championship games cannot end in a tie. If the score is tied after the regulation 60 minutes, additional periods of 15 minutes each are played. The first team to score a touchdown, field goal or safety is declared the winner and the game ends immediately. This "sudden death" system allowed Baltimore to defeat New York, 23 to 17, for the championship in 19j8 by scoring a touchdown after 8 min. 1j sec. of the first overtime period.

Court Ruling.—In 1957 a lawsuit instigated by a former N.F.L. player, William Radovich, resulted in a decision by the L.S. supreme court that professional football is a business subject to antitrust laws (Sherman act) in spite of a previous court ruling that professional baseball is exempt from this law.

(R. L. Tt.)

F. Glossary: L.S. Football

Approved ruling.—An official decision on a given statement of facts. It serves to illustrate the spirit and application of the rules.

Blocking.—Obstructing an opponent by contacting him with any part of the blocker's body; also stopping or deflecting an opponent's kick before it passes the scrimmage line.

Catch.—Act of establishing player possession of a live ball in flight.

Chain gang.—4 group of men under the direction of the linesman who handle the yardage chain and the down indicator.

Completion.—A catch of a teammate's pass.

Conversion.—A successful try.

Dead ball.—A ball not in play.

Dead-ball spot.—The spot on the playing field at which the ball became dead at the completion of the-last previous down.

Disqualified player.—A player who becomes ineligible for further participation in the game.

Down.—A unit of the game which starts with a snap or free kick and ends when the ball next becomes dead.

Down indicator.—A device mounted on a rod and showing the number of the down in the current series, the rod being positioned at one of the side lines on the defending team's scrimmage line.

Enforcement spot.—The spot from which the penalty for a foul is enforced.

Fade.—The movement of a passer toward his own end line prior to throwing a forward pass.

Fair catch.—A catch of a kick beyond the neutral zone by a player of the receiving team who has obviously signaled his intention by raising one hand clearly above his head. When a fair catch is made the ball becomes dead on the spot.

Field goal.—A place kick or a drop kick which passes over the crossbar or directly over an upright of the receiving team's goal before it touches the ground or a player of the kicking team. It may be a scrimmage kick or a return kick, but not a free kick. A field goal scores 3 points for the kicking team (4 points in six-man football).

Flag or handkerchief.—An official's penalty marker.

Forward pass.—A live ball thrown toward the opponents' end line. The ball becomes dead if it touches the ground before being caught.

Free ball.—A live ball, other than a forward pass, not in player possession.

Free kick.—A kick made under restrictions which prohibit either team from advancing beyond established restraining lines until the ball is kicked.

Fumble.—Loss of the ball by a player other than by handling, passing or kicking.

Gain.—Advancement of the ball beyond the line of scrimmage during a down.

Goal to go.—An expression used when the line to gain is the goal line.

Handing or hand-off.—Transferring the ball from one teammate to another without throwing or kicking it.

In-bounds spot.—The intersection of the nearer in-bounds line and the yard line passing through the dead-ball spot or through the spot where the ball is left by a penalty.

Interception.—A catch of an opponent's fumble or pass.

Kickof.—A free kick which starts each half of the game and follows each try or field goal. It must be a place kick or a drop kick.

Lateral or backward pass.—A live ball thrown toward or parallel to the passer's end line. The ball remains live even though it may touch the ground before being caught.

Linr to gain.—For a series of downs, a line 10 yd. (1 j yd. for six-man football) in advance of the ball's most forward point at the commencement of the series, but ii this line is in the opponents' end zone the goal line becomes the line to gain.

Live ball.—A ball in play. A ball passed, kicked or fumbled which has not yet touched the ground is a live ball in flight.

Loose ball.—A free ball.

Loss.—Failure to advance the ball to the line of scrimmage during a down.

Loss *of* a down.—Denial of the right to repeat a down because of a penalty or an incompleted forward pass.

Measurement.—The bringing in of the yardage chain from the side line to determine whether a team has advanced the ball to or beyond its line to gain.

Mug.—An unsuccessful attempt to catch or recover a ball, the ball being touched in the attempt.

Neutral zone.—The space, equal to the length of the football, between the two lines of scrimmage.

Out of *bounds.*—Any area other than that bounded by the two side lines and the two end lines.

Out-of-bounds spot.—The point at which, according to rule, the ball is declared out of bounds.

Pass.—Throw. A pass ends when the hall is caught, recovered or declared dead.

Play.—The tactic used during a down to advance the ball.

Player.—Any one of the participants actually in the game at any particular time.

Play ruling.—Statement of a play situation and the correct ruling.

Possession.—A player is in possession when he has a live ball in his hands and is exercising control over that ball. A team is in possession when one of its players is in possession, while a kick is being attempted or while a forward pass thrown by one of its players is in flight.

Previous spot.—The point from which the ball was last put into play.

Receiver.—A potential pass catcher on the offensive team or a potential kick catcher on the defensive team.

Recovery.—Securing player possession of a live ball after it strikes the ground.

Return *kick.*—A kick after change of team possession during a down, or kicking the ball while it is held ior an opponent's kick.

Runback.—Advancement of the ball by a catcher of an opponent's kick, pass or fumble.

Runner.—A player in possession of a live ball.

Safety.—See Touchback.

Scrimmage.—The interplay of the two teams during a down in which play begins with a snap.

Scrimmage kick.—A kick by the team designated to put the ball into play during a scrimmage before team possession changes.

Scrimmage *line.*—For each team, the yard line and its vertical plane which passes through the point of the ball nearest that team's entl line.

Series of *downs.*—A group of four consecutive scrimmage downs during which the team in possession must advance the ball to or beyond the line to gain. If they succeed a new series of downs is begun. If they fail they must surrender the ball to their opponents.

Snap.—Handing or passing a ball back from its position on the ground with a quick and continuous motion of the hand or hands, the ball actually leaving the hand or hands in this motion.

Spot of the foul.—The point at which a foul occurs; if out of bounds between the goal lines, the intersection of the nearer in-bounds line and the yard line extended through the spot of the foul; if the foul is committed by a nonplayer, the spot of the foul is the previous spot.

Spot *where* a *run* ends.—The point where the runner loses player possession of the ball or where the ball becomes dead in his possession.

Substitute.—.\ replacement ior a player or a player vacancy.

Succeeding spot.—Relating to a foul, the point at which the ball would have been put in play if that foul had not occurrcd. If the foul is committed after a touchdown but before the try, the succeeding spot is the 40-yd. line (30-yd. line in six-man iootball) of the team which next kicks off.

Touchback.—When the ball is out of bounds behind a goal line (except from an incompleted forward pass), when the ball becomes dead in possession of a player behind his own goal line or when a penalty leaves the ball on or behind that line, it is a touchback if the attacking team is responsible for the ball being on or behind that goal line Ii the defending team is responsible, it is a safety and scores 2 points for the attacking team.

Touchdown —A score of 6 points for the team whose player is legally in possession of the ball while any part of it is on, above or behind his opponents' goal line.

Try.—.\n attempt by the team making a touchdown to further increase its score during one scrimmage down from the defending team's 2-yd. line (professional and secondary school football) or 3-yd. line (college and six-man football) while time is out. During this down, a drop kick or a place kick in the manner of a field goal scores 2 points in 6-man, 1 point in 11-man iootball. A forward pass or run ending beyond the goal line scores 2 points in college and A.F.L. football, 1 point in N.F.L., six-man and most secondary school football.

Yardage *chain.*—A chain. joining two 5-it. rods, the rods being exactly 10 yd. apart (1 j yd. in six-man football) when the chain is fully extended. Used on one of the side lines to mark the line to gain.

Yard line.—Any line, marked or unmarked, on the field of play parallel to the end lines. A team's own yard lines are numbered consecutively from its own goal line to the jo-yd. line (40-yd. line in six-man football).

Yards to go.—On any down, the distance between the line of scrimmage and the line to gain. (A. Da.)

III. CANADIAN FOOTBALL

Although Canadian football stems from English Rugby, modern rules changes brought it closer and closer to U.S. football. Only the practised eye can discern the differences. The playing field is larger, being 110 yd. long and 65 yd. wide. The end zones are 25 yd. deep. The wide field encourages lateral passing and the deep end zones. forward passing for touchdowns. There are 12 men on a team. and the extra man is called a flying wing. He is invariably used in the backfield on offense and as a linebacker on defense. The other positions are the same as those in U.S. football and have the same names. Formerly they were different. but many players were imported from the U.S. after World War II and U.S. nomenclature was introduced.

There are only three downs in the Canadian game. Teams must try for the big gain, which makes the play more open than in U.S. football. Blocking. unlimited in U.S. football. was restricted in Canadian football to a point ten yards beyond the line of scrimmage. A single point may be scored in Canadian football if the team in possession kicks the ball over the defending team's dead line, which is 2; yd. beyond the goal line. and it may also he scored if the defending team's safety back is tackled or run out of bounds in his own end zone after receiving a kick. Otherwise the scoring in the Canadian game is exactly the same as that of the U.S. game, except that the try after touchdown (from the 5-yd. line) is worth only 1 point regardless of how it is made. Offensive and defensive formations are similar to those in U.S. football. (D. C.)

IV. ASSOCIATION FOOTBALL (SOCCER)

A. British Association Football

Rules of Play.—Association football (commonly abbreviated as "soccer") is played by two sides of 11 men each, with a round, leather-covered. inflated rubber bladder not more than 28 in. or less than 27 in. in circumference and weighing not more than 1 Ib. or less than 14 oz. at the beginning of the game. The ball may be kicked, butted or played with any part of the body except the hands; only the goalkeeper is allowed to handle the ball and he may handle it only in his own penalty area (and when so doing may not take more than four steps without bouncing the ball on the ground). The game is played on a field (pitch) not less than 100 yd. and not more than 130 yd. long, and not less than 50 yd. or more than 100 yd. wide. As a general rule full-size pitches are 115 yd. long and 75 yd. wide. Goals eight yards wide and eight feet high are placed in the centre of each end line. The markings on the field and the normal positions of the players at the start of the game are shown in fig. 11. The team scoring the greater number of goals wins the match. To score a goal a side must force the ball into its opponents' goal without throwing, carrying or propelling it by hand or arm; a player diverting the ball into his own goal by any method scores for his opponents. A free kick at the spot of the offense is awarded to the nonoffending side after a breach of the rules, the most common offenses being offside play, handling the ball, tripping, pushing or illegally charging or obstructing an opponent. An unintentional breach of the rules in most cases does not earn punishment. Many fouls by a defending player within his own penalty area (see fig. 11) are punished by a penalty kick, taken by any one of the attacking side from the penalty spot 12 yd. in front of the centre of the goal with only the kicker and the goalkeeper within the penalty area. The game lasts for 90 minutes or such less time as may be agreed upon, and is divided into two equal periods, the sides changing over and attacking different ends after half time. The teams toss before the start and the winners of the toss may decide either which end they will attack first or whether they will kick off first. The game is started or restarted after a goal or the change of ends by a place kick from the centre spot. If the ball is driven over a side line or touch line, play is restarted by a member of the side which did not last touch the ball throwing the ball into the field of play with both hands from above the head from a stationary position. This is known as a throw-in. If the attackers force the ball over their opponents' end or goal line, the defenders re-

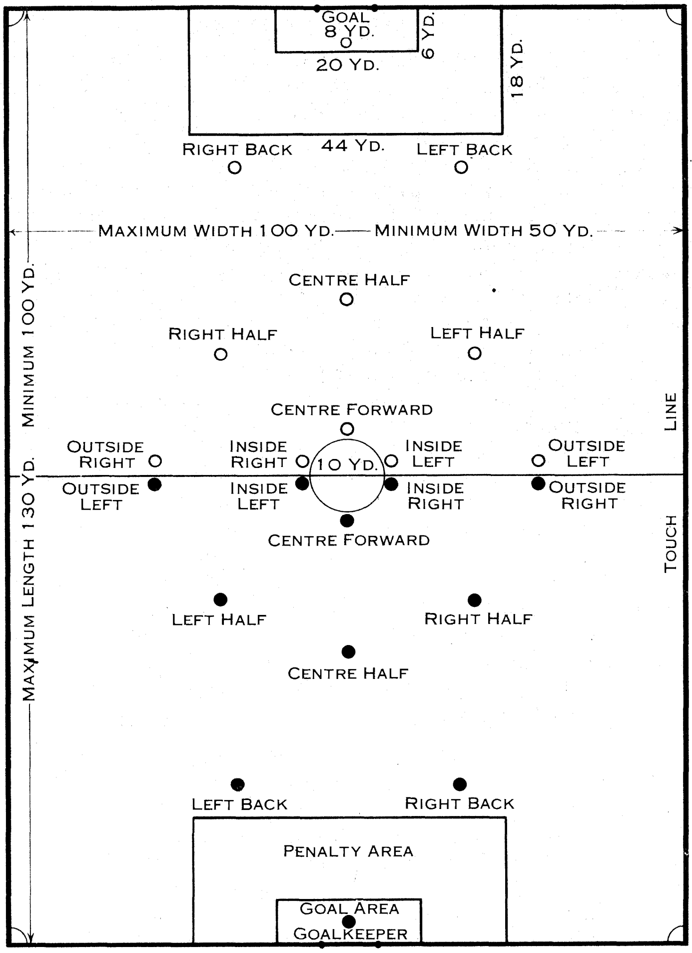


FIG. 11.—SOCCER FIELD AND POSITION OF PLAYERS AT THE KICKOFF

start play with a free place kick from within the goal area (see fig. 11); if the defenders divert the ball over their own end line the attackers restart play uith a free place kick from uithin one yard of the nearest corner of the playing area (a corner kick).

Changing Conditions.—Enthusiasts of the game would have had some difficulty in recognizing the sport until about 30 years after the founding of the Football association in *1863*. For a long time a side consisted of a goalkeeper, one back, one half-back and eight forwards who roamed the field more like a pack of hounds than a forward line. These forwards relied almost entirely on mass dribbling and on charging, especially charging of the goalkeeper out of the way of an expected shot or centre. Preston North End mas, perhaps, the greatest exponent of this method of overcoming the most important member of the defense. The next formation was a goalkeeper, two backs, two halfbacks and six forwards; but from *1883* on, most teams translated another forward into a halfback and so adopted the normal modern formation. The throw-in from touch at first was done with one hand, but so expert did some players become at hurling the ball into the goalmouth from a 40- or even jo-yd. range that it was thought necessary first to make the thrower use two hands and then to make him throw with tno hands from above his head from a standing position. Crossbars did not replace tapes and so avert innumerable arguments until *1883*. Until *1891* there were no linesmen; each side had its own umpire and the referee mas used only as a final court of appeal; after *1891* the umpires were abolished and the referee became an active participant; one result of this was the founding in *1893* of the Referees' association, which improved the standard of refereeing immeasurably and was the forerunner of similar invaluable organizations all over the world. It was only in *1891*, too, that the goalkeeper was protected from charging except when he was in the act of playing the ball or was 'obstructing another player. At about this time, again, the penalty kick uas introduced. It was not only the rules. however, which were far different in those days; so was the appearance of the players. For a long time it was customary to wear knickerbockers fastened tightly below the knee. with long, overlapping stockings; boots were of the ordinary type, with the addition of two or three crossbars on the sole and one crossbar on the heel; the wearing of moustaches and caps was normal, that of beards and top hats not rare.

The Offside Rule.—The rule which caused most trouble through the years was the one defining off side. From *1886* to *1928* it read: "When a player plays the ball or throws it in from touch any player of the same side, who, at such moment of playing or throwing in. is nearer to his opponents' goal line. is out of play and may not himself touch the ball or in any way interfere nith an opponent until the ball has been played. unless there are, at such moment of playing or throwing in, at least three of his opponents nearer their own goal line. A player is not out of play in case of a corner kick or when the ball is kicked out from goal or when it has last been played by an opponent."

Difficulty in applying the law arose from the words "at such moment of playing or throwing in." Presume that a centre forward *(A)* has the ball at his feet at the halfway line, that the outside left (B) is behind the halfway line and that seven or eight of the opposing side are in their own half. ***A*** now kicks the ball forward and high to the left-hand touch line; the attention of the players, and probably the referee, is directed toward the spot where the ball mill fall. But just as it is about to fall B suddenly arrives, having rushed up the field under the kick, and takes the ball on with him, although only two of the opposing side now are between him and the goal line. B obviously is not off side, because when the ball was kicked by ***A*** he was behind *A*. But from the crowd there is likely to be a vociferous shout of "off side." The difficulty of seeing and remembering the exact position of each player at the moment of kicking caused endless disputes. The adoption of the diagonal system of refereeing did much to ensure accuracy of official judgment. Under this system the referee moves along a prearranged diagonal of the field and each linesman is responsible for one set of forwards and alnays will be up with that set when it is attacking. The referee is in the best position to see incidents in the goalmouth and mill always have one linesman co-operating with him there while the other linesman is ready for a breakaway. The offside rule was revised in *1928* to provide that a player cannot be off side in his own half of the field and in his opponents' half needs to have only two opponents instead of three at the moment when one of his onn side behind him sends the ball forward. The change had become necessary because fullback strategists, notably W. McCracken of Newcastle United, had developed great skill in putting whole forward lines off side by clever anticipation of attacks and moving upfield at the crucial moment.

Changes of Style.—There were many big changes in the style of play after association football became an organized sport, and it became a far cry from the pack of eight forwards who dribbled, hacked and barged their combined path hither and thither. In the period 1880–96 the best sides began to add passing to their armoury while retaining all their old skill at dribbling. William Gunn (Notts County) and George Brann (Snifts), two great international cricketers, N. C. Bailey (Old Westminsters), W. I. Bassett (West Bromwich Albion), W. N. Cobbold (Old Carthusians), J. H Forrest (Blackburn Rovers) W. J. Townley (Blackburn Rovers) and J. Goodall (Preston North End and Derby) were among the brightest individual stars of this time. Soon after *1896* passing was developed to an extreme degree, and dribbling, outside Scotland, began to be neglected; individual brilliance began to play a smaller part in comparison with good teamwork, but the great figures of the years between 1896 and the start of

World War I in 1914 became as much household names as any of their predecessors or successors. G. O. Smith (Old Carthusians), who was anarded 21 caps (*i.e.*, played in 21 full international games for England). S. Bloomer (Derby County, 24 caps), R. Crompton (Blackburn Rovers, 42), J. W. Crabtree (Burnley. 14), E. Needham (Sheffield United. 16), W. J. Oakley (Oxford university, 6), J. Pennington (West Bromwich Albion. 2j) and V. J. Woodward (Tottenham Hotspur, 23) mere among England's best; in Scotland R. Walker (Heart of Midlothian) played 33 times for his country, but the most remarkable record of all was that of W. Meredith (Manchester City and Manchester United), who played in 50 full international matches for Wales between 1895 and 1920. Crompton's English record was not broken until W. Wright (Wolverhampton) won his 43rd cap in 1952. Wright played for England 85 times, 70 times as captain, by the end of the 1956–57 season.

After World War I dribbling never recovered its position, and passing at times seemed to become an obsession when quick shooting clearly was demanded. Heading the ball became a great art and W. R. Dean, centre forward for Everton and England, probably was the greatest marksman nith his head ever seen. The speed of the game increased, at times beyond all reason, so that play seemed to become a matter of kick and rush. but the most successful sides always had fine constructive halfbacks.

The most important change, however, was the result of the change in the offside lam (see above). Under the old rule the outside formards had taken the ball down to the corner flag before centring in order to ensure that their companions were on side. There was no longer so much need for this and outsides began to cut in and shoot or make short passes.

Herbert Chapman, manager of Huddersfield Town during its three successive championships in the 1920s, became manager of Arsenal and he fitted a fine team superbly to the new conditions and set a new style. The centre half, who previously had supported his own forwards closely in attack, was now made a defensive player lying well back to block the centre approach to goal; he had to be tall in order to ensure that he could deal with any high balls and he was not to be tempted to wander. The two backs hitherto had marked the opposing inside forwards and had kept fairly close together in front of goal while the wing halfbacks marked the outside forwards; now the backs stayed wider apart and took the outside forwards and the wing halfbacks took the inside forwards. In attack the cutting in by the outside forwards tended to crowd the penalty area and, partly because of this and partly in order to provide a necessary link with the defensive centre half, the inside forwards were stationed behind the other formards so that the line resembled a letter W; this disposition of forwards is. indeed, known as the W formation. Chapman not only worked out the implications of the new offside law but also had the men to put his ideas into practice; J. Hulme and C. S. Bastin were two fast outside forwards who could shoot hard with either foot; E. J. Drake was a fearless and dashing centre forward, and D. B. N. Jack and A. James were two remarkably constructive insides; at centre half he had tall "policeman" H. Roberts and at wing half two great international players in W. Copping and W. J. Crayston. In the last ten seasons before World War II Arsenal won the Football league championship five times and was runner-up once and third once, and won the Football Association cup twice and was runner-up once. It became the most famous team in the world, and its style was copied everywhere; unfortunately where the players modeling themselves on Arsenal were not expert the result was iron defense and kick and rush attack—which was dull.

The great problem in modern football inevitably became how to lure the centre half away from his post in front of goal or circumvent him. In no case has a side been consistently successful in this without having good constructive wing halfbacks. Teams such as Manchester United (Football Association cup winners and perennial top contenders in the Football league after World War II) achieved a good deal of success by having a wandering centre forward who popped up anywhere in the line and performed a scissors movement with his outside forwards, either breaching the defense on the flanks or eventually getting the centre half on the wrong foot. Others used inside forwards who could make cross dribbles toward a far corner flag and then shoot across a through pass back to their own normal position, having again put the defense on the wrong foot. The Italian side that was unlucky to lose to England at Tottenham in Nov. 1949 sorely upset the English centre half by adopting a deep V formation with the centre forward at the point of the V. There he received the ball in unmolested comfort from his own halfbacks and became, as many years before, a distributor of the ball. leaving the centre half, as it were, hanging in the air and confounding him with delicate ground passes for other forwards to run on to behind the centre half's back.

The Austrians developed in the middle years of the 20th century what was called the bolt system of defense. The centre half had a roving commission in mid-field and was helped there by the centre forward. who left the other four forwards to do the brunt of the raiding. The two backs played one behind the other in the centre to cover any breakthrough and the wing halves marked the opposing outside formards. This system was most confusing to sides meeting it for the first time. since they could not mark the men that they were used to marking. At the same time both continental European and South American teams concentrated far more than the British on accurate and patterned passing. nhich often seemed to the uninitiated to go on endlessly and pointlessly but was in fact done in the hope of exasperating their opponents or of causing them to make some desperate attempt to recover the ball which would result in the defense's losing position.

In mid-century Hungary under the autocratic control of G. Sebes developed an almost unbeatable team. It won the Olympic tournament in 1952 and in 1953 became the first team from outside the British Isles to win a full international match on English soil, succeeding by 6–3 at Wembley stadium, and won the return game 7–1 in Budapest. Germany's victory over Hungary by 3–2 in the World cup final in 1954 was the surprise of the year.

The Football Association. — The Football association (F.A.) in 1905 turned itself into a nonprofit limited liability company. It supported the formation of the Scottish. Welsh and Irish associations to supervise the game in those countries instead of trying to keep under its own control the clubs in those countries which had joined it in the early days. When those associations wished to introduce certain rules of their own it settled the differences by proposing an international board with two representatives from each of the four countries and later it joined the Fédération Internationale de Football Association (F.I.F.A.) in forming a new board to look after the rules. When it became obvious that veiled professionalism was taking place, the Football association did not attempt to evade the inevitable, but kept control of the situation by recognizing professionalism in 1885 and fixing rules for it. Its policy has been to avoid interference in the domestic affairs of the professional clubs except where they offend against the bylaws of their association. When this occurs, it comes down on them heavily with the full support of the professional leagues' own management.

The F.A. organized in the 1871–72 season the first of a series of knockout'competitions for the F.X. cup which were soon to become world famous. At first the competition attracted only a handful of entries, fewer than did the Scottish F.A.'s cup, first competed for in 1873. Amateur clubs, including Queen's Park (Glasgow), dominated the competition for the first 14 years and it was not until 1883 that the cup went to the north of England for the first time, to Blackburn Olympic; thereafter it left the north and midlands only rarely. The Scottish clubs soon dropped out but a small number of Welsh teams were admitted annually and one of them. Cardiff City, won the trophy in 1927. By the second half of the 20th century most victories in the final had been won by Aston Villa, Blackburn Rovers, Newcastle United. Wanderers (all before 1880), Sheffield United, West Bromwich Albion. Bolton Wanderers, Arsenal, Sheffield Wednesday and Wolverhampton Wanderers. After 1891 only Newcastle United in 1952 had retained the trophy in the following year. The Wanderers and

Blackburn Rovers each had won it three times in succession and twice in succession. Except in 1893 (Manchester), 1894 (Everton) and 1915 (Manchester), the final had always been played in London, first at the Oval or Lillie Bridge, then at the Crystal palace, then at Stamford Bridge and finally at Wembley; replays usually were outside London but there had been no replay necessary in the final since 1912. Immediately after the coming of professionalism the attendances at the "cup ties" began to increase rapidly. More than 100,000 spectators watched three of the finals at the Crystal palace and the record there was 120,028 in 1913. After the final was taken to Wembley in 1923 the attendance was limited to between 91,000 and 100,000 ticket holders, but when Bolton Wanderers met West Ham United there in 1923 the decision to make the final an all-ticket match had not been taken and the gates were rushed by persons trying to pay at the turnstiles. It was estimated that there were about 150,000 people inside the ground and many more outside. A new record of receipts at a final, £49,881, was set in 1955. The original F.A. cup was stolen from a Birmingham shop where it was on show after Aston Villa's victory in 1895; it was not recovered and a new cup was presented by Lord Kinnaird, himself holder of the record number of five cup winner's medals.

After the professional clubs had begun to swamp the amateurs in the F.A. cup competition the association put up another trophy for competition among amateur clubs. The final for this was taken to Wembley in 1949, and in 1951 a record crowd of 98,327 saw Pegasus beat Bishop Auckland. In 1954 Bishop Auckland and Crook Town had to replay twice; 100,000 watched them at Wembley, 60,000 at Newcastle and 36,727 at Middlesborough.

The association's other activities became almost boundless; by mid-20th century it represented about 50,000 clubs and more than 1,000,000 players. It controls and organizes international and representative matches, plans courses for players, coaches and referees, makes instructional films and publishes instructional books, approves the rules and regulations of all leagues, is the supreme court of appeal for those charged with breaking the rules in England and is continually giving advice and help to football organizations all over the world. Its address at 22 Lancaster gate, London, became one of the best-known in the football world. Two of its secretaries, Sir Frederick Wall and Sir Stanley F. Rous, were given knighthoods for their services to the game.

League Football. — William McGregor, known afterward as the "father of the league," wrote in 1888 to the strongest professional clubs suggesting that they should combine and form a league, arranging a championship on the basis of home-and-away matches with each other. The suggestion was accepted and 12 clubs formed the original Football league for the 1888–89 season. For a time they were almost a closed corporation but in 1892 a second division of the league was formed and the first division was increased to 16 clubs. Soon after the principle was adopted of promoting the first two clubs in the second division at the end of each season into the places of the last two clubs in the first. division. A southern league founded shortly before World War I was incorporated as a third division of the Football league in 1920 and in 1921 a northern section of the third division was formed, the first club in each section of the third division to be promoted annually into the second division into the places of the two bottom clubs in the second and the two bottom clubs in each section of the third to apply to their fellow members for re-election. Twenty-two clubs now were in each of the first two divisions and 24 in each third division, so that after the mid-1950s there were 46 Football league matches each Saturday in the season. Of the original 12 members of division I not one had retained its place in division I continuously; the last of them to fall was Aston Villa in 1936 and it returned to the top flight two years later. Three division I teams had never been relegated, Sunderland, Arsenal and Portsmouth. Sunderland was co-opted in 1890; first division status was won by Arsenal in 1904 and by Portsmouth in 1927. Liverpool had not been out of division I since 1905. Nineteen different clubs had won the championship by 1956— Arsenal (7), Aston Villa and Sunderland (6 each), Everton and Liverpool (5 each), Newcastle United and Sheffield Wednesday (4 each), Huddersfield Town (3 in succession), Manchester United (3), Blackburn Rovers, Portsmouth and Preston North End (2 each) and Burnley, Manchester City, Tottenham Hotspur, Sheffield United. West Bromwich Albion, Wolverhampton Wanderers and Chelsea.

Normally, more than 1,000,000 spectators watch the Football league games each Saturday; more than 80,000 have seen single games on the Chelsea and Manchester City grounds and even in division III 49,000 watched a league game between the two Nottingham clubs in April 1950. Nowhere had there been an association football league of such power and such a hold on the public's interest. Football pools were organized in many countries depending on the Football league results.

One of the most important rules in the Football league is that once a professional player has joined a member club he may not normally leave it for another without his old club's approval and the payment by the new club of such sum for his transfer as may be mutually agreed. These transfer fees grew enormously, even absurdly, and in 1951 J. Sewell, a young inside forward, was transferred from Notts County to Sheffield Wednesday for the record sum of £34,000, the player himself receiving nothing except a legal £10 signing-on fee, percentage of benefit accrued (£750 for each five years of continuous service uith a club) and the top weekly wage then permitted, £12. Such fees had become a burden to players transferred and though these fees might have been an advantage to clubs in financial distress, they were also a complete bar to many clubs' efforts to strengthen their sides. Transfer fees also caused dissatisfaction among the players who claimed that if the clubs could afford to pay out such huge sums for comparatively unknown players they could afford to pay much better wages. The fees had risen because the clubs had refused to impose self-discipline on themselves as a body. J. Seed, manager of Charlton Athletic, a first-division club, wrote in Fenmore's *Football Year Book, 1949–50,* that only their own jealousy and selfishness prevented their calling a halt in a drift toward undisguised commercialism. It was a source of satisfaction to many, however, that huge expenditure on new players in midseason had failed many times to save a club from relegation and that most successful teams. such as Portsmouth, Wolverhampton Wanderers, Burnley and Manchester United, had relied on finding their own talent and spent almost negligible sums on transfers. The transfer fee. or, in the case of a new professional, the big signing-on fee, had become the accepted thing among professional clubs the uorld over, and the F.I.F.A. had to take some steps to control international transfers. Outside Great Britain probably the strongest and best professional league in the mid-1950s was the Italian National league. There the clubs, with the aid of wealthy patrons, offered huge signing-on fees and wages to players in other countries, and their activities seriously weakened the national team of Sweden, where there was hardly any full professionalism.

The Position of Amateurs. — The standard of play in the early British professional clubs rapidly put the amateurs in the shade. In order to enable the best amateurs to meet the professionals on more or less even terms and facilitate the welding of the best of both in international teams, N. L. Jackson, assistant honorary secretary of the F.A., suggested the formation of a club made up of the best amateurs only. In this way was born the Corinthian F.C., and as long as Jackson remained active the club was remarkably successful. After his retirement in 1898, however, the club began to lose ground rapidly. In the 1920s an effort was made to improve matters by entering for the F.A. cup and the team was excused the qualifying rounds, but little success was achieved and later the club had to join forces with the Casual F.C. The Corinthians did not. perhaps, cast their net wide enough, particularly among the smaller universities, and at a time when almost every other club competed in some league there was a natural reluctance on the part of players to desert their old clubs to join a noncompetitive club. There remained, however, many good amateur club sides all over Great Britain and there was a noticeable revival of the game at Oxford and Cambridge, culminating in the formation of a joint past and present club called Pegasus which won the F.A. Amateur cup in 1951 and 1953, its third and fifth seasons. The game at these universities had for long been handicapped by the fact that the majority of the old public schools had adopted Rugby; association remained the chief game, however, at Aldenham. Bradfield, Charterhouse, Highgate, Lancing. Malvern, Repton, Shrewsbury, Westminster and Winchester, among others.

The British associations' insistence on the prohibition of payments to amateurs for loss of time at work doubtless helped to drive many players into becoming professionals, and it became comparatively rare to see an amateur in a club's Football league eleven and rarer still to see one in England's full international team. In Scotland, however, Queen's Park: one of the oldest clubs in the game, maintained its position remarkably. In 1946 it supplied two of Scotland's full team, and in 1948 it was in the A division of the Scottish league; it suffered relegation the next season (not for the first time) but in 1956 recovered its senior status. Its ground at Hampden park had for long been the biggest in the game and it held 149,547 spectators for the Scotland *v.* England match in 1937. Among the most famous players the club produced was A. Morton. an outside forward who later became a professional with the Glasgow Rangers, easily the most powerful Scottish club through the years; while mith the two clubs he won 32 Scottish full international caps between 1919 and 1932.

Outside Great Britain payments to amateurs for broken time were permitted as a normal thing and in consequence full professionalism either did not obtain or rarely became as dominant as in Britain. For instance. Sweden's team, which beat England in, 1949 in Stockholm, was composed entirely of players classified as amateurs under Swedish rules. In any case. however much publicity the professional leagues and players might receive. the amateurs remained the true backbone of the game in all countries; of 1.000.000 players attached to clubs under the F.A. at mid-20th century only about 6,000 were registered professionals.

B. World Association Football

Once association football had become a popular sport in Great Britain, its spread throughout the world was only a matter of time. Everywhere that Britons went they played association or "soccer"; and the simplicity of its basic principles and rules and the fact that it could be played satisfactorily under almost any conditions except in fog added to its appeal. Other countries soon started their own clubs, in many cases with the help of local British residents or visitors; such British clubs as the Corinthian F.C. made innumerable missionary and holiday tours in foreign countries. National associations followed naturally, in almost every case modeled on the Football association, and in 1904 these national associations combined to form the F.I.F.A. This vast federation, earliest and biggest of its kind, directs the game in almost every country in the world from its headquarters in Ziirich, Switz. The British associations withdrew from the international body in 1928 because of differences of opinion on points they regarded as fundamental — the payment of allowances to amateurs for time lost from work and the use of substitutes in a match — but the F.I.F.A. and the British associations remained good friends and continued to work together on the International Football Association board, whose chief duty was to discuss and accept or reject proposed alterations in the rules of the game. The British associations later rejoined the international body and by the second half of the 20th century few countries were not members.

Some form of world tournament became inevitable and in 1930 the F.I.F.A. organized its first competition for the Jules Rimet cup, commonly called the World cup. Uruguay won the title of world champions that year and Italy was successful in 1934 and 1938. The British associations did not compete in these first tournaments, but having rejoined the F.I.F.A. England entered the 1950 competition, in the final of which Uruguay beat Brazil. This tournament is divided into three parts. First. small regional qualifying competitions are decided. The winners of these and a few who have been given byes go forward to the second stage in the host country.

One of the greatest difficulties in international football had been the widely different interpretations put on the rules in different countries. In 1949, therefore. the F.I.F.A. invited Sir Stanley F. Rous. secretary of the Football association and a former referee of the F.A. cup final. to draw up instructions for the referees for the World cup tournament. The referees for the finals are chosen from a list submitted by all national associations, the final choice depending on their experience in international matches, knowledge of languages and age. Arrangements are made to call the chosen officials together in advance for a short course in order to obtain a uniform interpretation and a high general standard; this is one of the most valuable services of the F.I.F.A. to the game.

United States. — In the United States the first professional association football nas played in 1918 nhen a team was organized at the Bethlehem (Pa.) Steel company. Several professional leagues came into existence before World War II, but even the most important of these (the American league) mas limited almost entirely to the factory districts of New York and Philadelphia. The game was played and supported chiefly by foreign-born factory workers. though the business management was predominantly British. Whatever chance it had to become a leading sport in the U.S. was lost when professional U.S. football became established on a solid financial basis in the middle 1920s. Professional U.S. football draws crowds of up to 50,000; at association games it was rare before World War II to find as many as 5,000 spectators. Efforts were made to popularize the game by arranging visits from British clubs and national sides.

The game is played in many U.S. preparatory schools (corresponding roughly to British public schools) and city high schools, but only occasionally in other schools and colleges. Great surprise was caused when the Cnited States team beat England 1–0 in the World cup series in 1950 in Rio de Janeiro. When a return match was played in Yankee stadium. New York city, in June 19j3. however, England won 6–3. The popularity attained by the game in the U S. at that time may be gauged from the fact that only 7,271 spectators were present. (For further history and the rules of the U.S. game, see Soccer.)

The World cup tournament is an open one in which amateurs and professionals compete on level terms. but amateur players also have their private world tournament every four years at the Olympic games (*q.v.*).

C. Glossary: Association Football

Corner area.—At each corner of the playing field, a quarter circle mith a radius of one yard, drawn inside the field of play.

Corner kick.—A direct free kick from one of the corner areas by a member of the attacking team; used to restart play when the ball has been propelled across the goal line, but not between the goal posts, by a member of the defending team.

Direct *free* kick.—A iree kick irom which a goal can be scored directly against the opposing side.

Dribbling. — Movement of the ball along the ground by a player by a series of very short kicks, usually mith the instep or side oi the foot, to gain ground or take the ball past an opponent.

Foul.—A breach of the laws of the game, punishable by a free kick, direct or indirect.

Free kick.—A kick during which no member of the opposing team, unless he is standing on his own goal line between the goal posts, may approach within ten yards of the kicker until the ball has traveled the distance of its own circumference.

Goal. — Two upright posts, eight yards apart, joined by a horizontal crossbar and placed in the centre of each goal line. A net is fastened to the posts below the bar. Also the name given to a score made by propelling a ball betw-een these posts and under the crossbar.

Goal area.—A rectangular area immediately in front of each goal, 20 yd. wide and extending 6 yd. into the field.

Goal kick.—An indirect free kick by a player of the defending team; used to restart play when the ball has been propelled by a member of the attacking team over the goal line, but not between the goal posts. The kick is taken from within the goal area and the ball must be kicked beyond the penalty area.

Handling. — Any other player than the goalkeeper intentionally carrying, striking or propelling the ball with hand or arm.

Heading. — Striking, propelling or deflecting the ball with the head.

Indirect free *kick*.—A free kick irom which a goal cannot be scored unless the hall has been played or touched by a player, other than the kicker, before passing through the goal.

Kickof. — A place kick from the centre of the field by a player who kicks it into the opposing team's half of the field; used to start each half and to restart play after each goal is scored.

Passing.—Propelling the ball by head or foot from one teammate to another.

Penalty area.—A rectangular area in front of each goal, 44 yd. wide and extending 18 yd. into the field.

Penalty kick.—A direct free kick from a spot 12 yd. in front of the centre of the goal with all other players except the defending goalkeeper and the kicker outside the penalty area; may be awarded for any one of nine offenses by defenders within the penalty area.

Pitch.--The field of play, bounded by the goal lines and the touch (side) lines.

Throw-in.—A method for restarting play when the ball has been driven over a touch (side) line; it consists of a player of the team not responsible for the ball being out of bounds throwing it back into the field of play.

Touch line.—Side line.

V. RUGBY FOOTBALL

A. Rugby Union

Laws of *the* Game.—Rugby union football is played with an oval leather-covered ball by teams of 15 players each on a field not more than 110 yd. long and not more than 75 yd. wide, with an extra area, called in-goal. not more than 25 yd. in depth and the same width as the main field behind each end or goal line (see fig. 12). The extreme end lines are called the dead-ball lines. In the centre of each goal line there is a goal, comprising two uprights of not less than 11 ft. in height and 18 ft. 6 in. apart with a cross-bar 10 ft. from the ground. Lines are drawn across the field at halfway and 25 yd. from each goal line. Intermittent lines are marked ten yards each side of the halfaay line and five yards infield from each side (or touch) line. A match consists of two halves of not more than 40 minutes each, the teams attacking different ends in the two halves, and a match is won by the side scoring the greatest number of points.

A player touching the ball down on the ground in his opponents' in-goal area, before any of them can do so, scores 3 points for a try; any member of his own side may then take the ball out any distance into the field of play at right angles to the goal line from the spot at which the ball was touched down and endeavour to kick a goal with a place kick. some other member of the side having placed the ball on the ground; a goal is scored by kicking the ball over the crossbar and between the posts or the imaginary extensions of the posts, the ball not being touched by one of the defending side between the moment nhen it is kicked and the moment when it passes over the bar; the defending side is restrained behind its goal line until the kicker's friend has placed the ball on the ground; thereafter they may charge and endeavour to stop or touch the ball; if the kick is successful, the try is "converted" into a goal and becomes worth j points. A player kicking a goal with a drop kick during the run of play scores 3 points, provided no defender touches the ball in flight; a drop kick is made by a player in possession of the ball letting it fall from his hand or hands to the ground and kicking it at the first rebound as it rises. A player making a fair catch during the run of play off an opponent's kick or knock-on or throw-forward, digging his heel into the ground and simultaneously calling "mark" is allowed a free kick from behind that mark (his opponents being allowed to charge as soon as he moves to make his kick or the ball is placed on the ground for a place kick), and if with the free kick he place-kicks or drop-kicks a goal he scores 3 points for a goal from a mark. After certain offenses by his opponents a player is allowed a penalty kick at the spot of the offense and his opponents are forbidden to charge; if he place-kicks or drop-kicks a goal with the penalty kick he scores 3 points for a penalty goal.

A team normally is divided into eight forwards, one scrum half, one standoff half, four three-quarters and one fullback. The game is started, and restarted after a goal or at the beginning of the second half, by a place kick from the centre of the field; after an unconverted try it is restarted by a drop kick from the centre of the field The ball may be propelled in any direction with any part of the body except the hands and arms; if it is propelled forward by hand or arm it is a throw-forward; if it rebounds forward from arm or hand it is a knock-on except where a player is in the act of charging down a kick. A player catching the ball or picking it up fairly may run with it in any direction and may pass sideways or back to one of his own side. If the ball is driven

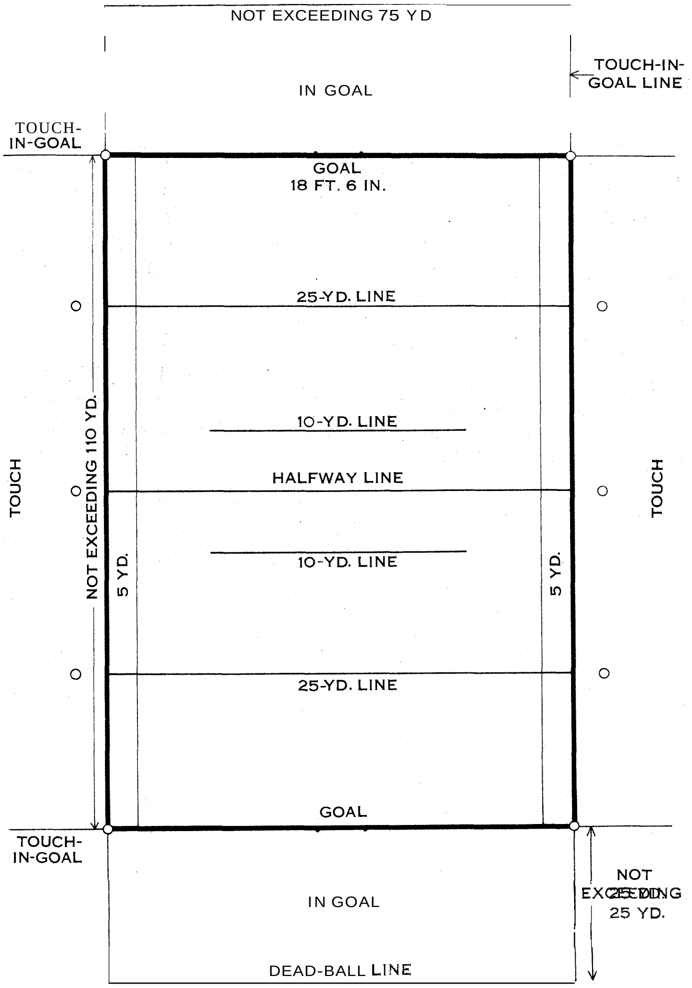


FIG. 12.— FIELD OF PLAY IN RUGBY FOOTBALL SHOWING DIVISIONS AND GOALS

over a touch line it is brought back into play by a member of the side which did not force it into touch; this player must throw the ball in straight across field from the spot where it entered touch, the forwards on each side forming a line straight across field and jumping for the ball when it is thrown to them; this is called a line-out and players in it may not barge opponents before or as they jump. If the ball is forced over a goal line by attackers and then is touched down first by a defender or forced over the dead-ball line the game is restarted by a member of the defending side with a drop kick from the 25-yd. line. But if the defending side carries or diverts the ball over its own goal line and the ball then is touched down by a defender or forced over the dead-ball line, play is restarted with a scrum five yards upfield from the goal line. A tight or set scrurn also takes place after minor offenses.

A tight scrum is formed by the forwards on both sides forming down in two or more rows (three in the front row) and preparing to shove against each other as soon as the ball is put on the ground between the two front rows by the scrurn half or some other player of the side which did not offend. The scrum half, or player acting as scrum half, must insert the ball at a moderate speed fairly between the front rows, with no spin on the ball, and none of the first three feet on each side may be used to "hook" the ball. The centre man of each front row is called the hooker, since he is the first man who may fairly attempt to hook the ball and is therefore carefully trained in this art. A loose scrum is formed when one or more players from each side close round the ball when it is on the ground After a player is tackled. that is to say, being in possession of the ball is so held that he cannot pass it, he must let the ball go free as soon as possible, and no player on either side may play it with the hand until it has been played by foot. While a ball is in either a loose or a tight scrurn no player may handle it.

A player is off side if: he enters any scrurn from his opponents' side; he remains with either foot in front of the ball while the ball is in the scrum, he not being in the scrurn; he stands or moves in front of a line-out before the ball is played; or the ball has been kicked or touched or is being carried by one of his own team behind him. In the last case a player may become on side without penalty (provided he does not interfere with play while off side) when an opponent carrying the ball has run five yards or has kicked the ball or handled the ball intentionally without catching or gathering it; or when one of his own side has run in front of him either carrying the ball or having kicked it nhen behind him Any player falling on the ball must get up immediately and play it with a foot or else roll away.

No player may charge or obstruct an opponent not holding the ball unless he himself is running for the ball. and he may only charge an opponent also running for the ball shoulder to shoulder. A penalty kick is awarded for such serious breaches of law as off side, obstruction, refusing to play the ball or playing it mith a hand after a tackle, handling the ball in a scrurn, putting the ball in crooked at a tight scrurn, illegal hooking for the ball in a tight scrurn, deliberately striking an opponent with fist or foot, tripping and barging in the line-out. A penalty try under the crossbar is awarded if a proper try would have scored had it not been for some exceptionally flagrant breach of the Iaws by the opposition. The game is controlled by a referee, who is sole arbiter. He signals his decisions with the aid of a whistle. He is assisted by two touch judges, armed with flags. whose chief duty is to signal when, uhere and by whom the ball is forced into touch.

The ball is 11 to $11\frac{1}{4}$ in. long, has a 30 to 31 in. end-on circumference, 24 to $25\frac{1}{2}$ in. sideways circuinference and weighs $13\frac{1}{2}$ to 1j oz. Slight variations are allowed in some countries to suit local conditions.

Changes in the Laws. — The original laws of the Rugby union in 1871 provided for a pitch 140 yd. long and 70 yd. nide. a match of 45 minutes each way and sides of 20 players each, with the result depending on which scored the greater number of goals; one goal outweighed any number of tries. Goals, obtained as in today's game, could also be scored mith a fly kick in the run of play (a field goal). The attempt to convert a try could be made from a point directly in front of the spot where the ball was touched down for a try, or one of the attackers could make a free punt out from the goal line in front of the spot where the try was scored to a friend standing in front of goal, and if a fair catch was made the kick at goal was from the spot where the catch was made; failure to make a fair catch forfeited the kick at goal. When a player in possession of the ball crossed his opponents' line they could try by any means to prevent him from touching the ball down, and this produced what was known as a maul-in-goal which theoretically could go on for the rest of the game and often did go on for several minutes in a most ferocious manner. It was only in 1871 that intentional hacking, or kicking of an opponent. were prohibited. The game was presided over by a neutral referee and tno touch judges, one representing each side; it is easy to see how on many occasions these three officials formed as it were a law court, the referee acting as judge and the two judges acting as attorneys at the bar. At the same time. curiously, the captains of the two sides still were sole arbiters of all disputes.

The number of players was reduced to 15 a side in the 1876–77 season for all matches, Oxford and Cambridge having played a similar number a year earlier. In 1875 it was decided that when no goals were scored or each side scored the same number of goals a majority of tries should win a match. It was not until 1886 that a point system of scoring was adopted. This was adopted as a result of a county match in which Yorkshire lost to Middlesex because it could not convert any of a large number of tries while Middlesex scored one dropped goal through A. E. Stoddart in a breakaway. The value of the various scores was altered several times until the 1905–06 season when the field goal was abolished and new values were accepted for all except the dropped goal; this was worth 4 points until after World War II. During the summer of 188j the rather ridiculous position of the referee and the judges was discussed and as a result the referee's authority was greatly strengthened. He was given a whistle while the judges were reduced to touch judges with flags and mere put under the referee for disciplinary action in just the same way as any player. It was not until 1888 that a penalty goal could be scored from a penalty for offside play and many other offenses were made punishable by a kick. At the same time the referee was given power to order a player off the field for rough play and to report to the union cases in which his decision was disputed. Later he could order a player off the field for the latter offense as well as for the former and also for persistent infringement of the laws.

Traveling expenses were first allowed in international games in 1880; hotel expenses were permitted soon afterward. Later a limited number of players playing for recognized club teams could receive traveling and hotel expenses for club matches away from home. The Rugby unions, however, remained constant in their opposition to any form of payment of allowances for loss of earnings suffered while playing or traveling to or from a match. Even presentations to players were strictly controlled, and there was a famous case in 1897 when A. J. Gould, a great three-quarter then at his best for Newport and Wales, was the beneficiary of the product of a large testimonial fund; this almost led to a breach of relations between the Welsh union and the other unions, but in the end bore better fruit in a new set of agreed laws defining acts of professionalism.

Development **of** Different Styles **of** Play. — In the 1860s the 15 or more forwards on each side were true descendants of the players at Derby. They concentrated on carrying the scrummage, as it was called, by superior weight and drive and considered it cowardly to scrummage head down in the modern manner. They hacked with a will and were hacked, tripped as often as they tackled, and usually went on enjoying their maul long after the ball had departed. Individually they could dribble well, but they rarely had a chance to make a combined dribbling rush because it was impossible for more than one or two at a time to disentangle themselves from a maul. Indeed, there was no attempt at combination in the modern sense between any parts of a side. The two halfbacks were complete individualists and it was considered unmanly to pass the ball rather than run with it until overwhelmed. The two backs guarded their goal and the solitary three-quarter roamed over the whole of the middle of the field seeking whom he might devour.

The first reform was achieved when a faster, more open game was found by certain clubs to be more profitable, even if it horrified some of their battle-scarred older members. The reduction in sides from 20 to 15, and consequently of forwards on each side from 15 to 10, was of great assistance to those reformers, who began to concentrate on combined dribbling. quick breaking from the mauls and scrums and intelligent looking for the ball before entering a maul mith a view to controlling its destination rather than overpowering the opposition by brute force. The Blackheath club in 1878 set up a new fashion on these lines which rapidly became popular among players. Their fast and agile forwards developed brilliant short passing movements and were largely responsible for 15 wins in 16 games and the scoring of 54 goals and 30 tries. To the disgust of many old gentlemen they also learned how to wheel a scrurn. Among Blackheath's earliest and best imitators was Oxford university, and in 1881 Oxford had one of the greatest footballers of all time in H. Vassall, who probably was the first to recognize the full value of speed and insisted on his forwards using their hands and their brains as well as their brawn. In 1882 Vassall found a great assistant in A. Rotherham, a halfback who applied his methods to back play. During 1881–85 Oxford lost only two matches, both to Edinburgh university, and it was unbeaten in 1882, 1883 and 1884. The formation of the side was changed gradually during these years to one fullback, three three-quarters, two halfbacks and nine forwards. Rotherham conceived and proved the value of halfbacks who would act as a link to get the three-quarters into action, and he appreciated and taught halfbacks how to get their three-quarters moving fast before passing to them; finally as opponents began to adopt correct defensive tactics to answer his passing out, he developed the use of the dummy or feint to pass when in fact he was going to retain possession.

Almost immediately after Rotherham had come to the front R. Robertshaw, a young Bradford centre three-quarter, applied his principles to centre three-quarter play and was the first to show the way in which a centre should act as link with the wings and make openings for them. Robertshaw wanted to have four three-quarters, taking a man out of the forwards for the purpose, but he found little support for the idea in his own country. Welshmen, however, were quick to profit from his lessons, and in 1885 both the Cardiff club and the Welsh national team included four three-quarters, F. E. Hancock and A. J. Gould being brilliant exponents of how to use the new formation. Wales did not always reap the profit it might have done from being the first to accept the new idea but its merits were obvious and soon the other countries had to follow suit in self-protection. This formation — one fullback, right wing three-quarter, right centre three-quarter, left centre three-quarter, left wing three-quarter, standoff half, scrum half and eight forwards — remained the most popular, New Zealand provided notable exceptions. There, until the laws were altered in the late 1920s and it was laid down that the front row in a tight scrurn must consist of three men, the New Zealanders had seven forwards and eight outsides. The forwards packed 2–3–2, and the outsides were fullback, left wing three-quarter, centre three-quarter, right wing three-quarter, second five-eighth, first five-eighth, scrum half and a rover, who was part forward, part scrum half. The essential differences in the back division are that in normal situations it is always the same man (first five-eighth) who receives the pass from the scrum half, that his pass is always taken by the same man (second five-eighth) and that it is always the same man (the centre) who draws the last man before sending the wing on his nay.

British teams, notably the Oxford university side which was unbeaten up to and including the match with Cambridge in 1949, occasionally used what they called first and second or inside and outside centres in order to achieve the same effect; but no British side really made the same use of the formation, for in New Zealand the two five-eighths are peculiarly a unit, working and planning the attack, whereas in Great Britain in most cases the halfbacks look on themselves as one unit and the three-quarters on themselves as a second unit. New Zealanders do not argue about the merits of their system; they regard its superiority as a self-evident fact and among other things point out that the duties of the third and fourth men behind the scrum (second five-eighth and centre) obviously are different and that certain players are better fitted for the one job than the other.

The only important modern development in back play after the general adoption of four three-quarters was the use of prearranged tactical maneuvers, involving return passes, reverse passes. scissors movements, various types of kick, etc., to force gaps in the middle of the defense, turn its flanks or defeat it by speed before it can turn round to get back to a cunningly placed ball. Between 1905 and 1914 the Harlequins became famous for their back play, but they did not in fact revolutionize back play; rather they assimilated and perfected much of the best shown by Wales and New Zealand in preceding seasons, put their faith in swift passing, running and backing up at all times, even when penned in their own quarter of the field, and had such fine players to carry out the plan as A. D. Stoop. H. Brougham, F. M. Stoop. J. G. G. Birkett, D. Lambert and H. J. Sibree. The basic tactics of back play hardly changed after the early years of the 20th century; they did not include the making of the fullback into a dangerous weapon of attack (see Rugby League, below) and they were affected only to a minor degree by the modern wing forward.

The modern wing forward is the degenerate descendant of D. Gallaher, captain and rover in the first New Zealand All-Blacks team to visit Great Britain and Ireland in 1905. He did not join the scrums and did not claim to be a forward; he put the ball into the scrum as often as did his scrum half and thereafter concentrated in the first place on strangling his opponents' attack at birth by helping his scrurn half smother the opposing scrum half or intercepting his pass to the standoff half. The New Zealanders reckoned and proved that by packing 2–3–2 they could hold any other formation of seven or eight forwards in the scrums and so had a man over to be rover; Gallaher's side lost only to Wales by a disputed try and the second All-Blacks team in Great Britain won every match and soon after returning home routed South Africa. New Zealanders resented the change in the laws toward the end of the 1920s which made it obligatory to have three men in the front row of a scrurn; they found that with three men in the front row they had to have eight forwards against eight and so lost their rover.

The modern wing forward, on the other hand, is neither flesh nor fowl. He is a forward and he packs down at scrums because his weight is needed. But often his shoving is little more than a pretense nhile he is saving himself in order to do the job of the rover; he tends to spend his time driving the opposing standoff half across field and in so doing reduced many a game to an untidy scramble; had he shoved harder like a genuine forward he might have crippled the enemy just as much either by enabling his own pack to get the ball or making the enemy's heel so slow that his own outsides had no difficulty in holding the consequent passing move. His concentration on the standoff half was due at least partly to a change of law, also in the late 1920s, which made it necessary to have both feet behind the ball instead of one while the ball is in a scrum; his chances of spoiling a good scrurn half were greatly reduced and his attention diverted to the next link in the human chain. Also as a result of this change in law it would appear that the standoff's (and consequently the three-quarters') job was made more difficult because the relief afforded to scrum halves tended to make them much slower in passing and thereby give the wing forward and defending outsides time to close on their men. When a really good quick passer-out like H. Tanner (Swansea, Cardiff and Wales) was in action his outsides had just as much chance as ever to be brilliant in attack and the modern wing forward became a liability to his own side as his skirmishing no longer compensated for his failure to do his full share of scrummaging and mauling.

Various theories arose as to how best to arrange eight men in a scrum. By a simple piece of mechanical calculation it can be shonn that, all things else being equal, a pack of forwards arranged 3–2–3 should be able to outshove a pack using the 3–4–1 or 3–3–2 orders, but 3–4–1 became popular early in South Africa and New Zealand and later everywhere except Scotland. The main reasons for this were: (1) in order to get the full benefit of 3–2–3 one must have two men of exceptional strength and ability in the second row capable of shoving themselves and transmitting on to the front row with a minimum of loss the shove applied to their own bodies by the back row; (2) in 3–4–1 heeling tends to be quicker; and (3) in 3–4–1 the wing forwards are a yard nearer their victims and the whole pack can disentangle itself somewhat more quickly.

The only marked tendency after World War II was for players in face of quick-breaking wing forwards to attempt to be clever without having the necessary basic equipment of technique, and for sides to concentrate on perfecting defense, always an easier art than attack for, strictly, if each defender is competent he will always tackle his man in an orthodox move and any move from a set scrum is likely to peter out tamely. A breach in the best defenses can be made, however, after a quick heel from a loose scrum when one or more defenders are on the ground or by introducing some element of surprise. Surprise was the constant tactic of J. Heaton (Waterloo). the finest centre three-quarter since the 1920s, who led Lancashire to a remarkable series of triumphs in the county championship which culminated in three successive championships in the first three years after World War II. Under Heaton. Lancashire's outsides would look quite ordinary for much of a game while he was assessing the strength and weakness of the opposition; then suddenly they would split the defense fatally by feinting to attack in one place and instead hurling their full weight on the weakest link. His greatest success, probably, was in 1947 when he led a combined Lancashire and Cheshire fifteen to the only victory gained by ordinary counties against the Australian touring team.

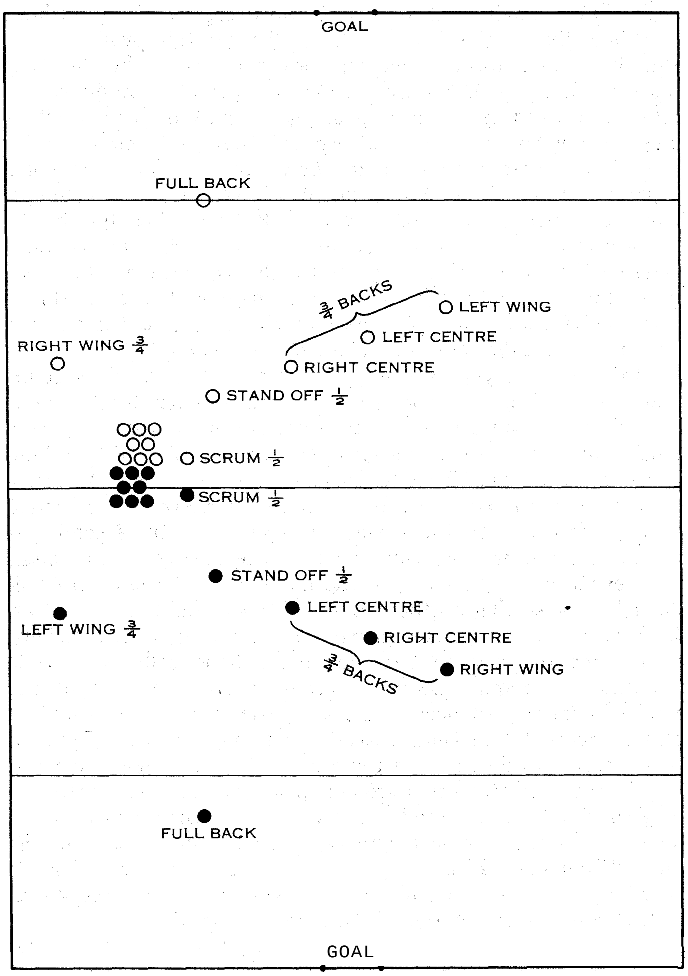


FIG. 13.— DIAGRAM SHOWING PLAYERS IN THE RUGBY FIELD IN POSITION FOR A SCRUMMAGE

There was a considerable revival of back play in the British Isles in mid-20th century. which won approval during the British tours of New Zealand and Australia in 1950 and South Africa in 1955 In all these countries there had been a tendency to concentrate on producing big, strong and fast forwards to dominate the game. The British showed that fast and accurate combined back play still could be effective as well as pleasant to watch, and in South Africa they won two of the four international games and attracted enormous crowds, especially at Johannesburg.

Government of **the** Game.—The formation of the Rugby union in 1871 was followed quickly by the founding of the Scottish Rugby union in 1873. the Irish Football union for southern Irish clubs in 1874, the North of Ireland Rugby union for northern clubs in 1875, the Welsh Rugby union in 1880 and the Combined Irish Rugby union in 1881. England first met Scotland in 1871, Ireland in 187j and Wales in 1881. Scotland first played Ireland in 1877 and Wales in 1883. Ireland and Wales first met in 1882. The unions supported such matches wholeheartedly and the English Rugby union officially sanctioned a county championship in 1890, although Lancashire and Yorkshire had been meeting for 20 years. They strongly discouraged big cup competitions, however, and opposed leagues; the most famous cup competitions permitted are for the Torkshire cup, the London Hospitals cup and the intercollege cups at Oxford and Cambridge; the winners of the England *v.* Scotland match hold the Calcutta cup.

The unions worked in harmony almost throughout. Early changes in the laws mere agreed upon easily. the other three regarding the English Rugby union as the parent and supreme body and changes of law never altering the game from Rugby, whereas in the U.S. modern football has little relation with the original game. The first serious dispute arose over the scoring of a try by England against Scotland in 1884, as a result of which Scotland refused to recognize England's union as sole arbiter of the laws; when the English Rugby union introduced point scoring in 1886 all three other countries refused to play England in the follon-ing season and the matter came to a head As a result of arbitration by Maj. F. A. Marindin (most famous of all F.A. cup final referees) and Lord Kingsburgh it was agreed in 1890 to form an international board to control laws as well as settle disputes of fact in connection with international matches; England was given six representatives on the board, and Scotland. Ireland and Wales were given two each. England's quota was later reduced to two and representation was given to New Zealand, South Africa and Australia. The election of all officials from the smallest to the highest in all the clubs and unions is based on democratic voting.

World-Wide **Rugby** Union.—Immediately after the formation of the Rugby union the game spread rapidly abroad as well as in Great Britain and in the 1870s it was being played in Australia. Canada, France. South Africa and the U.S., but it was only in New Zealand that it at once became the national game. As early as 1888 a New Zealand team composed chiefly of Maoris visited England and defeated many of the leading English clubs. The All-Blacks team of 1905 was the first fully representative New Zealand team to visit Great Britain and was beaten only by Wales by a solitary try. The second All-Blacks team in 1924 was even more successful, winning all its games. Both these teams were superior in basic technique, backing up and fitness, and by playing together regularly developed remarkable combination. The side of 1924 included two superb five-eighths in M. Nicholls and A. E. Cooke. an exceptionally strong and fearless fullback in G. Nepia, a Maori who played in every match, and great forwards in M Brownlie and J. Richardson. Another Maori team visited England in 1926 and the third All-Blacks arrived in 1935; the latter was a fine side, but it was dogged by injuries. especially to key men like J. Oliver. a splendid five-eighth, and W. A. Hadlee. its best hooker, and lost to both England and Wales. The fourth All-Blacks to visit Britain, in 1953–54, lost to Wales and France, but beat England, Ireland and Scotland. It included one of the greatest of fullbacks in R. W. Scott; in addition to being a superb defender and kicker he was. perhaps through playing Rugby league in his youth, a most dangerous attacker.

In Australia Rugby union acquired a great hold in New South Wales and a big following also in Queensland. but it had an unusual rival in Australian rules football and Rugby league was a strong competitor. Representative Australian teams visited Great Britain, in 1908, 1927, 1947 and 1957. There was a steady improvement in their standards. though they never equaled the brilliance of the New Zealanders in back play. Notable members of these sides were A. C. Wallace, a former Oxford and Scottish international three-quarter, and A. T. Lawton, former Oxford standoff half. in 1927 and T. Allan, centre, and D. F. Rraefft. D. H. Keller and C. J. Windon. forwards, in 1947; in the latter tour they also brought C. C. Eastes. a wing three-quarter of most formidable bulk and speed but unfortunately badly hurt early in the visit. The 1957 side included **A.** J. Summons at standoff and J. A. Phipps, inside centre.

In South Africa Rugby union had a long struggle before it took first place over both association football and a local hybrid game which embodied points from both Rugby and association. British sides nhich visited South Africa in 1891, 1896 and 1903 found the opposition stronger each time. These visits were returned by South Africa in 1906 and 1912; in the first of these tours they were good in the backs but were beaten forward; South Africa never forgot the lesson and its later sides were noted for their hard scrummaging. The great Rugby heroes of South Africa were nearly all forwards like P. J. Nel and M. M. "Boy" Louw. Its back play had never made the same progress. though in a tour of Great Britain in 1931 it had a remarkable general at standoff half in B. L. Osler nho, by nursing his forwards and sacrificing all thoughts of constructive back play. was largely responsible for the team's ninning 23 games. drawing 2 and losing only to a combined Leicestershire and East Midlands team (nhen they were a forward short almost throughout the game). British sides under R. Cove-Smith and S. Walker visited South Africa in 1924, 1938 and 1955 and found the opposition extremely powerful, and a New Zealand side (without Maoris) lost a series of international matches in South Africa in 1949. A South African team visited the British Isles and France in 1951–52 and won 30 of its 31 matches, including the 5 international matches against Scotland, Ireland, Wales, England and France. The side had an extremely powerful and skillful pack, which observed all the basic principles, and two brilliant halfbacks, P. A. du Toit and H. Brewis.

Rugby union reached France in the middle of the 19th century, but its development there was slow and it was not until 1906 that France met England in an international match; it began to play Wales in 1908, Ireland in 1909 and Scotland in 1910. For a long time it had little success in international matches but the spirited attempts of its players to play an open attacking game made its visits popular everywhere, and after World War II it was a serious contender for the unofficial international championship. In 1931 the British unions severed playing relations with France because they were dissatisfied with the control and conduct of the game in that country. Just before World War II, however, France was restored to its position in international football.

The game is played by Italy, Spain, Belgium, Rumania and Germany, who combine with France in a European championship, Malaya, Thailand, Japan, Fiji (which has beaten the full Australian side) and Argentina, which has a considerable population of British birth or descent. Teams from Ireland, the Rugby Football union and Oxford and Cambridge have visited Argentina and many clubs have played matches with teams from Europe outside France, but international matches with these countries were not approved by the British Rugby unions.

Largely because Canada and the United States have their own football games, both developed from Rugby, the parent sport has never been widely popular in those countries. There is some enthusiasm among the larger eastern universities in the U.S., in California and in British Columbia. Combined teams from Oxford and Cambridge made visits in 1934 and 1955.

B. Rugby League

Rugby league, played mainly in the north of England, Australia, New Zealand and France, is a direct descendant of Rugby union. There was at first no difference in the playing laws, for the original 22 members of the Rugby Football league, or Northern union as it was called until the 1920s, seceded from the Rugby Football union after and because a Yorkshire proposal to permit the payment of compensation for bona fide loss of working time by players had been defeated at the annual general meeting of the Rugby union in 1893. The majority of Rugby union clubs were then, as later, opposed to any proposal which appeared to prepare the way for the introduction of professionalism into the game. The Northern union clubs recognized professionalism in 1898, subject for a time to a condition that a professional must have another genuine job during the week; eventually this condition was dropped, but in practice almost every Rugby league professional continued to follow another trade or profession during the week, unlike the majority of professional association footballers in Great Britain. The Rugby league's rules governing the status of amateurs are as strict in their way as any put forward by the Rugby unions, and the backbone of the game in the second half of the 20th century was formed not only by the 30 professional teams of the Northern Rugby league but by more than 300 registered amateur teams in the three counties of Cumberland, Lancashire and Yorkshire. There were many cases of players playing as amateurs with the first teams of Northern league clubs.

The seceding clubs quickly established Northern and county league and cup competitions and gradually amended the old Rugby union laws in order to make play more attractive to spectators and, some stoutly maintained, more enjoyable for the players also. The main differences in the playing laws by the 1950s were: (1) there were only 13 men in a Rugby league side, two forwards having been cut out; (2) in Rugby league there was a scrummage instead of a line-out opposite the point where the ball entered touch; (3) from a kick the ball must touch an opponent or bounce on the ground inside the field of play before entering touch, except from a penalty kick or a kick traveling toward the kicker's own line, the penalty for failure to observe this proviso being that the scrum is formed back where the kicker was when he made his kick; and (4) that after a tackle the player with the ball is allowed to stand up and drop it so that it may be played with a foot. A try was still valued at 3 points, but any successful kick at goal after a try, with a penalty, or with a drop kick was worth 2 points. Most of the basic principles of strategy and technique remained much the same as those of Rugby union, but in the Northern Rugby league the standards of fitness and technical efficiency had been raised in the best clubs to a degree rarely seen in Rugby union and many tactical maneuvers had been developed to achieve the strategic end, especially moves making the fullback one of the most dangerous attackers on the field.

Professional players are recruited from the ranks of amateurs and overseas Rugby league teams as well as from Rugby union footballers all over the world but especially in the north of England, south and west Wales, Australia, South Africa and New Zealand. The sums given to players to induce them to change their status and those demanded by clubs for the transfer of registered professionals had increased enormously by the second half of the 20th century, reaching £6,000. The paying of such sums was beyond most clubs for, in the main, Rugby league was still played in the smaller northern England towns and the average attendance at Northern league games was only about 12,000, ranging from 2,000 to 3,000 at Featherstone, a little colliery town in Yorkshire, to about 25,000 at Wigan, where a quarter of the total population had become regular attenders. The export of players from New Zealand, Australia and South Wales had proved such a threat to the game in these countries that they asked for, and in the first two cases won, a part ban on recruitment by English clubs for a period. Naturally the wiser clubs turned more and more to the development of local resources and, of the great Wigan side which in 1949 won the Lancashire cup for the fourth time in succession, all except three were found in the Wigan district and trained to their high standard by the club.

The game was soon adopted in New South Wales and, to a lesser degree, Queensland, and test matches were played between Great Britain and Australia beginning in 1908; by the beginning of the 1955 season the British sides had won 33 and drawn 4 of the 54 games, and had retained the "ashes" from 1921 to 1950, when Australia won the rubber at home. Australia was handicapped by losing many of its best players to English clubs and not having them available for tours or international matches. New Zealand also took to the game early and had played 34 tests with Great Britain between 1908 and the beginning of the 1955 season, winning 10 and losing 24. In New Zealand, however, professionalism in the normal sense had never been obtained; players received free equipment, facilities and expenses but no regular wages. The game took root in France early in the 1930s, one of the main causes being the breach between the British Rugby unions and the French authorities in Feb. 1931. Rugby league acquired a big hold in the south and southwest of France, Toulouse, Bordeaux and Marseilles being the chief centres. Attempts were made to spread the game in Scotland, Northumberland, Durham, London and south and west Wales, but no great or permanent foothold was gained, chiefly because there had been no great popular demand and it had proved too expensive trying to create such a demand. The Rugby League Challenge cup final, however, has been played regularly for a number of years at Wembley stadium, London, and so many northerners make the occasion a holiday festival that by the second half of the 20th century the attendance had risen as high as 95,000 and the receipts to £31,000. In 1954 the final was drawn and the replay at Odsal stadium, Bradford, a natural but largely undeveloped amphitheatre, drew 102,575 spectators.

The first Rugby League World cup competition was played in France in 1954 and was won by Great Britain, the other entrants being Australia, France and New Zealand.

Of the 22 clubs which originally seceded from the Rugby union 15 were still among the 30 members of the Northern Rugby league in the second half of the 20th century: Batley, Bradford (reformed as Bradford Northern), Halifax, Huddersfield, Hull, Hunslet, Leeds, Leigh, Oldham, Rochdale Hornets, St. Helens, Wakefield Trinity, Warrington, Widnes and Wigan. Those which perished or were amalgamated were Brighouse Rangers, Broughton Rangers, Liversedge, Manningham, Runcorn, Stockport and Tyldesley. The leading clubs were those which concentrated on open attacking play, and the records of Huddersfield and Wigan were outstanding over many years. Between them, by 1952, they had been winners of the Northern Rugby league championship 14 times and runners-up 11 times and winners of the Rugby League cup 10 times and runners-up 5 times.

J. Sullivan, Wigan's fullback for 20 years and Great Britain's for 10, achieved the remarkable feat of kicking more than 100 goals in each of 18 successive seasons up to World War II and scoring almost 100 tries as well; he was one of the great defenders whose positional play mas so good that he seemed to run only in attack, when his habit of intercepting one of his own side's passes on the burst baffled innumerable opponents. H. Wagstaff (Huddersfield) was a peerless centre according not only to almost every Rugby league enthusiast but also to many Rugby union players who played with or against him during World War I. A. J. Risman (Salford) was not perhaps so great a centre but as an all-round back he was in a class of his own, being equally expert at fullback, centre and standoff, and after 20 seasons of first-class football he was still greatly to be respected as player-manager of Workington Town at mid-20th century. Among the wings A. Ellaby (St. Helens), a huge long-striding player, B. Bevan, who scored over 500 tries for Wallington, and S. Rosenfeld, Wagstaff's contemporary at Huddersfield, remain in the memory, and of standoff halves three Welshmen, Billo Rees (Sminton), Emlyn Jenkins (Salford) and W. T. H Davies (Bradford Northern) and one New Zealander, C. Mountford (Wigan) were among the great. Jonathan Parkin (Wakefield Trinity) probably would be almost unopposed as scrum half for a world team. but after World War II a wonderful new combination in both attack and defense was worked out for Wigan by M. Ryan, fullback, and T. Bradshaw, scrum half, under the coaching of J. Sullivan which was something new to Rugby of any kind and which penalized the unwary kicker-ahead as never before. The fullback was never left alone to face a follower-up; instead, by brilliant interpassing and changing of direction, the pair turned defense into attacks of blinding speed.

Great forwards were numerous: M. Hodgson, Swinton's towering imperturbable giant; L. Prigg, a tireless, intelligent attacker and deadly tackler from New South Wales; N. Silcock, a burly Widnes front-row man; K. Gee and J. Egan. another remarkable Wigan pair; D. Clarke (Huddersfield), famous also as a wrestler; T. Foster (Bradford Northern); and W. Burgess (Barrow) were only a few of them. Two others played as great a part as any individual player in the successes of their clubs. L B. Todd, a former New Zealand and Wigan player, took over the management of Salford when it was in sore distress in 1928 and by his shrewdness, wise selection, instruction and leadership enabled it to win the Northern league championship three times and the Rugby League cup once in the next 11 years before he was injured fatally in a road accident. Dai Rees, the Bradford Northern trainer and coach. showed such unrivaled knowledge of tactics and ability to nurse injured and aging players that he took his club into five of six Rugby League cup finals between 1944 and 1949.

C. Glossary: Rugby Football

Dead.—The ball is temporarily out of play.

Defending team.—The team in whose half of the ground the stoppage of play occurs.

Drop-out.—A drop kick taken by the defending team after a touch down or after the ball has been in touch-in-god or has touched or crossed the dead-ball line.

Dropped goal.—A goal scored by a drop kick during the run of play.

Fair *catch*.—A catch by a player of the opposing team direct from a kick, knock-on or throw-forward who at the same time makes a mark on the ground with his heel and exclaims "mark."

Field *of* play.—The area bounded by the inner sides of the goal lines and the touch (side) lines.

Free kick.—A kick allowed for a fair catch.

Goal.--Kicking the ball over the opponents' goal-post crossbar from the field of play by means of a place or drop kick (similar to U.S. field goal).

Grounding the ball.—The act of a player placing his hand or hands on the ball, while it is on the ground, so that he is able to exert on it a downward pressure.

Heeling.—Scraping the ball back mith the heel from a loose or set scrummage in the direction of one's own backs.

In-goal.—The area at each end of the field bounded by the goal line, the dead-ball line and the two touch-in-goal lines.

Kickoff.—A place kick from the centre of the halfway line taken at the beginning of each half and after a goal has been kicked; also a drop kick taken at or from behind the centre of the halfway line after an unconverted try.

Knock-on.—Occurs when the ball, after striking the hand or arm of a player, travels in the direction of his opponents' dead-ball line.

Mark.—The place at which a free kick or a penalty kick is awarded.

No-side.—The end of a match.

Penalty goal.—A goal scored from a penalty kick.

Penalty kick—A kick awarded to the nonoffending team by reason of an infringement of the laws of the game by their opponents.

Pitch.—The field of play.

Rebound.—Occurs when the ball, after striking any part of a player except his hand, arm or leg (from the knee to the toe, inclusive), travels in the direction of his opponents' dead-ball line.

Scrum.—Short for scrummage.

Scrummage.—The closing around the ball by one or more players on each team when it is on the ground (called a loose scrummage); a closed-up formation of players of each team in readiness to allow the ball to be put on the ground between them (called a set or tight scrummage), used to restart play after certain minor. infractions.

Tackle.—Occurs when the holder of the ball in the field of play is held by one or more players of the opposing team so that while he is so held the ball comes in contact with the ground or there is a moment when he cannot pass or play the ball in any other manner. When tackled a player must release the ball immediately.

Throw-forward.—Occurs when the ball is propelled by the hand or arm of a player in the direction of his opponents' dead-ball line.

Touch.—Out of bounds between the two goal lines.

Touch down.—The act of a defending player first grounding the ball in his own in-goal (similar to US. touchback).

Touch-in-goal.—Out of bounds between a goal line and a dead-ball line.

Try.—Obtained by the act of an attacking player first grounding the ball in his opponents' in-goal (similar to U.S. touchdown).

VI. AUSTRALIAN RULES FOOTBALL

The game of football under Australian rules seems to be indigenous to Victoria and is said to have been played in Melbourne before Rugby ever was introduced to the continent. It became the favourite game in Victoria, South Australia and Western Australia. It is played on an oval field with a greatest width of 120 yd. and a greatest length of 180 yd. Sides are made up of 18 players, 15 of whom remain in more or less fixed positions and mark fixed opponents. The ball is much bigger than a Rugby ball, the circumference being 29½ in. over the long axis and 22½ in. over the short axis. A player may kick or punch the ball forward but may not run with it unless he bounces it every ten yards. There is no off side. Four posts of any desired height and with no crossbar are set up seven yards apart at each end of the field. Any punt, place kick or drop kick which goes between the two inner posts without being touched by a defender scores 6 points; any kick which goes between the two outer posts or which goes between the inner posts after being touched scores 1 point.

(L. M.)

VII. GAELIC FOOTBALL

Gaelic football is distinctly Irish and is reputed to be the roughest of all football games, It has no connection directly with Rugby or association, being of direct descent from the medieval mellays in which entire parishes would embroil for daylong battles over many square miles of country. (See Early History, above.) The game mas without rules or restraint until 1884. Then two citizens of Carrick-on-Suir, Tipperary. Daniel and Mauric Davin, after watching a particularly bloodthirsty affray between 34 men of Tipperary and 34 of Waterford, decided that something must be done to restrain the ferocity of the players. With the aid of Michael Cusack of Clare and some of the leading players, they drew up a code of rules which slightly restricted brutality, and at a big meeting in Thurles, Tipperary, the same year these rules were accepted and the Gaelic Athletic association was formed and became the ruling body for the game throughout the world. The game is not played much outside Ireland except in the U.S.; the winners of the All-Ireland championship usually visit the C.S. each year to meet Gaelic representative teams in New York and other cities on the eastern seaboard. Sides are made up of 1 j men each, who may not throw the ball but may dribble with hand or foot, punt or punch the ball toward their opponents' goal, which resembles a Rugby goal in that the posts are extended above the crossbar and an association goal in that there is a net fastened to the posts below the bar and to the bar. One point is scored for punching or kicking the ball over the bar and between the posts and 3 points for punching or kicking it between the posts and under the bar into the net. The game consists of two halves of 30 minutes each. (A. S. BL.; W. J. CH.)

VIII. SPECIAL (BRITISH) SCHOOL GAMES

The Eton Wall Game.—Though both Rugby union and association are played at Eton at certain times, the college has retained two entirely distinct games called the wall game and the field game. The wall game owed its origin to the presence of a high wall enclosing part of the college grounds along the road from Windsor to Slough. The area of play comprises a strip of ground running along the wall. At each end there is an area known as "calx" equivalent to the in-goal area in Rugby. One end is called "good calx" and the other "bad calx." and goals are marked at the back of each calx. The teams are of 11 a side, 5 players on each side forming down against the wall in "bully" or scrummage and the others taking up positions outside the bully. The ball is put into the bully at the start of the game and whenever it goes out of the area of play. and the object is to work the ball along the wall with the feet into the calx. When the ball has been forced into calx the attacking side tries to gain a "shy," which is accomplished by a player lifting the ball with a foot against the wall and touching it there. This achieved, the ball may then be "shied" at goal. A goal outneighs any number of shies.

The Eton Field Game.—In the field game the usual number of players is 11 a side but more may be included. The game is played on a large field nith goals of a type similar to but smaller than association goals. The chief features of the play are the bully, resembling an attenuated Rugby scrum, dribbling by the forwards who form the greater part of the team and long and accurate kicking by the "behinds" or backs. A goal may be scored either by an ordinary shot or by forcing a "rouge." A rouge resembles a try in Rugby, being scored by an attacker touching the ball down behind his opponents' goal line. The ball is then brought out and a bully formed in front of goal and the attackers endeavour to force the ball through the goal. A goal scores 3 points and a rouge from which no goal is scored 1 point.

The Harrow Game.—The Harrow game is comparatively simple in principle and play. It consists mainly of dribbling by the forwards and long kicking by the backs. Two sets of posts are set up at each end of the field but there are no crossbars and a goal or "base" as it is called is scored when the ball passes between them at any height. The ball may not be handled but it may be caught from a kick, after which the catcher must either kick it or drop it and begin dribbling it. Players must keep behind the ball; otherwise they are off side except in certain circumstances similar to those recognized in Rugby. The most skillful player is the one who can keep the ball under closest control when dribbling. Teams usually are 11 a side but may be increased or decreased according to circumstances.

The Winchester Game.—The pitch for the Winchester game is much smaller than those used for Rugby or association, being only about 80 yd. long and 25 yd. wide. There are no goal posts, a goal being scored when the ball is forced beyond the end lines. This is not as easy to accomplish as it sounds, for the ball may not be kicked more than five feet in the air except when it comes rolling or bouncing toward a player direct from an opponent, a player is off side if he is in front of the ball and passing is illegal. The main feature of the play is the "hot." which is rather like an old-time Rugby scrum and takes place at the start of play or whenever the ball goes out of play. Dribbling forms no part of the game and almost the sole business of the backs is to kick hard and straight. In spite of the small area of play the game is most exacting and calls for endurance, speed and quickness. (F. I. W.)

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(L. M ; A DA)

FOOTE, ANDREW HULL (1806–1863), U.S. admiral and Union commander during the American Civil War, was born at New Haven. Conn.. Sept. 12, 1806. His father was Samuel Augustus Foote (1780–1846), a prominent lawyer and Whig politician nho as US. senator moved in 1829 "Foote's resolutions" on public lands in the discussion of which Daniel Webster made his "reply to Hayne." Andrew Foote entered the C.S. navy in 1822 and mas commissioned lieutenant in 1830. After cruising round the world (1837–40) in the "John Adams." he was assigned to the Philadelphia naval asylum, and later (1846–48) to the Boston navy yard. In 1849 he was made commander of the "Perry," and engaged for two years in suppressing the slave trade on the African coast. In 1856, as commander of the "Portsmouth," he served on the East India station, under Commander James Armstrong, and he captured the Barrier Forts near Canton. From Oct 1858 to the outbreak of the Civil War, he was in charge of the Brooklyn navy yard, becoming a full captain in 1861. In Aug. 1861 he was assigned to the command "of the naval operations upon the Western waters." His exploit in capturing Ft. Henry (on the right bank of the Tennessee river) from the Confederates, on Feb. 6, 1862. without the co-operation of General Grant's land forces, nho had not arrived in time, was a brilliant success, but their combined attack on Ft. Donelson (12 mi. off, on the left bank of the Cumberland river). to which most of the Ft. Henry garrison had escaped, resulted, before its surrender (Feb. 16), in heavy losses to Foote's gunboats, Foote himself being severely mounded. In March–April he co-operated in the capture of New Madrid (*q* v.) and Island No. 10. In June he retired from his command and in July was promoted rear admiral, and became chief of the bureau of equipment and recruiting. On June 26, 1863, he died in New York city.

See the *Life* (1874) by James Mason Hoppin (1820–1906).

FOOTE, SAMUEL (1720–1777), English actor, wit and playwright, nho had an astonishing gift for mimicry, was born at Truro, the son of a prosperous Cornish magistrate. He attended Worcester college, Oxford, but left without taking a degree. Then. "designed for the law," he established residence in the Temple, but in 1744, having dissipated his inheritance. turned to the theatre. His first efforts as an actor were not successful, but while playing Bayes in the *Rehearsal* he demonstrated his ability as a mimic. In 1747, therefore, he opened the Haymarket theatre nith a series of farcical entertainments called *Diversions of the Morning*, in mhich he ridiculed other actors and celebrities. Later, to avoid the restraints of the Licensing act, he called his entertainments "teas." After 1753 he returned occasionally to the regular stage, playing in Dublin and Edinburgh as well as in London;

but again he was unsuccessful except in his own plays, which, like his "teas," depended on topical allusions and upon his gift for mimicry. Foote was adept in exploiting any event for his purposes, even his own misfortune. In 1766 he fell from a horse and broke his leg, which had to be amputated. Characteristically, he turned this to account by writing *The Devil on Two Sticks* and *The Lame Lover*. Another consequence of this misfortune was that the duke of York, who was responsible for the accident, secured for Foote a life-patent for the Haymarket, which permitted him to continue his performances there without resorting to subterfuge.

Foote was doubtlessly a man of many talents, but his mind was of such a cast that he was incapable of employing them except for purposes of savage attacks upon others. David Garrick, who frequently befriended him, avoided public ridicule only through flattery. Samuel Johnson, who considered Foote's wit "irresistible," was obliged to threaten physical chastisement. In 1777, however. he met his match. Agents of the notorious Elizabeth Chudleigh, duchess of Kingston. whom Foote had satirized in *The Trip to Calais* and *The Capuchin,* retaliated with such persistence that he was compelled to quit the stage. He died at Dover on Oct. 21, 1777, and was buried in Westminster abbey.

In addition to the plays mentioned, Foote's best-known productions are *The Author*, *The Minor*, *The Maid of Bath* and a piece for puppets entitled *Piety in Pattens*.

See M. M. Belden, *The Dramatic Works of Samuel Foote* (1929)
(M. Rs)

FOOTINGS: *see* FOUNDATIONS.

FOOTSCRAY, a suburb of Melbourne, Victoria, Austr., on the Maribyrnong river. Area 4,441 ac. Pop. (1954) 57,915. Footscray is an important manufacturing centre.

FOPPA, VINCENZO (*c.*1430–1515/16), Italian painter. leading figure in 15th-century Lombard art, was born at or near Brescia between 1427 and 1430. His earliest dated work is a dramatic painting of the "Three Crosses" in the Accademia Carrara at Bergamo (1456). Among the sources of Foppa's early style were the paintings of Jacopo Bellini and the Cremonese Gothic painter Bonifazio Bembio, and northern manuscript illuminations; after about 1460 he seems to have come in contact with the work of Andrea Mantegna at Padua. Patronized by Francesco and Galeazzo Maria Sforza. he was employed in 1463–67 at the Certosa at Pavia, and he completed, probably by 1468, the first and greatest Lombard fresco cycle in the Portinari chapel in S. Eustorgio in Milan.

A celebrated fresco of "The Martyrdom of St. Sebastian" (1485) from Sta. Maria di Brera, Milan (Brera gallery, Milan), inspired by Bramante. affords a measure of Foppa's success in forging a Lombard Renaissance style. As a panel painter on a monumental scale Foppa's development can be traced from a polyptych of about 1476 painted for Sta. Maria delle Grazie at Bergamo (Brera gallery), through altarpieces at Pavia (c.1486) and Savona (1489/90), to the splendid "Adoration of the Magi" (about 1500; National gallery, London). Foppa died between May 3, 151j, and Oct. 16. 1516.

An artist of exceptional integrity and power, Foppa exercised a formative influence on the work of Butinone, B. Zenale, A. Borgognone and most of his younger Milanese contemporaries. In Milan his style was superseded by that of Leonardo da Vinci, but at Brescia, where he resided after 1490, its effect was more enduring, and it is reflected in the 16th century in the paintings of G. Savoldo.

See C. J. Ffoulkes and R. Maiocchi, *Vincenzo Foppa* (1909); F. Wittgens, *Vincenao Foppa* (1945). (J. W. P.-H.)

FORAIN, JEAN LOUIS (1852–1931), French painter and graphic artist who succeeded Honor6 Daumier as the outstanding illustrator of his day, was born at Rheims on Oct. 23, 1852. As an artist he was largely self-taught. A protégé of E. Degas. he exhibited with the Impressionists, but was from the first more attracted by graphic media.

He made his first etchings in 1876, and although from about 1890 it was lithography that principally occupied him, he returned to etching in 1908. His work was popular and well-suited to reproduction in large numbers. He contributed satirical and humorous drawings to *Le Rire, L'Echo de Paris, Le Figaro, Le Monde Parisien* and other journals. Whatever the medium, Forain took his subjects from the world of the prosperous Parisian bourgeoisie —the exchange, the law courts, the cafés, the artists' studios, the theatres, the demimonde—with a particular emphasis on the disreputable. His attitude was critical, pessimistic and a little cynical, but human behaviour was endlessly fascinating to him. In style and subject matter alike, Forain remained deeply indebted to Degas, and to a lesser extent to Daumier. Toward the end of his life he etched and painted religious subjects. He died in Paris on July 11, 1931. (A. Bs.)

FORAKER, JOSEPH BENSON (1846–1917), American political leader, was born near Rainsboro, Highland county, Ohio, on July 5, 1846. He enlisted as a private in July 1862, served throughout the Civil War and in 186j received a captain's brevet. After the war he spent two years at the Ohio Wesleyan university and two years at Cornell. In 1869 he was admitted to the Ohio bar. He was a judge of the Cincinnati superior court. 1879–82, and from 1885 to 1889 was governor of Ohio. In 1896 he was elected United States senator. was re-elected in 1902 and served until 1909. In the senate he strongly supported President McKinley in the debates preceding, during and immediately following the Spanish-American War. During the administration of President Roosevelt he vigorously opposed various measures advocated by the president, and led the opposition to the president's summary discharge of certain Negro troops after the Brownsville raid of Aug. 13, 1906. In 1916 he published *Notes of a Busy Life*. He died in Cincinnati on May 10, 1917.

FORAMINIFERA. Foraminifera, the so-called "oil bugs" of the petroleum industry, are amoeba-like animals provided with a shell or test. The pseudopodia are filose and anastomosing, never lobose, and the protoplasmic mass within the test contains either one or many nuclei. In most species the test is composed of calcium carbonate and consists of a series of chambers that communicate through passages which were the apertures of the test before each succeeding chamber was added. The name of the group was derived from these passages, the so-called foramina.

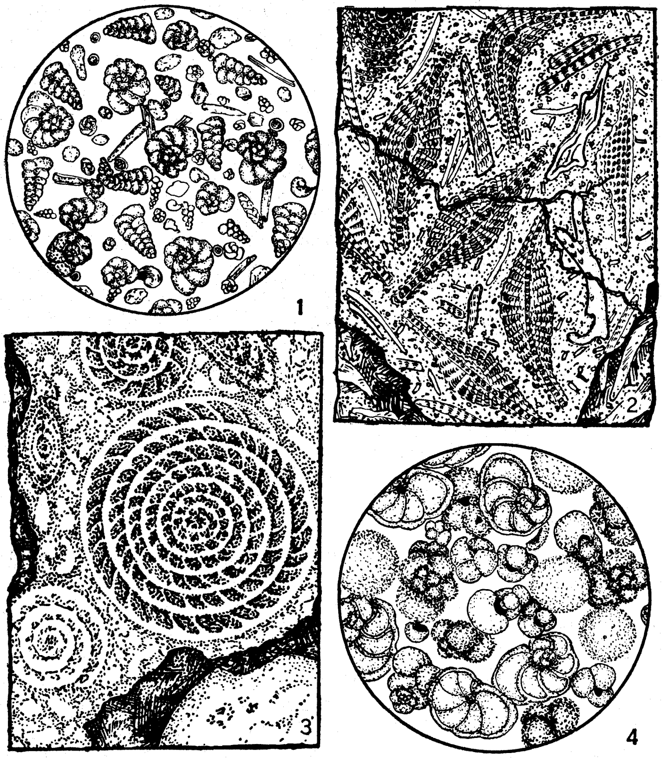
Position in the animal kingdom: phylum, Protozoa; class, Sarcodina; subclass, Rhizopoda; order, Foraminifera. *(See* PROTOZOA; AMOEBA.)

Occurrence.—Foraminifera occur in all oceans and most seas, and at all depths. Grayish riffle marks on sandy beaches often contain vast numbers of the empty tests, and the sand bordering some oceanic islands consists for the most part of the tests of pelagic species. These pelagic Foraminifera, the *Globigerinidae,* constitute 50% or more of the sediments covering about 49,000,000 sq.mi. of ocean floor, and the area would be greatly extended if it were not for the fact that the calcareous tests dissolve at depths in excess of from 2,000 to 3,000 metres. At Sanoer on the island of Bali the tests of larger species are used to gravel walks and roads. Most samples of off-shore sediment contain enormous numbers of tests of many species, as do the washings from seaweed taken from protected tide pools.

Geological Importance.—Much chalk, limestone and marble is composed for the most part of entire tests or residual calcium carbonate derived from the tests of Foraminifera. Evidence of this may be seen with the unaided eye in the polished surfaces of ornamental marble used in many bank and office buildings, and a fragment of stone from one of the pyramids of Egypt will show that they too were built from foraminiferal limestone.

Foraminifera occur in the sediments of pre-Cambrian seas but were seldom an important constituent prior to the coal age or the Pennsylvanian. In the Eocene this group reached its zenith in size, complexity of structure and the extent and thickness of deposits. At the 22,000-ft. level on Mount Everest in the Himalayas there is a 200-ft. stratum of foraminiferal limestone belonging to the period, while in other regions these formations are many thousands of feet in thickness. Recent faunas have existed with only minor modification since the hfiocene.

Marine sediments underlie more than two-thirds of all land areas and often contain fossilized Foraminifera. With the passage of time new species have come into existence; while others have become extinct. For these reasons the Foraminifera are useful in determining the probable age of formations and in making geological correlations between widely separated regions. Since petroleum is always associated with marine sediments, they provide a useful guide to structures which might contain oil and, in proved fields, the strata through which the drill must pass before reaching producing zones.



BY COURTESY OF EARL H. MYERS

FIGS. 1-4.— FORAMINIFERA IN RECENT AND GEOLOGIC MARINE DEPOSITS

1. Washed sample of gray chalk containing Foraminifera. 2. Marble from Italy containing Orbitoids. 3. Nummulitic limestone similar to that used in building the pyramids. 4. Washed sample of Globigerina ooze

Test Morphology.— Tests of Foraminifera range in size from that of a mere speck to several inches in diameter. **A** restricted group includes species that are little more than marine amoebae protected by a chitinous membrane or primitive test. From this simple beginning, species developed in which this primitive test assumes a globular shape, covered with sand, mica, sponge spicules, or other sedimentary material, or by a dense deposit of calcium carbonate. These globular tests are similar to the initial chamber or proloculus of the more common multichambered tests. To this simple test a meandering or spiral chamber may be imposed, or a number of chambers so arranged as to form a coiled, monoserial, biserial, or triserial test; and to a spiral or coiled beginning, a number of annular chambers may be added. These constitute the basic types from which the tests of most species were derived. The total number of chambers in a test may be one, a few, or many hundreds.

Usually there are either one or many apertures in the terminal chamber; and, when a new chamber is added, these become foramina or communicating passages between the chambers. In one major group the walls of most chambers are perforated by minute pseudopodial pores, and there are lesser groups in which the walls of the tests are provided with an elaborate system of canals.

The tests of many species are ornamented with ridges, spines, or bosses; and, because of the beauty and complexity of these, the Foraminifera were the object of intense study long before their economic significance was recognized.

Tests composed of either calcium carbonate or bits of inorganic debris on a chitinous foundation persist in geological marine sediments with little or no apparent change, except where the sediments were subjected to shearing and excessive pressure or the solvent action of acid-charged water. In consolidated sediments perfect moulds that are characteristic of the species may persist after the tests have been completely dissolved.

The four major groups based on the structure and composition of the tests are:

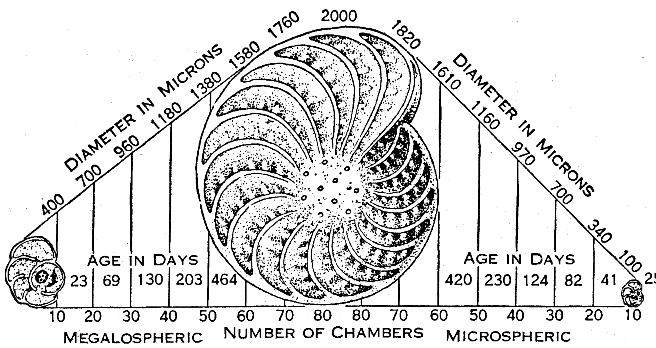
Chitinous, animal cement only;
Aranaceous, inorganic debris and cement;
Perforata, calcium carbonate with pores;
Aperforata, calcium carbonate without pores.

The Living Organism.—Most Foraminifera live on mud, or sandy mud bottoms, or on weed, while a restricted group is pelagic, inhabiting the open sea at moderate depths. The rate of movement in bottom forms is such that most individuals live and die within a matter of inches from the place of origin.

In species having a large aperture, the protoplasm within the test often contains bacteria, flagellated protozoa, spores of algae, diatoms and organic detritus, and it is presumed that these constitute the food of the Foraminifera. When the aperture is too small to admit larger food particles, these are digested by ferments contained in the pseudopodia

The pseudopodia arise from a mass of protoplasm near the aperture of the test or from pseudopodial pores and become attenuated almost to the vanishing point. Where several pseudopodia meet, they fuse or anastornose. These constantly streaming filaments of protoplasm provide locomotion, capture and in part digest food organisms, eliminate solid and liquid waste and, together with the film of protoplasm covering the test, carry on respiratory activities. Circulation within the test is provided by the streaming of the protoplasm, and extends through all of the chambers.

The colour of a living foraminifer is determined by the colour, density and, to some extent, structure of the test; and, when the walls are translucent, the green, brown, or red of the protoplasm and its inclusions may be a dominant factor. Chitin is brown. and often gives a brownish cast to tests that otherwise would be white. The more brilliantly coloured species are found in the vicinity of coral reefs. These range through shades of china-white, orange, bright red, brown and bright green, to lavender and blue, the latter colours being caused in part by refraction. In deeper water, species provided with a translucent test are green. aranaceous tests assume the colour of the shell substance or are made red or brown by iron salts contained in the cement that



FROM EARL H. MYERS IN "JOURNAL OF PALEONTOLOGY"

FIG. 5.— GRAPHICAL PRESENTATION OF THE RATE OF GROWTH BOTH IN NUMBERS OF CHAMBERS AND SIZE OF TEST IN ELPHIDIUM CRISPUM

binds the particles together, while calcareous tests of many species resemble white porcelain.

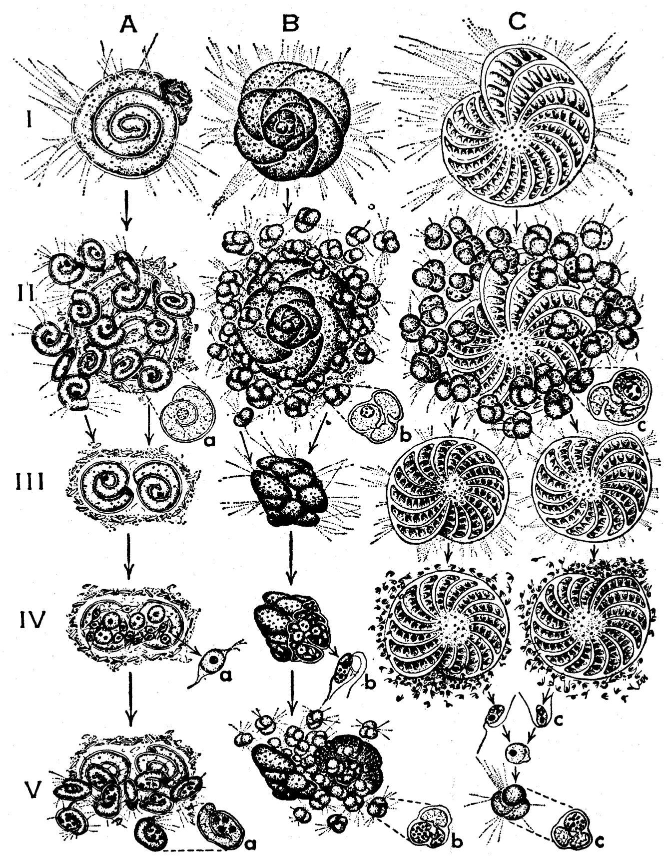
Zooxanthellae are symbiotic algae which live as a protoplasmic inclusion in certain species of Foraminifera inhabiting the shallow waters of warm seas, but their golden colour has little effect upon the colour of the Foraminifera.

Life Cycle.—In the life cycle of most Foraminifera there is a cyclical succession of sexual and asexual generations in which two distinct types of individuals are produced.

Sexual Phase.—In the sexual phase, flagellated gametes associate in pairs in fertilization, and the resulting zygote or fertilization amoeba becomes invested in a spherical test. To this, succeeding chambers are usually added one at a time to form a graduated series of chambers.

Immediately following fertilization, the fertilization nucleus divides, and succeeding divisions result in a number of nuclei that are proportional to the number of chambers in the test. These nuclei are moved from chamber to chamber by the streaming protoplasm and are not restricted to particular chambers. The tests of these sexually produced individuals have minute initial chambers and are therefore referred to as microspheric tests.

Asexual Phase.—Asexual reproduction by microspheric individuals is initiated by a series of nuclear divisions that approximately quadruple the number of nuclei originally present. The protoplasm surrounding each nucleus then separates from the common mass to form mononucleate amoebae which have a diameter several times that of a zygotic amoeba, and these become invested in globular tests that are proportionately larger than the initial test in the microspheric generation. To this relatively large initial test, succeeding chambers are added to produce a test that may be identical in appearance with that of the microspheric generation. These tests are referred to as megalospheric because of the larger initial chamber, and contain but a single nucleus which does not divide prior to reproduction.



FROM EARL H. MYERS IN NATIONAL ACADEMY OF SCIENCES PUBLICATION

FIG. 6.—LIFE CYCLES OF FORAMINIFERA

A. *Spirillina vivipara*, B. Discorbis *globularis*, C. *Elphidium crispum*. I Microspheric generation showing nature of pseudopodia. II Microspheric individuals asexually producing mononucleated megalospheric juveniles. III Beginning of sexual reproduction. in A. Megalospheric individuals merely associate, in B. they actually fuse, and in C. they remain independent. IV In A. gametes form and become fertilized within a brood cyst, in B. within a brood chamber, and in C. gametes are free and pelagic. V Growth of multinucleate microspherio juveniles

Each microspheric individual produces from tens to hundreds of juveniles depending upon the species.

Gametogenesis.—The sexual phase of the life cycle begins with the division of the megalospheric nucleus, and succeeding nuclear divisions produce enormous numbers of minute nuclei. Each nucleus, and the surrounding protoplasm, then gives rise to a small spherical body in which the nucleus—and finally the protoplasm—divides to form two minute amoebae. This final nuclear division is a reduction division. Later each amoeba develops whip-like structures or flagella by means of which it is propelled through the water. These gametes swarm from the test and, when two gametes derived from different megalospheric individuals come into contact, fertilization takes place and the life cycle is repeated.

This description is based on the limited number of life cycles that have been studied and the recognized dimorphic nature of the tests of most species. Briefly, the life cycle includes an alternation of generations in which two types of individuals are produced. In the sexual phase mononucleate megalospheric individuals produce flagellated gametes. Gametes from different megalospheric individuals unite in fertilization and give rise to multinucleate microspheric individuals, which in turn asexually produce the megalospheric generation.

Reproductive activities in most species require from two to three days, both in the sexual and the asexual phase of the life cycle. The addition of a new chamber requires one day, and several days usually elapse before the next chamber is added. The life span of these protozoa is from a few weeks to a year or more, depending upon the species and the season; and the life cycle, including a sexual and an asexual generation, requires from several weeks to two years or more.

Variations in Life Cycles.—In asexual reproduction, two- and three-chambered megalospheric juveniles develop either within the test of a microspheric individual or in its immediate vicinity after the protoplasm has escaped from the test. In sexual reproduction, two or more megalospheric individuals may either fuse or become enveloped in a common cyst or brood chamber before the gametes are produced, or the gametes may be released directly into the water. In still other species only one type of individual is known and, although these have but a single nucleus and would therefore seem to be megalospheric, they reproduce asexually over many succeeding generations. In a few species both microspheric and megalospheric individuals have been observed to reproduce asexually, but there is little evidence to suggest that this occurs in an appreciable number of species.

Ecological Relationships.—Many species of Foraminifera now occurring between certain depth limits are universally distributed. Similar conditions prevailed during other periods in the earth's history, and for this reason it is possible to correlate geological sediments of widely separated regions. Species restricted to shallow water are often limited in their distribution by the temperature of the water, and in ancient sediments these provide an index to the climatic conditions that prevailed on adjacent land areas. Other species are limited by factors other than temperature. These include the salinity of the water, the nature of the substratum and the food available. which in turn is influenced by factors associated with the depth of the water. Growth and reproduction in this group depends upon the availability of suitable food organisms more than any other factor or combination of factors.

The intertidal zone and adjacent water to a depth of a few metres is subjected to a wider range of changes, and more abrupt changes, in ecological conditions than the waters immediately adjacent to this area; and, as a result, the two areas are inhabited by related but different species. Many species of Foraminifera are restricted to areas covered with weed and grass, and the depth to which these plants thrive depends upon the nature of the bottom and the amount of solar radiation. which varies with the turbidity of the water and latitude. The empty tests of these several populations form a common assemblage in off-shore sediments, and in geologic marine sediments these shallow water species provide a guide to the boundaries of ancient seas.

Below the 20-metre line, or to somewhat greater depths where weeds abound out to the edge of the continental shelf at a depth of about 200 metres, there is a gradual change in populations with the increasing depth of the water, although many species inhabit the entire region. Petroleum originates in geological sediments that were deposited at these moderate depths.

From the edge of the continental shelf to a depth of 2,000 to 3,000 metres there is a more or less abrupt descent, and with this further increase in depth there is a corresponding change in populations. At still greater depths, including the abyssal deeps, aranaceous species predominate, since calcium carbonate dissolves under the pressure and slightly acid condition that prevails at the bottom. Pelagic species are typically oceanic and are not numerous in shallow water unless carried there by currents from the open sea. Therefore the relative abundance of the tests of pelagic species in geological sediments is an index to the depth of the water bordering ancient land areas.

The amazing abundance of Foraminifera in geologic sediments suggests sorting caused by current action, but this is not necessarily the case. At Sanoer on the island of Bali nearly pure deposits of a large species *(Tinoporous)* cover the bottom in some places to a depth of many feet, and the turf-like weed on adjacent submerged reefs support many thousands of individuals per square foot of surfsce. On mud bottoms in some portions of the Java sea an even larger species (*Operculina*) is so abundant that the empty tests in the mud constitute nearly one-half of the total mass of the sediments. In deep water the number of living Foraminifera per unit area is no doubt small, but in shallow water they vary from tens or hundreds to even thousands of individuals per square foot.

Role in Historical Geology.—The role of the Foraminifera in palaeoecology and historical geology is exemplified by a comparison of populations and the conditions under which they now exist with the assemblages of species recovered from stratified sediments in the hills back of Ventura, California.

Samples of sand, silt and conglomerate were obtained from oil wells and out-crops in Hall canyon. From the combined thickness of the strata it was determined that marine sediments some two and one-half miles in depth are exposed in the canyon wall, and, from the dip of the strata, that the more recent sediments are exposed at the lower end of the canyon while the older sediments occur near the summit of the ridge. The several hundred species of Foraminifera recovered from the samples could be divided into five more or less distinct assemblages and, on the basis of this, the geologic column is divisible into as many zones. At first it was thought that these several assemblages suggested a gradual change in climatic conditions during that portion of the Pleistocene when the sediments were being deposited.

It was known that many of the species in the Hall canyon fauna still survive in the sea, and a series of samples were obtained from the mud bottom of the San Pedro channel between San Pedro on the mainland and Avalon on Catalina Island. From these samples it was determined that species similar to those in the upper four zones of Hall canyon occur between about the same depth limits on the two sides of the channel while species characteristic of the fifth zone were present in samples obtained from the deeper water of the open sea west of the island.

Fresh water enters the San Pedro channel from the Los Angeles river and small streams on the island, and reduces the salinity of the water near the shore during the winter and early spring. The maximum depth of the channel is 900 metres, and the temperature at this depth remains at about 5° C. throughout the year. From this low the temperature ranges upward to a maxi mum of 25° C. near the shore on the San Pedro side and 17° C. at the surface in the vicinity of Avalon.

From these observations it was evident that the geological history of the Hall canyon formation includes a slow emergence from the sea from a depth of not less than 1,800 metres to its present elevation of 750 ft., and that the water temperatures during this period were about the same as those now prevailing in the sea adjacent to this area. It was further evident that the sediments in the upper portion of the canyon were deposited in deep water; zone 4, between 900 and 300 metres; zone 3. 300 to 50 metres; zone 2, 50 metres or less; and zone 1, at the lower end of the canyon in shallow water of low salinity. It was also apparent that the climatic conditions of the region during early Pliocene times were similar to those now prevailing, although a somewhat heavier rainfall is suggested, and that the cooling of the sea prior to the advance of the Pleistocene ice sheet had not yet set in.

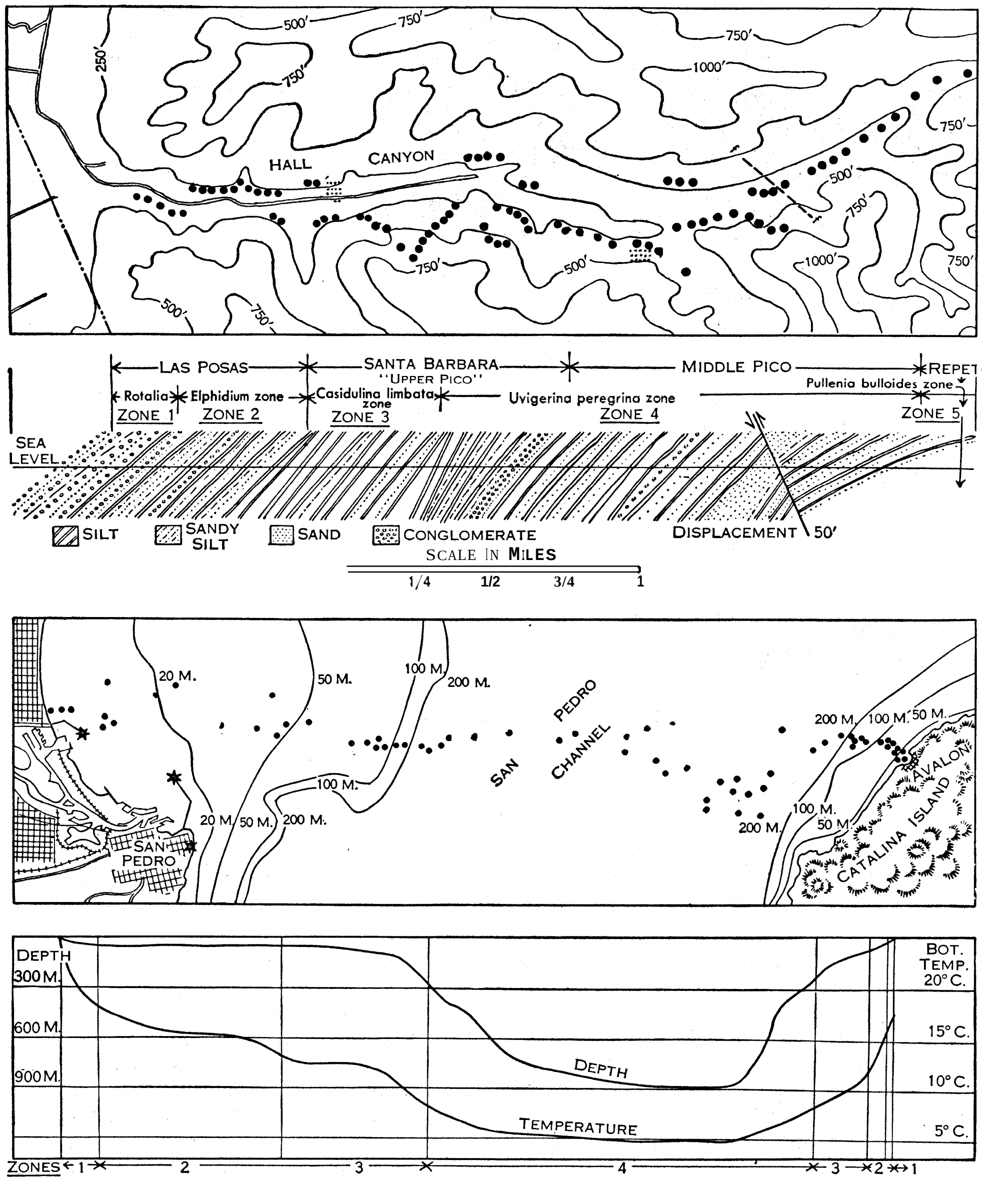


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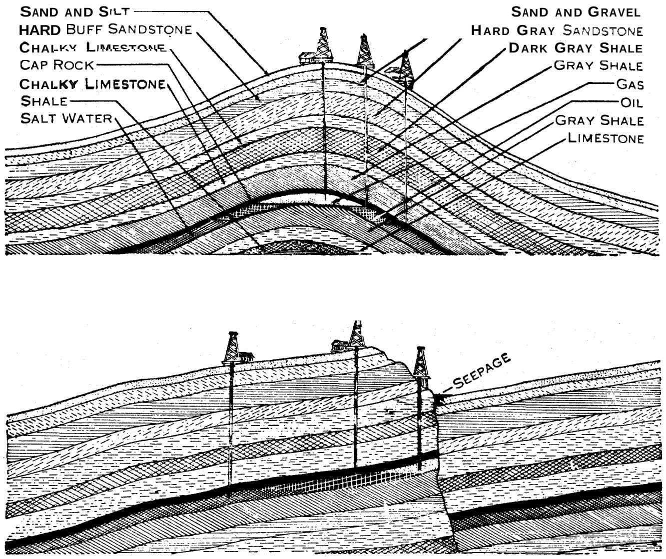
FIG. 7.— TOPOGRAPHICAL MAP OF HALL CANYON AND. BELOW. A STRATIGRAPHIC SECTION OF THE FORMATION. CHART OF THE SAN PEDRO CHANNEL AND BELOW A CROSS SECTION OF THE CHANNEL SHOWING DEPTH AND TEMPERATURE. BLACK DOTS MARK THE POSITION OF STATIONS WORKED

Role in Petroleum Geology. — The mother source of petroleum is the carbonaceous remains of plants and animals, including Foraminifera, that accumulated in the sediments of ancient seas. Conditions of life in these seas, and the chemical changes that occurred both during and after the deposition of the sediments, limited the areas in which petroleum was produced. Further, it was necessary that porous strata, covered with a cap rock of impervious shale, be present to conduct the petroleum to geological traps. These traps are either anticlines — referred to as domes — or sealed faults. Later changes in the earth crust, such as the opening of faults or erosidn, often permitted the oil to escape as seepage or gas. Producing zones are referred to as oil pools, but these pools are nothing more than porous rock, usually sandstone, saturated with oil under enormous pressure.

In the search for petroleum, seepage or escaping gas are valuable clews, but they do not suggest that oil in commercial quantities remain in the structure. Something of the geological history of a region may be determined from samples removed from



BY COURTESY OF EARL H. MYERS

FIG. 8. — SECTIONS THROUGH IDEALIZED OIL FIELDS. ABOVE. A DOME: BELOW. A FAULT

exposures such as cliffs, excavations or wells. The location of probable oil traps, such as anticlinal folds and fault lines, is established through the study of topographical charts, air reconnaissance or, where these fail, subsurface structures which may be recognized through the recording and interpretation of local seismic disturbances set up by the discharge of explosives. Chemical tests of the subsoil may reveal the presence of petroleum but not the existence of recoverable petroleum.

When a favourable site is located and drilling operations are under way, samples of the strata through which the drill passes are removed at frequent intervals and these are sent to a palaeontological laboratory for study. At the laboratory the sample is given a number and a careful description of its characteristics made. A portion of the sample is then reduced by crushing and washing away the finer sediments. It is then dried and the Foraminifera removed under a microscope with the aid of a small brush. The Foraminifera are then mounted on slides, and the individual species as well as the total assemblage of species are studied and compared with the species observed in previously obtained samples. Certain species are then selected as guide fossils for that particular zone, and the assemblage is represented on a chart by means of a special type of marking. From subsequent samples the total thickness of the zone, as well as that of succeeding zones, is also charted. When a producing zone has been located beneath a recognized series of other zones, and a similar sequence is encountered in a new well, the driller knows that the drill is penetrating favourable formations; but, should these zones fail to appear before deeper structures are encountered, he knows that these producing zones do not extend to the new location.

When the sequence of zones has been determined in several wells, these zones are charted by means of an electric logging device; and, when these logs are compared with that of a newly drilled well, correlations may be attempted and these substantiated through the microscopic examination of a minimum number of samples.

Although there are many guides to the possible existence of petroleum in subsurface structures, oil is where one finds it; and the only way to find oil is to sink test wells wherever conditions seem favourable. This is termed wildcatting.

In the ever-widening search for petroleum, geophysical and chemical methods are an aid to success but can never take the place of a sound knowledge of geology, stratigraphy and sedimentation. Recent work on the environment of sedimentation, ecological relationships and possible source rocks should provide a better understanding of the use of guide fossils, especially the Foraminifera, in locating and tracing new oil-bearing formations. (E. H. MY.)

FORBES, DUNCAN, OF CULLODEN (1685–1747), Scottish statesman, son of Duncan Forbes (1644?–1704), genealogist and M.P. for Nairn, was born at Bunchrew or at Culloden near Inverness on Nov. 10, 1685. He studied at Edinburgh and Leiden, and was advocate and sheriff of Midlothian in 1709. The influence of the Argyll family and his loyalty to the Hanoverian cause in 171j secured his rapid advancement. He became M.P. for Inverness (1722), lord advocate (1725), and lord president of the court of session (1737).

Some years before the rising of Forty-five Forbes had urged upon the government the expediency of embodying Highland regiments, putting them under the command of colonels whose loyalty could be relied upon, but officering them with the native chieftains and cadets of old families in the north. In 1739, with Sir Robert Walpole's approval, the original (1730) six companies (locally enlisted) of the Black Watch were formed into the famous "Forty-second" regiment of the line.

On the first rumour of the Jacobite rising in 1745 Forbes hastened to Inverness, and through his personal influence with the chiefs of hlacdonald and Macleod, these clans were prevented from taking the field for Charles Edward; the town itself also he kept loyal. In September 1745, after Cope's departure to the south. Forbes was the sole representative of government in the north. He worked hard to maintain order. But advances of arms and money arrived too late, and though Forbes employed all his own means and what money he could borrow on his personal security, his resources were quite inadequate to the emergency. It is doubtful whether these advances were ever fully repaid. Part was doled out to him, after repeated solicitations that his credit might be maintained in the country; but it is evident his humane exertions to mitigate the savage revenge on the rebels after their defeat at Culloden had brought him into disfavour in London. Forbes died on Dec. 10, 1747.

Forbes was a patriot without ostentation or pretense, a true Scotsman uith no narrow prejudice, an accomplished and even erudite scholar without pedantry, a man of genuine piety without asceticism or intolerance. His statue by Roubiliac stands in the Parliament house, Edinburgh.

FORBES, EDWARD (1815–1854), British naturalist who made an important analysis of the distribution of the natural inhabitants, plant and animal, of the British Isles as related to certain geologic changes. He was born at Douglas. Isle of Man, on Feb. 12. 181j. He studied medicine at Edinburgh. and in 1833 made a tour in Norway, the botanical results of which were published in J. C. Loudon's *Magazine of Natural History* for 1835–36. In 1836 he forsook medicine for natural science, and after a winter of lectures in Paris, he went to Algiers to study land and freshwater Mollusca. In 1838 appeared his *Malacologia Monensis,* a synopsis of the species of Manx Mollusca, and in 1841 his *History* of *British Star-fishes.* From 1841 to 1842 he investigated the botany, zoology and geology of the Mediterranean region, the results being made known in his "Report on the Mollusca and Radiata of the Aegean Sea, presented to the British Association in 1843," and in *Travels in Lycia* (1847). In 1842 Forbes became curator of the museum of the Geological Society of London, in 1843 professor of botany at King's college and in 1844 paleontologist to the Geological Survey of Great Britain. Two years later he published in the *Memoirs* of the Geological Survey, i. 336, his important essay "On the Connexion Between the Distribution of the Existing Fauna and Flora of the British Isles, and the Geological Changes which have Affected their Area," in which he maintains that the plants of Great Britain may be divided into five well-marked groups and that the majority of them, like the terrestrial animals, migrated to those islands over continuous land at three distinct periods, before, during and after the glacial epoch. In 1851 Forbes became professor of natural history to the Royal School of Mines, and in the following year published the fourth volume of Forbes and S. Hanley's *History of British Mollusca* and his *Monograph of the Echinodermata of the British Tertiaries* (Palaeontographical society). In 1854 he became professor of natural history at Edinburgh, but he died on Nov. 18 of that year at Wardic, near Edinburgh.

See G. Wilson and A. Geikie, *Memoir of Edward Forbes* (1861) ; *Literary papers,* ed. *by* Lovell Reeve (1855) ; *Forbes' Centenary Commemoration by* the London Manx Society (1915).

FORBES, JAMES DAVID (1809–1868), Scottish physicist, is best known for his researches on heat and on glaciers. He was born at Edinburgh on April 20. 1809. He studied at Edinburgh: became F.R.S.E. (1828) and F.R.S. (1832), professor at Edinburgh (1833–59), and principal of the United college at St. Andrews (1859–68). He died on Dec. 31, 1868.

Between 1836 and 1844 he published in the *Transactions of the Royal Society of Edinburgh* four series of "Researches on Heat," in the course of which he described the polarization of heat by tourmaline, by transmission through a bundle of thin mica plates, and by reflection from the surfaces of a pile of mica plates. and also its circular polarization by two internal reflections in rhombs of rock salt. In 1846 he began experiments on the temperature of the earth at different depths and in different soils near Edinburgh. Later he investigated the laws of the conduction of heat in bars, and his last piece of work was to show that the thermal conductivity of iron diminishes with increase of temperature. The Royal society awarded him the Rumford medal in 1838 and the Gold medal in 1843 for his work on heat.

He made several visits to Switzerland and also to Norway to study the flow of glaciers and developed a theory which involved him in some controversy with Tyndall and others.

FORBES-ROBERTSON, SIR JOHNSTON (1853–1937), Engiish actor, of great beauty and imagination, who was considered the finest Hamlet of modern times. was born in London on Jan. 16, 1853, the son of John Forbes-Robertson of Aberdeen. an art critic. Educated at Charterhouse school, he studied art before turning to the theatre in 1874, when he first appeared on the London stage as Chastelard in *Mary, Queen of Scots.* He acted with Samuel Phelps, the Bancrofts and John Hare, played opposite Mary Anderson in England and the United States and for some time was a leading member of Sir Henry Irving's company at the Lyceum. His first outstanding success was in Sir. Arthur Pinero's *Tlze Profligate* at the Garrick theatre in 1889, under the management of Hare. In 1895 he took over the management of the Lyceum, with Mrs. Patrick Campbell as leading lady, giving memorable performances of *Romeo and Juliet, Hamlet, Macbeth,* etc., and also producing John Davidson's *For the Crown* and Maurice Maeterlinck's *Pelle'as and Mélisande,* in both of which his romantic style of acting was highly successful. In 1900 he married Gertrude Elliott, who became his leading lady, appearing with him in many plays, such as *The Light That Failed,* Madeleine Lucette Riley's *Mice and Men,* George Bernard Shaw's *Caesar and Cleopatra* and, one of his biggest successeg, Jerome K. Jerome's *The Passing of the Third Floor Back.* Forbes-Robertson was knighted in 1913, and after occasional appearances and a farewell tour in Canada and the Cnited States finally retired in 1915. He died on Kov. 6, 1937. His daughter JEAN FORBES-ROBERTSOX (1905–) became a distinguished actress. (W. J. M.-P.)

FORBIN, CLAUDE DE (16j6–1733), French naval commander, was born at Gardanne, Provence, Aug. 6, 1656. He went to Siam in 1685 with the chevalier de Chaumont, sent by Louis XIV at the invitation of the king of Siam. He remained as admiral and general in chief to the king until 1687. He was the colleague of Jean Bart in his irregular operations in the channel, and distinguished himself at the battle of Lagos. He served in the French navy as *chef d'escndre* 1702–10, and played a brilliant part in the War of the Spanish Succession. In 1710 he retired to St. Marcel, near Marseilles. He died March 4, 1733. The latter part of his life was spent in writing his *Mémoires*'(1730).

FORCE. In general. strength or intensity of effort as applied to physical action. It is also used to denote a military or naval unit; for its legal application *see* CRIMINAL LAW. In physics force is measured by the product of the mass of a body (under acceleration) by the acceleration, or, more generally, by the rate of change, with time, of the body's momentum; *i.e.,* $\frac{d(mv)}{dt}$. *See* also ENERGY ; MECHANICS.

FORCED LABOUR: *see* CORVÉE; FEUDALISM; SLAVERY.

FORCELLINI, EGIDIO (1688–1768), Italian philologist, was born on Aug. 26, 1688, at Fener. Treviso, and studied at Padua under Facciolati (*q.v.*). From 1724 to 1731 he held the office of rector of the seminary at Ceneda. and from 1731 to 1765 that of father confessor in the seminary of Padua. He died at Padua on April 4, 1768, before the completion of the vast *Latin Lexicon,* on which he had for 3j years collaborated with Facciolati.

FORCHHAMMER, PETER WILHELM (1801–1894), German classical archaeologist, was born at Husum, Schleswig, on Oct. 23. 1801, and was educated at Lübeck and the University of Kiel, with which he was connected for nearly 65 years. In 1830–34 and 1838–40 he traveled in Italy, Greece, Asia Minor and Egypt. In 1843 he was appointed professor of philology at Kiel and director of the archaeological museum founded by himself in co-operation with Otto Jahn. He died on Jan. 8, 1894. Forchhammer represented the progressive party of Schleswig-Holstein in the German *reichstag,* 1871–73. His published works deal chiefly with topography and ancient mythology. *Hellenika. Griechenland. Im Neuen das Alte* (1837) contain his theory of the origin and explanation of the Greek myths which, according to him, arose from definite local (especially atmospheric and aquatic) phenomena, and represented the annually recurring processes of nature as the acts of gods and heroes.

FORD, EDWARD ONSLOW (1852–1901), distinguished English portrait sculptor. was born at Islington. London, on July 27, 1852. He was educated at Blackheath, near London, and studied art at Antwerp and Munich. He returned to England in 1874 and attracted attention with a bust of his wife which he sent to the Royal academy in 1875. Ford's best-known statues are Sir Rowland Hill (1882) outside the general post office in London; General Charles Gordon (1890) at Chatham and at Khartoum, and the Shelley memorial (1892) at University college. Oxford. Ford's busts include W. E. Gladstone (1883), Sir Henry Irving (1885), A. J. Balfour (1892), Sir Laurence Alma-Tadema (1896), Herbert Spencer (1897), Queen Victoria (1899) and Lewis Waller (1900).

His bronze statuette of "Folly" is in the Tate gallery, London, and in 1897 he made the Jowett memorial for Balliol college chapel. Ford was elected associate of the Royal Academy in 1888 and academician in 1895. He died in London on Dec. 23. 1901. (R. Gs.)

FORD, HENRY (1863–1947), C.S. industrialist who became within his lifetime the one person most universally identified as the creator of modern mass production, was born July 30. 1863, on a farm near Dearborn. Mich. The principal manufacturing innovation credited directly to Ford is the assembly-line method of automobile production, which he first employed in 1913. However, other technical advances and new ways of planning, organizing and controlling production that were developed during the more than 40 years that he ran the Ford Motor company also came to bear the "Ford label," as much attributed to the man as to the firm. Willingness to depart from previous practice—as by standardizing processes and products, integrating supplying industries, building assembly plants at dispersed locations and organizing manufacturing around continuous line-to-line flow of product components—was a significant factor in the company's success.

Ford's industrial philosophy was simple. Reduce the price of the product, increase the volume of sales, improve production efficiency, increase output to sell at still lower prices, and so repeat the cycle indefinitely. Contemporaries. viewing the automobile as a luxury item or rich man's plaything to be custom-produced for a restricted market, regarded Ford's policies as heretical. While in the company's formative years his ideas were pushed into practice against the resistance of his associates and stockholders, the workability of those ideas was demonstrated vividly by the growth of the Ford Motor company from a firm nominally capitalized at $100,000 in 1903 to an industrial giant with a surplus balance alone of nearly $700,000,000 in 1927, when the last of more than 15,000,000 of the famous Model T's built between 1908 and 1927 rolled off the assembly line.

There was a curious mixture of 19th and 20th century in Henry Ford, and his was a strong and contradictory personality. Though he rejected many of the doctrines of business and economics of his day, on some subjects he clung to anachronistic ideas. In 1914, when workers in U.S. manufacturing industries were making about $11 a meek on the average, he announced that every Ford worker would start receiving at least $5 a day through minimum wages about 15% higher than those paid elsewhere for the same types of work. as well as through participation in a profit-sharing plan. The impact of the move, both damned and praised in the press, naturally was great. It brought for Ford a reputation as a trail blazer. Yet at the same time Ford tightened his paternalistic labour policy, establishing sobriety and thrift on the part of the workers as conditions for sharing in the distribution of profits.

Ford always displayed concern for the welfare of workers and believed firmly in the dignity of work. But he resisted unionization for his employees, seemingly thinking unionism would pass away or that agitators were misleading his men. The company police in his plants for years waged a repressive campaign against union membership. Ford remained nonunion for several years after his competitors had concluded agreements with unions. Yet after he had lost a union-recognition election conducted by the National Labor Relations board in 1941, he signed the first union-shop and check-off contract in the automotive industry with the United Auto Workers.

Ford was a prophet of the new industrial order, yet he was reluctant to use new devices to achieve it. He had a profound distrust of bankers and of Wall Street, preferred financing expansion from earnings rather than by selling stock. and borrowed only when it was unavoidable. In 1917 he fought a suit brought by stockholders to force a distribution of most of the company's accumulated surplus, to compel future distribution of earnings and to enjoin the company from expanding its plant. The outcome was that a special dividend had to be paid, but the right of the company to use its capital for expansion was unimpaired. As he was able, Ford bought out the other stockholders and eventually attained complete control. He thereafter operated to suit himself, and his company ultimately became the only one of comparable size individually owned—a personal empire whose worth was estimated in billions of dollars.

Though Henry Ford showed great vision and "put America on wheels" nith the Model T, the first car designed for a mass market, he later failed to appreciate the dynamic character of that market. Against the advice of his management he held out for the planetary transmission against the conventional gearshift, the mechanical against the hydraulic brake, the four-cylinder against the six- or eight-cylinder engine and a single colour. black, against the colour variety offered by other manufacturers. However, when finally convinced in 1927 that the Model T had seen its day, he retooled completely and produced in the Model A an entirely new car. In 1932 he repeated the process in bringing the V-8 on the market. Nonetheless his adjustment to consumer demand for comfort, style and convenience was too tardy to prevent losing first position in the industry to General Motors.

Ford attended school only to the age of 1j. From an early age he showed a keen interest in things mechanical, an interest that never waned. Even after he had reached the apex of an industrial empire, he delighted in disassembling the watches of his friends or joining the mechanics in his plant in a greasy repair job. He was an empiricist, impatient of theory.

Diet faddist, foot racer, folk-dance enthusiast, collector of early Americana. philanthropist, practical joker, not always consistent—Ford was all these. He endowed a modern hospital and subsidized a newspaper that specialized in anti-Jewish articles. During World War I he chartered a ship and sailed with an oddly assorted list of pacifist passengers to appeal to heads of state to "get the boys out of the trenches by Christmas," and during both World Wars I and II his company was a major producer of war materials. He ran for the senate and lost and thought about running for president. He played his executives off against each other and banned smoking in his plants. Most important, he was the kind of man who could make an auto in his barn with his own hands and could also make the principles of mass production work on a scale unparalleled before his time.

He died April 7, 1947, at Dearborn.

Bibliography.—No definitive biography exists. Much information can be found in *My Life and Work* (1922) and *Today and Tomorrow* (1926), written by Henry Ford in collaboration with Samuel Crowther. *See* also Samuel S. Marquis, *Henry Ford: an Interpretation* (1923); William A. Simonds, *Henry Ford: His Life, His Work, His Genius* (1943); William C. Richards, *The Last Billionaire, Henry Ford* (1948); Keith Sward, *The Legend of Henry Ford (1948)*; and Harry H. Bennett, *We Never Called Him Henry* (1951). (J. D. Rs.)

FORD, JOHN (1586–*c.* 1640), English dramatist, was baptized on April 17, 1586, at Ilsington in north Devon. His father was in the commission of the peace and his mother was a sister of Sir John Popham, successively attorney general and lord chief justice. John Ford matriculated at Exeter college in 1601 and was admitted to the Middle Temple in 1602. In 1606 he wrote the elegy *Fame's Memorial, or the Earl of Devonshire Deceased,* and dedicated it to the widow of the earl, the famous Penelope, formerly Lady Rich. The elegy shows some sympathy for the fate of Essex. Ford's tract of *Honor Triumplzant, or the Peeres Challenge* (printed 1606 and reprinted by the Shakespeare society with the *Line of Life*, in 1843), and the simultaneously published verses *The Monarches Meeting, or the King of Denmarkes Welcome Into England,* show him in the capacity of a court poet. *The Time Poets (Choice Drollery*, 1656) suggests that Ford withdrew from literary life in London to his native place; but nothing is known as to the date of his death.

His career as a dramatist probably began by collaboration with Thomas Dekker with whom he wrote *The Fairy Knight* and *The Bristowe Merchant* (licensed in 1624, but both unpublished); and with John Webster *A Late Murther of the Sonne Upon the Mother* (licensed in 1624). A play entitled *An Ill Beginning Has a Good End,* brought on the stage in 1613 and attributed to Ford, was (if his) his earliest acted play; whether *Sir Thomas Overbury's Life and Untimely Death* (1615) was a play is extremely doubtful; some lines of indignant regret by Ford on the same subject are still preserved.

He is also said to have written, at dates unknown. *The London Merchant* (which! however, was an earlier name for Beaumont and Fletcher's *Knight of tlze Burning Pestle)* and *The Royal Combat;* a tragedy by him, *Beauty in a Trance,* was entered in 1653, but never printed. These three (or four) plays mere among those destroyed by Warburton's cook. *The Queen, or tlze Excellency of tlze Sea,* a play of inverted passion, printed in 1653 by Alexander Singhe for private performance, was edited by W. Bang (*Materialien zur Kunde d. älteren engl. Dramas,* 13, Louvain, 1906), and is by him on internal evidence confidently claimed as Ford's. Of the plays by Ford preserved to us the dates span little more than a decade—the earliest, *The Lover's Melancholy,* having been acted in 1628 and printed in 1629, the latest, *The Lady's Trial,* acted in 1638 and printed in 1639.

Two works, undoubtedly those most characteristically expressive of his peculiar strength, *'Tis Pity She's a Whore* and *The Broken Heart* (both acted 1628–32), were both printed in 1633 with the anagram of his name *Fide Honor.* The first is concerned with incest; the tragedy is well worked out, and the characterization vivid. The problem in which Ford was always most deeply interested is here stated at its most acute: the conflict between overwhelming passion and the whole range of restraints which can be opposed to it. *The Broken Heart* has another vivid and sensational plot, and the pathos, if forced, is effective. The influence of Burton's analysis of the emotions, strong in *The Lover's Melancholy*, is still traceable, but few were so capable of treating them sympathetically, and yet without reckless grossness or extravagance of expression.

For in Ford's genius there was real refinement, except when the "supra-sensually sensual" impulse or the self-delusion that he possessed comic humour came into play. *Love's Sacrifice* (acted *c.* 1630, printed in 1633) is a tragedy of a similar type. *Perkin Warbeck* (printed 1634; probably acted 1635) is a chronicle play; the versification is regular, and the element of buffoonery reduced to a minimum. *The Fancies Chaste and Noble* (acted before 1636, printed 1638) and *The Lady's Trial* (acted 1638, printed 1639) are negligible. There remain two other works. of very different kinds, in which Ford co-operated with other writers, the mask of *The Sun's Darling* (acted 1624. printed 1657), hardly to be placed in the first rank of early compositions, and *The Witch of Edmonton* (printed 1658, but probably acted about 1621), in which we see Ford as a joint writer with Dekker and Rowley of one of the most powerful domestic dramas of the English or any other stage.

Ford owes his position among English dramatists to the intensity of his passion. in particular scenes and passages where the character, the author and the reader are alike lost in the situation and in the sentiment evoked by it; and this gift is a supreme dramatic gift. But his plays — with the exception of *The Witch of Edmonton,* in which he doubtless had a prominent share — too often disturb the mind like a bad dream which ends as an unsolved dissonance; and this defect is a supreme dramatic defect which has caused the neglect of this author's works in modern days.

FORD, PAUL LEICESTER (1865–1902), U.S. author, was born in Brooklyn. N.Y., on March 23, 1865, the son of Gordon Lester and Emily (Fowler) Ford. His delicate health led to his being privately educated, his tastes being formed largely by long hours spent in his father's library, then one of the finest collections of Americana in the world. The environment of a select social circle and extensive travel on both American continents and in Europe fostered and intensified his cultural interests.

At the time of his death, when but 37 years of age, he had gained distinction as an editor, bibliographer, historian and novelist. his edited works and writings totaling more than 70.

In American literature he is most famous for his historical novels *The Honorable Peter Stirling* (1894) and *Janice Meredith* (1899). He was shot on May 8, 1902, by his brother Malcolm Ford, who in turn committed suicide.

FORDHAM, formerly a village of Westchester county, New York, U S., and now a part of New York city. It lies on the mainland, along the eastern bank of the Harlem river, east of the northern end of Manhattan Island. It is the seat of Fordham university (Roman Catholic), founded in 1841 as St. John's college. and since 1846 conducted by the Society of Jesus In 1907 the institution was rechartered as Fordham university. Fordham college, the graduate school, the college of pharmacy, and Fordham preparatory school of the university are all in Fordham. The other schools are housed in two locations in Manhattan.

In Poe park. Fordham, still stands the house in which Edgar Allan Poe lived from 1844 to 1849 and in which he wrote "Annabel Lee," "Ulalume" and other poems.

The hamlet of Fordham was established in 1669 by Jan Arcer (a Dutchman, who called himself "John Archer" after coming to America), who in that year received permission from Francis Lovelace, colonial governor of New York, to settle 16 families on the mainland close by a fording place of the Spuyten Duyvil creek, near where that stream enters the Harlem river.

Between 1655 and 1671 Archer bought from the Indians the tract of land lying between Spuyten Duyvil creek and the Harlem river on the east and the Bronx river on the west and extending from the hamlet of Fordham to what is now High Bridge. In 1671 Governor Lovelace erected this tract into the manor of Fordham.

In 1846 it was included with Morrisania in the township of West Farms; and in 1872, with part of the township of Yonkers, it was erected into the township of Kingsbridge, which, in 1874, was annexed to the city of New York, and in 1898 became a part of the borough of the Bronx, New York city.

FORD MOTOR COMPANY. The manufacturer of Ford and other automobiles, trucks, tractors, Dearborn and Ford farm equipment, industrial engines, parts and accessories, and aircraft engines, the Ford Motor company has its home office at The American Road, Dearborn, Mich. It was incorporated in Michigan June 16, 1903, with a capital of $100,000. Of the original 12 stockholders Henry Ford held $25\frac{1}{2}\%$ of the stock. Later he acquired $58\frac{1}{2}\%$. In 1919 Henry Ford and his only son, Edsel B. Ford (1893–1943), acquired the remaining $41\frac{1}{2}\%$. On July 9, 1919, the company was reorganized under the laws of Delaware, with a capitalization of $100,000,000.

From July 1919 until 1956, the company was privately owned, with all stock being held by the Ford family and the Ford Foundation. On Jan. 17, 19j6, the company again became publicly owned when the Ford Foundation put 10,200,000 of its Ford Motor company shares on the market. On Sept. 21, 1945, Henry Ford II, son of Edsel B. Ford, was elected president, and the company launched on a decentralization, modernization and expansion program.

As part of its international operations, the company established manufacturing subsidiaries in England, Canada and Germany. Other subsidiaries and branches of the company had assembly operations after mid-20th century in Argentina, Belgium, Brazil, Chile, Denmark, Egypt, Finland, the Netherlands, Mexico and Uruguay. Sales subsidiaries were operating in France, Italy, Portugal and Sweden.

The River Rouge plant in Dearborn was the largest industrial unit in the U.S owned by one company, covering 1,200 ac. Within the plant are blast furnaces, open hearth furnaces, blooming mills, hot and cold strip mills, coke ovens, engine plant, assembly plant, iron foundry, stamping plant, tool and die plant, frame plant, glass plant, rolling mills and power house. The plant has its own fire department and hospital and its own telephone and telegraph exchanges. The company owns its own ore boats which bring raw materials from the upper Great Lakes region directly to the Rouge plant storage bins.

On July 23, 1903, the company sold its first car, a two-cylinder — the original Model "A." The first Model T was made on Oct. 1, 1908, and on May 26, 1927, the 15,000,000th Model T left the assembly line. The new Model A was introduced to the public on Dec. 2, 1927, and on March 9, 1932, the first V-8 Ford was built. In 1959 the company introduced the Falcon, a six-cylinder car smaller than the standard Ford.

FORDUN, JOHN OF (d. *c.* 1384), Scottish chronicler. The statement generally made that the chronicler was born at Fordoun has not been supported by direct evidence. It is certain that he was a secular priest, and that he composed his history in the latter part of the 14th century; and it is probable that he was a chaplain in the cathedral of Aberdeen. The work of Fordun is the earliest attempt to write a continuous history of Scotland. We are informed that Fordun's patriotism was roused by the removal or destruction of many national records by Edward III and that he traveled in England and Ireland, collecting material for his history. This work is divided into five books. The first three are almost entirely fabulous. The fourth and fifth books, though still mixed with fable, contain much valuable information. The fifth book concludes with the death of King David I in 1153.

Besides these five books, Fordun wrote part of another book, and collected materials for bringing down the history to a later period. These materials were used by a writer in the middle of the 15th century, who is identified with Walter Bower (*q.v.*), abbot of the monastery of Inchcolm. The additions of Bower form 11 books and bring down the narrative to the death of King James I in 1437. In addition he did not hesitate to interpolate

Fordun's portion of the work with additions of his own, and the whole history thus compiled is known as the *Scotichronicon.*

Fordun's work was first printed in Thomas Gale's *Scriptores quindecim* (vol. iii. 1691). This was followed by Thomas Hearne's (5 vols.) edition in 1722. The whole work, including Bower's continuation, was published by Walter Goodall at Edinburgh in 1759. In 1871 and 1872 Fordun's chronicle. in the original Latin and in an English translation. was edited by Wm. F. Skene in *The Historians of Scotland,* the preface of which contains full bibliographical details.

FORECLOSURE is the extinguishment by order of the court of a mortgagor's equity of redemption. In the law of equity the object of every mortgage transaction is eventually the repayment of a debt. the mortgaged property being incidental by way of security. Therefore. although the day named for repayment of the loan has passed and the mortgagor's estate is consequently forfeited, equity steps in to mitigate the harshness of the common law and will decree a reconveyance of the mortgaged property on payment of the principal, interest and costs. This right of the mortgagor to relief is termed his equity of redemption This estate is no longer merely equitable but legal. However. this has not changed its attributes. which are that it can only be defeated by the mortgagee taking possession of the mortgaged property and retaining it for 12 years without acknowledging the mortgagor's title, or by the decree of the court ordering the foreclosure of it or the sale of the mortgaged property, or by a sale by the mortgagee under his statutory powers.

A foreclosure action is brought by the mortgagee against the mortgagor in the chancery division of the high court claiming that an account may be taken of the principal and interest due to the mortgagee. and that the mortgagor may be directed to pay the same, with costs, by a day to be appointed by the court and that in default thereof he may be foreclosed his equity of redemption. In such an action the court may always order a sale instead of foreclosure. English county courts have jurisdiction in foreclosure actions where the mortgage or charge does not exceed £500, or where the mortgage is for more than £500, but less than that sum has been actually advanced. Where there is a mere charge without an agreement for a legal mortgage there is no right to foreclose; this also applies to a Welsh mortgage.

(J. A. St.; X.)

United States.—Foreclosures in the United States are typically, but not always, by an action in court based upon the pattern of an English suit of foreclosure. But, though the action was copied from England. it differs radically from the English procedure and is highly diversified among the states. Thus strict foreclosure, by which the mortgagor's interest is forfeited to the mortgagee unless the debt is paid within a time fixed by the court, is the usual form of foreclosure only in Connecticut and Vermont. In most states the routine foreclosure action includes a judicial sale by which the property is sold to the highest bidder who may be and often is the mortgagee. The net proceeds of the sale are applied on the debt and the surplus: if any, is paid to the mortgagor. If the sale does not bring enough to pay the debt, the mortgagee is awarded a judgment against the debtor for the deficiency. The foreclosure sale thus serves not only to protect the mortgagor's equity, but also to fix the amount of the deficiency judgment when the sale price is less than the debt.

Experience showed that a forced sale, even though supervised by the court, rarely produced a surplus and indeed that sometimes the mortgagee's bid of a nominal amount was the best that could be obtained. In such instances the mortgagor not only lost his security but was saddled with an excessively large deficiency judgment. To provide additional protection to mortgagors numerous statutes regulating foreclosures were enacted. especially in the western states where debtor influence was strong. Some required that the sale price equal a stated percentage of the value of the property as fixed by appraisers. Others directed that if the "fair" value of the property was more than the sale price, the fair value rather than the sale price should control the deficiency judgment. In many states the equity of redemption was supplemented by statutory rights of redemption which entitled the mortgagor and others designated by statute to wipe out the lien of the mortgage and the foreclosure sale by paying within a specified time, which varied from six months to two years, the price which had been obtained at the sale. Usually the mortgagor would be entitled to retain possession of the property until the statutory period had expired. Thus the redemption statutes gave mortgagors a chance to live undisturbed and raise another crop as well as an opportunity to canvass still further, perhaps under improved conditions, the chances of private sale or refinancing. In addition, the statutes encouraged mortgagees to bid the full value of the property at foreclosure sales.

The long time which was required to complete a foreclosure action made it possible for a mortgagor whose situation was hopeless to milk the security by letting current expenses such as taxes, insurance and repairs accumulate and squeezing from it as much cash as possible before the ax fell. To prevent this, courts would appoint a receiver to manage the property while the foreclosure was pending in court. The purpose of the receivership was to sequester the rents as they accrued so that they might be applied on the mortgage debt and to preserve the property until the foreclosure could be completed. The grounds for a receivership varied from state to state. Usually, if the mortgage contained a clause pledging rents, a showing that the security without the rents was inadequate and that the mortgagor was insolvent would justify a receivership.

A special type of receivership, called a friendly or consent receivership because the proceeding was instigated by the debtor rather than the creditors came to be the usual method by which large corporations were reorganized and new securities substituted for the bonds which prevented the business from being continued on a sound financial basis. After the 1934 and 1938 amendments to the Bankruptcy act, reorganization proceedings in bankruptcy, in which the Securities and Exchange commission had an important role. were substituted for receiverships as the usual procedure for the enforcement of large corporate bond issues.

In the 1930s moratory statutes mere enacted by many states to shield mortgagors from the hardships caused by the general collapse of the economy. Some stayed foreclosures; others extended the time for redemption; others curbed deficiency judgments. Under a 1935 amendment to the Bankruptcy act, a farmer might retain possession of his farm pending an arrangement in bankruptcy and wipe out the mortgage by paying, not the amount due on the debt or the price which might be obtained at a judicial sale, but rather the value of the farm as fixed by appraisers in bankruptcy. The serious constitutional doubts raised by these acts were largely resolved by the supreme court in *Home Building and Loan Association* v. *Blaisdell,* 1934.

Because foreclosures in court are slow and costly, mortgagees have sought informal mays to foreclose. Sometimes a deed conveying the property to the mortgagee is used in lieu of a court decree. This is simple, but the transfer requires the consent of the mortgagor and others who have an interest in the security and it must be a bona fide sale rather than an extension of time for payment of the debt. Sometimes the mortgage authorizes the mortgagee or a trustee to bar the right of redemption by selling the property if default should occur. If such sales are allowed full effect, foreclosures are easy and inexpensive. But the power to sell may be abused and in some states such foreclosures are prohibited. In others, powers of sale are valid but are regulated by statutes to prevent abuses. Some prescribe the notice required for a sale under a power; others permit redemption from the sale, others provide a summary procedure in court to confirm the sale. In a number of states, a sale out of court under a power of sale is the usual method of foreclosure. In others, though the power is recognized, it is seldom used because of the fear that titles based upon such sales are not marketable. Thus in most of the states a practical substitute for foreclosure by action in court is not available even though in the long run the high costs of such actions may really be paid by mortgagors as a class in the form oi high interest rates and other stringent credit terms.

See George Edward Osborne, *Handbook on the Law of Mortgages* (1951); Garrard Glenn. *Mortgages, Deeds of Trust, and Other Security Devices as to Land,* 3 vol. (1943).

(S. Tt.)

FOREIGN AID PROGRAMS. Economic aid from one government to another and from international organizations to governments has grown from a temporary device adopted by the western Allies in World War II to a permanent feature of international economic relations. It is sometimes called international aid rather than foreign aid. In its evolution, the experience of the United States has been dominant, although other countries have also extended such aid. The dominions, for example, aided the United Kingdom during and after the war. Commonwealth and other countries extended aid to Asian countries under the Colombo plan after 1950. Soviet aid to underdeveloped countries since 1955 has led to competition in assistance. Many states have co-operated in giving aid through the United Nations and other international organizations.

The United States has used foreign aid for a variety of purposes: to transfer military equipment and civilian supplies to Allies during World War II; to assist relief and reconstruction after the war; to buttress resistance to communist aggression, both actual and potential; to meet emergencies of many kinds, such as natural disasters; to help refugees from behind the "iron curtain"; to clear the Suez canal; and to provide technical assistance and economic aid for countries engaged in programs of economic development. The total amount of U.S. aid in the 18 years from 1940 to 1958 amounted to more than $105,000,000,000, as shown in Table I.

Lend-Lease. — Mindful of the problem created after World War I by war debts owed to the United States by European Allies, and not paid, President Roosevelt in early 1941 devised the principle of lend-lease under which the United States agreed to provide supplies to countries engaged in fighting Germany (and later Japan) on a basis to be determined after the war. The equipment might be returned, paid for or regarded as a contribution. In return, these Allies aided U.S. troops when the United States entered the war; this so-called reverse lend-lease amounted over the period of the war to 16% of the value of lend-lease from the United States. The bulk of the lend-lease transfers were settled as grants. A few ships, airplanes and similar items of equipment were returned in kind at the end of the hostilities. (See INTER-ALLIED DEBTS; WAR FINANCE: COST OF WORLD WARS I AND II.)

Relief. — Lend-lease was restricted to Allies engaged in the war against Germany and Japan. But other aid was necessary for liberated countries, both for humanitarian reasons and to prevent

TABLE *I. — Summary of United States Foreign* ***Aid*** *by Program*
(in $000,000)

	(1940–45)*	(1945–50)*	(1950–55)*	(1955–58)*	Total†
Grants					
Lend-lease	46,728	1,906	...	...	48,634
Greek-Turkish aid	...	629	23	...	653
Mutual Security:					
Military aid	...	63	12,771	7,573	20,406
Contribution to multilateral construction Programs	...	...	286	206	492
Other aid (ec. tech.)	...	7,008	9,940	4,522	21,626
Civilian supplies	813	4,878	968	13	6,676
UNRRA, post-UNRRA, interim aid	83	3,443	...	...	3,526
Philippine rehabilitation	...	579	56	...	635
Surplus agric. commodities thru private welfare agencies	...	6	250	523	777
Military equipment "loans"	...	...	285	106	391
Chinese stabilization and military aid	380	258	4	...	641
Inter-American programs	...	134	35	43	212
Other	124	419	138	57	734
Total grants	48,128	19,262	24,978	13,042	105,403
Less. reverse grants, etc.	7,882	2,197	1,630	235	11,944
net grants	40,246	17,065	23,348	12,808	93,458
Credits					
Export-Import bank	329	2,651	1,825	1,290	6,095
British loan	...	3,750	...	...	3,750
Mutual Security	...	990	855	823	2,686
Surplus property	...	1,482	3	6	1,492
Lend-lease	349	69	2	...	420
Other	417	390	100	23	930
Prior grants donverted into credits	...	1,256	1,000	1	2,257
Total credits	1,096	10,589	3,784	2,143	17,631
Less: repayments	380	1,305	2,082	1,767	5,534
net credits	715	9,285	1,702	376	12,095
Net foreign aid	40,961	26,350	25,050	13,184	105,553

*U.S. fiscal year runs July 1 to June 30. †Detail may not add to totals because of rounding.
Source: U.S. Department of Commerce, Office of Business Economics, *Foreign Grants and Credits of the United States*, various issues.

disturbances in the areas through which military supply lines ran. Later, when Italy came over to the Allied side and Austria was liberated, civilian supplies were required for them. Finally, in occupied Germany and Japan, it was necessary for several years to provide minimum diets to prevent "disease and unrest in occupied areas such as might endanger United States forces."

Another quasi-military form of assistance rendered after the war by the United States was the disposal of surplus military stocks, including goods suitable for civilian use, at reduced prices and on long-term credit. Ships represented a special program of surplus disposal.

In 1943, while the war was still in progress, the United Nations (UN) created a relief organization, the United Nations Relief and Rehabilitation administration (*q.v.*) (UNRRA). The United States was the most important contributor, bearing originally 72%, later 78%, of the cost. The agency was established with money and with surplus military stocks, and operated originally in eastern Europe and China. Later, in 1946, it took over from military responsibility the relief of Austria and Italy.

After the abrupt termination of lend-lease in 1945, following the defeat of Japan, aid to United States Allies was initially expected to be given by the International Bank for Reconstruction and Development established at an international conference at Bretton Woods, N.H., in 1944. (See BANK FOR RECONSTRUCTION AND DEVELOPMENT, INTERNATIONAL.) Pending the functioning of this organization, and its sister agency, the International Monetary fund, designed at Bretton Woods to smooth out international payments difficulties, several expedients were used. The capital of the Export-Import Bank of Washington was raised by $3,000,000,000 in 1945. In 1946 a loan of $3,750,000,000 was made to Britain to assist in its reconstruction, but also to enable the pound sterling currency to become convertible into dollars.

These devices, however, proved insufficient. The extent of Europe's need had been seriously underestimated. With the removal of wartime economic controls in the United States in July 1946, prices rose so that the dollar amounts provided bought substantially fewer goods. A hard winter in 1947 compounded European difficulties. In the spring of 1947 western Europe appeared to be headed for economic collapse from which the Communist parties alone would benefit. In this circumstance, Secretary of State George C. Marshall on June 5, 1947, in a commencement address at Harvard university, indicated that if the countries of Europe were prepared to co-operate in a renewed effort toward recovery, the United States would be willing to assist. This was the origin of the European Recovery program (ERP), popularly known as the Marshall plan.

Marshall Plan. — The European Recovery program consisted of an effort by 17 countries of western Europe — broadly defined — to harmonize their recovery efforts and to indicate, on an agreed basis, what assistance would be necessary from the United States. The countries were Austria, Belgium, Denmark, Eire, France, Greece, Iceland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Sweden, Switzerland, Turkey, the United Kingdom and Western Germany. An organization for European economic co-operation was created with its seat at Paris. While plans were being formulated, a program of interim aid was voted by congress. Finally, on April 3, 1948, the Economic Cooperation act of 1948 was signed, setting in operation United States aid for economic reconstruction in Europe. A total of $5,600,000,000 mas appropriated for the first 1j months (to the end of the fiscal year on June 30, 1949.) It was expected that United States aid, amounting in all to some $17,000,000,000, would be eliminated at the end of four years.

Greek-Turkish Aid. — In Feb. 1947, before Secretary Marshall's speech, the British government had informed the United States that it was unable to continue financial support to the Greek government, which was engaged in resisting communist aggression based in Yugoslavia. President Truman responded with the Truman doctrine under which military and economic assistance was made available to Greece and also to Turkey, which was similarly threatened. This was the beginning of peacetime military assistance, apart from post-hostilities aid given to forces of the Chinese Nationalists on Formosa.

Korean War. — In 1950, however, with the outbreak of aggression in Korea and the intensification of the cold war, economic aid became overshadowed by military aid, which took many forms. Loans of military equipment, patterned after lend-lease, took place on a limited scale. Military aid consisted of grants of matériel to countries struggling against aggression, particularly South Korea, French Indochina, and the Republic of China (Nationalists). The United States also assisted its western European Allies, organized with Canada and the United States into a North Atlantic Treaty organization (NATO). The NATO defense plan called for the construction of some common military installations, to which the

United States contributed. With the stationing of United States troops in the far east and Europe, a form of indirect assistance, but one not recorded as such, was the local purchase of supplies, equipment and buildings for defense or personal use by troops.

Point IV and Economic Development. — In his inaugural address of Jan. 1949, President Truman listed as Point IV of his program a plan to make assistance available from the United States to underdeveloped countries. The United Kingdom had long been helping its colonies in this manner, and the world-wide agreement to create the International Bank for Reconstruction and Development had been reached with this end in mind Export-Import bank loans which promoted U S. sales of capital equipment to underdeveloped countries were frequently related to development projects Rut with the enunciation of Point IV, a new chapter in foreign aid began.

While it was unclear at the outset what form aid to underdeveloped countries would take, emphasis quickly was placed on technical assistance, largely in the fields of agriculture, public health and education. To private capital. on a remunerative basis. was left the task of providing public structures and resources needed in industry. Some technical assistance was furnished through specialized UN agencies. including the World Health organization (WHO), Food and Agriculture organization (FAO), and United Nations Educational. Scientific and Cultural organization (UNESCO). Most, however. was provided directly by the United States on a bilateral basis, frequently through the device of contracts nith United States business and educational organizations.

Table 11.—Area Distribution of United States Postwar Foreign Aid July 1, 1945–June 30, 1958

(in $000,000)

	(1945–50)*	(1950–55)*	(1955–58)*	Total†
Military Grants (Set)				
Western Europe (excluding Greece and Turkey)	45	8,904	3,930	12,879
Near East (including Greece and Turkey) Africa and South Asia	518	1,369	1,406	3,293
Other Asia and Pacific	871	2,561	2,251	5,683
American Republics	...	225	185	409
Unspecified Areas	4	147	74	225
Total	1,438	13,206	7,846	22,490
Nonmilitary Net Grants and Credits				
Western Europe (excluding Greece and Turkey)	17,889	6,474	618	24,982
Eastern Europe	1,107	7	4	1,118
Sear East and Africa	848	1,605	979	3,432
South Asia	12	500	438	950
Other Asia and Pacific	3,966	2,358	2,565	8,889
American Republics	356	682	492	1,530
Other International Organizations and Unspecified Areas	732	230	247	1,209
Total	24,912	11,847	5,343	42,103

*U.S. fiscal year runs July 1 to June 30. †Details may not add to totals because of rounding.

Source: U.S. Department of Commerce, Office of Business Economics, *Foreign Grants and Credits of the United States Government*, various issues.

Several new national and international organizations nere created or planned to contribute to various aspects of the development problem. In 1956, for example, the International Finance corporation was formed as an offshoot of the International bank. Its task nas to invest equity capital in private enterprises in underdeveloped countries. The next year the United States regularized its lending operations for development by the creation of a Development Loan fund for long-term credits. In 1958, the capital of the Export-Import bank was raised by $2,000,000,000; the UN established a Special fund of $100,000,000 annually to make grants or loans on special conditions to countries needing capital for basic projects; the Cnited States proposed an increase in the capital of the International bank, enlargement of quotas of the International Monetary fund. and the establishment of an International Development association. This last proposal was for an organization which could relend to developing countries some of the local currencies received by the United States as repayments of previous loans not received in dollars.

In 1958 the congress also increased by $2.500,000,000 the authority of the United States under Public Law 480 (1954) to make loans to underdeveloped countries in surplus agricultural commodities repayable on easy terms.

It can be seen that the character, scope and direction of the foreign-aid program of the United States have been continuously evolving — from military support during the war to reconstruction aid for Europe. then military support for Asian countries subject to aggression. and finally to economic aid for underdeveloped countries. Some idea of the redirection of postwar aid is provided in Table II

Forms. — Aid to foreign countries by the United States has consisted primarily of U.S goods and services — military equipment, civilian supplies, the services of technicians, the education of foreigners in the United States. surplus commodities, etc. But not all such aid has been of this kind. The British Ioan was made in money that could be spent anywhere. The purpose of the loan was to assist world trade through Britain by enabling the British to pay for imports from other countries in dollars. This helped the other countries with their payments difficulties. In the early stages of the Marshall plan some aid consisted in offshore purchases of goods. as, for example. in Canada or Latin America. These purchases provided goods that Europe needed and dollars sought by the seller.

Most assistance to Europe was given directly to individual countries. Some aid, honever, was made conditionally to one country provided it would agree to make certain surplus goods available to a third country. In this way both countries were assisted. This method. designed to stimulate intra-European trade, was abandoned in 1950 in favour of a loan of $526 000 000 to a nenly created European Payments union which cleared intra-European payments It provided, moreover, that if payments did not exactly balance. debtors would receive some credit. and pay some dollars, nhile creditors would receive some cash and extend some credit Since the creditors received more dollars at times than the debtors paid in, the U.S. loan was temporarily needed to balance the position

The United States has searched for opportunities to promote intra-regional trade in other parts of the world by reshaping its economic aid. It offered $200,000,000 to the Simla conference in India in May, 1955, contingent upon the Asian participants preparing an adequate plan for its multilateral use. But no agreement on such a plan could be obtained.

Conditions of Aid. — Under lend-lease, aid was given on the condition that the receiving country use it and its own resources efficiently to defeat the enemy. In addition, the countries were asked, under article VII of the lend-lease agreement, to subscribe to certain broad objectives of U.S. policy in the economic field, including the establishment of a freely trading world with equal access to materials and most-favoured-nation treatment of customers. The first condition gave rise to some difficulties of interpretation. particularly in connection with how rapidly Britain should run donn its holdings of securities, and how much it should maintain in wartime its export connections with an eye to its postnar position.

During the relief phase an objective determination of need was presumably possible. In actuality. however. the United States was reluctant to extend post-UNRRA relief to Yugoslavia, which was firing at U.S airplanes. or to Poland or Hungary after the Soviet coup in Czechoslovakia nhich intensified the cold war.

In the ERP. United States stipulated that each recipient country should co-operate with other European countries and exert a maximum effort toward its own recovery. These criteria mere again difficult to interpret. Moreover, they posed a dilemma which runs through all foreign aid: the more realistic and effective a country is in meeting its requirements, the less aid it needs, but the more it may be said to deserve. Conversely the less able a country is to meet its domestic problems, and the more ambitious its plans of expansion, the less aid it deserves, and the more it needs.

Soviet Aid. — A particular form of this dilemma was furnished by the entry of the Soviet Union into the aid field This aid was not. as a rule, in the form of grants, but consisted of low interest-bearing loans or credits in barter deals. Soviet aid to the Communist bloc mas estimated in 1958 at $7,000,000,000 (see MUTUAL

ECONOMIC ASSISTANCE, COUNCIL OF); and almost $2,000,000,000 in aid was pledged to other countries, largely to Egypt, Yugoslavia, Syria, India, Afghanistan and Indonesia. The $465,000,000 pledged to Yugoslavia, however, was held in abeyance. Soviet loans presented a dilemma for the western powers. If a country's economic needs were being met by the Soviet Union, its assistance from the west could be reduced. But this was considered politically undesirable. The receipt of Soviet aid, therefore, usually enabled a country to get more, not less, aid from the west.

Voices in the United States were raised calling for the imposition of certain conditions of aid, such as the abandonment of socialist forms of enterprise; alignment of the receiving country with the United States in NATO or the Southeast Asia Treaty organization (SEATO); membership in the Baghdad pact; or the repression of anti-American sentiments. These political conditions of aid were not enacted or enforced.

Bilateral versus Multilateral Aid.—Another recurring issue was whether aid should be given bilaterally or through international agencies. This problem goes back at least to UNRRA where the United States with one voice in 17 on the council, and bearing 72% of the cost of the program, sometimes found itself forced to make aid available against its wishes.

An entirely bilateral program is politically difficult in that it focusses all dissatisfaction with amounts of aid on the donor. For this reason the United States encouraged the preparation of multilateral programs in the ERP, and under NATO, and the British and the United States supported the creation of the Colombo plan (*q.v.*) in southern Asia. In the Colombo plan all aid is in fact conducted on a bilateral basis, between the several donors and recipients. Under the Marshall plan, there was at the same time an agreement between the United States and the Organization for European Economic Cooperation (OEEC) and separate agreements with each recipient. In the division of aid, however, the United States followed the recommendations of the OEEC.

The remaining problem, however, is between UN and bilateral arrangements for technical assistance and development loans. In the International bank and Monetary fund, the United States has put up the majority of the resources and retains a controlling voice in the operation of the fund and in the choice of the people running the bank. In the UN, it has far less share of decision-making power in the Economic and Social council (ECOSOC) or the general assembly. Meanwhile, however, the retention of bilateral arrangements for technical assistance and development loans assures the United States that foreign aid cannot be distributed entirely by a logrolling or politically dominated process in the UN contrary to its political interest or its view of the objective requirements. *See* also FOOD AND AGRICULTURE ORGANIZATION; WORLD HEALTH ORGANIZATION.

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FOREIGN EXCHANGE: *see* EXCHANGE, FOREIGN.

FOREIGN INVESTMENT: *see* CAPITAL, EXPORT OF.

FOREIGN LANGUAGES, TEACHING OF. The technique of teaching modern languages became a scholastic battleground during the first quarter of the 20th century. Even after Wilhelm Viëtor made his famous plea in *Der Sprachunterricht muss umkehren (1886)* for methods more rational than those used in the study of Latin and Greek, the dead hand of the classics rested heavily upon modern-language teaching. The contributions of Viëtor's disciples, Paul Passy and Daniel Jones, in the field of phonetics. made teachers realize the importance of pronunciation and of an oral approach in the classroom. The idea of giving all instruction in and through the foreign language soon gained ground, and what is termed the direct method came into being. Despite its great vogue it achieved only a partial success. But its fundamental idea. that a modern language should be taught as a living tongue. has become generally accepted. The early direct methodists, in their zeal to remain true to the idea of never using a single English word in their lessons, even by way of explanation, created serious difficulties for themselves and their pupils. Brilliant specialists with selected pupils on a generous allowance of teaching time ensured a measure of success. With vastly increasing numbers of merely average pupils as a result of the great expansion of secondary education from 1918 onward, the direct method showed its failure to secure for large classes firm foundations of language structure and a sufficient amount of reading in the foreign language. Fruitless dramatization and parrotlike repetition wasted much time, with the result that the content of firm, consolidated linguistic knowledge was often much too thin. Shaky grammar deprived oral and written exercise of accuracy. Lack of reading restricted the pupils' vocabulary. Despite these criticisms. the direct method established heightened standards of pronunciation and a consciousness of the need for some knowledge of life as lived in the foreign country.

The demands of the universities, imposed through their external examinations, which pupils take while still at school, required some modification of the direct method. Teachers agreed that there could be no return to formal grammar grind and were inclined to a compromise. The compromise that eventually emerged is called the oral method. This presentation aims at teaching the subject in a realistic atmosphere. the teacher using as much of the foreign tongue as is safely possible, avoiding blurred impressions in the pupils' minds and the blankness of noncomprehension. It is held to be no crime to explain a difficulty in English, but the need for the foreign language to be the main vehicle of instruction is strenuously upheld. A good teacher, without recourse to English. can ensure comprehension by gesture, dramatization, blackboard sketches, paraphrase and the use of contrary expressions already known to the pupils. With or without the aid of phonetic script—there teachers are divided—pronunciation and intonation receive due stress, oral work is fostered from the very start and remains an integral part of every lesson, and the basic foundations of language structure, often by means of memorized colloquial patterns, are firmly laid. Thanks to American research on word frequency, teachers give much thought to the selection of vocabulary and now distinguish between their pupils' "active" and "passive" knowledge of words and phrases which come from their carefully graded course of reading material, prose and verse, designed for intensive or for rapid treatment. Written exercise aims at creating an accurate linguistic sequence through dictation. free composition, formal prose composition and translation, rather than through the wasteful *non sequitur* of unrelated sentence work. Nor is the foreign country forgotten, its songs, its customs, its geography, its people. Older pupils naturally study its literature against social and historical background.

As supplementary visual and aural aids considerable use is made of films, film-strips, libraries, modern language rooms (with posters, periodicals. *Realien),* radio lessons and gramophone records. In Great Britain and Northern Ireland a fine contribution comes from a scheme by which young "assistants" give part-time service for one year in British schools before teaching English in their own country. Exchanges of experienced teachers on a full-time basis are also effected. Many schools organize collective holiday visits. particularly to France and Germany. Of even greater value are individual exchanges of pupils, the linking of foreign schools with their British counterparts, and correspondence.

BIBLIOGRAPHY.—H E. Palmer, *The Scientific Study and Teaching of Languages* (London, 1917); G. E. Vander Beke (ed.), *French Word Book* (New York, 1929); Incorporated Association of Assistant Masters, *The Teaching of Modern Languages* (London, 1949); V. Mallinson, *Teaching a Modern Language* (London, Toronto, 1953). (H F. C.)

U.S. Practice.—Between 1870 and 1925, methodologists and teachers of French, German, Spanish and later Italian, advocated six different methods. By 1917 only three survived: the grammar-translation, the direct method and the compromise or eclectic, a combination of the best features of the preceding methods. In 1901, the *Report* of the Committee of Twelve standardized the teaching of foreign languages in the high schools. The first two years of five periods a week were called elementary; the third intermediate; and the fourth advanced. It proposed a fourfold aim: speaking, understanding, writing and reading. the last of which was considered the most attainable. Only the direct-method proponents insisted on the oral-aural approach. Their contentions were borne out temporarily with the advent of World War I when the U.S. government had to encourage the establishment of courses in which large numbers of soldiers and employees were trained to really speak and understand the languages studied.

Later, because of the general dissatisfaction with the results in the teaching of foreign languages, the American Council of Education and the various language associations sponsored a national investigation (1924–27). More than 30 volumes (*The Modern Language Study*) were published from 1927 to 1937 under the chairmanship of Algernon Coleman. Finding that 87% of the students only pursued language study for two years, he reasserted the reading aim with a new reading method. The majority of the teachers opposed him and maintained the superiority of the oral-aural approach even for the reading aim.

J. Milton Cowan of the American Council of Learned Societies directed the setting up of intensive language programs which were developed and improved by the army and navy schools in World War II. Their main characteristics were: (1) insistence upon small drill sections with a native speaker or an informant, for 15 to 20 hours a week instead of the usual five; (2) grammar reduced to a minimum; (3) less emphasis on reading and writing. The army added area studies, to acquaint students with the geography, history and customs of the country of the language studied. Slavic and oriental languages were now included.

In spite of their enthusiasm over the success of these concentrated courses of six to eight months equal to four to eight years of the traditional classes: the schools and colleges were unable to adapt them to existing programs. Some institutions like Yale university. Adelphi College (Garden City. N.Y.) and Georgetown university (Washington. D.C.) continued to keep them as parallel courses to the regular language work.

Nevertheless, language teaching had become enriched with more oral-aural training and various kinds of audio-visual materials: phonograph records, radio. projectors, motion pictures, magnetic tape recorders. By the mid-1950s foreign language teaching was begun in more than zoo elementary schools.

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FOREIGN LEGION: see LEGION.

FOREIGN SERVICE. Foreign affairs are of such vital importance to nations that they are a primary concern of the highest levels of government. Professional foreign services. therefore, have been established to represent the home government's interest abroad and to provide the necessary information on which foreign policy is based.

There is a marked similarity in the foreign service organizations of most countries. Diplomatic and consular functions are generally performed by a single service which is expected to serve at home or abroad, enabling interchangeability of consular and diplomatic officers (see CONSUL and DIPLOMACY). The merger of the two functions came about when many European countries. beginning with France in 1880. recognized that the consular service, although less dependent on ceremony and prestige, could not be entirely separated from diplomatic affairs. With the passage of the Rogers act in 1924 the United States followed suit as did the United Kingdom with the promulgation of the so-called Eden reforms of 1943, which combined the diplomatic, consular and commercial diplomatic services into a single foreign service. The United Kingdom had already in 1919 established the interchangeability of personnel in the foreign office and in the diplomatic corps serving overseas following the report of a royal commission on the civil service, 1912–14. The United States was slower to integrate officers in its foreign service, serving primarily abroad, with civil servants in the department of state; and a vigorous "integration" program was not forthcoming until the adoption during 1954–56 of the proposals of the secretary of state's public committee on personnel. headed by Henry M. Wriston.

Recruitment. — Beginning in the middle of the 19th century steps were taken in most countries to establish a professional corps with entrance open to young men and women by competitive examination, advancement by merit and retirement by law at specified ages through a rigorous "selection up or selection out" procedure. Personnel are generally commissioned as foreign service officersand classified into established grades according to salary. Promotion is by commission to a higher class rather than by appointment to a post of higher salary grade.

Although diplomatic officials were once members of royal or noble families and served as the personal representatives of sovereigns who wielded supreme power in kingdoms or empires. private wealth and political connections are no longer essential for a professional foreign service career. When governmental authority came to reside in institutions other than monarchs, diplomats (or diplomatists in British usage) became the representatives of the government in power. As such. they were for a long time drawn primarily from wealthy governing and aristocratic classes. Prior to World War I candidates for the British diplomatic service, for example, had to show that they had an independent income. In the United States, despite the absence of an aristocracy or governing class, wealth and political connections were once important prerequisites owing to low salaries and meagre representation allowances; and in France of the third republic the diplomatic service remained largely in the hands of prosperous upper middle-class citizens and those members of the aristocracy whose wealth remained relatively intact. In imperial Germany and Russia the diplomatic services were almost exclusively in the hands of the aristocracy and high reserve officers of the army and navy. Conditions did not markedly change until after World War I although competitive examinations, notably in Great Britain as early as 1871, made professional competence also a criterion of selection.

More and more, however. recruitment was placed on a broad and democratic basis with the important qualification that a high degree of education and intellectual ability came to be regarded essential, The modern foreign service officer is almost inevitably a university graduate of superior talents who draws sufficient salary and allowances to maintain a relatively high standard of living. Required intellectual and personal standards no longer imply a class bias because the implications of a university degree have been modified sharply by governmental and private scholarship programs. Whereas traditional diplomacy was once the prerogative of the privileged few, it became the responsibility of an elite that is professionally trained and drawn from many segments of society. The means of selection necessarily differ from country to country, however. and generalizations are particularly risky with respect to communist totalitarian states.

Status. — Foreign service officers adhere lo rules and customs that are of long standing and have proved indispensable to governments in conducting their international relations. Modern practice dates principally from the congress of Vienna in 1815 and immediately subsequent congresses, and includes the category of diplomats (ambassador, minister and chargé d'affaires, etc.) and rules of precedence. which depend for all occasions on the priority of the ambassador's appointment to his post in the country to which he is accredited. Several newly established nations, in an effort to disassociate themselves as much as possible from a distasteful past. once sought to dispense with much of the custom and some of the rules of established practice, only to fall in step as experience suggested the utility of generally accepted standards. In varying degrees, for example, this development took place in the newly established United States, in republican France and Soviet Russia.

Under international law and usage personnel in missions abroad (usually embassies, legations and consulates), including members of their households, are immune from the jurisdiction of the government to which they are accredited, and the mission itself has the status of extraterritoriality and as such is considered legally a part of the home country. Personnel may not be sued in civil action or compelled to testify as witnesses, or compelled to pay taxes to the host country. Their official position does not sanction the evasion of private debts, however, and their private property is subject to local municipal law. An officer or staff member who does not conform to local regulations or who is otherwise unacceptable to the government to which he is accredited may be declared unacceptable (persona non grata) and his recall requested, a demand that is invariably obeyed. Accreditation of ambassadors or other chiefs of mission is handled in accordance with internationally accepted procedures, but appointment of both ambassadors and other officers follows the constitutional practice of individual states. In the United States the president, usually with the advice of his secretary of state, nominates a candidate who must then be confirmed by a simple majority of the senate. In the United Kingdom the foreign secretary, with the assent of the prime minister, submits the name of the candidate to the crown, and approval constitutes ratification of the appointment.

A guild spirit tends to characterize all foreign services as a legacy of the past and as a consequence of circumstance. The various services are small in comparison with home civil services, and entrance requirements are both differentand generally more rigorous. Service for the most part is abroad and involves both hardships and rewards not characteristic of other careers. Above all, foreign affairs involve the interplay of national interests including matters of state not infrequently of the highest importance. Since French is no longer the sole language of diplomacy, foreign service officers usually learn several tongues during the course of their careers. Traditionally foreign affairs were relatively distinct from domestic concerns, and diplomats inevitably stood rather apart from the main stream of national life. When the obligations of service and the skills required are taken into account, including knowledge of languages, economics, politics, science and sociology to name but a few, it is no wonder that foreign service personnel regard themselves as a dedicated elite. Like members of the armed services they are subject to assignments that may on occasion be difficult or even distasteful, and they must bring to their task not only highly trained knowledge but unfailing loyalty and devotion. They can never escape the responsibility of maintaining their country's dignity and prestige in both official and private life, and they are inevitably conscious that foreign policy is the first line of defense.

Nonetheless, although a corporate spirit continued, a foreign service career changed somewhat from what it was prior to World War II. Service abroad is scarcely as remote as it was prior to air transportation. Foreign and domestic affairs are no longer considered to be unrelated, and minimum periods of service in the home country are generally required so that diplomats may effectively represent their country's interests abroad. Foreign policy must run the same course as domestic policy in its formulation, and, in the United States, foreign service officers maintain close relations not only with the state department but with other governmental agencies and with members of the congress itself. A modern diplomat, in short, executes national policy that often involves both foreign and domestic considerations and which is formulated with regard to its economic, military and political ramifications.

It is sometimes asserted that professional diplomats do not make foreign policy. This is true only in the sense that they carry out foreign policy without hesitation once it is established by the national government. But it is equally true that reports from the field and judgment placed on reported facts by individual officers are highly influential in shaping policy, particularly since the views of a foreign minister in any government are heavily dependent on the information presented to him by his "desk" officers. To conceive of foreign service officers as messenger boys walled off from important decisions is to misconstrue the case. How they influence policy, however, varies considerably from country to country.

U.S. Foreign Service.—The foreign service of the United States was established on a professional career basis by the act of congress of May 24, 1924, and was reorganized with the passage of the Foreign Service act of 1946 and subsequent amendments and executive orders providing for the classification of officers including career ministers; the establishment of certain branches including a foreign service reserve which is composed of specialists serving for limited periods of time, and a foreign service staff which provides technical and clerical services; and the creation of the Foreign Service institute to train personnel progressively throughout their careers. The service is administered by a director general and the board of the foreign service including, in addition to state department officers. representatives from the agriculture, commerce and labor departments which are also served by the service.

Admission is open to United States citizens, both men and women, who take competitive examinations, usually for the lowest grade depending upon age levels. They serve in the state department as permanent career officials under the direction of the secretary of state, who is the senior member of the president's cabinet, and his undersecretaries and assistant secretaries who, like their chief, are political appointees of each presidential administration. (See GOVERNMENT DEPARTMENTS: Department of State.)

British Foreign Service. — The modern British foreign service was established by the Eden reforms of 1943 as noted above. In addition to unifying all main branches of foreign affairs work, the reforms provided for changes in recruitment, training and pay so that the service was opened to wider competition among men and women of outstanding ability. Four branches of the service were established, each containing several grades: branch A is the senior and political branch, providing the ambassadors, ministers, counselors. secretaries, senior consular personnel and the higher officials of the foreign office; branch B includes personnel of junior grade who enter by less rigorous examinations. who may compete for promotion to branch A and who perform both technical assignments and consular work; branches C and D include typists, messengers and comparable personnel who receive appointment by appropriate civil service examinations. With the exception of branch D which serves abroad, personnel in all branches are liable to service at home or overseas. In-service training is provided, and pensions and allowances permit suitable standards of living. Nowhere is the foreign service more highly professional or more respected than in Great Britain. Although deliberately differentiated from political appointees, such as the foreign minister (secretary of state for foreign affairs) and two assisting parliamentary ministers, called minister of state and parliamentary undersecretary of state respectively. members of the career service hold crucially important administrative positions, including the post of permanent undersecretary for foreign affairs. who is chief adviser on foreign policy and administrative head of the foreign service. Important diplomatic assignments likewise go normally to the most highly qualified members of the permanent service who, under the foreign minister's instructions, carry out foreign policy for which the cabinet is collectively responsible to parliament. The permanent officials, however, do not assume public responsibility for governmental policy, and questions or attacks in parliament are directed at the ministers and not at members of the foreign service. For a historical discussion of the British foreign office, see GOVERNMENT DEPARTMENTS.

BIBLIOGRAPHY.—For the foreign service organization of many states including Russia *see* Roy C. Macridis (ed.), *Foreign Policy in World Politics* (1958); also Frank T. Ashton-Gwatkin, *The British Foreign Service* (1950); *Proposals for the Reform of the Foreign Service*, Cmd. 6420 (1943); Lord Strang, *The Foreign Office* (1955); James L. McCamy, *The Administration of American Foreign Affairs* (1950); Henry M. Wriston, *Diplomacy in a Democraty* (1956); U S. Department of State, *Toward a Stronger Foreign Service*, publication 5458 (June 1954).
(D. S. C.)

FOREKNOWLEDGE: see FREE-WILL.

FOREL, FRANÇOIS ALPHONSE (1841–1912), Swiss geographer and doctor chiefly remembered for his studies of the natural phenomena of the Lake of Geneva, or Lake Léman, was born at Morges on that lake on Feb. 2, 1841. While teaching physiology and anatomy at Lausanne university, he prepared *Le Léman* (3 vol., 1892–1904).

On the science of limnology his standard work is *Handbzrch der Seenkunde* (1901); in this connection his investigations of the previously mysterious movements of lake waters known as seiches are important (see GENEVA, LAKE OF; LAKE). Forel's other researches include work on seismology and on Swiss Alpine glaciers. Forel died at Morges on Aug. 7, 1912.

FORENSIC PSYCHOLOGY: *see* PSYCHOLOGY, **APPLIED.**

FORESHORE is defined as "the shore and bed of the sea, and of any tidal water, below the line of the medium high tide between the spring tides and the neap tides" (Limitation act, 1939, s. 31). In Great Britain, the property in it normally and prima facie vests in the crown, except where it may vest in a subject by ancient grant or charter from the crown, or by prescription from which a grant may be presumed. It forms part of the adjoining county, whose justices have jurisdiction over offenses committed there, whether it is covered with water at the time or not. (*Embleton* v. *Brown,* 1860, 3 E. & E. 234). It also forms part of the adjoining parish. (R. v. *Gee,* 1 E. & E. 1068). The Public Health act, 1936, ss. 231–234, deals with the powers of local authorities to make by-laws for public bathing and allied purposes.

The chief acts showing title to foreshore are taking wreck or royal fish, right of fishing, mining, digging and taking sand, seaweed, etc., embanking and enclosing. There is a public right of user in that part of the foreshore which belongs to the crown for the purpose of navigation or fishery, but there is no right of passage over lands adjacent to the shore, except by a particular custom. So that, in order to make the right available, there must be a highway or other public land giving access to the foreshore. Thus it has been held that the public have no legal right to trespass on land above high-water mark for the purpose of bathing in the sea, though if they can get to it they may bathe there (*Blundell* v. *Catteral,* 1821, j *B.* & Ad. 268).

There is no right in the public to take sand, shells or seaweed from the shore, nor, except in certain places by local custom, have fishermen the right to use the foreshore or the soil above it for drawing up their boats, or for drying their nets or similar purposes. Improvements made by a tenant under the Landlord and Tenant act, 1927, must not infringe the rights of the public. As to registration of land comprising foreshore. *see* c. 21 of 1925, s. 97. (For foreshore protection *see* BREAKWATER.) (X.; W. T. Ws.)

In the United States, until 1947, the foreshore was considered to belong to the coastal state rather than to the federal government. The United States supreme court had stated in 1845 the rule which was to prevail for more than a century: "The shores of navigable waters, and the soils under them, were not granted by the Constitution to the United States, but were reserved to the States respectively."

However. in 1947 the supreme court decided against California in the federal-state controversy over rights to tidelands oil, holding that the federal government had paramount rights and power over the resources of the soil under the water area three miles from shore. Similar suits were decided against Louisiana and Texas in 1950.

Congress overrode these supreme court decisions in 1953 by passing the Submerged Lands act, which restored to the coastal states full rights of ownership to the foreshore and lands under territorial waters, subject only to the federal powers of regulation and control of the said lands for purposes of commerce, navigation, national defense and international affairs, all of which are considered paramount to, but not to include, proprietary rights of ownership. (C. M. FN.)

BIBLIOGRAPHY.—S. A. Moore, *History of the Foreshore end the Law Relating Thereto* (1888); H. J. W. Coulson and U. A. Forbes, *Law of Waters* (1902); *The Dictionary of English Law,* vol. 1.

FOREST LAWS, in medieval England, were laws applicable to land converted by exercise of the royal prerogative into a "forest," in which game mas preserved. Whereas an offender against the ordinary game laws was punishable by the courts of common law, an offender against forest laws was punishable in special courts. Trials took place in the swanimote, held three times a year, where freeholders within the forest did suit and of which the verderers mere the judges, on charges presented by the foresters in the woodmote, held every 40 days. Judgment, however, only took place in the justice seat, held by one of the two chief justices for the forest every three years.

The land within a forest might be owned by anyone, but rights of ownership were so restricted by the forest laws that constant complaint of hardship was made by landowners in and near the forests. The forest laws were among the grievances which united the barons and people against John. They were dealt with by Magna Carta but the first forest charter was Henry III's, in 1217, by which land afforested under Richard and John became purlieu, subject to forest law as it affected nonoviners of the land, but (subject to certain protection for the king's wild beasts) disforested for the landowners. Charles I revived the forest laws to extort revenue, but in 1640 parliament confined forests to their limits as in 1623. After the Revolution (1688) the forest laws fell into complete disuse.

FORESTS AND FORESTRY. The word "forest" has not always had its modern meaning. Toward the end of the 8th century A.D.. it denoted the royal woods in which the right to hunt was reserved by the king. although the right to cut wood and to clear for agricultural use or for pasture remained free to all. A century later it referred to a large tract including woods, pastures and even whole villages in which the rights of chase were reserved to the king. while other rights of use were limited. The famous forests of old England were tracts of this kind set aside by the Norman kings.

Eventually the royal hunt prerogative waned, the old legalistic meaning disappeared, and forest came to refer to wild land covered mainly by tree growth rather than meadows and fields. Forests are defined by the Food and Agriculture Organization of the United Nations (FAO) as "all lands bearing vegetative associations dominated by trees of any size, exploited or not. capable of producing wood or of exerting an influence on the local climate or on the water regime." Lands from which forests recently have been clear cut or burned out but which will be reforested in the near future are included, but not brushlands, groups of trees outside the forest or trees along roads, on agricultural lands (such as orchards) and in parks.

This article is divided into sections and subsections covering the principal aspects of forests and the science of forestry. In addition to the cross references to related articles given throughout this article *see* ARBORICULTURE; LUMBERING; TIMBER; and TREE. Additional information about diseases and pests will be found in the articles ENTOMOLOGY: *Applied Entomology* and PLANT AND PLANT SCIENCE. The various species of trees are treated under their individual titles. The economic role of forests is indicated in articles on individual states and countries.

Following are the main divisions of this article:

I. FORESTS

1. Forest Values.—Several aspects of the modern concept of the forest deserve emphasis. It is essentially a community, in which trees are the dominant form of vegetation but in which other plants, animals and the soil all play an important role. Trees, shrubs. herbs, fungi, insects, birds, mammals, worms. the humus in the forest floor and the organic matter in the soil all are an integral part of the forest and all react on each other. Like any other community—a city, for instance—a forest is an organism which is much more than the sum of its individual constituents. Also, like most communities, it produces a wide variety of goods and services. Of these the most conspicuous is wood nith its many derivatives and manufactured products; but such minor forest products such as turpentine, tar, pitch, naval stores, rubber, cork, tanbark, dyestuffs, maple sirup, lac and oils are also important. They are estimated by FAO to have an annual value of between $3,000,000,000 and $4,000,000,000, or more than a tenth of the estimated value of primary wood products of approximately $30,000,000,000. Of the latter value, 51% was contributed by lumber. 31% by pulpwood and 7% by fuel.

Among the important services rendered by the forest are control of soil erosion, protection of watersheds, amelioration of local climate and the provision of opportunities for physical and mental recreation and spiritual inspiration. The forest canopy breaks the force of violent rainfall on the soil. The decaying leaves and twigs make the soil more porous and, therefore, a more effective reservoir for the storage of water. The layer of humus which the leaves form delays and reduces surface runoff by preventing the formation of drainage rills and by absorbing large quantities of water, which seeps slowly into the underlying soil. Furthermore, the roots of forest trees help to hold the soil in place.

Much difference of opinion exists as to the influence of forests on the broader aspects of climate. which is controlled chiefly by latitude, elevation and meteorological forces that operate over wide areas. There is, however, general agreement that they reduce wind movement, moderate the temperature of the air, particularly in summer, increase the relative humidity of the air and reduce evaporation from the soil both under their immediate cover and to some distance in their lee. The net effect of these influences is to temper the local climate so as to add to man's comfort and to increase crop production in the lee of shelter belts.

Forests provide attractive opportunities for hunting, fishing, picnicking, camping and other forms of relaxation. They are a recreational asset that increases in value as increasing urbanization, industrialization and the mounting tensions of modern life create a need to "get away from it all."

2. Forest Resources.—Forests constitute one of the most prominent geographic features in the world. They are broadly restricted to parts of the earth where the winter season is not so long and cold as to make tree growth impossible. In general, these areas have an average temperature of at least 50° F. for the summer months. Within the zone of favourable temperatures, the occurrence of forests is sharply limited by precipitation, but the limiting amount is difficult to define since it varies with temperature and length of the growing season. Thus, the tropical forests require more water than those of the far north. In the temperate zone, where the subject has been most completely studied, about 16 to 20 in. of annual rainfall seem to be necessary for forests to exist on the well-drained uplands.

By the second half of the 20th century, forests occupied 29% of the land area of the world; another 23%, much of which was once forested, was devoted to agriculture; and 48% consisted of brushlands, deserts, mountain tops, towns and cities, roads, etc. The percentage of the world's forest area which occurred in each of the seven broad regions recognized by FAO is shown in Table I, as is also the percentage of the total land area in each region occupied by forests.

Latin America and Africa together accounted for 44% of the total forest area, the U S S.R. and North America (Canada and the United States) for 3674. and Europe for only 4%. Within regions. Latin America. the U.S.S.R. and North America were well above the average for the world as a whole, while Europe, Africa

*Table I.—Distribution of Forests by Regions**

Region	% of world forest	% of region in forest
Europe	4	28
U.S.S.R.	19	34
North America	17	36
Latin America	23	40
Africa	21	27
Asia	14	20
Pacific area	2	10
World	100	29

*The figures for individual countries in Tables I to V are for different years, mostly in the 1950s. These figures are at best approximations, since accurate and comparable statistics for different countries are not available.

Source: Adapted from UN Food and Agricultural Organization, ***World Forest Resources*** (1955).

and Asia were slightly below, and the Pacific area far below, that average. The reduction in the original forest area as a result of settlement and cultivation has been greater in Europe than in any other region.

By the second half of the 20th century less than one-half of the forest area of the world (47%) was accessible, and of the accessible area less than two-thirds (63%) was in actual use. In other words, the world's entire production of wood for fuel and industrial use was coming from 30% of its forest area. Figures for the different regions are given in Table II. The U.S.S.R. had both the largest area of accessible forest and the largest area in use. Latin America had the largest total forest area, but only 37% of this area was accessible and only 9% in use. In Europe 98% of the total forest area was accessible and 96% in actual use.

Table 11.—Accessible and Inaccessible Forest Areas in the World

Region	Total (000,000 ha.)	Accessible (000,000 ha.)	Accessible % of total	In use (000,000 ha.)	In use % of total	Inaccessible (000,000 ha.)	Inaccessible % of total
Europe	136	133	98	130	96	3	2
U.S.S.R.	743	425	57	350	47	318	43
North America	656	312	48	220	34	344	52
Latin America	890	329	37	83	9	561	63
Africa	801	284	35	108	13	517	65
Asia	525	311	59	232	44	214	41
Pacific area	86	20	23	17	19	66	77
World	3,837	1,814	47	1,140	30	2,023	53

Source: Adapted from UN Food and Agricultural Organization, ***World Forest Resources*** (1955).

From the point of view of composition, the forests of the world are divided into two main classes—conifers, often called softwoods, and broadleaf trees, often called hardwoods, although many of the species are softer than some of the conifers. The broadleaf trees in turn are divided into temperate hardwoods and tropical hardwoods, which commonly differ markedly in the character of their woods. There are extensive areas in which conifers and temperate hardwoods occur in mixture.

The percentage of the total forest area in the various regions occupied by coniferous forests and broadleaf forests is shown in Table III. The preponderance of broadleaf forests in the world as a whole, and of coniferous forests in the northern hemisphere, is striking. Particularly noteworthy is the scarcity of coniferous forests in Latin America and their virtual absence in Africa. In spite of the fact that conifers comprise only a third of the forests of the world, 53% of the forests in actual use consist of coniferous trees. This situation results from the fact that conifers are in

Table 111.—Coniferous and Broadleaf Forests of the World by Regions

Region	Coniferous forests (000,000 ha.)	Coniferous % of region	Coniferous % of world	Broadleaf forests (000,000 ha.)	Broadleaf % of region	Broadleaf % of world
Europe	79	58	6	57	42	2
U.S.S.R.	580	78	45	163	22	6
North America	463	71	36	193	29	8
Latin America	27	3	2	863	97	34
Africa	3	*	*	798	100	31
Asia	120	23	10	405	77	16
Pacific area	8	9	1	78	91	3
World	1,280	33	100	2,557	67	100

*Less than 0 5%.

Source: Adapted from UN Food and Agricultural Organization, ***World Forest Resources*** (1955).

general preferred to broadleaf trees for such purposes as construction, transport, timber fabrication and pulp, and that they occur chiefly in regions of relatively high industrial development. Economic and cultural progress in the less-developed regions, and technological progress in the use of broadleaf trees for a wider variety of industrial products, are bound to bring about a steadily increasing utilization of the tremendous area of broadleaf forests, still largely inaccessible and unexploited.

3. Growing Stock, Growth **and** Drain.—Statistics concerning the amount of standing timber—growing stock—in the forests of the world are even less satisfactory than those for forest area. In large areas, particularly in the tropics, no systematic sampling has been done, and methods of estimation vary widely. On the basis of the best obtainable information, FAO has estimated that the total growing stock in forests in use is 121,000,000,000 cu.m. (1 cu.m. = 35.3 cu.ft.) with bark. Only fragmentary figures are available for forests not in use.

Large but unknown volumes, chiefly of hardwoods, occur in regions where the percentage of forest in use is low. Latin America, for example, has 23% of the total forest area of the world but only 8% of the growing stock in forests in actual use, with large reserves in unexploited forests. Conifers comprise 55% of the total growing stock in forests in use and nonconifers 45%. Stands per hectare (2.471 ac.) average respectively 90 and 85 cu.ft., with an average for all species of 88 cu.ft. The stand per hectare is considerably higher in the U.S.S.R. than in Europe and North America, in all of. which coniferous forests predominate, because of the higher proportion in the U.S.S.R. of trees that are mature or nearing maturity.

The growing stock of marketable species of trees of merchantable size controls the amount of material available for current exploitation. The growth which takes place on the smaller timber, and on the young trees which follow the cutting of mature stands, controls the amount of material that will be available for future exploitation. Accurate information on both growing stock and growth is therefore essential for intelligent forest management. Gross growth in the forests of the world in use is estimated by FAO at 2,400,000,000 cu.m. (with bark) on the basis of the incomplete and often noncomparable information at its disposal. This figure represents 2.4% of the total growing stock in forests in use, with 45% in the form of conifers and 55% in nonconifers.

Net growth, which represents the amount of wood actually available for utilization, is determined by subtracting losses from fire, insects, diseases, windstorms and other causes from the gross growth. In Europe, where climatic conditions are favourable and the standard of forest management is high, natural losses are estimated at about 5% of gross increment. In the United States, including coastal Alaska, the forest service estimated at the beginning of the second half of the 20th century that losses due to mortality over a period of years averaged about 20% of the annual gross increment, plus a large additional loss due to the deterioration of standing timber. Similar figures are not available for other regions.

FAO estimates placed the annual removal of wood (without bark) from the forests of the world in use at about 1,400,000,000 cu.m. This figure was lower than actual removals since it did not include unrecorded and illicit fellings in countries for which no official estimates had been made. Industrial wood comprised 54% of all removals and fuelwood 46%. Conifers contributed 78% of the industrial wood but only 27% of the fuelwood.

Table IV.—*Removal of Roundwood From the Forests of the World*

Region	Total		Industrial wood		Fuelwood	
	(000,000 cu.m.)	%	% of world	% of region	% of world	% of region
Europe	303	19	21	64	16	
U.S.S.R.	328	21	24	67	16	
North America	416	26	39	86	9	14
Latin America	179	11	3	16	23	84
Africa	102	7	1	10	14	90
Asia	227	14	10	38	21	62
Pacific area	28	2	2	75	1	25
World	1,583	100	100	58	100	42

Source: Adapted from UN Food and Agricultural Organization, *Yearbook of Forest Products Statistics* (1957).

More detailed estimates are given in Table IV. Two-thirds of the total removals came from North America, the U.S.S.R. and Europe. Industrial wood comprised 84% of the total, with the same three regions leading in the same order of importance. Fuelwood comprised 90% of total removals in Africa, 84% in Latin America and 62% in Asia. Per capita consumption of roundwood, sawnwood, plywood and paper was considerably greater in North America than in any other region.

Sawnwood (chiefly lumber) has long been the most important forest product in terms of both volume and value. During the decade from 1947 to 1956, however, its production was relatively stationary as compared with that of plywood, which increased 237%, and that of wood pulp, which increased 84%, in a group of major-producing countries. Although the use of fuelwood tends to decline as greater use is made of mineral fuels and hydroelectric power, it continues to be an important forest product in all regions. Moreover, the reported production is undoubtedly an underestimate since many removals are not reported and much fuelwood is derived from other sources such as residues from logging and manufacturing and salvage from buildings and fences.

The steadily increasing use of wood resulting from an expanding population and a rising standard of living tends to put a severe strain on the forest resources of the world. Although fully reliable information on the subject is lacking, FAO, in a report on the world's forest resources, concluded that growth and drain were about in balance in the 600,000,000 ha. of coniferous forests in use, and that growth somewhat exceeded drain in the 540,000,000 ha. of broadleaf forests in use. On the other hand: the management of a large part of the forests of the world leaves much to be desired from the standpoint of their ability to meet permanently a continually mounting demand for timber products.

Such information as FAO has been able to obtain indicates that by the second half of the 20th century only 27% of the total area of forests in use was being managed under working plans. The estimates ran from lows of 6% in Latin America and 13% in Africa to highs of 42% in Europe and 54% in Canada and the Pacific area. Cutting practices for the world as a whole were described as good for 25% of the forests in use, fair for 35% and poor or destructive for 40%. Wide differences, of course, exist between countries and individual properties. In Sweden and Switzerland cutting practices were said to be good in 90% of the forests in use, as compared with 15% in Spain and 13% in Argentina. If properly handled, the forests already in use and those still to be exploited, in spite of the relatively poor quality of many of the latter, could support a much heavier drain than that to which they have so far been exposed.

4. World Trade.—International trade in timber products is active. In 1956, for example, estimated exports of industrial wood, as a percentage of removals, ran from 3% in the U.S.S.R. (1955) and the Pacific area to 39% in Europe and 40% in Africa. Much of the trade for Europe was intraregional, while practically all of that for Africa was interregional. European exports were valued at $2,461,000,000 and African exports at $119,000,000. North America was not far behind Europe, with total exports of $1,970,000,000. Both Europe and Africa were also heavy importers of timber. Only North America and the U.S.S.R. were net exporters.

Coniferous species comprised the bulk of the world trade in sawnwood, with Canada the largest exporter. World trade in broadleaf species was, however, increasing and constituted 10% of world exports in 1956. The leading exporters of plywood were Japan, Finland and Canada. In the same year Sweden accounted for 33% of world exports of wood pulp, Canada for 28% and Finland for 17%. The United Kingdom and the United States were the heaviest importers: with well over half of the total. The main lines of trade in wood pulp are from Canada to the United States and from northern European countries to western Europe.

5. Ownership.—Information as to forest ownership is fairly complete for Europe, the U.S.S.R. and North America, but far less so elsewhere. In the less-developed regions, and particularly in the remoter areas, considerable tracts of forest are unmapped, unsurveyed and without established titles. This situation reflects

TABLE V.—Ownership of Accessible Forests by Region

	Per cent of ownership in		
	State forests	Communal forests*	Private forests
Europe	33	13†	54
U.S.S.R.	100‡	—	—
North America	49	2	49
Latin America	58	6	36
Africa	74	23	3
Asia	72	18	10
Pacific area	76	—	24
World	69	9	22

*Includes forests reserved for the benefit of native tribes.
†Includes 1% in forests owned by institutions.
‡Includes 101,800,000 ac. managed by collective farmers.
Source: Adapted from UN Food and Agricultural Organization, *World Forest Resources* (1955).

both lack of knowledge as to the location and extent of the forest resources and failure to appreciate their future, if not present, value. The division of ownership among different classes of owners as reported to FAO for the accessible forests of the world is presented in Table V.

For the world as a whole, 78% of the accessible area was in state and communal ownership and 22% in private ownership. The U.S.S.R. was the only region in which the entire area was in public ownership, although Africa and Asia were not far behind. Private ownership was most conspicuous in Europe (54%) and North America (49%). The division of ownership between different classes of owners varied widely by countries within any given region. In Europe, for example, private owners held none of the accessible forest in Bulgaria, 12% in Poland, 64% in France and 96% in Portugal. In Latin America, private ownership amounted to 17% in Colombia. 49% in Mexico and 93% in Paraguay. In many countries, including the U.S., private holdings are often in tracts of such small size as to make intensive management difficult.

II. FORESTRY

1. Beginnings **of** Forestry.— Planned management of forests with the aim of perpetuating and improving them is a relatively new development. From earliest times, man's activities have tended to reduce the area occupied by forests and to impair their productivity. Large areas were burned, often repeatedly. to improve hunting; fire, girdling and cutting were used to clear the way for farms and pasture; and heavy inroads were made for fuelwood and construction material.

The process of destruction and deterioration was encouraged by the almost universal belief that the forests were inexhaustible. if not in the immediate vicinity of settlements, at least regionally and for the world as a whole. Forests were often a nuisance, and where they were clearly an asset lavish use was the order of the day. Always beyond the horizon were untouched resources. Even at mid-20th century the 70% of the world's forest area that is not in use because of inaccessibility, or for other reasons, helps to maintain the myth of inexhaustibility.

Nevertheless, local shortages of wood long ago led to occasional, usually ineffective, action to assure future supplies. About 450 B.C. Artaxerxes I attempted to restrict the cutting of the cedars of Lebanon. Efforts to prevent the use for other purposes of trees suitable for ship timbers were made in the time of the Roman empire and much later in England. During the 12th and 13th centuries, in Germany, more drastic restrictions were imposed, such as limiting the amount that could be cut by each family and prohibiting the use of live trees for fuel. As time went on, the practice of leaving seed trees, making cuttings so as to avoid wind throw of the remaining trees, and other applications of good sense to the management of the forest began to make their appearance.

Then in the middle of the 18th century a sudden change in attitude and practice occurred in central Europe. Among the factors responsible for the change were local timber famines resulting from the destruction accompanying the wars of the 17th century, the gradual shift of interest from game to wood as the chief product of the forest, and the growth of a group of writers and state officials known as cameralists who were essentially political economists interested in the money-making capacities or public revenue of the principalities with which they were connected. Books dealing with many phases of forest production began to appear, and both public and private landowners became active in developing the capabilities of their lands. During the next century the movement toward modern forestry steadily gained momentum in Europe and spread to other parts of the world, particularly those most affected by the Industrial Revolution.

2. Modern Forestry.— Forestry has been defined in many ways. In essence. it is the management of forests and forest lands for the continuous production of goods and services. It is an art based on scientific information applied with due regard to economic and social considerations. The biological. physical and social sciences, mathematics. engineering and even philosophy all make substantial contributions to its successful practice. It has. in short, developed into a profession for which a broad and intensive training is required.

Several features of forestry deserve emphasis. It deals with production as well as exploitation, with the future as well as the present. with services as well as goods and with intangible and social as well as tangible and economic values. It must compare the value of products and services for which there is no common measuring stick, such as the lumber and pulp produced from wood and the pleasure and inspiration afforded by recreation; and it must convert anticipated returns into present worth. This responsibility requires foresight and sound judgment in the development of plans and technical skill in their execution.

Two important aspects of modern forestry are multiple use and sustained yield. Multiple use means the management of any given area (usually an administrative unit of considerable size) for several different purposes, such as timber production. watershed protection and recreation. Since some uses are incompatible under certain conditions. and since maximum yields from all uses are a physical and biological impossibility, a decision must be reached as to which uses shall be given priority. In effect, this means determining the use or combination of uses to which the different parts of a forest are best adapted in the light of the natural environment and of economic and social considerations.

Sustained yield implies the continuous production and use at a given level of some product such as wood or wildlife, or the maintenance without impairment of some service such as watershed protection or the values afforded by wilderness and other recreational areas. Of major importance is the level at which the yield is to be sustained, with constant pressure for higher and higher levels as population increases and standards of living rise. The technical difficulties of attaining such higher levels for products and services of various kinds mount rapidly and complicate the problem of multiple use.

The first steps in placing a forest under management are to establish its boundaries, to map its topography and other physical features. to determine the kind and amount of its various resources and to provide for its protection from fire, insects and disease. These are basic activities that must be undertaken whatever the specific objectives of the owner.

3. Forest Protection.— The danger from fire varies widely depending upon the climate and the nature of the forest. Coniferous forests. for example, burn more readily than broadleaf forests. Fires are virtually unknown in the tropical rain forests but are common even in broadleaf forests wherever there is a long, dry season. as for example, in parts of Latin America and Africa. The danger is slight where the forest is broken into small, more or less isolated holdings, as is the case in much of central Europe. On the other hand, it is great in the broad coniferous forests of North America and Asia, where conflagrations are not uncommon, particularly in portions subject to thunderstorms accompanied by little rainfall.

In much of the world. fire is still regarded as the most serious enemy of the forest. Although there are circumstances under which it may prove a useful tool in forest management, when out of control it kills and weakens trees of all sizes, destroys wildlife, paves the way for attack by insects and diseases, results in deterioration of the soil and increased surface runoff of water and reduces recreational values. Protection from fire is. therefore, an essential part of forestry and a prerequisite to the actual management of the forest resource. Much progress is being made in determining the conditions under which fires occur most commonly and under which they spread most rapidly, and in the more effective use of mechanical machinery, chemicals and airplanes in their suppression. Less progress is being made in the prevention of fires, the great bulk of which are caused by human carelessness.

Insects and diseases are other enemies that must be controlled, particularly as the resources at stake increase in value. Even normal, endemic populations may cause serious losses,. and the danger becomes acute when these populations swell, often rapidly, to epidemic proportions. In North America forests have been virtually wiped out over vast areas by bark beetles and by the spruce budworm, while the imported chestnut blight has completely eliminated the native chestnut as a commercial species. The forest service estimates that by the second half of the 20th century the mortality on commercial forest lands in the United States caused by insects and diseases was, respectively. more than four times and more than three times that caused by fire: with still larger additional losses of wood from heart rot in living trees.

Methods of protection vary widely depending on the characteristics of the particular organism involved. Leaf-eating insects such as the spruce budworm and the hemlock looper can be controlled by spraying with poisons from airplanes, but bark-boring beetles can be controlled only by logging operations. Biological control by the introduction of parasites and predators that live on the destructive insects is feasible in some cases. White pine blister rust can be controlled by the eradication of all currant and gooseberry bushes, on which the fungus spends part of its life, in the neighbourhood of pines. There is no known method of control for some diseases, such as the chestnut blight. In general, the most effective and permanent control for most forest pests lies in the production of stands composed of thrifty trees of more than one species and harvested at maturity; in other words, in management of the forest: not of the pest.

4. Timber **Management.**—Although forests are commonly used for more than one purpose (multiple use), it is convenient to consider separately their management for their major products and services. Of these, timber is by and large the most important, and the technique for its production is the most highly developed.

One of the first things a forest manager must determine is how much timber of different sizes the forest contains, how fast it is growing and what yields can be expected at various future dates under whatever methods of cutting and utilization he may adopt. He must then develop a working plan which will enable him annually or periodically to harvest the same amount of timber (sustained yield), with sufficient provision for flexibility to enable him to adjust cutting operations to changing market conditions and to unexpected occurrences such as fires or insect attacks. For convenience of administration the tract is divided into a number of smaller units, often on the basis of small drainages or other topographic features. Cutting operations are allocated to these units in accordance with their productive capacity and consequent ability to yield the harvests called for in the working plan.

Silviculture, literally "care of the forest," includes practices designed (1) to maintain a vigorous, productive forest of the desired species and sizes; and (2) to provide for the replacement of stands as they are harvested, either by natural means or by tree planting or seed sowing. The first objective is attained chiefly by the removal of trees that are undesirable because of species, shape, injury or other defect (weed trees), and by thinning out stands that are too dense so that growth will be concentrated on a smaller number of high-class trees whose growth will be stimulated by the reduction of competition. Weedings are usually conducted at a current net cost, but thinnings may yield a substantial net income where there is a market for small material.

Silvicultural systems for obtaining reproduction after cutting by natural means are divided into several conventional classes. Clear cutting of all merchantable trees may be done in narrow strips or in small patches, with the expectation that the area will be reforested by seeds from the adjacent uncut stands, or enough scattered seed trees may be left on the cutover area to provide for its reforestation. The shelterwood method involves a series of cuttings several years apart in which the stand is first opened sufficiently to permit reproduction to come in under the shade of the overwood and is later removed after the reproduction has become established. These two systems are best suited to even-aged stands, in which the trees do not vary in age by more than about 20 years.

The selection system involves the harvesting of individual trees and is much better adapted to uneven-aged forests. The entire forest is gone over at regular intervals and the trees that have matured or reached a specified size since the previous cutting are removed. This procedure always leaves uncut a part of the stand from which reproduction is expected to take place. but the process is somewhat uncertain, and undesirable species may tend to dominate. Another system depends on reproduction by sprouts from the stumps of the cut trees. With a few exceptions. such as redwood, it is applicable only to broadleaf trees. It usually results in gradual deterioration of the stand and should be supplemented by provision for the establishment of seedlings.

Modifications and combinations of these various methods are common. When they fail to obtain adequate reproduction. or when the forest is destroyed by fire or other catastrophe. recourse must be had to artificial reforestation. Planting of young, nursery-grown trees is the method generally used, but direct seeding is possible and has the advantage of cheapness where climatic conditions are favourable and protection of the seeds from destruction by birds and rodents is feasible. Planting machines drawn by tractors are increasingly used where the ground is not too steep or too stony. The rate of planting has risen markedly and there is a growing tendency to use artificial reforestation immediately after cutting as a means of obtaining prompt restocking with desirable species, even where the prospects for natural reproduction are reasonably good.

Efficient harvesting of the timber by logging requires a carefully planned network of permanent forest highways, together with many temporary woods roads or trails over which the logs are hauled out. Logging methods vary widely in different countries and in different forest types. Throughout the world there is a tendency toward increased use of heavy bulldozers and graders for road construction, of power saws for tree felling, of tractors for moving logs from the stump to the log yard and of trucks for transporting the logs to the mill. Where close utilization of the tops and branches is impracticable, it may be necessary to treat the debris. or slash, by burning, piling or scattering so as to reduce the danger from fire or insects or to prevent the smothering of established reproduction.

Manufacture of timber into lumber, veneer, furniture, containers, pulp. paper and innumerable other products is not a part of forestry, but it is an activity in which the forest manager has a keen interest. These products not only furnish a market for the forest crop, but they determine the kind and amount of material for which there will be a demand. Making wood go twice as far has the same effect as doubling its production. For many reasons wood technology exercises a profound influence on forestry and is a field with which the forest manager must be well acquainted.

5. Range Management. — In many parts of the world grassy meadows and other range lands are so intermingled with forest lands that the two classes of land must be managed together. Furthermore, there are some forest types, as in the coniferous forests of the western United States. in which much forage suitable for use by domestic livestock occurs within the forest itself. In such situations the forest manager must have sufficient knowledge of range management to assure full use of the range resources. both in the open and in the forest, without overgrazing and consequent damage to the forest, to the water supply, to recreational values or to the range itself.

A different situation exists in forests of broadleaf trees. where grazing by domestic livestock is nearly always injurious. Trampling packs the soil and exposes tree roots, while browsing kills off the young growth and prevents reproduction. Here the problem is primarily one of exclusion rather than control of grazing.

See also RANGE (IN AGRICULTURE).

6. Watershed Management. — In hilly and mountainous country, a primary responsibility of the forest manager is to reduce the surface runoff of water so as to minimize erosion and to regularize the flow of springs and streams. Where clear cutting of any considerable area is avoided. the occurrence of organic matter in the soil. the accumulation of litter on the forest floor and the presence of herbs, shrubs and trees are ordinarily adequate to attain this result.

In arid and semiarid regions, the total amount of water available for domestic, municipal and industrial use, 'for irrigation and for power is another item of major concern. Here the influence of the forest may be adverse because of the large amounts of precipitation which it intercepts and the large amount of water which it transpires. There is some experimental evidence that the opening up of a forest by small clearings or in other ways may substantially increase the total runoff of water. but far more research is needed to determine how and to what extent such openings can be made without unduly increasing the danger of soil erosion. And there is always the further question as to whether the water or the timber is the more valuable.

7. Wildlife and Recreation **Management.**—Wildlife is an ever-present component of the forest in which hunters, fishermen and nature lovers have a special interest. Since many animals. such as deer, prefer edge conditions where forest and open land meet. the forest manager must face the problem of creating such conditions without undue interference with timber production.

Other forms of recreational use of the forest. such as picnicking and camping. are steadily increasing in importance and occasionally come in conflict with uses such as timber management and range management, Here again. much needs to be learned about ways and means of reconciling the different uses and about the relative values involved. Of particular urgency is decision as to the extent to which forests should be set aside as wilderness areas. and how they should be managed to best serve the purposes for which they are established.

8. Education and Research. — Formal schools for the training of foresters were first started in Russia. Germany. France and Sweden in the early 1800s. Other schools followed gradually. first in Europe and later in other parts of the world. Professional instruction in forestry was not undertaken in the Cnited States until 1898 but thereafter developed rapidly. In most countries the trend has been toward the broader training of general practitioners and the more intensive training of specialists.

Experiment stations for the conduct of forest research were established in Germany in the 1860s and 1870s. Other countries gradually followed suit, and research has received steadily increasing attention as forest problems have grown in importance and in complexity. That developments are not keeping up with needs. however. is indicated by a study made by a committee of the Society of American Foresters which recommended that expenditures of $45,400,000 in 1953 for research in timber management and related fields (including wood technology) be increased to $200,000,000 by 1978. Governments are generally the leaders in the research field. but substantial contributions are made by educational institutions and private organizations.

III. WORLD SURVEY

1. Government and Forestry. — Forests are of such vital significance in the economy and general well-being of a nation that governments have long recognized a responsibility to see that they are so managed as to promote. or at least not to jeopardize, the public interest. Governmental participation in forestry affairs may take the form of ownership of forest lands. of control of the activities of private onners or of assistance to private owners. All three approaches are commonly used in the same country, with uide differences in the reliance placed on each.

With 78% of the accessible forests of the world in public ownership, governments are clearly in a position to exercise direct control over the bulk of the world's forest resources. Such control does not, however, necessarily result in efficient forest management. particularly in countries with relatively small industrial development. Outside of the U.S.S.R.. where all of the forests are in public ownership, forestry has made the most progress in Europe and North America, where 54% and 49% of the accessible forests are in private ownership.

2. Protection Forests. — Public regulation of the management of their forests by private owners is of long standing in Europe, particularly in the case of protection forests. which include those so located that mismanagement is likely to result in serious damage to the community from such causes as soil erosion. floods. avalanches and the encroachment of sand dunes. Any general regulation of the management of other private forests is a later development. which perhaps has gone farthest and been most successful in Sweden. Norway and Finland. In the Cnited States, a few states have enacted regulatory legislation of this character.

Public assistance to private owners is extended in a wide variety of ways. It may take the form of partial or complete assumption of the responsibility for protection from fire, insects and disease, of payments for the adoption of improved forest practices. of tax concessions. of credit under favourable terms. of the provision of nursery stock at or below the cost of production, of education and of free or low-cost service in the management of forests and in the harvesting and marketing of forest products. Research by public agencies: much of which deals directly with private lands, also may be regarded as falling in this category.

3. Forestry in Europe. — The development of forestry throughout the world can be illustrated by a brief presentation of the policies and practices of a few selected countries in the various regions. Forestry as an art with a sound scientific foundation was first developed in Germany. and German-trained men played an important part in early developments in Scandinavia. Russia, the British Commonwealth and the United States. Special emphasis was placed on the technology of forest management, on financial considerations and on the organization of forest properties for sustained yield. Theories and formulas commanded much attention and were rather rigidly applied in practice. Policies with respect to private forests have swung between the two extremes of strict controls and virtually free enterprise. From World War II private forests in west Germany have been largely under state supervision. while those in east Germany are all managed by the central administration.

France became interested in forestry at an early date. In 1669 Jean Baptiste Colbert. Louis XIV's great minister, promulgated a comprehensive forest code which set up a complete administration for all the forests of the country and prescribed many detailed silvicultural practices. This code was abrogated by the French Revolution, but in 1827 a new Code Forestier prescribed in detail for the management of public forests and provided severe penalties for trespass and for starting fires on any forest land. Except that the clearing of forest land without permission was prohibited, private owners were otherwise left practically free of public control, as is still the situation. Among France's outstanding achievements are the control of mountain torrents, the stabilization of extensive sand dunes and the reforestation of large areas of waste lands.

The forests of the Alps are important to Switzerland both as source of timber and as a scenic and protective asset. A law of 1902 authorized the federal government to designate protection forests, a fourth of which proved to be in private ownership, and provided for such public control over their management as necessary to prevent impairment of their protective function. Subsidies are granted the private owner to aid in reforestation, the construction of dams and other measures to control torrents. In general, the technical management of Swiss forests is of a high order. The city forest of Zurich (*Sihlwald*) has been under management with a definite working plan since about 1680, making it the oldest continuously managed forest in the world.

Sweden's extensive forests, largely located on rivers which provide cheap power and log transportation, long have enabled it to be a heavy exporter of lumber and of wood pulp and paper. The public forests were placed under the supervision of trained personnel toward the middle of the 19th century, and about 50 years later intensive management practices began to be adopted by the larger private owners. particularly in the pulp and paper industry.

Public control over private forests was established by the law of 1903, which was revised and strengthened in 1923 and 1948.

The 1948 law provides that "Forest land together with the forest growing thereon shall, through suitable use of the productive capacity of the soil. be so managed that a satisfactory economic return is obtained and, so far as possible, substantially sustained yield." Responsibility for supervising the management of forests in accordance with the law is lodged in county boards of forestry. These boards usually consist of three members of whom the chairman is appointed by the king and the others by the county council and the county agricultural society. They must be well acquainted with forestry and forest conditions in the county and are typically forest oaners. The county forestry boards are in turn supervised by a private forestry board in the department of agriculture which exercises general federal leadership with respect to private forestry. Educational and service. as well as regulatory, activities are conducted by the county boards through their technical staffs; and under certain conditions owners may receive grants to aid in undertaking measures that are desirable but too costly to promise satisfactory economic returns.

The Swedish system of controlling the management of forest lands in private ownership places the determination of policy at the national level and administration of the policy at the county and district levels. It meets with almost universal approval in theory and in general works well in practice. Although it has greatly improved the handling of the small farm wood lots, which comprise more than three-fifths of the total area in private and community ownership, it has fallen considerably short of getting them all under really satisfactory management. Management of the forests in the hands of the larger companies, on the other hand, compares favourably with that of the national forests. In Sweden, as in many other parts of Europe, forest owners, co-operative associations and forest management associations exert a constructive influence in the management of the smaller forest properties.

Great Britain, once densely wooded, was gradually deforested until by the outbreak of World War I it was almost wholly dependent on imports for its wood supply. The virtual stoppage of these imports by German submarines awakened the nation to the importance both of wood and of building up a domestic supply on which it could rely in time of crisis. Little progress had been made in this direction when World War II created a second and even more drastic emergency. As a result, parliament in 1945 adopted a plan for the creation of 5,000,000 ac. of forest in the next 50 years. partly by national purchase and planting and partly by regeneration of badly depleted private woodlands. A unique arrangement for encouraging action by private owners was embodied in subsequent legislation (1947) and in agreements entered into between the government and associations of forest owners. Under these agreements private owners, in return for heavy public subsidies, voluntarily covenant to dedicate their lands permanently to forest production..

4. Forestry in the **U.S.S.R.**—Interest in the perpetuation of the forests of European Russia developed in the 17th century. and from then on sporadic attempts were made to check devastation, particularly in protection forests. In 1888 a comprehensive law provided for the conservation of forests. public and private alike.

Following the fall of the czar, the U.S.S.R. in 1918 ended all private ownership in land. water and forests. Since then the forests have been managed, and production from them tremendously increased, under the various five-year plans. The volume of timber cut has not been limited to the annual growth but has been determined by the economic and industrial needs of the country.

Much stress is laid not only on the economic value of the forests but on their influence on climate, erosion, streamflow and health. Large areas have been set aside around health resorts and industrial areas; protection forests, in nhich cutting is forbidden or restricted, have been established on critical natersheds and along the banks of the larger rivers; and the forest area has been extended by large-scale planting operations. ;\ particularly ambitious project is the erection of a forest barrier about 3,300 mi in length in the path of hot southeast winds. and the planting of nearly 6,000,000 ha. of shelter belts around cultivated fields.

The U.S.S.R. has 12 institutes of university grade for the training of students in all branches of forest management and forest utilization. These schools graduate between 2,500 and 3,000 students each year. Many vocational schools also are training forest personnel. Research is conducted at the professional schools of forestry, at 1j special forest research institutions and at scores of experimental stations and laboratories.

5. Forestry in North America.— With some minor exceptions. practically uncontrolled exploitation of the forests of the United States continued until the end of the 19th century, when acts passed in 1891 and 1897 authorized the president to reserve portions of the public domain from alienation.

Then in 1911 and 1924 congress authorized the purchase of forest lands by the federal government for watershed protection and, under certain conditions, for timber production. By the second half of the 20th-century national forests reserved from the public domain and acquired by purchase totaled about 180.000 000 ac. in the U.S.. including 21,000,000 ac. in Alaska, all of which were handled under the multiple-use principle. There was an additional 225,000,000 ac. of public land in Alaska. much of it in forest, uhich received inadequate protection from fire and was otherwise unmanaged. Most of the other states (notably Michigan. Minnesota. Pennsylvania and Washington) had state forests which aggregated 19,000,000 ac.. or 4% of the commercial forest area of the country. An additional 8,000,000 ac. was in county and municipal ownership. Each state has its own system of forest fire protection and co-operates with private owners in educational and service activities. Grants-in-aid for these purposes are received from the federal government.

Private forestry started on a small scale in the early years of the 20th century, but it was not until after 1940 that the movement gained real momentum. The change in attitude and practice nas due to a variety of factors, among which increased timber values, improved technological processes and the need for adequate permanent supplies of raw material to safeguard heavy investments in plant and equipment were of prime importance. A helpful influence was the tree farm program initiated by industry in 1941. In less than 20 years more than 11,000 forest owners in 45 states with a total of 45,000,000 ac. were participating in the program. Its purpose is to encourage better forest practices by formal recognition of onners who meet certain specified standards of practice. As elsewhere throughout the world. the management of farm wood lots and other small tracts is much less satisfactory than that of large properties. A few states exercise some control over the management practices of private owners, but there is no federal legislation on the subject.

Because of adverse climatic or soil conditions only three-fifths of Canada's forest area is classified as capable of producing crops of merchantable timber and of this area 30% nas considered inaccessible for commercial purposes. In spite of these handicaps forests play a major part in the economic life of the country. Exploitation ran about the same course as in the United States, with planned management on any considerable scale not taking place until well into the 20th century.

Of the total forest area. 73% is owned by the provinces and 21% by the federal government. Private ownership constitutes 50% or more only in Prince Edward Island. Nova Scotia and New Brunswick. Forests in the provinces are administered by the provincial governments, with financial assistance from the federal government. Cutting is done by private operators under timber licences, which may contain detailed requirements as to the amount to be cut and the methods of cutting. Increasing emphasis is being placed on silviculture. sustained yield and integrated utilization of all merchantable wood. Steady progress toward well-planned, long-range management is being made under the combination of public ownership and private operation.

6. Forestry in Latin America.— Throughout Latin America, utilization and management of the forests have been complicated and delayed by their inaccessibility and by the enormous number of species of which they are composed. For the majority of these species. little is known as to the characteristics of the trees and the properties of their woods, and still less as to their growth. yield and management. The more accessible forests have deteriorated greatly as a result of temporary clearing for agriculture, culling of the more valuable species and overutilization. In general, drain considerably exceeds growth.

The division of the forest area between public and private ownership varies tremendously in the different countries. With both classes of ownership, only a small start has been made toward satisfactory forest management. Forestry is officially recognized in the central governments of all the Latin-.American republics, but the forest services lack in stability, in financial support and in professional training of their personnel. Legislation dealing with the control of cutting by private owners and operators is not uncommon, but is more honoured in the breach than in the observance.

In spite of these difficulties, forestry, in the second half of the 20th century, was making considerable progress. Mexico and the European territorial possessions were the first to inaugurate substantial forestry programs, but promising developments were occurring in other countries throughout the region. Far greater emphasis on education and research, greater stability and financial support of governmental agencies and the introduction of sound practices in the utilization of the forests are essential to enable them to play the part which they should in the economy not only of the region but of the world. FAO's Latin American forestry commission exerts a helpful influence in these directions.

7. Forestry in Africa. — The rain forests of Africa constitute a vast reserve. full utilization of which probably will come slowly because of their relative inaccessibility, the high cost of harvesting and transportation to world markets and the preponderance of hard and very hard woods. Exploitation in general, as late as the 1950s, was promoting deforestation, with which the local governments were unable to cope in spite of good intentions and the establishment of limited areas of forest reserves. The dry forests were cut almost entirely to meet local needs, chiefly for fuel. Because of the unfavourable climate and the prevalence of fires, their continued deterioration seemed probable.

In South Africa, the true forest of evergreen hardwoods, never extensive, has been pushed back until by the second half of the 20th century it occupied only about 0.5% of the land area. In 1876 the government undertook to control unconsidered exploitation, but without much success. Since 1913 cutting has been much restricted with a view to keeping the drain within the annual growth. Planting, chiefly of pines from other parts of the world, has been extensive and is being continued on an increasing scale.

8. Forestry in Asia.——Forestry in India had its beginnings in the middle of the 19th century, when the British organized an Imperial forest department. Forests were classified as "reserved," because of the vital role they play in the national economy, in which only well-defined and limited private rights were recognized, and as "protected," in which only such restrictions were imposed as were in the interest of the right-holders themselves. Neither these provisions nor those of the Indian Forest act of 1927 were adequate to prevent continuing destruction of the private forests. A "New Policy" adopted by the Indian government in 1952 designated those private forests over which governmental control was to be exercised and provided for their management in accordance with approved working plans. Special attention is paid to the preservation of protection forests. Professional education and research have occupied a prominent place in forestry affairs in India since the establishment of a forest rangers' school at Dehra Dun in 1878.

In the Philippines forestry started with the establishment of the bureau of forestry by the United States in 1900. With 96% of the accessible forest area in public ownership, the government has been able to exercise virtually complete control over their utilization and has made steady progress in the development of working plans and the application of sustained yield. Lumbering, which is one of the main industries of the islands, is not permitted in areas classified as protection forests.

Japan is a mountainous country in which forests occupy 62% of the land area. As elsewhere throughout the world, they were long exposed to destructive utilization in spite of sporadic governmental efforts at control. Although there is evidence that the relationship between forest devastation and destructive floods was recognized early in the Christian era, well-defined national efforts to correct the situation did not appear until 1878. when a bureau of forestry was organized. Since that time progress toward improved forest management has been steady and in places intensive forest practices are in force. However, the heavy post-World War II need for wood resulted in enormous demands on the forests which led to overcutting. The greatest drain has been on the coniferous forests, estimated early in the second half of the 20th century at more than two and one-half times the annual growth. The problem of soil stabilization and flood prevention in the mountains is receiving intensive study but has not yet been solved. A promising development was the formulation by the U.S. occupation force of forestry programs which are being effectively carried out by the Japanese government.

Except during the Chou dynasty (1122?–256 B.C.), forest destruction in China continued unabated until by the middle of the 20th century its once "boundless stretches" of forest had been reduced to 9% of the land area. Even this diminished area, all of which is theoretically in government ownership, provides considerable wood for lumber, pulp and fuel. Forestry, first given official recognition in the government in 1911, was elevated to the status of a ministry in 1951. A comprehensive national forest law provides for the recognition and maintenance of protection forests and requires the reforestation of all cutover areas, but its enforcement is another matter. Planting has been done rather extensively, but no long-range plans for forest management have been developed.

9. Forestry in the Pacific Area. — The forests of Australia, which are confined to a relatively narrow belt along the coast, comprise nearly one-half of the total forest area of the Pacific area and more than three-fourths of the accessible forest area. They consist predominantly of evergreen hardwoods, among which eucalyptus is the characteristic genus. To help remedy the deficiency in coniferous timber extensive plantations, largely of Monterey pine, have been made. Approximately 65% of the productive forest area is under some form of reservation. The individual states are autonomous in forestry matters, but there is a central forestry and timber bureau which is concerned chiefly with education, research and advising the administrations of the commonwealth territories on forest management. The application of intensive silviculture and the practice of sustained-yield management is likely to be slow until fire control becomes much more effective.

New Zealand's forests, once regarded as inexhaustible, have been greatly reduced in area by the use of fire for land clearing. Fire and exploitation have resulted in deterioration of a considerable part of the remaining forest and the beautiful and famous kauri pine (*q.v.*) is no longer of major economic importance. Forestry activities have been largely concentrated on the planting of exotic conifers.

10. Outlook. — Accurate information is not available as to the area: volume. growth and use of the forest resources of the world. Indications are, however, that these resources, if properly managed, are adequate to meet the world's needs for wood and other forest products for an indefinite period. Although progress is being made in many countries, there is as yet no assurance that effective management will be attained. Much remains to be done in securing the adoption and execution of policies and practices that will assure the contribution of which forests are potentially capable to the economic and social well-being of people everywhere, a process in which education, research and constructive legislation must play a prominent part.

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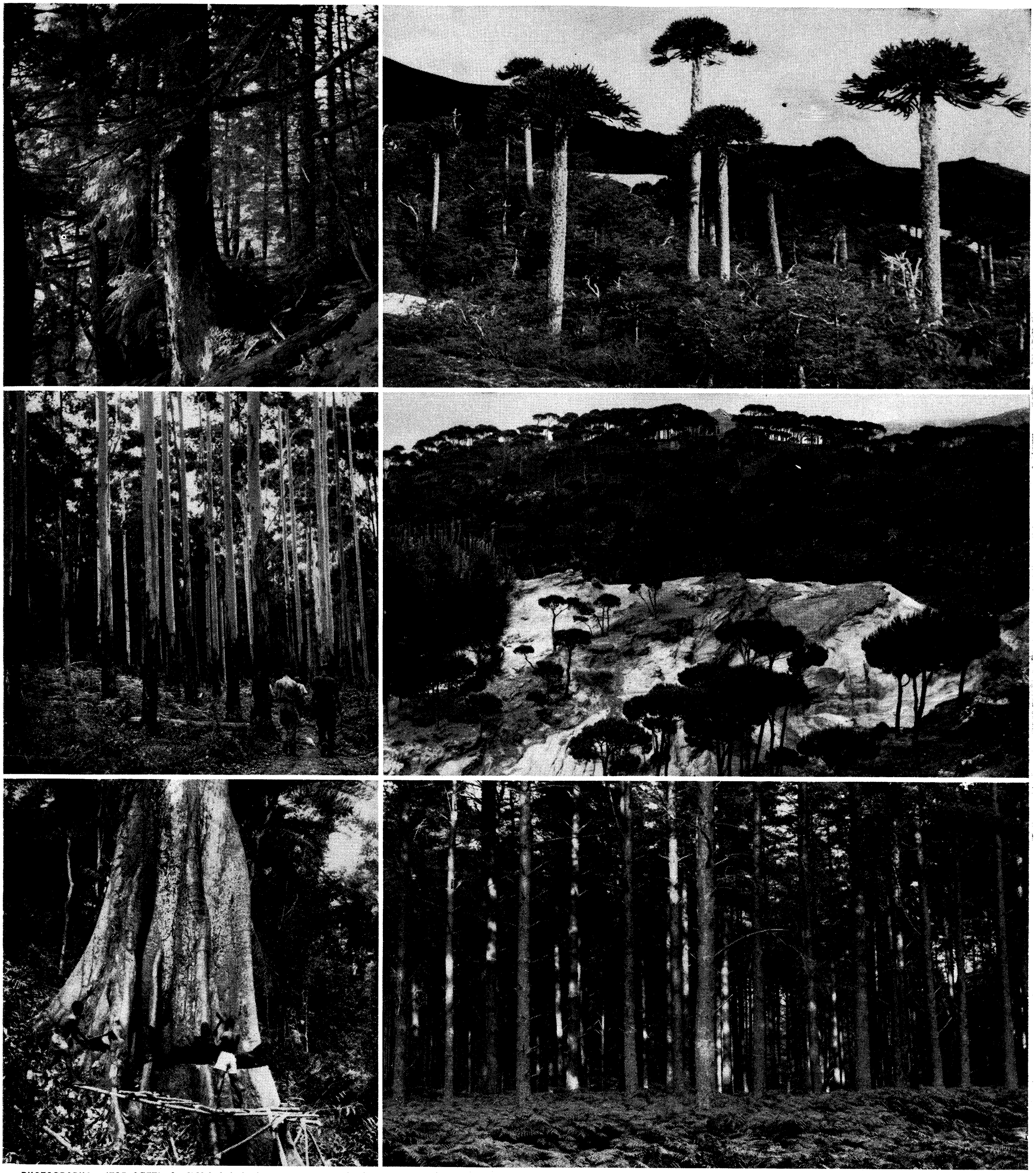
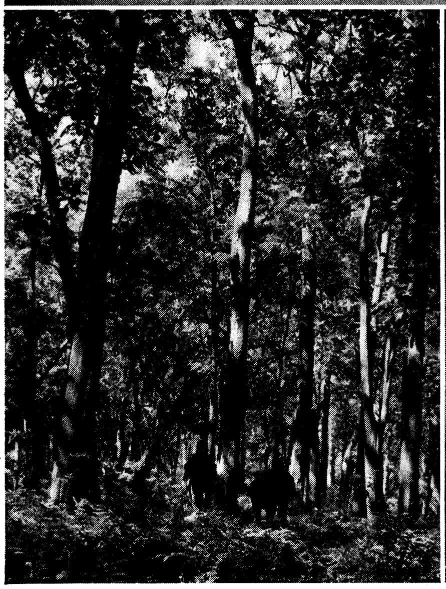
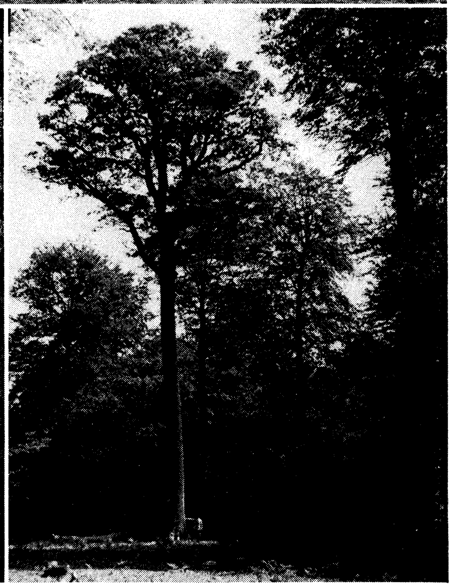


FORESTS OF THE WORLD

Top left: Spruce and hemlock forest in southeastern Alaska
Top right: Stand of araucarias in Chile. The araucaria is a conifer of the southern hemisphere
Centre left: Regrowth of ***Eucalyptus grandis,*** New South Wales, Aust.
Centre right: Heavily grazed forest of ***Pinus pinea,*** Lebanon
Bottom left: Cutting a giant Limbo tree (***Terminalia superba)*** in the Belgian Congo
Bottom right: A 55-year-old pine wood in the New Forest, England

FORESTS AND FORESTRY





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FORESTS OF THE WORLD

Top left: A 25-year-old stand of *Pinus* radiata, New Zealand
Top right: Moist deciduous forest, Uttar Pradesh, India
Centre left: Veneer timber, central Finland
Centre right: Improvement selection cutting followed by natural reforestation in a stand of ponderosa pine, Arizona
Bottom left: Teak (Tectona *grandis*) forest near Madras, India
Bottom centre: Well-stocked stand of firs in the Jura mountains, Germany
Bottom right: Old oaks in the forest of Compiègne, France

BY COURTESY OF (TOP LEFT, CENTRE LEFT, BOTTOM LEFT, BOTTOM RIGHT) U.S. FOREST SERVICE, (CENTRE RIGHT) AMERICAN FOREST PRODUCTS INDUSTRIES; PHOTOGRAPH, (TOP RIGHT) LESLIE R. HOLDRIDGE

FOREST MANAGEMENT

Top left: Clear-cutting in an old growth of Douglas fir. Natural reproduction is expected from adjacent uncut stands (Oregon)

Top right: *Cupressus* lusitanica serving as windbreaks on the slope of Barba volcano, Costa Rica

Centre left: Forester spraying longleaf pines with paint to mark them for cutting in a pulpwood thinning operation (Florida)

Centre right: Residual stand of slash pine after selective logging on a "tree farm." Remaining trees are measured to determine the volume left on the area and to forecast when the next cut may be made (South Carolina)

Bottom left: Aerial spraying of Douglas fir to control spruce budworm infestation (Montana)

Bottom *right:* Experimental clear-cutting to determine the effect of forest cover on water run-off and soil erosion (North Carolina)

BY COURTESY OF (TOP LEFT, CENTRE RIGHT) THE AMERICAN-SWEDISH NEWS EXCHANGE, INC., (TOP RIGHT, CENTRE LEFT, BOTTOM LEFT, BOTTOM RIGHT) U.S. FOREST SERVICE, (BOTTOM CENTRE) AMERICAN FOREST PRODUCTS INDUSTRIES

FOREST MANAGEMENT

Top left: Partial cutting to remove mature timber and open the stand for natural reproduction (Sweden)
Top right: Machine planting of young trees on an area being converted from potatoes to forest (Vermont)
Centre left: Felling a large Sitka spruce to be used for pulp (Alaska)
Centre right: Natural reproduction obtained by the shelterwood method of cutting (Sweden)
Bottom left: Fire lookout tower in relatively fiat country (Arkansas)
Bottom centre: Hand planting of young trees on burned-over land (Washington)
Bottom right: Using an aerial map to plan spraying from an airplane for insect control (Montana)

Range Policy (1956); Stephen Haden-Guest *et al.* (eds.), *A World Geography of Forest Resources* (1956); U.S. Forest Service, *Timber Resources for America's Future* (1958). (S. T. D.)

FOREY, ELIE FREDERIC (1804–1872), marshal of France, was born in Paris on Jan. 5, 1804, and entered the army from St. Cyr in 1824. In 1844, after ten Algerian campaigns, he was a colonel. Services in Paris in 1848 and in the coup d'état of Dec. 2, 1851, made him general of division and gave him the 1st corps in the Crimea; but A. J. J. Pélissier replaced him in Jan. 1855. A good general of division in Italy in 1859, he won an independent success (May 20) at Montebello and fought hard at Solferino. But the command of the expedition in Mexico from Sept. 1862 was too much for him; made a marshal on July 2, 1863, after the capture of Mexico City in June, he was superseded in August by A. F. Bazaine and recalled to France. His health gave way in 186; and he died at Paris on June 20, 1872. (I. D. E.)

FORFAR, a royal and small burgh and the county town of Angus (Forfarshire), Scot. Pop. (1951) 9,981. It lies at the east end of Forfar loch in the valley of Strathmore, 13 mi. N. by E. of Dundee by road. The town and county hall is one of the principal buildings and contains portraits by Sir Henry Raeburn, George Romney, John Opie and others. Peter Reid, a merchant, gave the Reid hall and a public park to the town. The staple industries are linen and jute manufactures and minor industries include the manufacture of agricultural machinery, fruit and vegetable canning, an iron foundry and ladder making.

Forfar is at least as old as the time of Malcolm Canmore, for the first parliament after the defeat of Macbeth (1057) met in the castle. which stood on a mound north of the town. The parliaments of William the Lion, Alexander II and Robert II also assembled within its walls. The town was created a royal burgh by David I and was burned about the middle of the 13th century. Edward I captured the castle, Robert the Bruce seized and destroyed it, its site now being marked by a 17th-century octagonal tower. which was presented by Charles II as a mark of regard for the loyalty shown by the town to his father, Charles I, during the Civil War. A witches' bridle, a gag to prevent witches from speaking while being led to execution, is still preserved in the town and county hall. One mile to the east lie the ruins of Restenneth priory, of 13th-century origin but believed to have been founded six centuries earlier by St. Boniface. (I. A. M.)

FORFARSHIRE: see **ANGUS.**

FORFEITURE, in law, the termination of a right; the loss or liability to the loss of property in consequence of an offense or breach of contract; it is also applied to the property of which the party is deprived. Under common law, conviction and attainder on indictment for treason or felony was followed by forfeiture of the life of the offender as well as his lands and goods. In the case of treason all the traitor's lands of whomsoever holden were forfeited to the king; in the case of felony (*q.v.*), including *felo*-de-se, or suicide (*q.v.*), the felon's lands escheated to his immediate lord, subject to the king's right to waste them for a year and a day. This rule did not apply to lands held in gavelkind in the county of Kent. The goods of traitors and felons were forfeited to the king. The desire of the king and his officers to realize the profits of these forfeitures was one of the chief motives for instituting the circuits of the king's justices throughout England, and from time to time conflicts arose from attempts by these justices to extend the law of treason — under which the king levied all the forfeitures — at the expense of felony, in which the lord of the felon benefited by the escheats. As regards theft, the king's rights overrode those of the owner of the stolen property, until, in the reign of Henry VIII, provision was made for restitution of the goods to the owner if he prosecuted the thief to conviction. It was common practice for persons anticipating conviction for treason or felony to assign all their property to others to avoid the forfeiture; and in some instances the accused refused to plead to the indictment and endured the *peine forte* et dure, until death supervened, to avoid these consequences of conviction. The royal rights to forfeitures arising within particular areas were frequently granted by charter to corporations or individuals. In 1897 the courts had to interpret such charters granted to the town of Nottingham in 1399 and 1448. All forfeitures and escheats with respect to conviction and attainder for treason and felony were abolished as from July 4, 1870, except forfeitures consequent upon the now disused process of outlawry, and the forfeitures included in the penalties of praemunire.

The term "forfeit" is also applied to penalties imposed by statute for acts or omissions which are neither treasonable nor felonious. In such statutes the forfeiture enures in favour of the crown unless the statute indicates another destination; and unless a particular method of enforcing the forfeiture is indicated it is enforceable as a debt to the crown and has priority as such. The words "forfeit and pay" are often used in imposing a pecuniary penalty for a petty misdemeanour, and where they are used the court dealing with the case must not only convict the offender but adjudicate as to the forfeiture.

Statutory forfeitures in some cases extend to specific chattels; *e.g.*, of a British merchant ship when her character as such is fraudulently dissimulated (Merchant Shipping act 1894, ss. 70, 76), or of goods smuggled in contravention of the Customs acts or books introduced in violation of the copyright acts. Recognizances are said to be forfeited when the conditions are broken and an order of court is made for their enforcement as a crown debt against the persons bound by them.

The term "forfeiture" is now most commonly used with reference to real property; *i.e.*, with reference to the rights of lessors to determine the estate or interest of a lessee for breach of the contractual terms of tenure. By legislation of 1881 and 1892 there is jurisdiction to grant relief upon terms against the forfeiture of a lease for breach of certain classes of covenant; *e.g.*, to pay rent or to insure. This previous legislation was re-enacted by the Law of Property act, 1925.

FORGERY, a common-law crime (*i.e.*, one originally created by England's courts rather than by its parliament), has been defined in various ways; one definition is "a false making (which includes every alteration of or addition to a true instrument), a making *malo* animo, of any written instrument for the purpose of fraud and deceit" (2 East, Pleas of the Crown, 852 [1803 ed.]). At common law, forgery and its companion crime of uttering a forged instrument (see below) were misdemeanours; under modern statutes in the U.S. and England these crimes generally are felonies. Forgery and uttering are made criminal acts principally to safeguard confidence in the various papers relied upon in commercial activity.

Definition. — Unless the definition is varied by statute, forgery consists of three elements: the making of a false writing (including the material alteration of a genuine writing), of a type that either has legal significance or is commonly relied upon in business or commercial transactions, with intent to defraud.

Writing. — The writing which will do for forgery is not limited to handwriting; it includes printing, engraving and typewriting as well. Thus a railroad ticket, though entirely printed, can be forged. "Writing" excludes pictures, sculptures and antiques; signing the name "Rembrandt" at the foot of a painting done by someone else is not forgery. (In some cases, however, the scope of forgery has been expanded by statute to apply to these and other articles which are not considered "writings" in common law.) Generally speaking, the writing must have legal significance — that is, it must be of a kind that, if it were genuine, would impose or alter or extinguish a legal obligation. Thus checks, promissory notes, stock certificates, bonds and other negotiable instruments, deeds, mortgages, leases, wills, receipts, contracts and the like may be forged. But forgery also encompasses some documents which, even if genuine, have no legal efficacy, such as a false letter of recommendation for employment, as it is a document commonly relied upon in the business world. On the other hand, a false letter of introduction will not suffice for forgery, even though it may request that courtesies be extended to the bearer of the letter.

Making a False Writing. — The forger may begin with an entirely blank piece of paper, with an incomplete genuine instrument with blanks to be filled or with a completed genuine instrument that may be altered. The usual manner of forging is to prepare a false writing and sign another's name to it, or to make a material alteration to a valid writing already signed by another. Forgery may be committed not only by the forger's signing of another's name. but by signing the name of a fictitious person whose purported signature is entitled to more credit than the forger's own signature; or by signing one's own name intending it to be accepted as the signature of another person of the same name; or by fraudulently securing the signature of another (as by showing the other an innocent writing and then fraudulently substituting a legal document for him to sign). It may be committed by an unauthorized filling-in of blanks in a genuine writing, as where the drawer of a blank check, after signing it, hands it to the forger with instructions to use it to pay the drawer's debt to his creditor, and the forger, in violation of his instructions, makes it payable to himself. It may be committed by a material alteration of a genuine writing, as by "raising" the figure "nine" to "ninety" on a valid check payable or endorsed to the forger. The alteration may be accomplished by means of the addition or substitution or erasure of words or letters or figures on a writing. The alteration must be material; it is not forgery to raise the figure 9 to 90 on a check if the written word "nine" is not raised to "ninety," since it is the written words, not the figures, which control in case of a variance.

A writing which contains false statements is not necessarily the "false writing" which forgery requires. Thus an employee who writes and signs a time sheet showing that he has worked 40 hours, when in fact he has worked but 30, is not guilty of forgery though he intends to defraud his employer. A check drawn on a bank wherein the drawer has no funds is not forgery, though the drawer implies that he has funds therein. These are examples of genuine writings containing lies. Thus it is sometimes said, "A forgery tells not merely a lie but a lie about itself."

Intent to Defraud.—A successful forgery may cause financial loss either to the person whose signature is upon the forged instrument or to the person to whom the instrument is negotiated and who relies on its genuine character. The forger need not intend to defraud any particular person; an intent to defraud in general will suffice. He need not intend to benefit himself; thus he may forge a check payable to his son. He is guilty of forgery though he intends to restore later what the injured party loses, or though he forges to collect a debt which he honestly believes the injured party owes him. Although in these situations he is not morally as much at fault as the forger who intends to obtain permanent financial rewards for himself, the goal of protecting commercial activity from spurious documents is furthered by the stricter rule. On the other hand, it is not forgery for one to sign another's name or fill in blanks or alter a genuine writing honestly, though mistakenly, believing that such conduct is authorized For forgery it is not necessary that anyone be actually defrauded by the false document. Unlike crimes such as criminal homicide, battery and arson. which require a specified bad result (a human death or injury; the burning of a house), forgery is committed when the forger makes the false writing nith fraudulent intent, without regard to any bad result of his conduct.

Uttering.— One who does not himself forge an instrument may be guilty of the related crime of uttering a forged instrument This crime is committed by offering as genuine a writing which the offerer knons to be false, done with intent to defraud. It is not necessary that the person to nhom it is offered be deceived, for "utter" means "offer" rather than "pass." Though the common-law crime of uttering a forged instrument is a crime separate from forgery proper, modern statutes sometimes consolidate the two, providing in effect that nhoever either forges a writing or utters a forged writing is guilty of "forgery."

Related Crimes.— Forgery is different from, but related to the crime of obtaining property by false pretenses. Making false statements in a genuine document— as in the case above of the employee who "padded" the figures in the time sheet in order to obtain more pay than he was entitled to—is not forgery; but if money or property is obtained as a result of the false statements. the crime of false pretenses is committed. "Bad check" statutes commonly make it a crime to draw a check on a bank in which the drawer has no funds, or insufficient funds, with intent to defraud, although such conduct does not amount to forgery.

A thorough study of bad checks in the state of Nebraska *(see* F. K. Beutel, *Some Potentialities of Experimental Jurisprudence as a New Branch of Social Science,* pp. 405–407, 1957) disclosed that one-half of 1% of all checks written in Nebraska were bad checks in the broad sense of forgeries, no-fund checks or insufficient-fund checks. Of these bad checks, 90% were insufficient-fund checks, 9% were no-fund checks and only 1% were forgeries. What is true in Nebraska is doubtless indicative of the situation elsewhere. So far as fraudulent checks are concerned. forgery does less harm to commercial activity than other forms of criminal conduct relating to checks.

See also CRIMINAL LAW. (4. W. ST.)

FORGES, COMITÉ DES. The *comite' des forges,* a French body, under state control, founded in 1864 to centralize and divide up the supplies of rough casting and to deal in British steels. was instituted as a "professional syndicate" in accordance with the law of 1884.

The *comite' des forges* dealt on behalf of its adherents with matters referring to their corporative interests: development of the industry on the home market and on the market abroad, commercial agreements, specifications, company matters and labour questions, etc.. etc. the study of these latter questions taking place in agreement with the other syndical chambers making part of the Union of the Metallurgic and Mining Industries; *e.g.,* the drafts of law on the workmen's superannuation, weekly rest: working of children in works with continuous fire, duration of work, company insurances, etc.

In 1891, seven years before the legislative work, the *comite' des forges* created and organized, under the form of a mutual insurance pay office. the pecuniary compensation of working accidents. This institution inspired the general principles of the law of 1898. Later the Insurance Pay office against working accidents was completed by a department for prevention of working accidents.

In 1894, the *comite' des forges* created the Superannuation Pay office of the forges of the metallic construction, the electric industries and industries combined with same, to ensure retiring pensions for metallurgical workers.

Seven years later the law on workmen's pensions was voted; a legislative regulation allowed joint-stock companies having the object of supplying pensions to workmen, to continue their operations; only the Pensions Pay office of the *forges* was able to benefit by this exception. (P. PE.; X.)

FORGET-ME-NOT, called also scorpion grass, the name popularly applied to the small annual or perennial herbs forming the genus *Myosotis*, of the family Boraginaceae (*q.v.*), from the Greek *mys* ("mouse") and *otos* ("ear")— the shape of the leaves. The genus is represented in Europe, north Asia, North America and Australia by over 40 species, and is characterized by oblong or linear stem leaves; the small flowers in terminal one-sided clusters are blue, pink or white with a five-cleft persistent calyx. The common Eurasian forget-me-not, *M. scorpioides,* found in Great Britain and naturalized in North America is perennial; it grows to a height of 6 to 18 in., with a creeping rootstock, softly hairy stem and light-green leaves. The flower buds are pink, becoming blue as they expand; the saucer-shaped corolla is bright blue with a yellow centre. The forget-me-not has several horticultural forms; some dwarf forms make fine ground covers.

ROCHE

ANNUAL FORGET-ME-NOT, A HORTICULTURAL FORM

About a dozen species are native in the United States, and

M. virginica is found throughout the country.

The forget-me-not, a favourite with poets, and the symbol of constancy, is a frequent ornament of brooks, rivers and ditches and, according to an old German tradition. received its name from the last words of a knight who was drowned in the attempt to procure the flower for his lady. It attains its greatest perfection under cultivation and; as it flowers throughout the summer, is used with good effect for garden borders. Various species are widely cultivated, especially *M. scorpioides* and *M. sylvatica. M. azorica,* which has no yellow "eye," is best grown as an annual, and is not easy to cultivate.

In *M. versicolor* the flowers are yellow when first open and change generally to a dull blue. Many reputed species are widely cultivated for their generally prostrate habit and profuse bloom. Most of the popular sorts are horticultural forms of M. *sylvatica,* which is an annual, but best treated as a biennial, and often persists from self-sown seeds. Some species make a beautiful ground cover when planted under tulips. (S. TR.)

FORGING. In the principal forging processes, articles of metal are shaped by hammering or pressing metal blanks between a pair of forging dies. In most processes an upper die is attached to the ram of a forging hammer, or press, so that it may be raised and dropped or forced under pressure against the rigidly supported, stationary lower die.

There are few theoretical limitations on the shape or size of a forging. other than the obvious need for a shape which can be removed from the die cavity. It has been estimated that more than 600,000 different closed die forgings are in regular production, including parts ranging from one-half ounce automobile carburetor links up to aircraft landing gear weighing as much as four tons.

DROP FORGING

Drop forging employs a drop hammer. so designed that the falling weight of the ram and upper die forces the heated metal into cavities cut into the face of each die. Similar closed dies are used for forging in presses. upsetters, etc.. described below.

Drop-forged articles are irequently confused with castings. but the manufacturing process is entirely different. Drop forging is essentially a shaping operation. the metal being worked in a forging hammer or press, commonly at a sufficient heat to bring it to a plastic state but never in the molten condition necessary for the production of castings.

Steel forgings ordinarily are produced from forging-quality steel. In producing forging-quality steel, improvement of the metal properties begins in the melting stage. The chemistry of the steel is carefully controlled. As the steel is processed from the ingot stage to bars, blooms, billets and slabs for forging, special care is exercised to eliminate foreign material and porosities which might be detrimental to metal quality. The forging operation constitutes a final step in improvement of metal quality to its maximum degree.

To understand the effect of the forging process on metal quality, it is necessary to consider the normal state of solid metal. Metals solidify from the molten state in minute crystal form. The process of rolling bars, billets, etc., from the ingot tends to elongate these crystals of metal and lock them together. This produces a "grain" in the metal (so called from the analogy to grain in wood) and the mechanical properties of the metal are usually found to be somewhat better in the direction of the grain. (This is not to be confused with "grain size," which refers to crystal size.)

In closed-die forging, the fibrelike flow lines of grain structure developed by rolling are worked into such positions as to impart maximum strength relative to the stresses expected in the forged article. For maximum strength the grain should not run transversely to the axis of the greatest bending stress. This is one of the great advantages of drop forgings over castings. In a casting, where the metal is melted and poured into a mold, there is no grain in this sense; but in closed-die forgings, always made from bars or billets which have the grain running longitudinally, very careful attention can be paid to the grain disposition so that maximum strength is achieved.

Forgings are made in many metals. In addition to the various alloys of steel and iron, other metals and alloys that may be forged include copper, brass, bronze, nickel, aluminum, magnesium, titanium and the various high temperature alloys. Considerable progress has been made in forging the newer light alloys.

Conventional iorging is divided into four classes, dependent on the type of machine used: hammer forging, upsetting, open frame or smith forging, and helve hammer forging.

Hammer Forging.—In hammer forging, four types of hammers are employed: the board drop gravity hammer; the air lift gravity drop hammer; the steam drop hammer; and the steam-driven hammer. All have these features in common: a base; a hammer or ram which strikes the base and which travels vertically between side guides, and the overhead mechanism for lifting the hammer and releasing it. In the board drop gravity hammer a board, or set of boards, generally of maple, raises the ram. The lower end of the board is fastened to the upper portion of the ram and the upper end of the board travels between two driven rolls revolving in opposite directions. An automatic mechanism moves rolls toward one another, into contact with the board, and as they revolve they lift the board and attached ram. The rolls then spread apart, allowing the ram to fall. The steam drop hammer utilizes a steam cylinder for the lifting mechanism, a piston rod taking the place of the board and the ram being fastened to the lower end of the piston rod. The air lift gravity drop hammer is fundamentally the same as the steam drop hammer, but uses compressed air instead of steam. The steam-driven hammer operates in similar fashion except that the downward stroke of the ram is accelerated by both gravity and steam pressure.

Whether for closed die or flat die (smith) forging, metal to be drop forged is first heated in an adjacent furnace. In closed die forging, the heated metal is placed between the drop hammer dies and several blows are struck in quick succession, forcing the metal evenly into the die impressions. The number of blows must be gauged with close accuracy by the forging hammer operator. Too few blows will not obtain uniform strength in the forging, while too many will shorten the life of the dies. A small quantity of metal is forced outward, beyond the limits of the actual forging impressions when the two dies meet, and this surplus, called "flash!" is removed after forging by means of trimming tools fixed in a press. One tool duplicates, in solid form, the outline shape of the forging; the other is made hollow to the outline of the part at the point of the flash. The forging is forced through the hollow tool by the solid one, cutting off the flash. The forging may subsequently be returned to the hammer for one more blow to correct any small distortion occurring during the trimming operation.

Drop forging hammers are rated according to the weight of the falling ram. Ratings range from 400 to 7,500 lb. capacity for board drop hammers; 500 to 5,000 lb. for air or steam lift gravity drop hammers; 1,000 to 50,000 lb. for steam-driven closed die drop hammers; and 200 to 100,000 lb. for steam-driven smith hammers.

Upsetting.—In the upsetter or forging machine, a bar or "multiple" is heated and placed in the opening between a pair of gripping dies; one of these may be fixed or both may be movable. A ram is then forced against the end of the held bar, upsetting it and forcing the metal to fill whatever impression the gripping dies contain. The ram is then withdrawn and the gripping dies open for removal of the piece. The size of forgings produced by the upset method ranges from less than a pound to as much as 500 lb. Gpsetters are rated according to the size of the initial stock processed. Commonly, the size range of equipment is from one-half inch to about eight inches.

Open Frame or **Smith** Forging.—Open frame forgings are made by hammer forging the metal between a pair of flat dies, and some of the shape may be given to the piece by use of stock hand tooling. Thus, the shaping of the forging depends to a great extent upon the skill of the hammersmith. Smith forgings are made to approximate sizes and usually must be machined on surfaces requiring close dimensions. For this reason, the smith-forging method is usually employed when quantities are small and the finished shape can be completed by machine work, or when sizes are too large or irregular to be contained in closed dies. The size range of smith forgings is from less than a pound to more than 200 tons.

Helve Hammer Forging. — Helve hammers are used principally for high-speed work for which the heavy impact of drop hammers is not required. The striking force is delivered to the dies by a wooden helve (handle), operating with the motion of a hand sledge. The upper die may be fastened to a guided ram operated by the helve, or to the helve itself. Preparatory and finishing operations and light production work are usual applications of helve hammers.

Forging Presses. — The machines used for forging can be classified in two major categories, hydraulic and mechanical. Hydraulic forging presses are used both for smithing operations and for closed-die forging. The hydraulic medium may be either water or oil, but steam- and air-operated presses are also used. The hydraulic pressure may be applied through one or more rams to give single pressing action from above or below, or in combination with side-cylinder movements. For double-action purposes, one set of rams may furnish a holding action while another ram or rams complete the forming action. The source of fluid pressure may be a storage accumulator of the water, air or nitrogen type. Alternatively, a direct pumping system commonly is used for efficiency and rapid response on self-contained presses.

Mechanical forging presses are the second structural type. A crank or eccentric drive furnishes power stored in a flywheel through a clutch to the slide and dies of the press. Mechanical forging presses are used particularly for mass-production closed-die work. More care must be taken with billet-size control and with thorough heating of billets to avoid damage to the positive actuating structure of the press. Single-crank machines are the most common, although wider double-crank types are desirable where a number of operations are required to complete the forging. Also in use are double-action mechanical presses in which one action closes the dies and the second action forces the metal to fill the dies.

The sizes of commonly used forging presses range from 50- to 300-ton capacities (this rating describes the pressure which can be exerted), while larger mechanical presses range up to 6,000 tons. The need for larger, stronger parts for jet and turbojet aircraft made necessary the development of giant hydraulic forging presses ranging from 25,000 to 50,000 tons capacity and larger. On these presses, complete wing and air-frame components formerly requiring hundreds of assembled parts can be forged in one piece, resulting in important savings in time and tooling costs as well as improvements in strength-to-weight ratio and performance.

In conjunction with the larger presses, heavy mobile manipulators or overhead cranes and lift trucks are essential for handling large forgings and for changing dies. Control systems for forging presses vary widely in design, depending upon the type of press and the work to be performed. Thus. for flat-die presses the ram is made to respond directly to manual hand or foot control so that the stroke may be long or short and pressure may be applied in a series of rapid strokes or intermittently, as required. For production types with closed dies, it is more usual to employ push-button or foot-pedal remote control, and the operator, aided by simple gauges, plus sight, sound and touch, can easily judge the proper action.

Control of the larger 25,000- to 50,000-ton forging presses requires the operator to depend on indicating instruments, servo-mechanisms and electronic aids for instantaneous, exact information on press reactions. Operators must also undergo special training. Severai crewmen and observers are required, working under the chief operator who is stationed at a console-type control board.

OTHER FORGING PROCESSES

Roll Forging. — Another method of forging is by the use of matched rotating rolls or segments of rolls which have impressions sunk in their surfaces. The metal blank is rolled into these impressions a's the rolls turn. Forging rolls are used chiefly for elongating and tapering stock for parts such as gear shift levers. Processing in forging rolls is frequently used in conjunction with other forging operations in hammers or upsetters.

Impact Forging. — The impacter is essentially a forging hammer in which both dies are moved from opposite directions, meeting at the point where the forging blow takes place. The movement of the dies is in the horizontal plane. The process has several advantages. Since the dies are of approximately the same weight, each tends to absorb inertial energy of the other at the point of impact. in contrast with the conventional hammer which transmits energy through the anvil and hammer base to its foundation. For this reason the impact type of equipment does not require the heavy foundations necessary for conventional hammer-type equipment. For the same reason, more energy is absorbed by the metal blank being forged, which is of advantage in processing material which is tough and resistant to forging, such as stainless steel, or which has a low modulus of elasticity and consequently absorbs much energy, such as aluminum. Other advantages include the facts that stock is worked equally from two opposing sides; that contact between stock and die occurs only during actual impact, resulting in lower die temperature and longer die life; and that stock is moved more rapidly and less forging energy is required. The capacity of impacters is rated according to the force of the blow delivered, measured in foot-pounds, and sizes range from 400 ft.-lb. to 15,000 ft.-lb.

Counterblow Forging. — Similar to the impacter, counterblow forging hammers were introduced in the United States after World War II. The counterblow hammer, as may be inferred from the name, uses two vertically operating, counteracting rams. The lower ram and die replace the anvil of the conventional forging hammer. The rams move together with nearly equal kinetic energy, imparting this energy to the metal being forged. Thus, kinetic energy is concentrated upon the forged piece from two opposite sides. This symmetrical blow of two rams on the forged piece, with accompanying energy concentration, makes possible the forging from resistant alloys of intricate shapes to close tolerances. It also provides for shock absorption within the forging itself. eliminating the need for deep hammer foundations and avoiding energy losses into the foundation. The impact velocity of the rams for counterblow hammers is reported to be about half that required for conventional drop hammers. The counterblow hammer fills a gap between the drop hammer and the hydraulic press, because it makes possible the economical forging of larger parts and complex shapes.

Cold Forging. — Much progress has been made in forging metals "cold." or at temperatures below the point at which grains begin to coarsen (a point above 1,700° F. for steels, varying according to alloy content). Advantages of dimensional accuracy, improvement of mechanical properties and other benefits are gained. Cold heading has of course been used for many years in the manufacture of bolts and similar products.

DIE BLOCKS AND DIE MAKING

For production of a closed-die forged article, impressions are cut in two die blocks to the exact shape and size of the part wanted, with compensation for normal die wear and shrinkage. Since metal is forged while hot and shrinks in cooling. contraction must be allowed for when making dies. All forging dies are made larger than the size of the cold piece by an amount equal to normal shrinkage. Careful attention is given to the cutting of die impressions, which are frequently very intricate. Expensive steel is employed for dies, and highly skilled craftsmen prepare the die impressions. In the design of dies for production of forgings. no hole or depression may be larger at the bottom than at the top, although it may be smaller. In actual practice. it is ordinarily slightly smaller by an amount equal to the "draft." as the angle at the side of every depression is called. No surface of a drop forging may be parallel to the path of travel of the dies, but must depart from parallelism by an amount not less than the draft angle and in the direction which will make all parts of the forging smaller at the bottom of the impression than at the top in each die. The usual draft angle is 7°.

Die design is influenced by the quantity of parts to be made at one setting of the dies as well as by the quantity eventually wanted. Dies may be designed to make two or more forgings at once, the forgings later to be cut apart by trimming.

The cutting of die blocks involves several steps. and various impressions may be cut into the die faces to permit successive stages in forging the part to final shape. Basic preshaping forging impressions in sequence are fullering and edging, to alter the cross section of the material and blocking, to rough-shape the metal prior to placing it in the finishing impression. After the finishing impression has been cut in the die blocks, accuracy of the nork is tested by placing the pair of die blocks face to face and pouring melted lead into the impression and allowing it to harden. The resultant lead model of the finished forging is checked against specifications for the desired part

The quantity of forgings which one pair of dies will produce varies from as few as 100 pieces under poor conditions to a maximum of 500,000 under the best conditions. Normal life lies between 10.000 and 40 000.

Much attention has been given to improvement of die-sinking methods. One of the newer methods employs semiautomatic machinery which sinks die impressions by pantographic copying from a master or mock-up. Another method employs electrical disintegration. The "tools" used in this latter method are electrodes cast in the shape of the part to be forged. The cast electrode is placed in contact uith the face of the new die block and high voltage electric current is passed through it. The die metal erodes at points of contact with the electrode. passing into a solution in which the die is immersed. As metal is eroded the electrode sinks into the die face, forming the exact impression required It is reported that this method eliminates bench work and produces new dies at approximately 50% saving. The same method can be used to resink worn dies. *See* also METALLURGY. (R. E. KR.)

FORK, an implement formed of two or more prongs at the end of a shaft or handle the most familiar type of which is the table fork for use in eating. In agriculture and horticulture the fork is used for pitching hay and other green crops, manure, etc.; this has two to five prongs, or tines; for digging, breaking up surface soil. preparing for hand weeding and for planting the three-pronged fork is used. The word is also applied to many objects which are characterized by branching ends, as the tuning fork. with two branching metal prongs. which on being struck vibrates and gives a musical note, used to give a standard pitch; to the branching into two streams of a river. or the junction where a tributary runs into the main river; and in the human body, to that part where the legs branch off from the trunk. The *furca,* two pieces of wood fastened together in the form of the letter A, was used by the Romans as an instrument of punishment. It was placed over the shoulders of the criminal, and his hands were fastened to it. Condemned slaves were compelled to carry it about with them, and those sentenced to be flogged would be tied to it; crucifixions mere sometimes carried out on a similarly shaped instrument. See also CUTLERY.

FORKEL, JOHANN NIKOLAUS (1749–1818), German musician, was born on Feb. 22, 1749, at Meeder. Saxe-Coburg. The son of a cobbler, he was a good musician; but his fame rests on his historical work. His library, which was accumulated with care and discrimination at a time when rare books were cheap, forms a valuable portion of the State library in Berlin.

Forkel became organist to the university church of Gottingen, where he had been a student. in 1770, was made musical director of the university in 1778 and obtained the Ph.D. degree in 1780. He died there on March 20. 1818. His most important work is the *Allgemeine Literatur* der *Musik* (1792). His Uber *J. S Bachs* Leben, Kunst *und* Kunstwerke (1802), the first biography of that master, remains valuable and was translated into English in 1820 (new trans. by C. S. Terry, 1920).

FORLÌ, a town and episcopal see of Emilia Romagna (anc. *Forum Livii*), Italy, capital of the province of Forli. 40 mi. S.E. of Bologna on the railway to Rimini, 108 ft. above sea level. The population (1931) 45,927. The church of S. Mercuriale in the square contains paintings, and good carved and inlaid choir stalls. The fine square, brick campanile (1178–80) is 252 ft. in height. The municipal picture gallery contains works by Marco Palmezzano (1456–1537) and other interesting pictures, including a fresco representing an apprentice with pestle and mortar (Pestapepe), the only authentic work in Forli of Melozzo da Forli (1438–94), pupil of Piero della Francesca, and master of Palmezzano, of whose works there are several there. The Palazzo del Podesta is a brick building of the 13th century. The citadel (Rocca Ravaldina) uas constructed about 1360–70 and rebuilt later. The felt industry has considerable importance and the surrounding territory is very fertile.

Of the ancient Forum Livii, which lay on the Via Aemilia, hardly anything is known. In the 12th century we find Forli in league with Ravenna. and in the 13th the imperial count of the province of Romagna resided there. In 1275 Forli defeated Bologna with great loss. Martin IV sent an army to besiege it in 1282, which was driven out after severe fighting in the streets; but the town soon afterward surrendered. In the 14th and 15th centuries it was under the government of the Ordelaffi; and in 1joo was taken by Caesar Borgia, despite a determined resistance by Caterina Sforza, widow of Girolamo Riario. Forli finally became a part of the papal state in 1504.

FORM, in ordinary language, is the shape or structure of a thing, as contrasted with the materials of which it is made, or with its contents. Two objects might then be said to differ from each other in respect of their contents while being similar in form (*e.g.,* two of Shakespeare's sonnets); or in respect of their form, while being similar in materials (*e.g.,* two different models built from the same constructional apparatus) or similar in content (*e.g.,* Shakespeare's play *Othello* and Verdi's opera based on the story); or in respect both of form and of materials or content. Differences and similarities of form are a matter of degree. Two musical compositions may both be in sonata form, while differing greatly in their formal detail.

One play may resemble a second in being operatic, while differing from it and resembling a third nonoperatic play in being a tragedy. The greater the emphasis placed by an author, composer or artist on the structure of a composition, and the leis on its content. the more formal the work is said to be, so that in the extreme case "formal" is applied as a term of critical disapproval to a work which is highly strict and rigid in its structure, while bloodless in its content.

philosophy **and Logic.**—The notion of form has been constantly used in a variety of different ways throughout the history of philosophy. While Plato's word *eidos,* which is normally translated "form," perhaps should not be so translated (see IDEALISM; UNIVERSAL), Aristotle certainly made the distinction between matter (hypokeimenon or hyle) and form (eidos or *morphe*). The matter of a thing will consist of those elements of it which, when the thing has come into being, may be said to have become it; and the form is the arrangement or organization of those elements, as the result of which they have become the thing which they have. Thus bricks and mortar are the matter which, given one form, become a house, or, given another, become a wall. As matter they are potentially anything that they can become; it is the form which determines what they actually become. Here "matter" is a relative term, for a brick on the pile, while potentially part of a house, is already actually a brick; *i.e.,* it is itself a composite of form and matter, clay being matter to the brick as the brick is to the house or to the wall. Matter is that which is potentially a given object but which actually becomes that object only when it is given the right form.

Aristotle's notion of form combines with his teleological viewpoint to give the conclusion that formal development has a direction and may have a goal and that some things are more informed than others. Bricks are more informed than clay, and a house more than bricks. The four elements of which man is, as it was held. composed are the matter of man, but he, although at death he decomposes into them, is not the matter of them, for in his creation they are given a form whereas in his dissolution he is not given a form.

In logic (*q.v.*) it has always been recognized that form is the central notion of the subject; that logic is the study of the rules of argument, independent of the particular subject matter involved in the argument: and that the validity of the argument depends upon the formal properties and relations of the statements. Because logic is in this sense formal, logicians have since the time of Xristotle tended to employ symbolic notations designed to exhibit the forms of statements and of arguments independent of their subject matter. in this way assimilating logic to mathematics; some have even gone so far as to claim that mathematics is reducible to logic. While the use of a special notation is helpful for displaying logical form. it has encouraged certain erroneous tendencies such as to suppose that a given statement has only one form. so that the question can sensibly be asked what is the form of that statement (whereas in fact it may have different forms in difierent respects) ; that the parts which a statement may play in arguments depend on its form (whereas in fact those parts are its form); or that the logical form of a statement is quite separate from its linguistic form (a mistake made possible only by a very superficial view of the nature of language). The logical forms of statements are wrongly conceived of as the skeletal structure of each: they should rather be thought of as the logical powers which they possess in varying kinds of arguments and inferences. (A. D. W.)

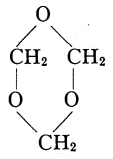
Other Senses. — Some notion of form is indispensable to the practice and criticism of several disciplines other than philosophy and logic. In literature, form is the schema or structure that a writer chooses for the presentation of his matter; *e.g.*, novel, short story. maxim: epic. sonnet: pantoum, etc. (see the individual articles on the various prose and verse forms). In criticism of the graphic and plastic arts. form means either the effect achieved by draftsmanship or mass as opposed to that achieved by colour or the total effect of the technical organization of the work as opposed to its representational significance (if any). In the study of the Gospels, form criticism is the attempt to analyze the narrative according to supposed sources and to classify each episode according to the form in which it is recorded, this form being regarded as distinctive of the special interests and motives of a particular body of preaching from which the evangelists derived the story of the episode. In sport, form is the standard of an athlete's or an animal's attainment as tentatively calculated from past performances.

FORMALDEHYDE, is the first member of the aldehyde group of chemical compounds. Pure monomeric formaldehyde is a rather unstable compound. but it has been obtained and is a gas (boiling point. −21° C.; melting point, −92° C.). It has the formula H.CHO. On keeping, the monomer is transformed into the polymer, trioxytrimethylene, $(CH_2O)_3$, which has the cyclic structure (I) below.

Practically all the formaldehyde now produced is made by a catalyzed vapour phase oxidation of methanol, $2CH_3OH + O_2 \rightarrow 2CH_2O + 2H_2O$. Of the many different catalysts which are effective, those which are used most frequently are silver either as a deposit on asbestos or as a fine wire mesh. Formaldehyde is available commercially as its aqueous solution, which is normally called formalin and which contains 36%–38% by weight of formaldehyde. On keeping formalin solutions. paraformaldehyde is precipitated as a white Solid; it has the indefinite structure $(CH_2O)_n$. H_2O. Paraformaldehyde is of considerable technical importance because it is transformed into formaldehyde just by heating. Thus the solid paraformaldehyde is a convenient source of gaseous formaldehyde.

Chemical Properties. — Although formaldehyde contains the aldehydic $-CH=O$ function, it does in fact show many reactions which are not typical of the other aldehydes. Formaldehyde is oxidized to formic acid and is reduced to methanol. It reacts with practically all types of organic compounds including unsaturated hydrocarbons. aldehydes. ketones, esters, alcohols. carbohydrates. proteins, amines. amides and phenols, and it is this versatile chemical behaviour which makes formaldehyde such an important intermediate in technical processes.

Industrial Uses. — Formaldehyde and ammonia yield hexamethylenetetramine (II), which is used medicinally as a urinary antiseptic. Nitration of hexamethylenetetramine gives the explosive, RDX (III). Formaldehyde, acetaldehyde and calcium hydroxide give pentaerythritol, $C(CH_2OH)_4$, the intermediate in the manufacture of the explosive penterythritol tetranitrate, PETS.



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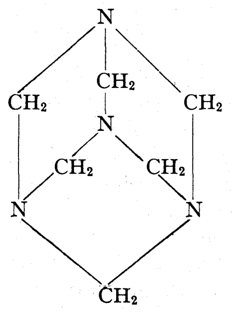

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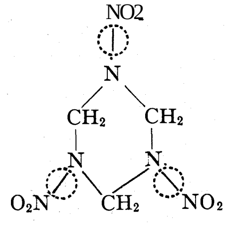


III

Large quantities of formaldehyde are used in the manufacture of urea-formaldehyde and phenol-formaldehyde plastics (*see* RESINS: Synthetic Resins). The reaction of proteins with formaldehyde forms the rationale for its use in the tanning industry and in the treatment of various vegetable proteins so that they become fibrous and can then be used in textile manufacture. The reactivity of proteins toward formaldehyde is also the reason for its use as a disinfectant, as an embalming agent and as a sterilizing agent for soil.

See J. F. Walker, Formaldehyde (1944). (W. D. Os.)

FORMALIN: see FORMALDEHYDE.

FORMALISM, in philosophy generally, means undue attention to forms (of thought. or reasoning, etc.), at the expense of content and concrete circumstances. In ethics and religion it refers to the attachment of undue significance to the externals of convention, or to ritual, at the expense of the spirit and substance of morality and religion respectively.

FORMAN, ANDREW (c. 1465–1521), Scottish ecclesiastic, was educated at the University of St. Andrews and entered the service of King James IV, who employed him on various foreign missions. In 1501 he became bishop of Moray, and in July 1513 Louis XII of France secured his appointment as archbishop of Bourges, while Pope Julius II promised to make him a cardinal. In 1514 Forman was nominated by Pope Leo X to the vacant archbishopric of St. Andrews and was made papal legate in Scotland, but his possession of the see was delayed until 1 j16 because of the rivalry of Gavin Douglas, the poet, and John Hepburn, prior of St. Andrews. He died on March 11, 1521. As archbishop he issued a series of constitutions which are printed in J. Robertson's *Concilia* Scotiae (1866).

A. Lang (History of Scotland, vol. i) describes Forman as "the Wolsey of Scotland, and a fomenter of the war which ended at Flodden."

See J. Herkless and R. K. Hannay, The Archbishops of St. Andrews, vol. ii (1909).

FORMAN, SIMON (1552–1611), English quack physician and astrologer, was born on Dec. 30, 1552, in Quidhampton, a small village near Wilton, Wiltshire. At the age of 14 he became apprentice to a druggist at Salisbury, but at the end of five years he exchanged that profession for one of a schoolmaster. Shortly afterward he entered Magdalen college: Oxford: where he studied chiefly medicine and astrology. After continuing the same studies in the Netherlands he commenced practice as a physician in London, but he possessed no diploma and was imprisoned a number of times.

Ultimately, however, Forman obtained a diploma from Cambridge university after he had established himself as a physician and astrologer at Lambeth, where he was consulted by many persons of high society, especially women.

A professed practitioner of necromancy, he was condemned on various occasions by the College of Physicians: He died suddenly while crossing the Thames on Sept. 12, 1611.

FORMIA, a town of Lazio. Italy (anc. *Formiae*), province of Latina, on the new direct line between Rome and Naples, 50 mi.

N.W. of the latter. Pop. (1951) 12,077. It is situated at the northwest extremity of the Bay of Gaeta and commands beautiful views. It lay on the ancient Via Appia, and was much frequented by wealthy Romans; and it is still a seaside resort in the summer. There was considerable imperial property there and along the coast as far as Sperlonga, and there are numerous remains of ancient villas along the coast and on the slopes above it in some of which important sculptures have been found. The so-called villa of Cicero contains two well-preserved *nymphaea* with Doric architecture, now visible in the villa Caposele, once a summer residence of the kings of Naples. There are many other modern villas, and the sheltered hillsides (for the mountains rise abruptly behind the town) are covered with lemon, orange and pomegranate gardens. The now deserted promontory of the Monte Scauri to the east is also covered with remains of ancient villas; the hill is crowned by a large tomb, known as Torre Giano. To the east at Scauri is a large villa with substructions in "Cyclopean" work.

The ancient Formiae was a Volscian town. Cicero possessed a favourite villa there, and was murdered in its vicinity in 43 B.C., but neither the villa nor the tomb can be identified with any certainty.

FORMIC ACID was first prepared from red ants (Lat. *formica*). It occurs naturally in animal secretions and in muscle. It is the first member of the series of aliphatic monobasic acids (*q.v.*), distinguished from the other members of the series by certain characteristic properties. For example, it shows an aldehydic characte'r in reducing silver salts to metallic silver, it does not form an acid chloride or an acid anhydride, and, by the abstraction of the elements of water from the acid, carbon monoxide is produced, a reaction which finds no parallel in most higher members of the series. Finally, formic acid is, as is shown by the determination of its ionization constant, a much stronger acid than the other acids of the series. Its formula is H.COOH. It may be prepared synthetically by the oxidation of methyl alcohol and of formaldehyde; by the rapid heating of oxalic acid (J. Gay-Lussac, 1831); but best by heating oxalic acid with glycerine at a temperature of 100°–110° C. (M. Berthelot, 1856). In this reaction a glycerol ester is formed as an intermediate product, and undergoes decomposition by the water which is also produced at the same time.

On the industrial scale, formic acid is made from sodium formate (*see* below). It is employed in the dyeing and tanning industries and in organic synthesis.

Formates are produced by the action of moist carbon monoxide on soda lime at 190°–220° C. (V. Merz and J. Tibiriçá, A. Geuther, 1880). An interesting process for sodium formate, due to Bredig and Carter (1915), consists in reducing a solution of sodium bicarbonate with hydrogen at 70° C. under 60 atm. pressure in presence of a palladium catalyst. Sodium formate is manufactured by absorbing carbon monoxide by sodium hydroxide at 120°–130° C. under a pressure of 8 atm.

Concentrated formic acid is prepared by dissolving sodium formate in an equal weight of 90% formic acid, and then distilling the mixture with concentrated sulfuric acid in copper vacuum pans (M. Goldschmidt, 1894). Anhydrous formic acid results when the lead or copper salt is decomposed by dry hydrogen sulfide at 130° C. Solid formic acid melts at 8.6° C. At ordinary temperatures, formic acid is a colourless, sharp-smelling liquid that boils at 100.8° C. Its specific gravity is 1.2206 (20°/4°). It is miscible in all proportions with water, alcohol and ether. The sodium and potassium salts, when heated to 400° C., give oxalates and carbonates of the alkali metals, but the magnesium, calcium and barium salts yield carbonates only. The free acid, when slightly warmed with concentrated sulfuric acid, is decomposed into water and pure carbon monoxide; when heated with nitric acid, it is oxidized first to oxalic acid and finally to carbon dioxide. The salts of formic acid, the formates. are mostly soluble in water. The calcium salt, when heated with the calcium salts of higher homologues, gives aldehydes. The esters of the acid may be obtained by distilling a mixture of the sodium or potassium salts and the corresponding alcohol with hydrochloric or sulfuric acids.

Formamide, $H.CO.NH_2$, is obtained by heating ethyl formate with ammonia, by heating ammonium formate with urea to 140° C., or by heating ammonium formate in a sealed tube for some hours at 230° C. It is a liquid ahich boils at 122° C. under a pressure of 32 mm., but at 200° C. under ordinary atmospheric pressure. with partial decomposition into carbon monoxide, water, ammonia and hydrogen cyanide. (*G.* W. WD.)

FORMICARIIDAE: *see* PITTA.

FORMIGNY, BATTLE OF (1450). The battle of Formigny, fought on April 15, 1450, was the last but one waged by the English during the Hundred Years' War. Its special interest lies in the use of field artillery, and its influence on bow and lance tactics. The duke of Somerset was at Caen threatened by an overwhelming French army under King Charles. To open a way to this city. Sir Thomas Kyriel and 4,500 men were dispatched from England. At Formigny this force was confronted by the count of Clermont at the head of about 3,000 lances, a body of local infantry and two small cannons. Kyriel should have attacked the French at once, since his object was to relieve the duke who was hard pressed, but so wedded were the English to defensive tactics that he fell back behind Formigny to a brook lined by orchards, and there drew up his men in a convex line, the archers covering their front by a trench and the usual palisade of stakes. The French, having by now learned the folly of assaults on unshaken bowmen, skirmished for a while. Then Clermont ordered Giraud. "master of the royal ordnance" to bring up his two guns to enfilade the English line. This proved so effective that the archers left their defenses and charged forward capturing the pieces. Kyriel, in place of advancing the whole line and so taking advantage of the mêlée, persisted in the defensive, with the result that the archers who had captured the two guns were attacked in flank, and not being able to make use of their bows were thrown back in disorder onto the men at arms. A clinch then took place, and the battle was decided by a fresh body of French knights (under the counts of Richemont and Laval) appearing on the field. This force charged the English in flank, surrounded them and annihilated Kyriel and his main battle. The English losses amounted to no less than 3,750, those of the French were probably about 1,200. This battle marks one of the great turning points in tactics, for before the 15th century ended cannon played an increasingly important part at every siege, and on every field.

See Blondel, *Reductio Normanniae;* C. Oman, *The Art* of *War in the Middle Ages* (1924). (J. F. C. F.)

FORMOSA, a northern province of Argentina bordering the republic of Paraguay, has an area of 27,825 sq.mi. Pop. (1956 est.) 184,719, a large percentage of whom are Indian. The province lies within the Chaco (*q.v.*), a vast alluvial plain covered with forests interspersed with grasslands and marshes. It has a subtropical climate, with a long rainy season (October to June) and an average temperature during those summer months of 80° F. The winter months are dry, with an average temperature of 63°. Agriculture (particularly tobacco and sugar) and cattle-grazing are the chief sources of wealth, but both activities are seriously handicapped by recurrent droughts and floods. Quebracho trees (from which tannin is extracted) grow wild in the more distant forests. The capital is Formosa (pop. 1956 est., 26,645) on the bank of the Paraguay river. (GE. P.)

FORMOSA (TAIWAN), is an island separated from the southeast coast of China by the 100-mi. wide Taiwan strait (T'ai-wan hai-hsia) and one of a great island system rimming the western Pacific ocean. Generally oval-shaped and with a north-northeast-south-southwest axis, it is 235 mi. long and 90 mi, wide at maximum; it lies between parallels 21° 54' N. and 25° 20' N. and meridians. 120° 4' E. and 121° 57' E. Its area, exclusive of the neighbouring Pescadores but including several other small offshore islands, is 13,837 sq.mi. To the northeast are the Ryukyus; to the south the Bashi channel and the Philippines. The origin of the Chinese name T'ai-wan (conventionally Taiwan) is unclear; Formosa, commonly used by many is from the Portuguese word meaning beautiful.

Physical Geography. — Formosa is a great fault block, tectonically unstable, trending north-northeast — south-southwest and tilted toward the west. Its eastern margin marks the edge of the continental shelf. The highest areas are in the Chung-yang Shan-mo (Central range). the crest of nhich lies east of the island axis. Numerous peaks rise above 10.000 ft.. the highest being Yu Shan (12,959 ft.; called Niitaka Yama by the Japanese and Mt. Morrison by westerners). Old. resistant sedimentary and metamorphosed rocks are exposed by erosion in the east. and younger softer sedimentary formations in the west. East of the mountains is a long (100 mi.), narrow (5–9 mi.) valley of fault origin, covered with alluvium and open at its northern and southern ends to the sea. Farthest east are the eastern coastal ranges of volcanic origin, rising to 7,000 ft.

TIERS FQOM MCNKMEYER

COOKING ON A HABACHI ("STOVE") IN T'AI-CHUNG, FORMOSA

West of the central highlands is a coastal alluvial plain, still being extended into the shallow Taiwan strait, 25 mi. at its greatest width. and the heartland of the island. This plain is broken by hills north of 24° N. into a southwestern component and a lesser, fragmented northern portion, including the fertile T'ai-pei basin, to the north of which are volcanic highlands rising to 3,700 ft. Along the northeastern coast is an isolated alluvial lowland. the triangular I-Ian plain.

Rivers in general are short and subject to extreme variations in flow especially on the southwestern plain. Soils of alluvial origin cover about a fourth of the island and are its chief wealth. Upland soils are leached, acid and of low fertility.

About 55% of the island is forested; another 12% is wasteland. Forests are graded altitudinally, from coniferous stands above 9,000 ft. through mixed stands to about 6,500 ft. of cedars, cypress. junipers, rhododendrons. maples and cryptomeria to broad-leaved evergreen forests which include camphor trees. In the lowlands are mixed bamboo, evergreen and palm stands. Steppelike vegetation occurs in the drier southwest.

Climate.—Lowland Formosa is frost-free. The climate is ameliorated by the waters of the warm Japan or Black current. The mean temperature of the coldest month, January, in the north is about 58° F.; summers are hot and humid. and in the south winters are warm to hot as well. Temperatures fall with altitude. however, and the central mountains are snow-covered in winter. All areas receive 40 or more inches of rainfall. and the mountains receive up to five times that figure. The southwest. which lies in the winter lee of the central mountains, receives its rainfall almost entirely in the summer months. The northeast also receives orographic winter precipitation.

Population. — Population is predominantly Chinese. Most are the descendants of immigrants from Fukien (Fu-chien) province, chiefly from the Lung-ch'i (Chang-chou) and Ch'üan-chou areas; secondly from Kwangtung (Kuang-tung) province, chiefly Hakkas (*q.v.*) from the hinterland of Swatow (Shan-t'ou). Seven major Chinese dialects are spoken by these people. In addition, a sizable immigration of Chinese, many Mandarin-speaking, from other parts of China occurred after 1946. The aborigines, numbering some 200.000. are of Indonesian origin and reside in the foothills and highlands where many practice shifting cultivation. The Ami. Atayal, Paiwan, and Apayao (Izneg) are the major groups, all experiencing partial assimilation.

In 1905 the Japanese took the first census! and seven population censuses were taken thereafter at five-year intervals: followed by censuses in 1946 and 1956. The population of Taiwanese (exclusive of Japanese and other foreigners) increased from 2,970,000 in 1905 to 5,510.000 in 1940. By the mid-1930s the rate of natural increase had accelerated to 24 per 1,000. This rate increased in the late 1950s to about 36 per 1,000 because of falling death rates (8 per 1,000 in the late 1950s) and continued high birth rates (about 46 per 1,000). This meant a young population, and over 40% was under 16 years of age. The official population for 1956 was 9,390,381, not including military personnel from the mainland. their families or others not classified as permanent residents. Estimates of total population, however, reached 12,000,000 or 867 per square mile.

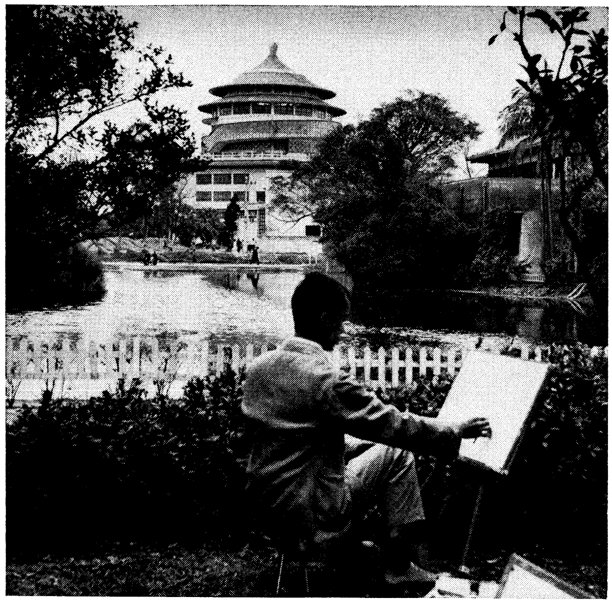
Most Taiwanese live in villages, as in the south, or in dispersed rural settlements, as in the north. Few are urban, although a pre-World War II drift to the cities mas accelerated after 1949. The mainland Chinese are urban, and the rapid urban growth since 1946 partially reflects their arrival. In 1956 T'ai-pei with 748,510 population and Kao-hsiung, the southern regional focus with 371,-22j, were the major cities. Three others had populations of over 200,000, including Chi-lung (Keelung), the port of T'ai-pei. However, population figures were inflated by many rural people living within the official municipalities. Other large towns are Hsin-chu (Sin-chu) and P'ing-tung (*qq.v.*).

History.—Taiwan was known to the Chinese as early as the beginning of the 7th century A.D., but settlement did not take place until the first quarter of the 17th century after recurrent famines in Fukien province encouraged the emigration of Fukienese from the Chinese mainland. Before then, the island was a base of operations for Chinese and Japanese pirates. The Portuguese who discovered the island in 1590 and named it Formosa. made several unsuccessful attempts at settlement. The Dutch and Spaniards established more lasting settlements, the Dutch at An-p'ing in southwestern Taiwan (1624), the Spaniards in 1626 at Chi-lung. Until 1646 when the Dutch seized the Spanish settlements, northern Taiwan was under Spanish domination. the south under Dutch control. The Dutch were defeated in 1661 by Koxinga (Cheng Ch'eng-kung), a man of mixed Chinese-Japanese parentage and supporter of the defeated Ming emperors. who used the island as a centre of opposition to the Ch'ing (Manchu) regime. In 1683, 20 years after Koxinga's death, the island fell to the Ch'ing and became part of Fukien province. Meanwhile. sizable migrations of refugees. Ming supporters, had increased the population to about 200.000. Settlement proceeded from south to north and from the western coast to the foothills of the central highlands, held by the aboriginal tribes.

Population increased rapidly as immigrants streamed in from the southeast China coast: and large areas in the north came under the plow. T'ai-nan (then known as T'ai-n-an) acted as the capital. Settlement of the eastern coastal areas began in 1796. By 1842 the population had risen to an estimated 2,500,000, and both rice and sugar had become important exports to China proper. In 1858 the treaty of T'ien-ching (Tientsin) designated two Taiwan ports as treaty ports. T'ai-nan and Tan-shui, the latter a river port, long used as a port of call under the Spanish and Dutch, and downstream from the growing city of T'ai-pei. Tea became an important export crop, and the island's trade centre shifted to the north. particularly to Tan-shui where British and other trading companies established their headquarters. In 1875 T'ai-pei became the capital of northern Taiwan.

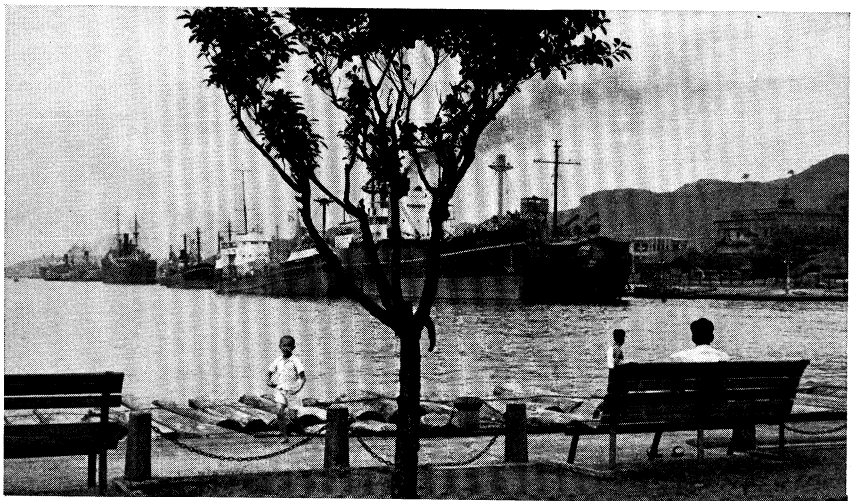
Japan's continued interest in the island was reflected in a Japanese punitive expedition of 1874 ostensibly to protect the lives of Ryukyu fishermen along the island's coasts. The French

Aerial view of a river valley in the western coastal region of Formosa which is composed of alluvial plains interrupted by ranges of eroded hills

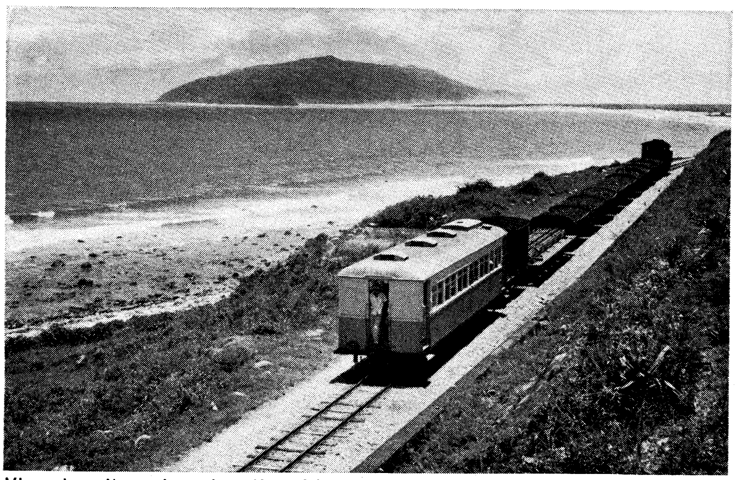


Formosan artist sketching in the Botanical gardens at T'ai-pei. Across the lagoon is the National Science hall

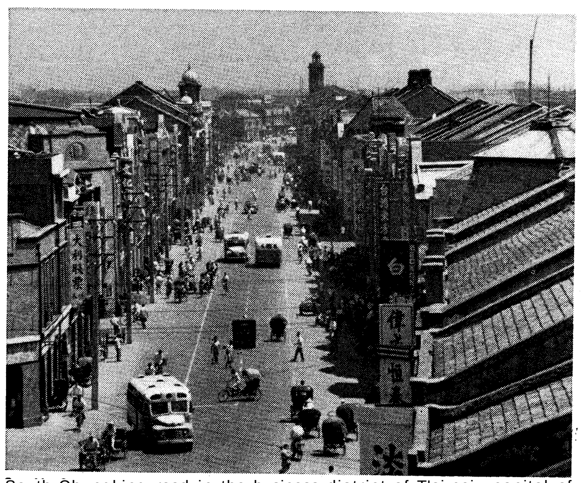
Mother and child before a shop in a village market place. Most Formosans live in rural settlements



Chi-lung (Keelung) harbour, the port for T'ai-pei, which has facilities for accommodating ships up to 20,000 gross tons



View along the east coast portion of the island's 590-mi. railway system. This part of the line is used to transport cane, sugar and timber between T'ai-ting and Hua-lien

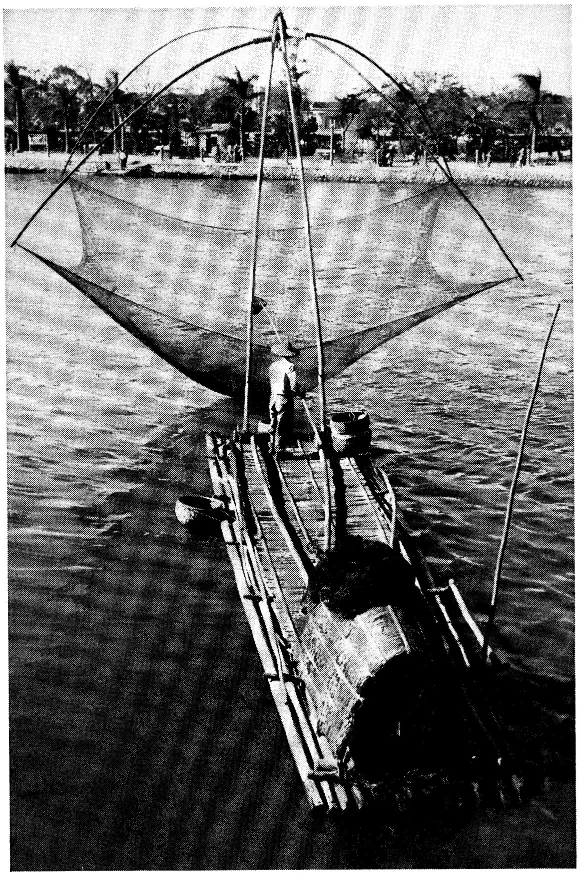


South Chungking road in the business district of T'ai-pei, capital of Formosa and provisional capital of the Republic of China

VIEWS OF FORMOSA

PHOTOGRAPHS. (TOP LEFT) HORACE BRISTOL FROM PHOTO REPRESENTATIVES, (TOP RIGHT) HEDDA MORRISON— CAMERA PRESS— PIX FROM PUBLIX. (CENTRE LEFT) BOB KLEIN FROM BLACK STAR, (CENTRE RIGHT) QUENTELL VIOLETT FROM BLACK STAR, (BOTTOM LEFT) BARRY SCHUTTLER FROM BLACK STAR, (BOTTOM RIGHT) PAUL BERG— POST DISPATCH PICTURES FROM BLACK STAR

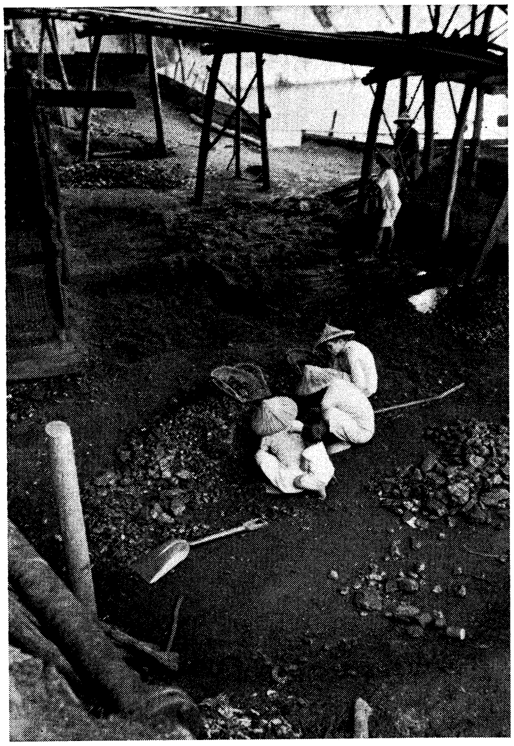
FORMOSA



Fisherman ladling fish from his dip net, on the Love river at Kao-hsiung. Since World War II, fishing has become an essential element in Formosan economy

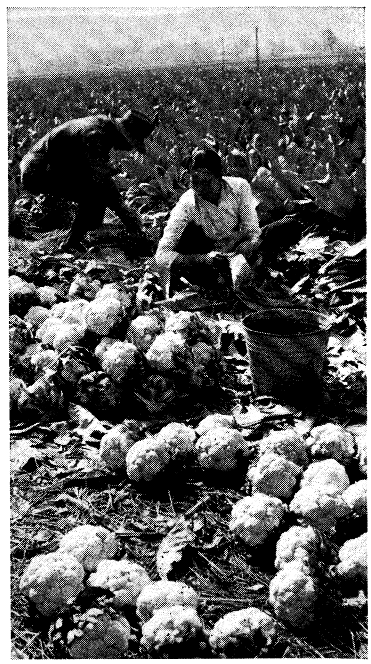
Farmer transplanting rice seedlings in his paddy field. More than 50% of the cultivated land in Formosa is devoted to growing rice, the island's major crop

Harvesting sugar cane near Hua-lien. Grown primarily in the southwest, sugar cane is the second most valuable crop in Formosa and its primary export product



Formosan women grading coal by hand at the Homei mine in northern Formosa. Of the few minerals found on the island, coal is economically the most important

Bagging dried peanuts at Tsoying, near Kao-hsiung. Stacks of rice straw, used as fodder for livestock, are in the background



Gathering cauliflower on a Formosan farm. The island's temperate climate is conducive to growing fruits and vegetables

AGRICULTURE AND INDUSTRY IN FORMOSA

PHOTOGRAPHS. (TOP LEFT, CENTRE RIGHT) BARRY SCHUTTLER FROM BLACK STAR, (TOP RIGHT, BOTTOM LEFT) PAUL BERG— POST DISPATCH PICTURES FROM BLACK STAR. (BOTTOM CENTRE AND RIGHT) HEDDA MORRISON— CAMERA PRESS PIX FROM PUBLIX blockaded the island during the undeclared Chino-French war of 1884–5 and occupied Chi-lung for a short period. In 1886 Taiwan became a separate province of China with a legal capital at T'ai-chung and a temporary capital at T'ai-pei which became the legal capital in 1894. Considerable economic development took place in the next eight years under the initial leadership of Liu (Ming-chuan).

In 1895, as a result of the treaty of Shimonoseki after the Chinese-Japanese War (*q.v.*), China ceded Taiwan and the Pescadores Islands (*q.v.*) to Japan, and the Japanese occupied T'ai-pei in June of that year over the violent opposition of the Chinese population. For several months a Republic of Taiwan was in existence. but it was overcome by Japanese army and naval forces. The Japanese also faced the hostility of the aborigines, some of whom remained uncontrolled until the outbreak of the Pacific war. Under the Japanese. Taiwan was developed as a major supplier of rice and sugar for Japan. Irrigation projects, agricultural extension services, and improvements in transportation and power supplies led to rapid increases in Taiwan's gross product. Japanese policy was oriented toward the Japonicization of the Taiwanese; Japanese was the language of instruction in a widespread basic educational system, and even after the end of World War II Japanese remained a *lingua franca* among the various Chinese dialect groups. In the 1930s Japanese economic policy shifted toward the development of industries based on relatively cheap hydroelectric power. such as aluminum refining and ferroalloy manufacturing. Nevertheless, rice and sugar remained the basis of Taiwan's prewar export trade, almost all of which was directed toward Japan. Imports consisted largely of diverse manufactures from Japan. During World War II, Taiwan was a major staging area for Japan's invasion of southeast Asia, and it was described as the largest "aircraft carrier" outside Japan. By 1940 its total population, including Japanese, had risen to 5,870,000.

As a result of the Cairo agreement of 1943, Taiwan was turned over to the Chinese Nationalist government on Oct. 25. 1945, after the defeat of Japan. Antagonism against the new regime was reflected in an uprising in 1947. In 1949–50, following the victories of the Chinese Communists on the mainland, a stream of Nationalist troops, government officials and other refugees estimated at 2,000,000 persons. poured onto the island, and Taiwan became the effective territory, apart from a number of islands off the China coast. of the Republic of China (Nationalist China).

Following the outbreak of the Korean war in 1950, the United States interposed its 7th fleet between the island and the mainland to protect it from further Communist attack. In 1955, Nationalist China and the Gnited States entered into a mutual security agreement to defend the island and the Pescadores. American assistance was given in two forms, economic and defense. Economic support amounted to about $650,000,000 between 1951 and 1958. Direct military assistance was estimated to be at least that figure. An American military advisory group was established in 1951 to assist in training military forces and to advise on other military matters. Throughout the 1950s the government of the People's Republic of China declared its intention of eventually conquering the island; the Nationalists, also describing it as an integral part of China, held to their objective of using Taiwan as a stepping-off point for an eventual return to the mainland. (*See* also CHINA: *History;* CHIANG KAI-SHEK.)

Administration and Social Conditions.—Taiwan is regarded by both Communist and Nationalist Chinese as a province of China (T'ai-wan sheng). Controlled by the Nationalists, it is divided into 16 counties (hsien) one of them the Pescadores, and 5 municipalities (*shih*)—T'ai-pei, Chi-lung, T'ai-chung, T'ai-nan and Kao-hsiung (Takao) ; the provincial government is headed by an appointed governor; a provisional provincial assembly is elected. Governments at the *hsien* and *shih* level also are elected, as are officials of townships and villages. T'ai-pei is the temporary capital of the Republic of China. The provincial capital is located at Chung Hsing Hsin Ts'un, near T'ai-chung. Thus. two governments are operative on the island, one national. one provincial.

In the late 1950s a national military establishment numbering about 600,000 persons, chiefly mainland Chinese, was based on the island. equipped with weapons provided under the military aid program of the United States; American personnel acted as advisors.

Living standards in Taiwan were among the highest in Asia in the 1950s, but rapid population increases, underemployment and overcronding, particularly in the cities, have created major problems. Although a third of the people were illiterate. education at the elementary level was available for about 94% of the younger population; instruction was in Mandarin, the Chinese national language. Only one-fifth of the lower school graduates attended secondary school. and less than 4% attended institutions of higher learning The latter included the National Taiwan university (T'ai-pei), with over 6 000 students and a library of 500,000 volumes, the Taiwan Provincial Normal university (T'ai-pei), the National Political university (near T'ai-pei), the Cheng-kung university (engineering) at T'ai-nan, and after 1957 a new National Ch'ing-hua university at Hsin-chu. Several American universities were co-operating with these and other institutions.

Public health facilities uere widely distributed in the form of over 400 government-supported health stations and clinics, although environmental sanitation remained poorly developed, and only the major cities had pure nater supplies.

Social change in Tainan was accelerated during the 1950s as an urban way of life began to permeate the island through improved communications. About 30 newspapers had a combined direct circulation of 350,000 and an effective circulation several times that number. There were some 475 periodicals and magazines and over 200 000 radio sets, each serving several people. The many traditional and government-sponsored local associations, organized for varied socioeconomic purposes, reflected both Chinese and Japanese influences. but the family was becoming less important as the key to social organization. Religion tended to be a polytheistic amalgam of Buddhist, Confucian, Taoist and animist ingredients,

TIERS FROM MCNKMEYER

WASHING CLOTHES AT THE EDGE OF A CANAL IN T'AI-CHUNG, FORMOSA

with Christianity a minor element.

Economy. — Formosa's industrial resources are limited and agriculture is the leading element in the framework of the economy. In the late 19jos. 60% of the gainfully employed were engaged in agriculture and fishing

Agriculture.—The single most important crop was rice, which supplied one-half of the total agricultural product and occupied 61% (most of the irrigated portion) of the total cultivated area (2 200,000 ac.. one-fourth of the island's area). Most paddy fields nere double-cropped. Half the rice produced was high-grade *pon-lai* rice, introduced originally by the Japanese. Both rice acreages and output were higher than in the pre-World War II period, output reaching 1,900,000 metric tons of brown rice, or one-third more than in 1938, although yields per acre remained about the same. Sugar cane, the next most valuable crop in the southwest, competes with rice for land and is raised on smallholdings. Acreages vary, but averaged about 200,000. Annual sugar output was about 800,000 metric tons, considerably lower than the 1,400,000 tons produced in 1938–9. Sweet potatoes occupied the second largest acreage, 625,000, chiefly on slope lands unsuited to rice or cane. Production approximated 2,500,000 metric tons. Other important crops included tea, peanuts, bananas, pineapples, soybeans, wheat, citrus fruit and citronella grass. Increased consumption of wheat, both local and imported, reflected both dietary shifts and the presence of urban northern Chinese.

Production of rice and sugar cane depended on commercial fertilizers (500,000 tons consumed annually; 350,000 imported). Farm-originated fertilizers also were intensively applied, nightsoils and hog manures contributing to the formation of compost. The hog population exceeded 3,000,000; the water buffalo and cattle population 400,000. Agricultural improvement was encouraged by the Sino-American Joint Commission for Rural Reconstruction established in 1948. Farmers' associations and co-operatives helped provide credit, marketing facilities and technical assistance. The Land-to-the-Tillers act of 1953 resulted in a diminution of tenancy to 15% of the cultivated land from a previous 40%.

Fisheries.—Fisheries production rose to 200,000 metric tons annually, of which one-fourth mas produced by pisciculture.

Forestry.—Forestry production amounted to less than 500,000 cu.m. annually, chiefly from government-owned lands. Inaccessibility, low quality of many stands, and high costs of production made substantial lumber imports necessary. Over-cutting and delayed reforestation were associated with excessive erosion and destructive floods.

Mining.—Mineral resources are modest. Coal deposits, the most important, measured 115,000,000 metric tons of low-grade sub-bituminous reserves, and production varied around 2,500,000 tons annually. Some petroleum and natural gas were produced. Sulfur and sulfur pyrites mere important mineral resources; copper and gold less so. Salt (300,000–400,000 tons annually) was produced by the evaporation of seawater, though at relatively high costs.

Industries.—Industrialization, begun by the Japanese, centred about the generation of electric energy. Total capacity in the late 1950s was 520,000 kw. of which 75% was hydroelectric. The island is covered by an integrated distribution grid centring about the great installation at Sun Moon lake (Jih-yueh T'an). Nearly 80% of the electricity produced (1,800,000,000 kw.hr. was consumed by industry. Government participation characterizes almost every major industry. Government-owned enterprises include fertilizer, aluminum, sugar (26 large mills), coal, cement, paper, mining and machinery manufacturing, power, fertilizer. A largely privately owned textile industry with nearly 300,000 spindles makes the island virtually self-sufficient in cotton goods, and woolen, rayon, and silk mills also contribute to textile production. Glass, cement, leather goods, rubber goods and electrical equipment are important products, but the processing of agricultural products (rice-milling, sugar refining) remains the chief industrial activity.

Communications.—The government-operated railway system, also developed originally by the Japanese, extends for 590 mi., chiefly on the western plain; most trackage is Cape-gauge, but the 109 mi. east-coast line between T'ai-tung and Hua-lien is two feet six inches gauge. Additional two feet six inch gauge tracks (nearly 1,860 mi.) primarily carry cane, sugar and timber. Highways are less well developed. Of the total of 9,750 mi of roads and highnays, about 10% is surfaced, all-weather roads. A main north-south highway connects Chi-lung and Kao-hsiung; and there is a cross-island road. Port facilities are best developed at Kao-hsiung and Chi-lung, each of which can accommodate ships up to 20.000 tons gross.

Trade.—Merchandise trade balances in the 1950s unlike those of pre-World War II years, are adverse. In 1958, total trade was U.S. $397,000,000, of which U.S. $164,400,000 were exports. The deficit was balanced by United States economic assistance. As before 1941, the chief export items were sugar, rice and other agricultural products, but sugar exports were restricted by international agreement to 750,000 tons annually as compared with a pre-World War II average of nearly 1,000,000 metric tons. Rice exports amounted to only 15% of the prewar annual total of over 700,000 tons. Japan was the chief postwar customer, taking from 35% to 60% of Taiwan's exports; it also supplied up to 60% of the imports. Nevertheless, trade orientations were diversified as compared with the prewar period when Japan was virtually the sole trading partner. Imports were highly diversified, consisting chiefly of a variety of consumer goods plus raw materials (*e.g.,* bauxite, lumber, rubber, cotton and wool) for Taiwan's infant industries.

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(N. S. G.)

FORMOSAN LANGUAGE: see MALAY LANGUAGE; POLYNESIAN LANGUAGE.

FORMOSUS (*c.* 816–896), pope from 891 to 896, was made cardinal bishop of Porto by Nicholas I, who sent him to Bulgaria to promote the conversion of that country. In 867 Formosus returned to Rome. where he enjoyed the favour of Adrian II. Pope John VIII, however. treated him as a personal enemy, and Formosus fled from Rome and was excommunicated and reduced to the lay state. Absolved under Marinus I and restored to his see of Porto by St. Adrian III, Formosus was elected pope on Oct. 6, 891. He died on April 4, 896. Under Stephen VII his political enemies had his body disinterred and subjected him to a posthumous trial. His election was declared invalid and his acts quashed. A mob cast his body into the Tiber. Later popes reversed the decisions of Stephen's synod.

Formosus' letters are printed in J. P. Migne (ed.), Patrologia *Latina,* vol cxxix, 837–848. (J. V. HN.)

FORMULA, in general, a stereotyped form of words to be used on stated occasions, for specific purposes, ceremonies, etc. In the sciences, the word usually denotes a symbolical statement of certain facts; for example, a chemical formula exhibits the composition of a substance (see CHEMISTRY); a botanical formula gives the differentia of a plant; a dentition formula indicates the arrangement and number of the teeth of an animal.

FORNER, JUAN PABLO (1756–1797), Spanish scholar and satirist, one of the most violent agitators in the literary polemics of his time, was born in Mérida. Spain, on Feb. 23, 1756, and died at Madrid on March 17, 1797. His brilliant wit was often admirably used against fads, affectations and muddleheadedness, but often cruelly and spitefully against personalities. Typical of his libelous satire is El *asno erudito* ("The Erudite Ass"; 1782) ridiculing the character and works of the erudite but irritatingly self-righteous Tomás de Iriarte. His scholarly *Exequias* de la *lengua* castellana ("Exequies of the Castilian language"; 1795) is a constructive defense of Spanish letters addressed to writers who ignorantly despised them. (I. L. McC.)

FORRES, a royal and small burgh of Moray, Scot., 12 mi. W.S.W. of Elgin by road. Pop. (1951) 4,463. Forres (Gaelic, far *uis,* "near water") in the centre of the Laich of Moray, one of the most fertile areas of Scotland, is among that country's most ancient towns. It is mentioned by Andrew of Wyntoun and Fourdun, according to whom King Donald (d. goo), son of Constantine, and King Duff (d. 967) died there. It had a castle, the site of which is still known, associated with Duncan, Macbeth and many later kings of Scotland. Within the burgh boundary is Sweno's stone, a sculptured sandstone monolith with figures of men—soldiers or captives—on one side and an elaborately carved cross with Runic ornamentation on the other. This is now under the care of the Ancient Monuments commission. Nearby is the Witches' stone, which marks the site of early witch burnings The town house, or tolbooth, stands on the site of earlier tolbooths, the distinctive ieatures of which have been retained in the present structure; the town cross, in the square in front of the tolbooth, is Decorated Gothic.

The Falconer museum was erected in memory of Hugh Falconer, the scientist responsible for the introduction of the tea plant into India, who was born in Forres in 1808. Forres also possesses a fine park, the Grant park, at the eastern entrance to the town, and behind it the Cluny hills, a property given to the town by royal charter. On the northern hill is the Nelson monument. To the south is the beautiful valley of the Findhorn. The climate is dry and sunny. The chief industries are those connected with farming and forestry; there are woolen and oat mills. distilleries and engineering works. Forres is largely residential in character.

FORREST, EDWIN (1806–1872), U.S. actor, centre of two major scandals of the mid-19th century. was born in Philadelphia on March 9, 1806. In 1820 he made his stage debut as Young Norval in Home's *Douglas* at the Walnut Street theatre in Philadelphia. After four years spent on the frontier, he arrived in New Orleans (1824), where the wild, colourful life made a lasting impression on him. In 182j he played in support of Edmund Kean, and his maturity as an actor dates from this experience. During 1826 he played Othello in New York to great critical acclaim. On ofiering cash prizes for plays by U.S. authors. Forrest received several plays suited to his talents. including John Augustus Stone's *Metamora* and Robert Montgomery Bird's The *Gladiator*. In Metamora and Spartacus, Forrest found characters that served him to the end of his career.

Forrest was initially successful in his first engagement in England in 1836, but a misunderstanding led him to hiss publicly a performance of William Macready's, arousing great indignation in England. His disagreement with the English actor culminated in the infamous Xstor Place riot of May 1849. While Macready was playing at the Xstor Place Opera House, a mob of Forrest supporters stormed the theatre. The militia was called out. the rioters fought the militia, and the militia men fired on the mob. Twenty-two persons were killed and 36 wounded. Forrest's reputation never quite recovered from this catastrophe. and only two years later he caused another national sensation when he instituted a divorce suit against his n-ife. the former Catherine Sinclair. Although he lost the verdict. he appealed the decision for 18 years. Aiter 1852 Forrest acted only sporadically: spending much time alone in his gloomy Philadelphia mansion. where he died on Dec. 12, 1872. He left most of his money for the establishment of a home for aged actors.

Opinions on Forrest as an actor varied. Although many critics considered him first-rate. he was described by William Winter as "a vast animal, bewildered by a grain of genius."

See M. J. Moses, *The Fabulous Forrest* (1929); B. Matthews and L. Hutton, *Actors and Actresses of Great Britain and the U.S.*, vol. iv (1886). (S. W. H.)

FORREST, JOHN, FORREST, 1ST BARON (1847–1918), Australian statesman and explorer who increased the knowledge of the interior oi Western Australia, was born at Bunbury, Western Australia, on Aug. 22, 1847. He joined the government survey department in Perth, and in 1869 led an expedition into the desert to search for traces of Friedrich Wilhelm Ludwig Leichhardt. In 1870 he traveled overland from Perth to Adelaide, and in 1874 explored the arid country from Champion bay eastward to the telegraph line between Darwin and .Adelaide. Forrest was appointed surveyor general of Western Australia in 1883. He took part in Western Australia's struggle for self-government and, after it was granred in 1890. became the state's first premier. He attended the discussions which led to the federation of the .Australian colonies in 1900. contested the first federal election, and until his death was a member of the commonwealth parliament and a minister in liberal governments.

He was raised to the peerage in 1918, the first native-born Australian to be so honoured, and died at sea en route for England on Sept. 3. 1918. (T. M. PY.)

FORREST, NATHAN BEDFORD (1821–1877); Confederate cavalry general in the American Civil War who achieved fame for his brilliant cavalry raiding, chiefly against enemy communications or against posts deep within the enemy lines, mas born near Chapel Hill, Tenn., on July 13, 1821. He never received any formal education, but he taught himself with very fair success and is said to have been an able mathematician. He was in turn a horse and cattle trader in Mississippi and a slave dealer and horse trader in Memphis, Tenn., until 1859, when he took to cotton planting in northwestern Mississippi and acquired considerable wealth. At the outbreak of the Civil War in 1861 he volunteered as a private, raised a cavalry unit of which he was lieutenant colonel, and in Feb. 1862 took part in the defense of Ft. Donelson. Refusing, like Generals J. B. Floyd and Gideon Pillow, to capitulate with the rest of the Confederate forces, he made his way out, before the surrender, with all the mounted troops there. He was made a colonel and regimental commander, and fought at Shiloh with distinction. He was promoted brigadier general in July 1862. At the head of a mounted brigade he took a brilliant part in Gen. Braxton Bragg's autumn campaign, and in the winter of 1862–63 was continually active in raiding hostile lines of communication. One of his most remarkable actions was the capture, near Rome, Ga., after five days of marching and fighting, of an entire cavalry brigade under Col. A. D. Streight (April 1863).

He was present at Chickamauga in September, after which he was transferred to the Mississippi. He was made a major general in Dec. 1863.

On April 12, 1864, he assaulted and captured Ft. Pillow, in Tennessee on the Mississippi; U.S. Negro troops formed a large part of the garrison and according to survivors many were massacred after the fort had surrendered. The "massacre of Ft. Pillow" has been the subject of much controversy and there is conflicting testimony regarding it, but it seems probable that Forrest himself had no part in it.

On June 10 he decisively defeated a superior Federal force at Brice's Cross Roads, Miss.. and throughout the year, in spite of the efforts to crush him, he raided successfully in Mississippi, Tennessee and Alabama. He was once more with the main Confederate army of the west in the last disastrous campaign of Nashville, and fought stubborn rear-guard actions to cover the retreat of the broken Confederates. In Feb. 1865 he was made a lieutenant general, but the struggle was almost at an end and Gen. James H. Wilson rapidly forced back the few Confederates. now under Forrest's command, and stormed Selma, Ala., on April 2. The surrender of General Forrest and his whole command followed on May 9.

After the war he lived in Memphis, and for several years was president of the Selma, Marion and Memphis railroad. He died at Memphis on Oct. 29, 1877.

Of great height and commanding appearance, exemplary in personal habits, Forrest came near to being a military genius. As he never commanded a considerable force of men, it remains a matter of speculation what he might have done in charge of an army, but as a leader of cavalry he has had few equals.

See the biographies by J. A. Wyeth (1899) and J. H. Mathes (1902).

FORRESTAL, JAMES VINCENT (1892–1949), U.S. cabinet member and first secretary of the defense department, mas born on Feb. 15, 1892, at Beacon, N.Y. He studied at Dartmouth college, Hanover, N.H., and at Princeton university, graduating in 1915. He served in naval aviation during World War I, and in 1919 resumed his connection with a New York city investment banking firm, of which he was made president in 1938. In June 1940 he became an administrative assistant to Pres. F. D. Roosevelt, and in Aug, was named undersecretary of the navy to direct the huge expansion and procurement programs. He was appointed secretary of the navy in May 1944, following the death of Sec. Frank Knox.

Upon enactment of the National Security act of 1947, Forrestal was appointed to the nen cabinet position of secretary of defense and initiated a reorganization and co-ordination of the armed services.

He resigned, effective March 28, 1949. Suffering from what navy doctors called "a severe depression of the type seen in operational fatigue during the war," Forrestal entered the U.S. naval hospital at Bethesda. Md., and on May 22, 1949, plunged through a window to his death.

See *Forrestal Diaries,* ed. by Walter Millis (1951).

FORSSELL, HANS LUDVIG (1843–1901), Swedish historian and political writer, was born at Gefle on Jan. 14, 1843 He studied at Uppsala, and had a distinguished career in the civil service, becoming in 1880 president of the department of inland revenue. He died at San Bernardino, Switz., on Aug. 2, 1901. Of his historical writings the most important were: *The Administrative and Economical History of Sweden After Gustavus I* (1869–75) and *Sweden in 1571* (1872).

FORSSMANN, WERNER (1904–), German surgeon, who shared with A. Cournand and D. W. Richards (*qq.v.*) the 1956 Nobel prize for medicine, was born in Berlin on Aug. 29, 1904. Having qualified in medicine at Berlin university, he started practising at a private hospital at Eberswalde. His contribution to the development of cardiac catheterization (*q.v.*) started in 1929 when he opened a vein in his arm and inserted a catheter until it reached the right atrium of the heart. He then had an X-ray photograph made of his chest. By this daring experiment Forssmann showed the practicability of passing a radio-opaque catheter into the heart for investigating its structure and function. This method made slow progress, however, because of difficulties of research. During World War II Forssmann served first at the front and later as chief surgeon of a military hospital for the seriously mounded. In 1950 he was appointed chief surgeon of the urological department of a hospital at Bad Kreuznach. In 1951 he was honoured as a pioneer in heart research by the *Deutsche Gesellschaft für Kreislaufforschung,* and three years later he was awarded the Leibniz medal of the German Academic Societies. Finally, on Dec. 10, 1956, his services were internationally recognized. From 1957 Forssmann served as chief surgeon of the evangelical hospital at Dusseldorf. (R. B. J.)

FORST (originally FORSTA or FORSTE), town of Germany, in the district of Cottbus, on the Neisse, 44 mi. S. of Frankfurt an der Oder. Pop. (1950) 30,475. Founded in the 13th century, Forst became part of electoral Saxony in 1740. It was ceded to Prussia in 1815. The chief industry of Forst is the manufacture of cloth. but spinning and dyeing are carried on.

FORSTER, EDWARD MORGAN (1879–), British novelist, was educated at Tonbridge school and King's college, Cambridge. His first novel, *Where Angels Fear to Tread* (1905) was followed by *The Longest Journey* (1907) and *A Room With a View* (1908). Wider attention was won by *Howards End* (1910), but thereafter, except for some short stories. *The Celestial Omnibus* (1911), he published little till 1924. when *A Passage to India* appeared. This was a fruit of first-hand observation of Indian life, and with it Forster entered into a fuller recognition of his powers as a writer. In 1927 appeared *Aspects of the Novel,* his first volume of criticism; in 1936, *Abinger Harvest.*

Forster deals with the interaction of two types of character, the intersection of two planes of living. In all his novels he brings into conflict those who live by convention and those who live by instinct; those for whom property and propriety, and those for whom personal relationships, are the most important things in life. The world of convention he describes with keen observation and satire; and his descriptions of it abound in unforgettable touches of wisdom and humour; in the world of instinct and emotion he is really at home, and perhaps never so much as when (as in several of his short stories) he is frankly telling a fairy tale. (J. SP.)

See L. Trilling, *E. M. Forster* (1943).

FORSTER, FRANÇOIS (1790–1872), French engraver. was born at Locle in Neufchâtel on Aug. 22. 1790. In 1805 he was apprenticed to an engraver in Paris, and at the same time he studied painting and engraving in the École des Beaux-Arts. He obtained in 1814 the first *grand prix de gravure.* The king of Prussia. then with the Allies in Paris, bestowed on him a gold medal and a pension of 1,500 fr. for two years. He then pursued his studies in Rome. nhere his attention was devoted chiefly to the norks of Raphael. In 1843 he succeeded Tardieu in the Academy. He died at Paris on June 27, 1872. Among his works may be mentioned "The Three Graces" and "La Vierge de la Légende," after Raphael; "La Vierge au bas-relief," after Leonardo da Vinci; Francis I and Charles V, after Gros; St. Cecilia, after Paul Delaroche; Durer and Henry IV, after Probus; Wellington, after Gérard; and Queen Victoria. after F. X. Winterhalter.

FÖRSTER, FRIEDRICH CHRISTOPH (1791–1868), German historian and poet, was the second son of Karl Christoph Forster (1751–1811) and a brother of the painter Ernest Joachim Forster (1800–85). Born at Münchengosserstadt on the Saale on Sept. 24, 1791, he studied theology at Jena, afterward devoting some time to archaeology and the history of art. At the outbreak of the War of Liberation in 1813 he joined the army, and by his war songs added to the national enthusiasm. He then became professor at the school of engineering and artillery in Berlin, but was dismissed in 1817 because of his democratic leaning. About 1829 he received an appointment at the royal museum in Berlin. He was the founder and secretary of the *Wissenschaftlicher Kunstverein* in Berlin, and died there on Nov. 8, 1868.

FORSTER, (JOHANN) GEORG (ADAM) (1754–1794), German explorer, writer, scientist and politician, was born at Nassenhuben, a small village near Danzig, on Kov. 26, 1754. With his father, Johann Reinhold Forster, a clergyman and brilliant amateur scientist, he emigrated to England in 1766. In 1772 the father and son were invited to accompany Capt. James Cook on his second voyage around the world. Georg Forster's account of the journey, entitled *A Voyage Round the World,* appeared in London in 1777, and the German version, *Reise um die Welt,* in Berlin in 1778–80. This book is a work of travel, science and literature all in one! and it established Forster's name as one of the most advanced German thinkers and accomplished stylists of the time. It had a wide influence on German scientific and literary writing, including that of Goethe, Johann Gottfried von Herder, Friedrich Schlegel, Samuel T. Sommerring and Alexander von Humboldt. Since its publication the literary travel book has become a favoured genre in German literature, and Goethe's *Italienische Reise* and Heinrich Heine's *Harzreise* are its direct successors. Forster made also, in his articles and letters! major contributions to the scientific, especially botanical, knowledge of the South seas. From 1778 to 1784 he held a professorship at Kassel, and from 1784 to 1787 at the University of Vilna. He subsequently became university librarian in Mainz. A keen sympathizer with the French Revolution, he became the leading spirit in the republican government of Mainz. In 1793 he went to Paris to carry out negotiations on behalf of that government. Meanwhile the Germans seized Mainz. Unable to return, publicly reviled in Germany as a traitor, especially by Friedrich Schiller, and disillusioned by what he had seen of the Revolution in France, Forster died in Paris on Jan. 12, 1794.

His collected works are *Sämmtliche Schriften* (1843) and *Werke* (1958–).

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FORSTER, JOHN (1812–1876), English writer and journalist, friend and biographer of Charles Dickens and a notable figure in mid-19th-century literary London. Born at Newcastle on Tyne. April 2, 1812, he read law and history at University college, London. and began to write, undertaking biographies of statesmen of the Commonwealth period for a 10-vol. *Cyclopedia* and contributing to periodicals. In 1832 he became a critic on the *True Sun* and there met Leigh Hunt, through him entering on the third aspect of his career—as adviser, agent and proofreader to most of the writers of the day. He joined the staff of the *Examiner* in 1834 and was editor from 1847 to 1856. He met Dickens in 1836 and, until Forster's marriage in 1856, was his closest personal and professional friend, following him as editor of the *Daily News* and receiving from him the innumerable letters "of unexampled candour and truthfulness" which formed the basis of his biography. After 1850, ill-health caused his withdrawal into the research which had formed the background to his busy life. He became secretary to the commissioners in lunacy in 1855 and a commissioner in 1861, and died in London, Feb. 2, 1876.

Forster was a discriminating editor, an indefatigable friend and a careful scholar. Pugnacious and possessive, yet inexhaustibly kind, he roused strong feelings. He was nicknamed "Fuz" by Carlyle, and "the Beadle of the Universe" by Thornton Hunt. caricatured as "Fuzbuz" in Rosina Bulwer's novel, *Cheveley,* loved and admired by "L. E. L." (Letitia Landon) to whom he was briefly engaged, Lady Blessington, Landor, Tennyson and Browning. His *Life of Dickens,* 3 vol. (1872–74) is an essential source book and a literary masterpiece, despite its personal bias and occasional suppressions and inaccuracies, especially for the period after 1856. His *Life of Oliver Goldsmith* (1848; expanded into *Life and Times,* 1854), his *Life of Landor* (1868), and the unfinished *Life of Swift* (1875) remain authoritative and readable, revealing, as do his now superseded historical works on the 17th century, his shrewdness, trenchancy of style and keen, yet selective, interest in detail.

See R. Renton, *John Forster and His Friendships* (1912); *M.* Elwin in *Victorian Wallflowers* (1934).

FÖRSTER, JOSEF BOHUSLAV (1859–1951), Czech composer belonging to the school of Dvořák and Smetana. Born at Prague, Dec. 30, 1859, he was the son of the composer of organ music, Josef Forster (1833–1907). After studying at the Prague conservatory, he was organist at several Prague churches and music critic of *Narodny Listy.* In 1888 he married the Wagnerian soprano, Berta Lauterer, and from 1893 to 1903 lived in Hamburg where he became a friend of Gustav Mahler and taught at the conservatory. From 1903 to 1918 he was music critic of *Die Zeit* in Vienna. In 1919 he taught composition at the Prague conservatory and was later appointed director. He died at Nový Vestec, near Mladá Boleslava, May 29, 1951.

Forster's music was largely inspired by personal memories and associations. His second and fifth symphonies, his cantata, *Mortuis fratribus* and his Trio in A minor were tributes to his near relatives. He was a devout man and his fourth symphony ("Easter Eve"), and his operas, *Nepromozeni* (1918), *Srdce* (1923) and *Bloud* (1936), were inspired by religious subjects. He also wrote four masses, two violin concertos, a cello concerto and chamber and vocal works. Though his romantic and religious outlook suggests Mahler, his simpler, lyrical works, notably the song-cycle, *Liebe,* show his allegiance to the heritage of Dvořák and Smetana.

See J. B. Forster, *Der Pilger. Erinnerungen eines Musikers,* trans. by *P.* Eisner (1955); *J.* B. *Foerster,* a symposium ed., with a bibliography, by J. Bartóš *et al.* (1949).

FORSTER, WILLIAM EDWARD (1818–1886), British statesman, was born of Quaker parents at Bradpole in Dorsetshire on July 11, 1818, and educated at the Friends' school at Tottenham. Becoming a woollen manufacturer at Bradford. Yorkshire (whence after his marriage he moved to Burley-in-Wharfedale), he became known as a practical philanthropist. In 1846–47 he accompanied his father to Ireland as distributor of the Friends' relief fund for the famine in Connemara, Ire., when the state of the country made a deep impression on him. He married in 1850 Jane Martha, eldest daughter of Thomas Arnold of Rugby. Being childless they adopted the four orphans of Mrs. Forster's brother, William Arnold. when he died in 1859. One of these children. H. O. Arnold-Forster (18jj–1909), the well-known Liberal-Unionist member of parliament, became a member of Lord Balfour's cabinet; he was secretary to the admiralty (1900–03); secretary of state for war (1903–05); and was the author of numerous educational books.

In 1859 W. E. Forster stood as Liberal candidate for Leeds, and was beaten. In 1861 he was returned unopposed for Bradford and again in 1865 and 1868. In 1865 he was made undersecretary for the colonies in Earl Russell's ministry, and became a prominent advocate of imperial federation. In 1866 his attitude on parliamentary reform attracted a good deal of attention. He demanded universal education as the essential complement of an extension of the suffrage. Forster and Cardwell. as private members in opposition. brought in Education bills in 1867 and 1868; and in 1868, when the Liberal party returned to office, Forster was appointed vice-president of the council, with the duty of preparing a government measure for national education. The Elementary Education bill (*see* EDUCATION, HISTORY OF) was introduced on Feb. 17, 1870. The Dissenters were by no means satisfied with Forster's "conscience clause" as contained in the bill, and they regarded him, the former Quaker, as a deserter from their own side; while they resented the "25th clause," permitting school boards to pay the fees of needy children at denominational schools out of the rates, as an insidious attack upon themselves. The controversy assumed threatening proportions, and Dixon. the Liberal member for Birmingham and chairman of the Education league, moved an amendment, the effect of which was to prohibit all religious education in board schools. The government made its rejection a question of confidence, and it was withdrawn; but the result was the insertion of the Cowper-Temple clause as a compromise. Extremists on both sides abused Forster, but it is to his enduring credit that the bill of 1870, imperfect as it was, established some approach to a system of national education in England.

Forster's next important work was in passing the Ballot act of 1872. In 1874 he was again returned for Bradford, in spite of Nonconformist attacks, and took his full share of the work of the opposition front bench. In 187j, when William Gladstone "retired." he was strongly supported for the leadership of the Liberal party, but declined to be nominated against Lord Hartington. On Gladstone's return to office in 1880 he was made chief secretary for Ireland, with Lord Cowper as lord-lieutenant. He carried the Compensation for Disturbance bill through the commons, only to see it thrown out in the lords, and his task was made more difficult by the consequent agitation. On Jan. 24, 1881, he introduced, with reluctance, a new Coercion bill in the house of commons, to deal with the growth of the Land league. The Irish party used every opportunity in and out of parliament for resenting this act, and Forster was kept constantly on the move between Dublin and London, conducting his campaign against crime and anarchy and defending it in the house of commons. He was nicknamed "Buckshot" by the nationalist press, on the supposition that he had ordered its use by the police when firing on a crowd. After the arrest of C. S. Parnell (Oct. 13) Forster's life was in constant danger, and he had to be escorted by mounted police when he drove in Dublin. On May 2, 1882, Gladstone announced that the government intended to release Parnell and his fellow prisoners in Kilmainham, and that both Lord Cowper and Forster had in consequence resigned; and the following Saturday Forster's successor. Lord Frederick Cavendish, and Burke were murdered in Phoenix park.

It was characteristic of the man that Forster at once offered to go back to Dublin temporarily as chief secretary, but the offer was declined. He delivered his fiercest attack on Parnell in the debate on the address (1883), charging him, not with directly planning or perpetrating outrages or murder, but with conniving at them. Forster died on April 6. 1886, on the eve of the introduction of the Home Rule bill, to which he was stoutly opposed. He had found himself in an increasing degree at variance with Gladstonian Liberalism on other questions, for instance, as regards the Sudan and the Transvaal, nor was he inclined to tolerate the claims of the Caucus or the Birmingham programme. When the Redistribution act divided Bradford into three constituencies, Forster uas returned for the central division, but he never took his seat in the new parliament.

See T. Wemyss Reid, *Life of the Right Hon. H. E. Forster.*

FORSYTH, ANDREW RUSSELL (1858–1942), Scottish mathematician, was born at Glasgow, on June 18, 1858. He studied at Liverpool and Trinity college. Cambridge, and held the following posts: professor of mathematics, University college, Liverpool (1882–83); lecturer in mathematics. Trinity college, Cambridge (1884–9j); Sadlerian professor at Cambridge (1895–1910) and professor of mathematics, Imperial College of Science and Technology, London (1913–23). After 1923 Forsyth held the post of emeritus professor at the Imperial college. London. His work covered a wide field in pure mathematics and his treatises contained much that was original, showed creative ability and at the same time established his reputation as a teacher. Forsyth was the author of a number of papers on different. equations, on the theory of functions and on the differential invariants of space. His *Treatise on the Theory of Functions* (1893, etc.) dealt with the theories of Friedrich Riemann. Augustin Cauchy and Karl Weierstrass and by means of this work and his other writings on the theory of functions, Forsyth stimulated interest in the works of Felix Klein, Jules Poincaré, Weierstrass and other mathematicians.

Forsyth also wrote exhaustively on the subject of differential equations and most of his work on this subject is contained in *A Treatise on Differential Equations* (188j. etc.) and *Theory of Differential Equations*, 4 vol. (1890–1906). Forsyth edited volumes viii to xiii and the supplementary volume of *Cayley's Collected Mathematical Papers* and was the editor of the *Quarterly Journal of Mathematics* from 1884 to 1895. He was a member of many learned societies and was awarded the Royal medal of the Royal society in 1897.

The works of Forsyth included *Lectures Introductory to the Theory of Functions of Two Complex Variables* (1914); *Lectures on Differential Geometry* (1912, etc.); *Calculus of Variations* (1926); *Intrinsic Geometry of Ideal Space* (1935). He died June 2, 1942.

FORSYTH, PETER TAYLOR (1848–1921), an outstanding Scottish Congregationalist theologian, was born at Aberdeen on May 12, 1848. The son of a postman, he was educated at Aberdeen grammar school and university, and spent a term at Göttingen, where he was deeply influenced by Albrecht Ritschl. After a brief period studying theology at New college, London, he was minister of several Congregational churches in England, including Emmanuel church, Cambridge. In 1901 he became principal of Hackney theological college, London, where he remained until his death in London on Nov. 11, 1921. He was a distinguished preacher, but exercised his influence chiefly through his numerous books and published lectures, which were written in a vigorous and highly characteristic, though over-epigrammatic, style.

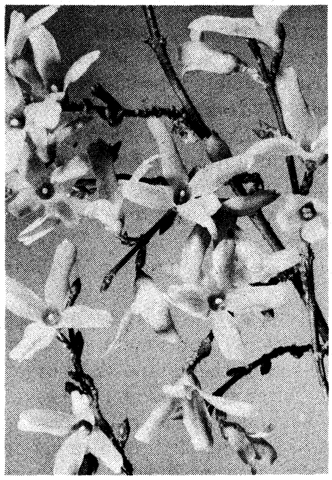
Beginning as a theological liberal, Forsyth gradually moved to a position of great originality and power to which there was no precise equivalent in his own time, although it had some affinity with the "positive theology" of Germany. He had little in common with old-fashioned evangelical orthodoxy but was the shrewdest critic of the modernistic liberalism which was then at the height of its popularity in the free churches. He reasserted the classic faith of the Reformation in terms appropriate to his own time, bringing the word "grace" back into Protestant theology and showing afresh what was meant by the sovereignty of God revealed in holy love in Christ. He thus anticipated many of the characteristic insights of Karl Barth, and there are also similarities of spirit between the two men.

Forsyth's most famous book, *The Person and Place of Jesus Christ* (1909), was an attempt, in his own phrase, "to moralise dogma," to express in terms of modern personal experience the meaning of the doctrine of Christ's divinity. His *Positive Preaching and the Modern Mind* (1907) and *Lectures on The Church and the Sacraments* (1917) recalled Protestants to the richness of their own teaching about the church at a time when liberalism and evangelicalism together were in danger of making them forget it. He also wrote on the relation between Christian faith and the questions of his day. *The Justification of God* (1916) is one of the best essays of the 20th century in this subject. *Christ on Parnassus* (1911) was notable as one of the first efforts in the same century to relate theology and the arts, although it has worn less successfully than most of his writings.

In the range of his interest and the breadth of his sympathy Forsyth was the successor in the theological life of England of John F. D. Maurice (*q.v.*), whom he greatly admired. Like Maurice, he was widely misunderstood in his own time, although never without powerful support and devoted disciples. Since the theological revival led by Barth, however, his work has been much more readily understood and appreciated.

See G. O. Griffith, *The Theology of P. T. Forsyth* (1948); R. M. Brown, *P. T. Forsyth: Prophet for Today* (1952). (D. T. J.)

FORSYTHIA, an old world genus of the olive family with several very showy, hardy, spring-blooming species that are widely planted for their profuse, usually yellow flowers that bloom before or with the unfolding of the foliage. and are commonly called golden bell. They usually have arching or spreading branches bearing opposite leaves. $2\frac{1}{2}$ to 6 in. long, that are carried late in the fall and often become olive or purplish in colour. The plants are not particular as to soil and do well in partial shade, although they prefer the open, especially in masses against a background of evergreens.



ROCHE

WEEPING GOLDEN BELL (FORSYTHIA SUSPENSA)

Weeping golden bell (F. *suspensa*), an upright shrub to 10 ft., with the tips of the long, arching, hollow branches often pendulous and, in age, rooting at the tip, has golden-yellow flowers about an inch long. Some of its horticultural varieties show variations in plant form. Greenstem golden bell (F. *viridissima*), has erect, bright green branches, reaching 10 ft., and greenish-yellow flowers about an inch long. Border golden-bell (F. *intermedia*), a hybrid between F. *suspensa* and F. *viridissima*, is deemed by many as the best of the forsythias, particularly the variety *spectabilis* with its bright yellow flowers about $1\frac{1}{2}$ in. long.

Other varieties show flower colours from pale to deep yellow. Early golden bell (F. *ovata*), sometimes called Korean forsythia, a shrub up to j ft.. has solitary, amber-yellow flowers about $2\frac{1}{2}$ in. long. It is the earliest to bloom. (J. M. BL.)

FORTALEZA, a city and port of Brazil and the capital of the state of Ceara (*q.v.*), on a crescent-shaped indentation of the coast line. $7\frac{1}{2}$ mi. from the mouth of the Ceara river. Pop. (1950) 205,052, (1958 est.) 375,264. The city stands on an open sandy plain overlooking the Atlantic. and is regularly laid out. with broad streets and numerous parklike squares.

Because of the arid climate the vegetation is less luxuriant than in most Brazilian cities. The usually high temperature is modified by the strong sea winds and the climate is considered healthful. A small branch of the Ceará river: called the Pajeu, traverses the city and divides it into two parts, that on its right bank being locally known as Outeiro. Fortaleza is the see of a bishopric, created in 1854.

Its public buildings include the government house, legislative chambers. bishop's palace, an episcopal seminary, a lyceum (high school) and hospital. The port is the principal outlet for the products of the state. Long an open roadstead harbour, it has been much improved by construction of a breakwater and port facilities at Mucuripe point 4 mi. E. The Baturité railway, built by the national government partly to. give employment to starving refugees in times of long droughts. connects the city and its port with fertile regions to the southwest and extends southeast to Patos in Paraiba.

The exports include sugar. coffee, rubber, cotton, carnauba wax, oiticica oil, rum, rice, beans. fruits. hides and skins.

Fortaleza had its origin in a small village adjoining a fort established by the Portuguese at this point in early colonial times. In 1654 it took the name of Villa do Forte da Assumpção, but it was generally spoken of as Fortaleza.

In 1810 it became the capital of Ceará captaincy and in 1823 it was raised to the dignity of a city under the title of Fortaleza da Nova Bragança. It is sometimes referred to as Ceará.

(Js. J. P.)

FORT ANCIENT, prehistoric Indian defensive work on the Miami river in Warren county. Ohio, stands on a headland (260–280 ft.) projecting from a plateau. and is now included in a state park. The total area is estimated at 100 ac., and its solid content at 3,000,000 cu.ft. The wall, chiefly of earth cast up from an inner ditch. follows the zigzag course of the bluff. except where it crosses the level neck in the rear of the fort. and is 18.712 ft., or a little more than 33 mi. in length, while the height is 6 to 10 ft., except at the only level point of approach, the neck referred to above. where it is 18 to 19 ft. At the north the points more easily approached are generally narron, sloping ridges, crossed at the upper terminus by a wall, outside of which the ridge was cut down several feet to present a steep slope corresponding to the outer slope of the wall; but where similar ridges form approaches from the south and at some other points, the defenses are formed by raising the wall considerably above the usual height. The most vulnerable point was at the isthmus separating the two portions of the fort, known as the Old Fort and the New Fort. where a short space was undefended, though the ascent is not difficult. Several small mounds and a number of stone graves containing human remains mere within the fort.

FORT DODGE, a city of Iowa, U.S., situated on the Des Moines river at its junction with the Lizard, 85 mi. N.W. of Des Moines; the seat of Webster county. It was established as an army post, Ft. Clarke, Aug. 23, 1850, and in 1851 was renamed in honour of Israel and Henry Dodge, father and son, senators from Wisconsin and Iowa. When the troops left in 1853 Maj. William Williams remained and bought the land and buildings. He laid out the town the following year and became its first mayor and postmaster. The town was chartered as a city in 1869. Many of the earlv settlers of the fertile lands around Fort Dodge who held title under federal patents were dispossessed in the 1860s by the Des Moines Navigation and Railroad company which had its grant from the state of Iowa ior work done in a futile effort to make the river navigable.

Extensive gypsum deposits make Fort Dodge one of the centres of this industry. Clay is abundant and several plants make tile, brick and sewer pipe. Other industries include meat packing, farm implement plants and pharmaceutical production. (For comparative population figures see table in IOWA: *Population.*)

The "Cardiff giant," famous hoax of the 19th century was carved from the Fort Dodge gypsum deposits. In 1868 George Hall of Binghamton, N.Y., procured a block of gypsum from the deposits in Fort Dodge, hauled it overland to Chicago, had it carved in the shape of a human figure, and buried it near Cardiff, Onondaga county, N.Y., where it was discovered by men digging a well in 1869. The "Cardiff giant" was exhibited in various parts of the country as a petrified man or a statue dating from prehistoric times, and was the subject of much discussion among scientists and scholars, until the hoax was exposed by Othniel C. Marsh of Yale, and the perpetrator confessed his part in it. (E. J. BR.)

FORTESCUE, SIR JOHN (*c.* 1385–*c.* 1479), English judge, is famous for his legal treatise written for the instruction of Prince Edward, son of Henry VI. The second son of Sir John Fortescue, he was born at Norris, near South Brent, Somersetshire. He was admitted to Lincoln's Inn before 1420, and in 1421 was elected to parliament. In 1430 he became a serjeant and in 1441 king's serjeant. In 1442 he became chief justice of the king's bench, and was knighted the following year. He fled to Scotland with Henry VI in 1461, when he seems to have been appointed lord chancellor. In 1463 he went into exile with Queen Margaret, and returned to England with her in 1471. On the final defeat of the Lancastrians, he submitted to Edward IV. He retired to Gloucestershire and died some years later. He was most learned and upright, and from his decision in *Thorpe's* Case in 1452 stems the modern doctrine of parliamentary privilege. His treatise, De Laudibus *Legum Angliae,* was written while in exile, and eulogizes the constitution and much of English law and legal education, with many comparisons with Roman and continental law, and proposals for law reform. Its outlook was ahead of its time, and it was not published until 1546.

His other works included *The Difference between an Absolute and a Limited Monarchy (see* C. Plummer, ed., *Sir John Fortescue: The Governance of England* [1885]). *See* S. B. Chrimes, ed. and trans., *Sir John Fortescue: De Laudibus Legum Angliae* (1942); Lord Campbell, *Lives of the Lord Chancellors (1868).* (R. E. MY.)

FORTESCUE, SIR JOHN (*c.* 1531–1607), English statesman, was the eldest son of Sir Adrian Fortescue (executed in 1539), and of his second wife, Anne Reade or Rede. Through his father's mother, Alice, daughter of Sir Geoffrey Boleyn, he was connected with Queen Elizabeth I. He directed the princess Elizabeth's classical studies in Mary's reign, and, on his pupil's accession, was appointed keeper of the great wardrobe. He entered parliament in 1572. In 1589 he was appointed chancellor of the exchequer and a member of the privy council. In 1592 he was knighted, and in Nov. 1601, in addition to his two great offices, he received the chancellorship of the duchy of Lancaster. He was a member of the court of the star chamber and an ecclesiastical commissioner, sat on various important commissions, and as chancellor of the exchequer explained the queen's financial needs and proposed subsidies in parliament. He was deprived by James of the chancellorship of the exchequer, but retained his two other offices. In 1604 Sir John: who stood for Buckinghamshire, was defeated by Sir Francis Goodwin, whose election, however, was declared void by the lord chancellor on the ground of a sentence of outlawry under which he lay, and Fortescue was by a second election returned in his place. This incident gave rise to a violent controversy, regarding the chancellor's jurisdiction in deciding disputed elections to parliament, which was repudiated by the commons but maintained by the king. The matter after much debate was ended by a compromise, which, while leaving the principle unsettled, set aside the elections of both candidates and issued a new writ. Fortescue died on Dec. 23, 1607.

FORT GEORGE RIVER (BIG RIVER), Quebec province, Can.. rises in Lake Nichicun at 1,737 ft. above sea level and flows northward for 60 mi. before turning west for the final 420 mi. to discharge into James bay. Except for its lower course it has no well-defined valley and consists of a series of irregular lakes connected by rapids. Hudson's Bay company posts are situated at its mouth (Fort George) and on Lake Nichicun, the latter being established prior to 1800. (J. D. I.)

FORTH, a river and firth of east Scotland, the *Bodotria* estuary of Ptolemy. It is formed by the junction, 1 mi. W. of Aberfoyle, of two headstreams, Duchray water and Avondhu, the latter carrying the overflow from Loch Xrd. The Kelty. the main right-bank tributary, joins the Forth on Flanders Moss, S mi. below Aberfoyle. The largest tributary is the Teith which enters the main river on the left bank, 2 mi. N.W. of Stirling, and carries the discharge of Loch Katrine and Loch Vennachar. All these streams have their sources in the high ridge east of Loch Lomond. Other left bank tributaries are the Allan water and the Devon. After receiving the Kelty the Forth follows a most tortuous course over the flat, alluvial, moss and carse country to Stirling and Alloa. Thus its course to Kincardine is 65 mi.. whereas the direct distance is only 38 mi. The fall from Aberfoyle to the sea is about 80 ft., a fact which largely explains the meanders. The lowest road bridge at Kincardine is generally taken as the beginning of the firth. The tidal flow reaches beyond Stirling but very little shipping moves above Grangemouth.

The firth extends 48 mi. from Kincardine to the Isle of May. Its width increases rapidly below Queensferry to 19 mi. between Musselburgh and Largo but narrows again to 8½ mi. between Elie and the east Lothian shore. Depths are greater in the inner firth (over 200 ft. near the Forth bridge) and decrease seaward for a distance.

The chief ports are, on the north side, Methil and Burntisland, serving the Fife coalfield, and the naval base of Rosyth; on the south side. Leith and Granton serving Edinburgh, and Bo'ness and Grangemouth dealing with the trade of the industrial areas to the west. Inchkeith and Inchcolm are small islands of volcanic rock. Both have monastic ruins. (T. HER.)

FORTIFICATION, the military art or science of strengthening positions against attacks. Permanent fortifications include lasting and elaborate forts and troop shelters; they are usually constructed of masonry, concrete or stone and are most often erected in times of peace. Field fortifications are those constructed when in contact with an enemy, or when contact is imminent. They consist of entrenched positions for personnel, weapon emplacements, cleared fields of fire for weapons, manufactured obstacles like mines and barbed-wire entanglements. and the strengthening of available natural obstacles by utilizing felled trees, rocks and other materials. Modern field fortifications require concealment and camouflage, and covering fire to hold the enemy at bay.

There are two chief reasons for fortifications: to obtain the greatest advantage from one's own strength and weapons; and to prevent the enemy from using his resources to advantage. The defender is shielded by the protecting fortification, and the attacker is delayed or his impetus minimized by obstacles.

The defense of cities and trade centres, usually by high walls, has been important for centuries as a protection for their wealth. Permanent fortifications have also been established at strategic points along routes of invasion. Seacoast fortifications have normally been for protection against naval attack, though from a military standpoint they sometimes included protection from the land side. Field fortifications have been used in varying degrees since the time of the Greeks and the Romans.

The citadel was the municipal fortress of the ancient world. It appeared in cities of Egypt, Greece and the Roman empire. Roman citadels were less important than those of Greece because they were less necessary as most Roman cities were less exposed to potential attackers.

Obstacles have been utilized throughout history to prevent an enemy from coming to close quarters. The Romans depended upon protective walls and dry ditches' in the republican era but later utilized ditches filled with water and spiked tree trunks set in the ground. Obstacles were of little value unless they were tied into the defense system. For instance, the concrete dragon's teeth of the German west wall of World War II were an inconsequential obstacle when no troops or defense guns were nearby. Bulldozers merely pushed dirt over them to create an elevated road, or engineers dynamited a path through them.

In ancient days, fortifications held up the best attacking troops for months and even years. The medieval castle was almost impregnable until gunpowder gave artillery increased battering power. Even against artillery, the "land battleships" of World War I, which were tremendous fortifications, were able for a time to bear up successfully. In World War II new methods of combined attack made even the strongest permanent fortifications vulnerable. Field fortifications gave some help to the defense by channelizing enemy offensive and local attack. though at no time were they impregnable for any considerable period.

Historically, both permanent and field fortifications were strong against hand weapons and engines of war (*q.v.*), but required extensive modification after the arrival of gunpowder. In the age of the tank and airplane, permanent fortifications became inadequate, but field fortifications were able to compel some delay in enemy advances.

EARLY HISTORY OF FIELD FORTIFICATIONS

The Ancient World.—Field fortifications played an important role in warfare of the ancient world. The main purpose, particularly among the Greeks, was to secure an advantage by being above the enemy, so that the defenders could stand on a hillside while engaging in personal combat. A Roman legion was trained to dig a ditch and erect a palisade each night that it made camp. In preparation for the defense of the camp, each man had a set job to do, and each legionary carried a piece of the palisade that was erected inside the ditch. When Roman columns met with resistance while on the march, half of the force would engage the enemy while the remainder prepared a fort on a height or slope. The palisades were low because the men behind them fought with shields and needed space to use their lances. When campaigns extended over long periods, the main camp of the Romans was further protected by outlying redoubts, or small forts, which were occupied by a cohort of the legion.

Julius Caesar mentions the building of walls as much as 14 mi. long during his campaign in Gaul. On one occasion, Caesar reversed the usual procedure. He surrounded a town with a line of fortifications 11 mi. long, thus permitting his 60,000 Romans to bottle up 80,000 Gauls in Alesia. Then he turned in the other direction to fight 100,000 Gauls who were in turn besieging him. It appears that had it not been for Caesar's fortifications, all Gaul would have been lost. Caesar was a master at field fortification and the construction of obstacles; he employed nearly all the basic types known in modern times.

In later centuries, when the Roman empire had been extended through much of Europe, a system of permanent forts was built along the Rhine and Danube rivers to form the defense of the empire. The technique of entrenching for the protection of the legion was passed on to the Byzantine armies, which insisted that troops entrench their camps in the manner of the Roman legion. The Byzantines also erected a chain of fortresses to defend the line of the Danube river. These frontier posts were worked into a system of defense together with the walled towns and castles of the Balkan area. After the fall of Rome, field entrenchments were almost unknown for many centuries because the code of feudal warfare looked upon such devices as unchivalrous.

Middle Ages.—In the 13th century the Mongols revived the long-forgotten field entrenchment in Europe. Timur consistently followed a tactic of defending his centre in battle by entrenchment, employing the troops thus released for strengthening his flank operations on the wings of the defended position. The next notice of field fortification is in the late 16th century during the Huguenot uprisings against Henry IV. The duke of Parma, in support of the Catholic monarch of Spain, fought Henry several times from behind field fortifications which his veterans had erected overnight. In this same period the Spaniards, under Parma and his successors, encountered a master at maneuver and fortification in Maurice, comte de Saxe. Spanish generals tried again and again to bring Maurice to a pitched battle. When challenged he threw up field fortifications too strong to be taken.

17th, 18th and 19th **Centuries.**—Gustavus Adolphus, the father of modern tactics and organization of armies, also made a considerable contribution to field fortification. The Swedes were thoroughly impressed with the necessity of digging as well as shooting. Gustavus had adopted the Dutch engineering system of Maurice, comte de Saxe, but he was more than an imitator. Outlying posts were defended by redoubts, while his forts were protected by palisades and entanglements; in the field, his armies always built a ditch and a wall around their camp. Instead of the single line common to his day, he prepared two lines of mutually supporting fortifications, possibly the forerunner of the 20th-century system of detached fortresses. Gustavus' field fortifications staved off his defeat by Johann Tzerclaes, count of Tilly, on the banks of the Elbe. Tilly twice attacked the earthworks of the Swedes, but was repulsed by case shot fired at point-blank range from the Swedes' new regimental cannon.

The American Revolution dramatically demonstrated the value of field fortifications. At Bunker Hill, the Americans utilized entrenchments in a manner that seemed entirely natural to the frontier spirit. A low trench, a parapet chest-high or a tree gave the frontiersman protection while he reloaded and aimed his musket. In all the battles of the Revolutionary War, the Americans utilized field fortifications, particularly earthworks. At the last battle of the war, Yorktown, the Americans and French conducted a successful siege against the excellent British defenses, utilizing Marshal Sébastien de Vauban's system of digging parallel trenches and moving forward gradually against the main system of entrenchments and redoubts. Within a generation, American troops under Andrew Jackson at the battle of New Orleans made effective use of cotton bales to defend their position against the advancing British troops.

In the Napoleonic period the one great historical example of field fortification was that known as the Tôrres Vedras line. The duke of Wellington, with 60,000 men, faced French armies of more than double his strength in the campaign in the Spanish peninsula. During the winter of 1810 he built a series of 87 connected redoubts about 25 mi. N. of Lisbon. There, from two low ranges of hills and with almost 300 guns in his redoubts, he defended the

Lisbon peninsula from the Tagus river to the sea. Again and again the Frenchmen assaulted the slopes but were unable to take Wellington's position. Later, the lines were blockaded by the French, but in the spring both armies had to withdraw because they were near starvation.

From the start of the American Civil War, troops fought behind stone walls and trees, or dug entrenchments. In two notable sieges. that of Vicksburg. Miss., in the west and a later one at Petersburg, Va., in the east, trench warfare was the accepted method of siege. The Vicksburg siege lasted almost a year. The Union forces supplemented their artillery and rifle fire by mining, much in the nature of siege warfare against permanent forts. The men tunneled under the fort and placed there a charge of powder to explode after they had withdrawn to safety. In the Cold Harbor, Va., campaign, when Gen. Ulysses S. Grant sent his troops against earthwork defenses of the Confederates he lost 14,000 men in 13 days. Early in the war Gen. Robert E. Lee adopted the frontier riflemen's breastwork comprising two logs on the parapet of the entrenchment. The logs afforded protection to the upper part of the soldier's body but enabled him to fire from the slit between the logs.

At no time during the Civil War were great efforts made to furnish material and supplies for such fortifications. The soldiers usually brought their own spades and axes, and with them built field fortifications far beyond anything known to that date. Changes in tactics wrought by the new rifles and by field entrenchments on defense did not reach European battlefields in time for the Franco-German War in 1870. Both armies were so steeped in the idea of attack that it was unthinkable to take advantage of the folds in the ground and of trenches for defense.

World War I.—The offensive tactics in which the German and French armies were educated bogged donn within a few months after the outbreak of World War I. The fire power of the machine gun brought the war to a stalemate. War on the western front took on the nature of a gigantic siege operation.

For 600 mi. from the border of Switzerland to the channel, two systems of trenches faced each other. During the period from December 1914 to March 1918 this zigzag gash of trenches shifted no more than ten miles at any one place with the single exception of one salient which the Germans voluntarily gave up in order to straighten their lines. For 29 months the expression "western front" became synonomous with a new way of life which was lived by several million uniformed men. "No man's land" was known around the world. At night it was often lighted up by coloured flares and brilliant star shells. At the glimpse of a patrol nervous fingers touched off hundreds of rifles, machine guns and artillery cannon. As the danger disappeared, the battlefield returned to its former quiescence, while a few men did sentry duty in the trenches and their fellow soldiers slept as best they could in the dugouts deep under the earth. In daytime the opposing lines were marked by balloons and occasionally by the dogfights of a few biplanes, which strangely enough enlivened by their combat the daily grind of the human moles in the trenches.

Throughout this entrenched line, the typical trench system was not unlike the parallel trenches which Vauban (*see* belon, *Permanent Fortifications: Vauban's Siegecraft*) had prepared two and one-half centuries before as a means of attacking fortresses. Early in the war. the trenches were normally in four parallels about a mile in depth. Each trench was angled so that no enemy, standing at one end, could fire for more than a few feet down its length. In the zigzagging of the trenches lay protection for the defenders when a breakthrough occurred at one point. Each of the four lines of trenches was connected by a series of communication trenches. perpendicular to the front. These were the supply avenues for the bringing of food, ammunition and mail and through which relief and replacement of troops were affected. In general, the first line of trenches was known as the outpost line and was thinly held. The next tno lines were commonly called the main line of resistance and the supporting line, while the fourth was the reserve line. Still farther to the rear of this rigid defense system, the artillery was posted. The main purpose of this defense in depth was to prevent an enemy from getting through the third iine.

After many months of stalemate. both sides adopted new ideas in both attack and defense. The Hindenburg line in the rear of the regular trench system was the German contribution to defense in depth, far beyond the one-mile-deep, rigid defenses previously used. The Hindenburg trench system was an extremely elaborate field fortification with a unique feature known as the pillbox. These concrete shelters for machine guns were spaced along the front where the protected machine guns were most effective against infantry attack. Behind the pillboxes were trenches and dugouts reinforced with concrete designed to withstand artillery bombardment. These defenses were scattered over a depth of three or four miles. The second position, spaced approximately two miles from the first, was out of range of artillery. The artillery, being about two miles behind its own front lines, was therefore four miles from the second. or main positions, of the Hindenburg line. This distance was further than the artillery could fire effectively. Another reason for this spacing was that, in the attack formations, the co-ordination between infantry and artillery had become so close that the troops followed a creeping barrage which moved forward on a regular time schedule without regard to the actual position of the troops.

FIELD FORTIFICATIONS OF WORLD WAR II AND THE KOREAN WAR

Defensive Systems.—Entrenchments in World War II followed somewhat the general pattern of those of World War I, with one great exception. They had to be prepared for all-around defense against tank attacks The development of the land mine made it possible to work out field fortifications which restricted the movement of tanks but actually did no more than delay the enemy for a time. When the German army attacked France in 1940, the tank columns were organized into two groups; the first was primed to rupture the French defense. and the second, in the rear, to penetrate and then fan out in exploitation of the attack.

The French field fortifications were in many places well built. There were ditches sufficiently deep to stop tanks. and antitank guns sited to fire down the front of these ditches. First of all, the Germans bombarded the French positions with artillery and low-flying aircraft. The tanks then advanced under the cover of smoke against the zigzag antitank ditches. Knowing about where the antitank guns would be placed in the defensive system. one vehicle moved against the antitank gun position and, when it was knocked out, blocked the view of the gunner. In this way, some protection was given to other machines nhich moved upon the ditch. bridged it with special equipment and then moved forward. Against each of the successive defense lines, German tanks advanced under cover of smoke against the concrete emplacements and pillboxes, utilizing flame throwers to compel the defenders to close their loopholes. The German tanks then pulverized them with their heavy guns.

During World War II, field fortifications were thrown up in practically every kind of terrain. In north Africa, men dug individual protection trenches, called foxholes, in the desert. or used sandbags for the same purpose. The coral rock of some Pacific islands made it impossible to dig field fortifications. In such cases the only salvation was to stack sandbags. cut down vegetation and make use of other devices to create a form of field fortification. In the Pacific nar there were many atolls where Allied forces had to mop up Japanese troops hidden in caves, log bunkers or trenches that had been covered and cleverly concealed. Japanese field fortifications had been built methodically during the long period of preparation for the expected U.S. offensive; they were probably the most difficult ones attacked by the Allies during the war. Jungle foliage quickly covered the earth which had been dug out, making entrances to emplacements and shelters almost impossible to discover except by close inspection, an extremely dangerous practice.

Attack of Field Fortifications.—The U.S. method of operating against the cave systems of field entrenchments was to employ machines, instead of manpower, in every possible way. The sequence sometimes included aerial bombing. followed by naval bombardment of the area for days, or even weeks, and then close-up attack by artillery and tanks. The final effort was an infantry mopping up after infiltrating through the jungle areas.

On the eastern European front, the Germans found little difficulty in moving through the field fortifications of the Stalin line, employing tactics of penetration and exploitation by teams of tanks and dive bombers which had been so successful in France. However, the Germans made the mistake of believing that once through the Stalin line they could move unopposed, as they had in France. Russians of all ages and sexes helped dig parallel trench systems outside such cities as Moscow and Leningrad. They were hasty, improvised trenches and antitank ditches, but they proved sufficient to stop the German attack, which had been blunted by continuous fighting.

Hasty Fortification in Towns.—A striking development in the realm of fortifications was the house-to-house fighting in western Europe. As combat troops moved into a new village they invariably selected certain homes, preferably those of stone on the outskirts of the village, as their field fortifications. The next problem was how to develop a co-ordinated field fortification system utilizing the inherent strength of the buildings augmented by fieldworks on commanding ground near the town.

Field Methods.—The location of field fortifications required knowledge of terrain and of the fire power of weapons and evaluation not only of the protection offered by the ground but also the terrain advantages to the attacker. The usual sequence after determining the general location of combat emplacements was the clearing of fields of fire, the provision of observation and signal communication, the laying of mine fields and barbed mire entanglements, the preparation of individual shelters, the emplacement of weapons, the preparation of obstacles other than mine fields and the improvement of supply routes and paths for the movement of reserves. As a part of camouflage and concealment, most armies took advantage of ruses such as dummy positions and the use of deceptive devices, both of which might be interpreted as part of field fortification methods.

The tools the men used for field fortifications were necessarily what they were normally carrying with them and in the use of which they were skilled. The most important was the entrenching tool; an axe was helpful in hard turf and power tools were especially good for heavier construction. Bulldozers, tractors, pneumatic drills and other construction tools, as well as explosives, were helpful in preparing field fortifications. Individual shelters and hasty emplacements were usually built with the materials naturally available. Manufactured items were also necessary for barbed wire, concrete construction and mine fields.

Occasionally there were natural breastworks and parapets, such as in the hedges of the *bocage* country in Normandy. Stone walls in Germany and France on practically every farm and in every village also assured certain defensive assistance. In the hedge country, ports for firing machine guns and other weapons were cut through the dirt ridges, thus providing a well-camouflaged strong point. In the villages, stone and brick walls as well as rubble from demolished buildings made natural breastworks and parapets. German forces in Italy showed great skill and ingenuity in taking advantage of terrain features to develop a network of field fortifications that forced the Allies to pay dearly for every foot of ground, particularly at Cassino. (*See* WORLD WAR II: The *Italian Campaign, Sept. 1943–May 1945*.)

Foxholes.—Foxholes provided the best defensive position for the individual rifleman. They afforded good protection against enemy fire, both small arms and artillery, except for direct hits by shells. Furthermore, they gave protection against the crushing action of tanks. The first reaction of foot soldiers in their foxholes when confronted by a tank attack was one of flight. However, once it mas realized that the tank guns were unable to fire at a depressed angle, the men's best protection was to crouch down in their foxholes when the tanks passed over them. The best foxhole was found to be about three and one-half feet long, two feet wide, or the nidth of a man's shoulders, and at least four feet deep to the firing step. Below the firing step. it was desirable to dig a drainage pit which, in dry weather, gave some measure of comfort as a place for the feet when in a sitting position. Soldiers found that the earth taken out of foxholes needed to be removed since it gave away the location of the hole. Camouflage was achieved by covering the hole with sticks and vegetation. If the unit was in the line or in a defensive position for a day or more, foxholes were connected into V- or Y-shaped figures for better defense.

Emplacement of Weapons.—Dugouts for weapons were more involved, since not only the weapon but the men had to be concealed, and yet there had to be sufficient elbow space for efficient use of the weapon. The pit with parapet was the normal type of emplacement for weapons.

The digging in of heavy artillery and supply depots created great difficulty. Not only were large areas needed, but mechanical equipment was required to dig these emplacements and shelters. In many cases, time and effort mere saved by digging into the sides of hills or by merely constructing a camouflaged area in heavy woods. Another method was to push earth around the supplies and then cover the area with camouflage nets or natural materials.

Mines.—In field, as well as permanent, fortifications, the obstacles of World War II were much more complex than and varied greatly from those of World War I. The greater use of vehicles, amphibious operations and air-borne drops all evoked the development of obstacles. On the defensive, antipersonnel and antitank mines mere located so as to offer additional security to the defending unit. For example, antipersonnel mines were used to break up or hinder enemy patrol action and to slow down infantry assaults. The antipersonnel mine was a charge of explosive, encased in steel, wood or plastic and equipped with a detonator activated when a fuse was stepped on, pulled or kicked. German box mines popped into the air when fired, often blowing off the foot of the individual who had fired it. This mine was also used for "booby traps," a method of killing or injuring souvenir-hunting soldiers particularly. Traps were placed on doors of evacuated buildings, on equipment which might be picked up, in abandoned vehicles and wherever else human ingenuity dictated. The trap was usually so hidden that an unsuspecting person set it off merely by lifting or moving an apparently harmless object.

Antitank mines were similar to antipersonnel mines in their action. but were heavier and had greater explosive charges in order to blow the tracks off tanks and to blow up vehicles. Obviously, mine fields were of permanent defensive use only when covered by weapon fire.

It was absolutely essential to leave paths through friendly mine fields, and it was required that all friendly mine fields be shown on maps. During the mar, retreating troops often laid what were known as nuisance mine fields. scattering them along normal avenues of approach to slow the advance of their opponents. In laying mine fields the geometric patterns were varied so as not to be obvious. Yet mine fields had to be laid quickly and recorded so there would be no difficulty with them later. Mine clearance never quite caught up with mine laying, partly because it was slow work locating mines and then deactivating them to make them harmless. Toward the end of the war, mines were made with plastic and were impossible to locate with the normal radar-type mine clearance device which "pipped" when its rays struck metal. (*See* MINE, LAND.)

Other Obstacles.——Many obstacles other than mine fields were used against troop movements. The Germans, for example, set up tree trunks in fields before the Normandy invasion as obstacles to parachute troops or gliders. They also felled trees or left vehicles abandoned in open pastures where landings might occur.

There were a number of types of barbed-\$ire entanglements, but the most effective were balls three feet in diameter with two on the ground and one placed on top. The wire was rolled in continuous piece in what is known as a concertina. In Europe, antitank ditches were common and in some places were dug on beaches. Other types of obstacles were roadblocks made of logs (the abatis), which included trees placed across an enemy path of approach so as to point at a 45° angle. Another obstacle was a forest of steel beams and the cement dragon's teeth of the Siegfried line, which traversed the whole frontier of Germany. At a distance, eight or ten rows of them looked like the tread of an automobile tire.

Typical Field Fortifications.—The sequence of field fortification in World War II included the location of a defensive position preparation of emplacements and shelters and the creation of obstacles such as mine fields and barbed-wire entanglements. It was regularly put together in a defensive situation in land warfare. A schematic picture of a typical battlefield showed an antitank ditch running down the centre. The defenders behind it would have in sequence concealed entrenched riflemen and gunners spaced backward about 600 yd.. so that their machine guns, mortars and bazookas were able to fire most effectively on an enemy held up momentarily by the obstacles in front of the antitank ditch. The defenders looked out beyond the antitank ditch to barbed mire and the main mine fields, then more barbed wire and, farther in the distance, antipersonnel mines and again barbed wire uith mine fields among it The total depth of this obstacle area in front of the defensive position was usually from 400 to 600 yd.

An example of the development of complete field fortifications in World War II was the Papuan campaign in New Guinea in early 1943, when U S. troops attacked Japanese positions in the jungles. The defenses often consisted of groups of bunkers arranged about five yards apart in circular or oval patterns. Automatic neapons mere sited to fire six or eight inches above the ground and long fire lanes so skillfully cleared that the jungle appeared undisturbed. A typical Japanese perimeter defense in the Sananand area was about 120 yd. long and 70 yd. wide. The network of trenches gave protection to the riflemen and automatic weaponeers. The positions were linked by connecting trenches, and in the centre were bomb shelters to which all the men could repair. The outer perimeter included concrete pillboxes artfully worked into the jungle vegetation so that they were concealed completely. About ten yards from the perimeter and encircling it were trip wires, to which antipersonnel mines were attached.

From 1941 until the Allied invasion of Normandy in 1944, the Germans publicized the Atlantic wall as their response to any attempts at invasion. Huge guns, pillboxes, entrenched troops, antitank ditches and barbed-wire entanglements were pictured. The Allies meanwhile were photographing the beaches from the air and gathering data about them. Underwater obstacles, though not publicized, were an essential part of this field fortification. As many of them were festooned with mines, they caused great concern to the Allies.

From the bluffs, attacking troops were under constant fire, both plunging and grazing, from all types of infantry weapons. In addition, lateral fire was received along the beaches from emplaced artillery in concrete pillboxes. Behind the close-up infantry entrenchments, antitank ditches were laid about roo yd. from the beach and along the limited number of roads and paths running inland from the beach.

When the combination of defensive fire, obstacles and well-trained troops nas considered, it looked at first as if any invasion would be thrown back into the channel. However, bombardment from the air, sea and land was effective in knocking out some of the field fortifications. Once a breakthrough was made. and the Allied invaders got inland in any area, they compelled the Germans who were nearby to withdraw from their long-held Atlantic wall. *(See* WORLD WAR II: *Allied Reconqzrest of Western Europe*)

Korean War.—After the first year of the Korean war, elaborate field fortifications assumed a prominent role in the fighting. The North Korean and Chinese troops nere indefatigable in burrowing into the earth, particularly on the reverse slopes of hills. and concealing their positions. They were known at times to dig all the way through a hilltop to reach the crest facing the enemy. Extensive log-faced bunkers of the type built by the Japanese in World War II provided safe refuges and were remarkably resistant to artillery fire. Both sides followed the standard practice of establishing a thinly held line of outposts to sound the alarm if the enemy attacked. The lines of field fortifications were often five or ten miles deep and extended across the entire Korean peninsula.

PERMANENT FORTIFICATIONS

Permanent fortifications have been important in the history of warfare since earliest times. These fortifications followed a pattern which essentially included: the use of walls during the period of the Greeks and Romans; the feudal castle with its moat and drawbridge; the bastioned fortresses of the early modern period; and the ring fortresses or "concrete battleships" of the early 20th century.

Permanent fortifications were. of course, either emphasized or relatively forgotten as the cycle of war changed from the defense to the offense. When the defensive was predominant, fortifications were inevitably important; when the offensive was supreme, permanent fortifications were bypassed or blasted and their place taken by field fortifications.

Ancient Fortifications.—The civilized tribes of Africa utilized a bank of earth from which they were able to gain an advantage over an attacking force by defending from behind a parapet filled with alternate layers of stone, earth and logs. Some time later came the wall made of mud, sun-dried brick or masonry. The construction of towers at intervals along the wall was the next development. The towers served as sentry posts, barracks and rallying points for the defenders; they were spaced close enough to permit archers to cover the intervening distance with arrows.

In Egypt, labour was available to build walls as much as 120 ft. high and 30 ft. thick. Frequently a ditch was dug on the outside to keep attackers and their siegeworks at a distance. The attacking group usually tried to scale the wall or heap up materials, such as branches, to give them a footing and to permit them to hurdle the wall. As the walls became higher and too difficult to scale, men turned to attacking devices such as the battering ram and to mining. The use of devices for throwing heavy missiles came later, though they were mentioned at the defense of Jerusalem against the Philistines in the 8th century B C. At the siege of Jerusalem two centuries later, there is the first mention of the ram and of movable towers designed to overlook the walls. *(See* ENGINES OF WAR.)

In Greece and Rome the feats of building fortresses and towers and constructing the mechanical devices for attack are the wonder of modern engineers accustomed to machinery and the use of steam, hydraulic and diesel engines. The Romans brought fortifications to a stage of development unequaled until Vauban. They perfected the siege towers, one of which Caesar mentions as being 150 ft high. The lower stories housed the battering ram, which had a pointed head for breaching walls and a ram's head for battering walls. The upper stories were occupied by archers whose object was to drive the defenders from their platforms. Mention is made also of hinged bridges at the top of the tower which were dropped to assist the assaulting parties to get into the fortress.

The long history of the wall as a dominant feature of permanent fortifications must include mention of the famous Chinese wall, built about the 3rd century B.C. The great wall was 1,400 mi. long with 25,000 towers; it was as much as 17 ft. thick with an average height of more than 20 ft., but even so did not prevent invasion by large armies. It did serve as an obstacle to small raiding parties who nere unable to get their horses over it and lacked the tools for opening a gap in the wall.

Roman Empire Defense.—Great walls were built by the Roman emperor Hadrian in Britain and between the Rhine and Danube. The barbarians, though able to make raids against Roman outposts. were not capable of strong attacks against walled fortresses Accordingly. the Roman plan for frontier defenses included masonry malls and fortified camps, and in places merely a line of detached forts. The number of defenders was normally small, though reserves had to be concentrated to meet the invaders when they broke through. As the barbarians grew in strength, the forts developed into fortified cities nhich served as refuges for the neighbouring people.

The defense of the empire was on the Rhine, or in Britain, but always a great distance from the city of Rome. As a result, the city was relatively unfortified and stood as testimony to the fact that fortification was not needed when a nation's strength was great enough to meet the enemy far from its borders. On the other hand, Constantinople, which stood for 1.000 years as the bulnark of the eastern Roman empire, fought off one besieger after another. During this period the genius of its military leaders managed at first to extend the empire's frontiers, but there were a number of times later when the empire was overrun except for its greatest city.

Medieval Castles. — The decline of the Roman empire and the barbarian invasions brought new problems to the defense of western Europe. The more powerful groups fortified their states against the marauding bands, and the weaker turned to the stronger for protection. Central governments dwindled away, to be replaced by local lords whose strongholds were their castles, located on difficult ground since they were used mainly for passive defense.

The forts constructed by William the Conqueror to consolidate his conquest of England were of wood. On the other hand, the Norman castles in western Europe were built of stone, to get maximum strength and utility with a minimum perimeter to defend. The Normans constructed a single large tower, named a keep or donjon, and surrounded it with a low wall a short distance from the tower. As time went on, this outer wall became the first line of defense and was gradually moved farther from the keep. Most of these castles were practically impregnable against the siege weapons then available. Blockade was the only way to reduce them, but long blockades were very difficult to maintain because the lords were unable to keep their serfs for more than 40 days' service each year (see CASTLE).

Influence of Gunpowder. — The introduction of cannon in the 14th century brought about new developments in fortifications. Protection thereafter lay only in the erection of much larger and better-built fortifications. In 1450 Charles VII of France had so powerful a siege train that he captured all the castles in Normandy from the English in one year. Charles VIII moved against Italy at the end of the same century and conquered so many castles and fortified towns that it became obvious a new defense system was needed. The leaders of the opposition came from Italy, and many of them were the greatest figures of the Renaissance. Leonardo da Vinci, Michelangelo and Niccolò Machiavelli all interested themselves in the problems of defense. About this time the famous painter Albrecht Dürer became the first to write of modern fortifications.

Bastioned Forts. — After 1500, when the private castle had lost its defensive capacity, interest centred again on the defense of cities and towns, as had been common in ancient ages. The citadel once again achieved a position of importance as the centre of municipal defense. Strategically significant were border towns like Metz and Verdun between France and Germany, and cities like Liége, Namur and Charleroi on the Franco-Belgian border. Nations sought to control the key approaches to their territory while giving themselves a base or springboard for invasion against enemy countries. From that day to the 20th century, military engineers laboured to make these fortress cities strong.

The terms used by military engineers which are of importance in studying forts and sieges include: the complete wall, known as the *enceinte;* the parapet or top of the wall; the escarp or face leading into the ditch; the counterscarp or opposing wall of the ditch; the covered way on top of it; and finally a mound or glacis leading away from the fort (see fig. 1). The glacis was sloped upward so that a projection of its incline was higher than the parapet wall. Artillery fire directed at the fort could not be raised, and thus projectiles were often lost in the soft earth of the glacis instead of reaching their target.

The general outline of the fortress was also changed, the old straight walls being altered by adding a bastion. These were projections shaped like an ace of spades, which assured that the defenders' weapons and artillery would ward off the assault forces when they approached the walls. Bastions were built into the forts at intervals and so arranged that their guns covered each other. The usual forts had five or six bastions, and were called star fortresses.

Military engineers developed many elaborate geometric patterns to increase the power of defense, their competition in design emphasizing that once again the defense had become dominant over attack.

After the development of the bastion, military engineers still sought the objective of obtaining the greatest amount of protection, combined with the strongest defensive fire power. The simple star trace (*i.e.,* outline) with four or five bastions was replaced by the tenaille trace (fig. 2), in which the flanks were placed back-to-back between the faces. This had the disadvantage that there was still a certain amount of dead ground in the ditch which could not be reached by the guns on the parapets. Eventually military engineers found the solution in what became known as the bastioned trace, its flanks directly opposite each other and linked by curtains (fig. 3). In succeeding decades, fortifications became geometrical patterns with all sorts of details such as gates, sally ports and hornwork coverings. Each part of the fortification became a separate fort that could be divided off from the remainder and be self-sustaining with its own garrison, while still offering mutual support to the remainder of the units in the system.

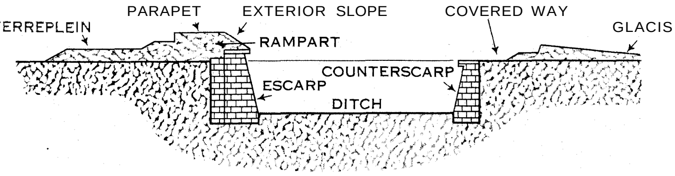


FIG. 1.— DIAGRAM OF A TYPICAL CROSS SECTION OF A FORT

FIG. 2.—TENAILLE TRACE

Vauban's Siegecraft. — Even the bastioned fortress had a short-lived day of predominance, for in the latter part of the 17th century Louis XIV's engineer officer, Marshal Sébastien de Vauban, developed a systematic method of attacking bastioned forts. His objective was to make a breach in the walls through which the attacking column could pass, but to do this he had to establish his artillery on the glacis directly opposite the wall. To make his own artillery safe, he had to knock out that of the enemy. Since the range of guns was from 600 to 700 yd., the first move after the investing forces had established themselves was to set up batteries at that distance to engage in a duel with the artillery in the fort. When the artillery defenses had been reduced, though not necessarily silenced, trenches had to be pushed to the front, so that the guns could be taken to the glacis and the assaulting troops prepared in safety for the launching of their attack. The Vauban system. which long served as a model for armies, was known as the approach by parallel lines (see fig. 4). Its first use was at the siege of Maastricht in 1673, where Vauban completed the capture in 13 days after commencing the digging of trenches.

FIG. 3.—BASTIONED TRACE

Vauban placed his engineers just behind his heavy siege artillery, where they dug a trench parallel to the fort's walls. This served as a shelter for the infantry, from which they could protect the batteries when the defenders sallied forth to try to capture them. While the counterbattery duel was in progress, approach

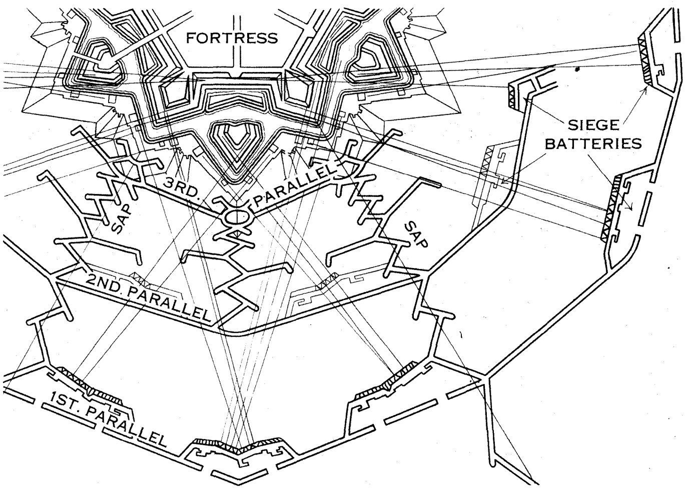


FIG. 4.— REGULAR ATTACK ON A FORTRESS (VAUBAN'S SYSTEM)

trenches perpendicular to the walls were dug from the parallel, but in zigzag form so that the batteries of the fort could not sweep down their length.

From the approaches, a second parallel trench was dug closer to the fort. These trenches were about 12 to 15 ft. wide and 3 ft. deep. with the earth from the excavation thrown forward to make a parapet. The second parallel, about halfway to the wall, was again used as a base for the infantry, and was protected in part by its own batteries which were brought up in closer support. Again the approaches were pushed out, and now they came within musket range of the fort's defenders. Specially trained men called

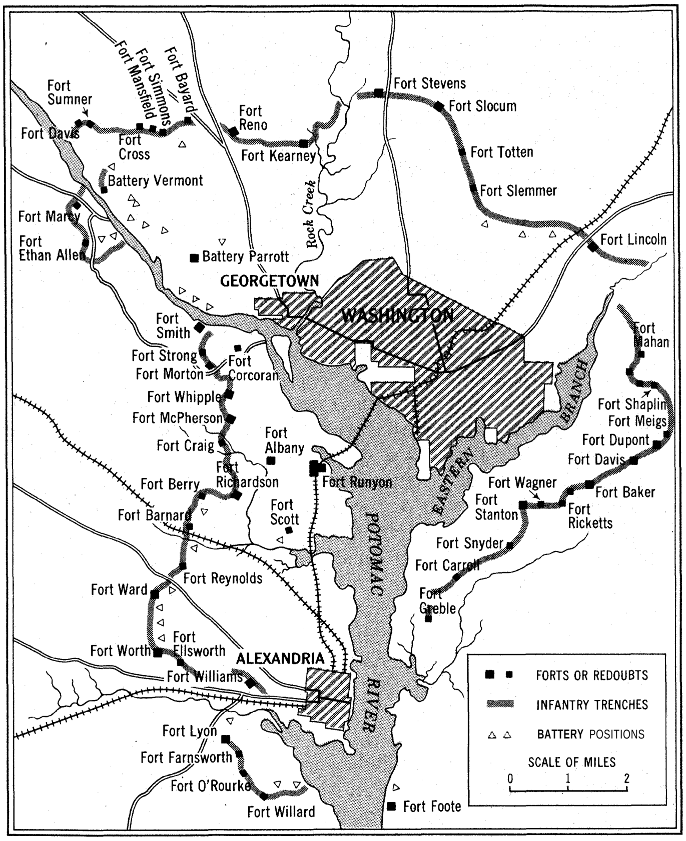


FIG. 5.— DEFENSES OF WASHINGTON, D.C., IN AMERICAN CIVIL WAR

sappers dug slowly ahead under a shelter called a gabion. This was a shield on wheels pushed ahead by the first sapper. The leading man was followed by others who increased the width of the trench and its depth under cover of additional shields. Because of the danger of the work at the head of the sap, Vauban paid them on the spot piecework rates which rose rapidly in proportion to the risk. He counted on a rate of progress of about 50 yd. a day for the usual sap.

Finally, the third parallel was dug near the glacis, irom where the sappers dug their way up the slope to its top. The breaching batteries were then established in iull view oi the escarp, and when it was breached the fortress usually surrendered. Most of the sieges during the century and a half aiter Vauban's successes followed his method with some variation.

19th Century. — As a result of the open tactics of the Revolutionary army in America, the idea of linear battle formations and infiltration was taken up by Napoleon. Also, in the manner of Frederick the Great, he depended upon superior strategy and expert battlefield tactics to win victories. He did not believe in shutting up his armies in fortifications, and whenever possible he avoided attacks against permanent forts. When in exile he stated that in his campaigns against Austria, Prussia and Spain those nations might well have been saved irom defeat had their capital cities been iortified. Under the mode of warfare of that day, as long as the government was preserved and had fighting forces ior protection, the country was not defeated. Napoleon added, "Had Paris been fortified in 1814, my own Empire would have been saved from overthrow."

At the outbreak of the American Civil War, the U.S. had no permanent iortifications except on the seacoast. Several fortresses were built later, however. such as those in Washington, D.C. The system included 68 separate forts, a number of blockhouses and 20 mi. of connecting rifle trenches. The works were so devised that they could support each other by fire. Though never put to test, these fortifications had an indirect influence on the campaigns in Virginia (see fig. 5).

Greater attention was paid to permanent fortifications in the Franco-German War. Developments in rifles and artillery made attacks against fortresses successful. The Germans were victorious in rapid order since they attacked with rifled guns against French fortifications armed with smooth-bore artillery, and in many cases insufficiently protected by detached forts. The German siege howitzer was able to breach the walls of the fort at Strasbourg from more than a mile away, while the largest German gun hurled shells into Paris from a distance of four miles.

The great increase in artillery range compelled the spreading out of detached forts around the fortresses, from a minimum of a few hundred yards to a minimum of six miles by 1910. These detached works were moved out so far from fortress towns that they became almost independent of them. Consequently, fortifying of towns became too expensive, and declined rapidly. The towns began to seek some other means of defense, and unless a town dominated a strategic point its fortifications fell into disuse.

Artillery made its greatest advance in the race against the defensive capabilities of fortifications in the latter half of the 19th century. Once again the attack became ascendant, requiring land fortifications to be rebuilt. The idea of detached forts had, of course, increased the capability of defense, but now the construction of the forts themselves bad to be changed. It was useless to have correct dispersion and mutually supporting fire unless the forts could stand up under artillery pounding. Revetments had to be strengthened immensely and concrete roofs from six to ten feet thick were built over them.

The leading fortification engineer in this period in Europe was Gen Henri Brialmont, who was considered a Belgian Vauban. He placed his iorts at an average distance of four miles from a city such as LiCge, and at intervals of approximately two and one-half miles. At Antwerp, his defense system was even more dense. His idea was that forts could be joined by a ring of infantry trenches, but this was never effected by the Belgians. One of his greatest contributions was the use of armour to protect the guns. He devised disappearing cupolas, and turrets of steel, so that the guns popped out only when they were being fired. The remainder of his fortress (known as the ring fortress) was built of concrete.

Some of the iorts were five-sided, while others were triangular. They appeared far smaller than they actually were, because most of their bulk was concealed underground. Brialmont's ideas were used by the French in developing their fortress systems along the German frontier. Antwerp, Liége and Namur were Brialmont's masterpieces.

Wbrld War I.—Though the Allies subscribed to the axiom of war that victory is the result of offensive action. they looked to their fortresses to give them time for mobilization. The fortresses in France and Belgium were designed not only to delay the enemy on important lines of advance but also to channel his attack. From an offensive standpoint, the fortresses were useful for maneuvering since they formed a pivot for the attacking formations.

By marching through Belgium in 1914, however, the Germans avoided the strong fortresses on the eastern border of France. The fortresses of Liége and Namur in Belgium, and their counterparts in northern France, which were in the path of the German right wing, were weak in comparison with those iurther south on the eastern frontier of France. The Germans had assessed this problem and developed what mas known as the Schlieffen plan. This called for a strong right wheeling movement in an area where there were good railway connections. As long as the Belgians held Liége, the German plan would be blocked. However, it was not a modern, strong fortress and its ring of 12 forts fell within 11 days. The town itself, with its vital bridges over the Meuse, was captured on the third day, after which the howitzers pounded the fortifications for a week more. Namur stood up for only four days under German bombardment, and four of the Xntwerp forts were reduced in three days.

Further south, the forts on the eastern front of France gave a better account of themselves. There were no serious attacks against the Verdun and Belfort fortifications. though the Germans did reduce some of the lesser forts in from 2 to 11 days. Consequently the French high command, seeing how weak fortifications were against the new artillery, decided to abandon permanent forts like Verdun and put their faith in field fortifications. However, when it was later discovered that the steel turrets and concrete of the modern forts had sufferedlittle damage, they were reoccupied and became the focal points for some of the greatest battles of the war.

Permanent fortifications were nor only costly but they gave an illusion of security. Field fortifications had proved as effective as permanent ones since they were able to take advantage of concealment and had been built rapidly in many areas. During the war there had been few instances of the use of mines, or sapping, against permanent fortifications. On one occasion 20 mines, containing 1,000,000 lb. of explosives, were detonated under the German lines on the Messines ridge. Before that time, mining operations had been resorted to in the battle of the Somme, where great quantities of explosives were used against the Ludendorff line. One mine, for instance, took months to'complete and when exploded its concussion nas felt ten miles away. Gen. Erich Ludendorff reported that "the moral effect of these explosions was simply staggering." Just as the appearance of the tank made fortifications of a permanent type less useful, so, too, did tanks eliminate the need of these tremendous mining operations.

The experience of World War I appeared to have dictated the passing of the great fortified areas, but the French continued to rely upon an elaborate chain of defenses which they built in the interim between World Wars I and II.

Developments Between 1918 and 1939.—The fact that certain modern fortresses had held out against German artillery during World War I, as well as the admitted saving in military manpower, induced France to build the celebrated Maginot line as a permanent defense against German attack. This ultramodern defensive fortification showed traces of the old circular system of fortifications but its dominant feature was linear. The Maginot line was, from the standpoint of the troops, a tremendous advance over previous fortifications. Its concrete was thicker than anything heretofore known and its guns heavier. In addition, there were air-conditioned areas for the troops, and the line was usually referred to as being more comfortable than a modern city. There were recreation areas, living quarters, supply storehouses and underground rail lines connecting various portions of the line. Strong points had been established in depth, capable of being supported by troops moved underground by rail.

Germany, too, fortified the Rhineland in 1936 with a series of obstacles and pillboxes known as the Siegfried line. It had steel and concrete defensive positions, behind great masses of concrete and steel obstacles running along the entire frontier of Germany. The frontier fortifications of the Soviet Union against Poland, known as the Stalin line, were built on the model of the Maginot line.

World War 11.—The Germans marched through Belgium in May 1940 on a modified Schlieffen plan. As in 1914, they struck at the crossings of the Rleuse and at the Albert canal near LiCge. Once more the Allies expected the LiCge fortifications to hold the enemy for a time along the Meuse. However, the system's key fort of Eben-Emael fell within 24 hours. The whole world mas startled by this rapid fall of a modern fortification. The Belgians had manned the fort with good troops and incorporated the newest ideas in its erection.

The alarm of the western world was expressed in the phrase "secret weapon." The Germans never disabused the world of this thought. For a long time there was a belief that the Germans actually had some new weapon which could bring about the downfall of a modern fort in a day's time. In reality, the Germans had merely planned the operation completely and rehearsed their attack with models. The assault was perfection in co-ordination. Early in the morning German gliders landed troops directly on top of the fortification. Trained engineers acted swiftly in placing charges to blow up the cupolas, used explosives against the ammunition hoists, and even dropped grenades into the muzzles of the guns. By the time the air raid sirens had given their warning, dive-bombing planes were bombarding the other forts. The airborne troops were strengthened by infantry which crossed the river in rubber boats, and together they mopped up the entire LiCge fortification system in an unbelievably short period. Besides attributing the fall of the forts to new weapons, the "fifth column" was also blamed. The real reason was skill, plus the action of the air-borne troops, and the co-ordination of all German arms, both ground and air, in the attack.

The Germans continued their march through Belgium and crossed the Somme, where they struck at Sedan at the northern end of the Maginot line. Having made a breakthrough with their tanks and planes, they continued around to the rear of the line, making it useless. Later, on the eastern front, the Germans used similar tactics in cutting through the Stalin line. Again and again they broke through at one point, employing a combination of tanks, planes, infantry and engineer troops to exploit their success as they had done in France. In some places the Russian zone of permanent fortiiications was roo mi. deep but it was insufficient to halt the German blitzkrieg.

The Soviet Union, however, had never placed the same dependence upon the Stalin line that the French had on the Maginot, but considered it rather as a method to compel the Germans to attack through certain areas. One writer maintained that upon the German breakthrough of the Stalin line they were the victims of a Maginot-line complex in reverse, for they believed the offensive had been successful once the fortified line was pierced. The delay which the Germans encountered in getting through the line gave the Russians two months to determine the direction of the German attack and to bring up their reserves. Also, the line had blunted the cutting edge of the German offensive.

A short time later, the great coast defense of Singapore fell to the Japanese, an event which the western nations hardly believed possible. For Singapore was "the mighty bastion of the far east" and a symbol of Allied resistance. The Japanese landed far to the north of Singapore and after fighting their way southnard, attacked it from the land side. The fort was under constant attack from the air and was heavily bombed by artillery. It had neither fighter planes nor anti-aircraft guns for defense, and its huge 16-in. guns could fire only seaward.

During the middle period of the war, little was heard about permanent fortifications playing a part in any of the battles. 'There mere none in north Africa except the crumbling Mareth line in southern Tunisia, and none at all in the Pacific war after the fall of Corregidor in the Philippines. The great battles of 1942 and 1943 were fought behind and against field fortifications, though during this period there mere the great defense and siege operations at Leningrad. This city, despite the support of a number of naval forts on the Baltic and a lake to its rear, was not completely fortified. However, the combination of permanent forts, water barriers, field fortifications and ruined buildings made of the city a fortress which held out for 515 days until relieved by Soviet forces.

By 1944 there was more and more emphasis on concrete and steel fortifications in the defense of Germany's "fortress of Europe." Newsreels from Germany filtered out through neutral nations to show the world the strength of the channel defenses. Tremendous areas of concrete served by rail and road and mounting railway guns in disappearing turrets brought fear to the onlooker. The forts were built into the sides of cliffs and gave an appearance of impregnability, beyond anything known in previous fortifications. However, when the Allied troops went ashore in the invasion of Normandy they caught certain of the garrison troops napping and also utilized both air and naval bombardment to drive the garrisons underground. It was found upon entering the continent that the permanent fortifications at the seacoast had insufficient support of infantry troops and that there was not a continuous fort along the entire seacoast as had been intimated by German propaganda.

At the close of World War II it was generally concluded that permanent fortifications were not worth the economic cost and the material effort, because, in most cases, delay of an enemy could be accomplished by other means. That is not to say that permanent fortifications were forever outmoded, since in an atomic attack troops might well return to earth or concrete dugouts. Also, permanent fortifications when fitted into a defense pattern continued to have a definite use along river lines and near mountain passes. Third-dimensional warfare, however, had very nearly ended their usefulness as harbour defenses or beach defenses. *See* COAST DEFENSE; TACTICS.

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(W. H. BAU.)

FORTIS, ALESSANDRO (1842–1909), Italian statesman, a prominent republican of the Risorgimento who eventually became prime minister under the monarchy, was born at Forlì. He was brought up as a republican under the influence of Giuseppe Mazzini in the most revolutionary of Italian regions, the Romagna. He fought with Garibaldi in 1866 against the Austrians in Trento and again in 1867 against the papal troops when Garibaldi tried to capture Rome. Most of the Italian republicans had defected since the success of the monarchy in 1860. But Fortis still remained faithful for some time longer. In 1874 the government arrested him with other republicans as they were working out their party program at Villa Ruffi, but a jury acquitted them. In 1876 the party congress at last agreed to drop their former intransigence and to accept the permission held out to them by the new government of the left to take part in parliamentary politics. Fortis himself became a deputy in 1880, attaching himself to Francesco Crispi's group, which sat well over on the left of the chamber. In parliament he proved to be an assiduous but not brilliant politician. He was minister of agriculture in Luigi Pelloux's government in 1898–99. Giolitti chose him as a safe man to take over the premiership for a few months in 1905–06. Fortis' most important achievement in this post was to carry through the nationalization of the railway system. He died in Rome on Dec. 4, 1909. (See also ITALY: History.) (D. M. SH.)

FORT KNOX, a U.S. army reservation, is approximately 35 mi. S. of Louisville in Kentucky. Comprising 110,000 ac., the reservation contains the United States Army Armored centre and the principal U.S. bullion depository.

The fort was established in 1918 as Camp Knox and used as the army's Field Artillery Officer Training school. In 1932 the name was changed, and the following year the 1st cavalry regiment mas moved from Marfa, Tex., to Ft. Knox where it was mechanized. The fort was made headquarters of the armoured force in 1940 and became the armoured centre in 1944.

Located at the centre are several units, including the U.S. Army Armor school, 6th armoured cavalry, Army Armored Training centre, Army Medical Research laboratory, army armour board and the army maintenance board. The primary function of the post is the training of soldiers for armoured warfare.

For maximum security, the bullion depository was built at Ft. Knox in 1936. By the second half of the 20th century the gold stocks there were valued at more than $10,000,000,000. The fabulous treasure is housed in a solid square bombproof building, constructed of granite, steel and concrete, enclosing a two-level torch-proof steel and concrete vault. Added security is provided by guards, sentries and an encircling steel fence, as well as by mechanical protective devices, such as the photoelectric eye. The nearby army post gives further protection.

During World War II the gold vault was used as a repository for the original copy of the U.S. constitutian and the Declaration of Independence, the Magna Carta, a copy of the Gutenberg Bible and the original draft of Lincoln's Gettysburg address.

(G. H. T.)

FORTLAGE, KARL (1806–1881), German philosopher, was born at Osnabrück. Originally a follower of Hegel, he turned to Fichte and Beneke, with whose insistence on psychology as the basis of all philosophy he fully agreed. The fundamental idea of his psychology is impulse, which combines representation (which presupposes consciousness) and feeling (*i.e.*, pleasure). Reason is the highest thing in nature, and God is the absolute Ego, the empirical egos being his instruments.

FORT LAUDERDALE, a residential and resort city of southeastern Florida, U.S., at the mouth of New river on the Atlantic ocean, 26 mi. N. of Miami; the seat of Broward county. The city is noted for its water areas and water fronts; of the incorporated area 10% is water, and there are 260 mi. of ocean, bay, river and canal frontage, 135 mi. of which are navigable. The Intracoastal waterway, a yacht highway in winter, brings 1,000 boats a year to city-owned Bahia Mar yacht basin. Port Everglades on the south limits of the city, built jointly with Dania and Hollywood, is the deepest harbour on the Atlantic coast south of Norfolk, Va., and ranks third in Florida after Jacksonville and Tampa in cargo volume, much of it tanker borne fuel.

A fort named for Maj. William Lauderdale in 1838 was a base for expeditions into and across the nearby Everglades in search of Seminole Indians for removal to the west. Washington Jenkins came to the region in 1876 as keeper of a house of refuge on the uninhabited and lonely coast. Frank Stranahan, the first permanent white settler came from Ohio to operate a ferry and a trading post where he befriended and traded with Seminole Indians. There were 52 inhabitants in 1900, and 175 people incorporated the city in 1911. In 1930 there were less than 9,000 inhabitants but by 1960 the population was 83,648. (For comparative population figures see FLORIDA: Population.) The city adopted a council-manager form of government in 1925. (C. W. TE.)

FORT LEE, a borough of Bergen county, in northeastern New Jersey, U.S., across the Hudson river to the west of New York city and connected to the borough of Manhattan via the George Washington bridge. It is a residential community, lying mainly along the top of the Palisades. It was the site of Ft. Constitution (later renamed Ft. Lee) which along with Ft. Washington defended the southern approach to \Vest Point during the American Revolutionary War. The location has been continuously inhabited since about 1700, but the borough was not incorporated until 1904. From 1907 till 1919 Fort Lee was the motion-picture capital of the world and important players of the early silent films — such as Rudolph Valentino, Charlie Chaplin, Lon Chaney, Theda Bara, Lillian Gish, "Fatty" Arbuckle and Marie Dressler—worked there. The last picture mas made there in 1923, but the borough remains a major film processing centre, turning out large quantities of film daily for the motion-picture industry. For comparative population figures see table in NEW JERSEY: Population.

(D. N. A.; M. P. M.)

FORT MADISON, a city in the southeastern corner of Iowa, U.S., on the Mississippi river; the seat of Lee county.

Fort Madison has large railroad shops and various manufacturing industries. It is the seat of a state penitentiary. A 525-ft. movable swing span railroad bridge across the Mississippi was completed in 1927. A fort was built there in 1808, and was named after James Madison, who was elected president that year. It was constantly harassed by the Sauk and Fox Indians, who considered that its erection was a violation of the treaty made with them by Gen. William Henry Harrison in 1804.

In Sept. 1813, the little garrison of 100 men abandoned the post, burning the fort behind them and escaping to the river through a tunnel. Permanent settlement began in 1833. The town was incorporated in 1838 and chartered as a city in 1839. The courthouse, built in 1841 and constantly in use thereafter, is the oldest in the state. For comparative population figures see table in

IOWA: *Population.*

FORT MYERS, a city of southwestern Florida, U.S., on the Caloosahatchee river. 13 mi. from the Gulf of Mexico. 145 mi. N.W. of Miami; the seat of Lee county. The city is at the western end of the cross-state waterway through the St. Lucie canal and Lake Okeechobee. There is a municipal boat basin with a capacity for 100 yachts and smaller boats. The city is the centre of a trading area including five nearby counties. A state farmers' market and local packing houses process the citrus fruits, truck crops, cut flowers and commercial fishing products of the area'. The city's boulevards are lined with royal palms, and more than 100 varieties of palm are found in the city and along the banks of the river. which is stocked with tarpon. Fort Myers, named for Lt. Col. Abraham C. Myers, was established on Feb. 20. 1850, on the site of the old Ft. Harvie, a temporary post during the Seminole War (1835–42). The city was incorporated in 1905. For comparative population figures *see* table in FLORIDA: *Population.* (J. E. *D.)*

FORTROSE, a royal and small burgh and seaport of Ross and Cromarty. Scot.. on the southeastern coast of the Black Isle peninsula. by Inverness firth, 28 mi. N.N.E. of Inverness by road. Pop. (1951) 882.

The burgh of Fortrose consists of the two towns of Fortrose and Rosernarkie, about 1 mi. apart. which were united into a free burgh by James II of Scotland in 1455. though total union was achieved only by an act of the Scots parliament of 1661.

Rosemarkie had a monastery founded by St. Moluag in the 6th century, and St. Peter's church, built in the 8th century, while David I in 1124 instituted the bishopric of Ross with its seat there. A century later the bishop's seat was transferred to Fortrose, thereafter to be known as the Chanonry of Ross. a name which survived the Reformation and is still used locally. Tradition has it that part of the cathedral was built by a countess of Ross (her canopied tomb still exists'). while it seems to have been completed in about 1500 by Bishop Fraser. The style has been described as of the purest and most elaborate middle-Pointed. The north aisles were never erected, and all that now remains is the south aisle to the nave and chancel. with the chapter house, a two-story structure, standing apart near the northeastern corner. The curfew is sounded nightly on a bell of 1460.

An ancient Celtic carved cross stands in the old churchyard of Rosemarkie. The academy is the successor of an ancient grammar school. Fortrose and Rosemarkie are residential and seaside holiday tonns.

FORT SMITH, a city on the western border of Arkansas. U.S.. the state's second largest city, midway between the Ozark or Boston mountain range to the north and the Ouachita mountains to the south, on the south hank of the Arkansas river at the mouth of the Poteau river; the seat of Sebastian county. The site was known as Belle Pointe to the early French explorers. An army post was established there in 1817 and named for Gen. Thomas A. Smith. The town was laid out in 1821, incorporated in 1842 and chartered as a city in 1845. Troops were finally withdrawn in Sept. 1871. and the military reservation was transferred to the department of the interior.

The U.S. district court for the western district of Xrkansas was located in Fort Smith for many years and had jurisdiction over the Indian territory. now the state of Oklahoma. Isaac C. Parker. judge of the court from 1875 to 1896, had the difficult task of enforcing federal law in Indian territory, refuge for great numbers of outlaws and the home of the "five civilized tribes." He used 200 deputy United States marshals in the task. In 1957 the Fort Smith Historical Restoration corporation restored Judge Parker's courtroom in its original building and built an exact replica of the hanging gallows used by this court in punishing convicted capital offenders.

Local industries include the manufactures of wood. metal: paper, glass. fibre and electronic products. The city is in the heart of a natural gas region and the Arkansas-Oklahoma coal field. Truck and food crops are grown in abundance in the rich Xrkansas river valley. Livestock production, dairying, poultry and meat packing are important sources of income. One of the greatest horse and mule markets in the nation is located in West Fort Smith.

Two city-owned mountain lakes and several man-made lakes within easy driving distance provide excellent Ozark mountain water and recreational facilities in addition to the many parks and playgrounds and the Arkansas-Oklahoma Livestock Exposition grounds n-ithin the city limits.

Van Buren, Ark.. to the north. and West Fort Smith, Okla., are adjacent cities. Ft. Chaffee army base is 8 mi. E.

The population in 1960 was 52.991 by federal census. For comparative population figures *see* table in ARKANSAS: *Population.* (E. P. *Hi.)*

FORTUNA (FORTUNE), an Italian goddess who later became identified with the Greek Tyche, a divinity of chance or lot. The original Italian deity, however, was not an abstraction of chance or luck, but rather the bearer (her name is derived from the root *fer-)* of, it is hoped, prosperity and increase. As such she approaches a fertility deity and hence her association with the bounty of the soil and the fruitfulness of women. Frequently she is an oracular goddess, consulted in various ways regarding the future. She is worshiped under numerous cult-titles (*e.g., muliebris, virilis, equestris,* etc.), a complete account of which is to be found in W. Roscher, *Ausführliches Lexikon der griechishen und römischen Mythologie.*

Fortuna was worshiped extensively in Italy from the earliest times Her introduction at Rome was comparatively late, traditionally under the auspices of Servius Tullius. who built a temple of Fors Fortuna outside the city on the right bank of the Tiber. She had numerous other shrines in Rome, many of nhich traced their founding back to the regal period. The most celebrated shrines of Fortuna outside the city were those at Praeneste and Xntium. At Praeneste. where she was norshiped particularly by women as Primigenia. "first born" (apparently of the daughters of Jupiter), her shrine was an oracular seat of some celebrity. The procedure was for a child to draw at random from an ancient collection of nooden tiles bearing various messages, nhich would then be related to the problems of the consultant. The cult of Fortuna Primigenia on the Capitoline was according to tradition established by Servius Tullius. The shrine at Antium, well known from Horace's *Odes* i. 35, had two Fortunae who gave responses by the mysterious movement of their cult statues.

ALINARI

STATUE OF THE GODDESS FORTUNA HOLDING CORNUCOPIA AND RUDDER, THE SYMBOLS WITH WHICH SHE IS USUALLY ASSOCIATED. FOUND AT OSTIA, THE STATUE IS NOW IN THE VATICAN CITY. ROME

Fortuna is represented in literature and art as bearing a cornucopia as the giver of abundance. a rudder as controller of destinies, or standing on a ball to indicate the uncertainty of fortune.

See also G. Wissowa, *Religion und Kultus,* pp. 256–268 (1912) ; W. W. Fowler. *Roman Essays and Interpretations,* pp. 64–70 (1920). (R. B. LD.)

FORTUNATIANUS, ATILIUS. Latin grammarian of the 4th century A.D. He was the author. of a treatise on metres, dedicated to one of his pupils. a youth of senatorial rank. The manual discusses the fundamental ideas of metre and the rules of prosody. and ends with an analysis of the metres of Horace. The chief authorities used are Caesius Bassus and the Latin adaptation by Iuba the grammarian of the *Techne* of Heliodorus.

Editions of the *Ars* in H. Keil, *Grammatici Latini,* vi, and separately by him (1885).

FORTUNATUS, the hero of a popular European chapbook.

He was a native. says the story, of Famagusta in Cyprus, and meeting the goddess of Fortune received a purse which was replenished as often as he drew from it. He wandered through many lands, and at Cairo was the guest of the sultan. Among the treasures which the sultan showed him was a hat which had the power of transporting its wearer to any place he desired. Of this he feloniously possessed himself, and returned to Cyprus, where he led a luxurious life. On his death he left the purse and the hat to his sons Ampedo and Andelosia; but they, by their recklessness and folly. fell on evil days. The moral of the story is obvious: men should desire reason and wisdom before all the treasures of the world. In its full form the history of Fortunatus occupies more than 158 pages in Karl Simrock's *Dte deutschen Volksbucher,* vol. iii. The style and allusions indicate a comparatively modern date for the authorship; but the nucleus of the legend can be traced back to a much earlier period. The earliest known edition of the German text of Fortunatus appeared at Augsburg in 1509. Innumerable versions occur in French, Italian. Dutch and English,

The story was dramatized by Hans Sachs in 1553, and by Thomas Dekker in 1600. Tieck has used the legend in his *Phantasus,* and Chamisso in *Peter Schlemihl;* and Ludwig Uhland left an unfinished narrative poem entitled "Fortunatus and His Sons."

See W. V. Schmidt, *Fortunatus und seine Sohne, eine Zauber-Tragödie, von Thomas Decker, mit einem Anhang,* etc. (1819); J. J. Görres, *Die deutschen Volksbucher* (1807).

FORTUNATUS, VENANTIUS HONORIUS CLEMENTIANUS (530–609), bishop of Poitiers, and the chief Latin poet of his time, was born near Ceneda in Treviso in 530. He studied at Milan and Ravenna, with the special object of excelling as a rhetorician and poet, and in 565 he journeyed to France, where he was received with much favour at the court of Sigbert, king of Austrasia, whose marriage with Brunhild he celebrated in an epithalamium. After remaining a year or two at the court of Sigbert he traveled in various parts of France, visiting persons of distinction and composing verses. At Poitiers he visited Queen Radegunda, and she induced him to prolong his stay in the city indefinitely. There he enjoyed the friendship of Gregory of Tours and others. He was elected bishop of Poitiers in 599. and died about 609. The later poems of Fortunatus were collected in 11 books, and consist of hymns (including the *Vexilla regis prodeunt,* translated into English by J. M. Neale as "The Royal Banners Forward Go"), epitaphs, poetical epistles and verses in honour of his patroness Radegunda and her sister Agnes, the abbess of a nunnery at Poitiers. He also wrote a large poem in four books in honour of St. Martin, and several lives of the saints in prose.

An edition of the works of Fortunatus was published by C. Brower in 1603 (2nd ed, 1617). The edition of M. A Luschi (1785) was afterward reprinted in Migne's *Patrologiae cursus completus,* vol lxxxviii. *See* the edition by Leo and Krusch (1881–85). There are French lives by Nisard (1880) and Leroux ([illegible]).

FORTUNE, ROBERT (1813–1880), Scottish botanist and traveler, was born at Kelloe Berwickshire, on Sept. 16, 1813. He was employed in the botanical garden at Edinburgh, and afterward in the Royal Horticultural society's garden at Chiswick, and upon the termination of the Chinese war in 1842 was sent out by the society to collect plants in China. His travels resulted in the introduction to Europe of many beautiful flowers; but another journey, undertaken in 1848 on behalf of the East India company, had much more important consequences, occasioning the successful introduction into India of the tea plant. In subsequent journeys he visited Formosa and Japan, described the culture of the silkworm and the manufacture of rice paper, and introduced many trees, shrubs and flowers later generally cultivated in Europe. The incidents of his travels were related in a series of interesting books. He died in London on April 13. 1880.

FORTUNY Y CARBÓ, MARIANO JOSÉ MARÍA BERNARDO (1838–1874), an influential Spanish historical painter. was born at Reus on June 11, 1838. He entered the Academy of Barcelona, where he worked for four years under Claudio Lorenzale, and in March 1858 he gained a scholarship which enabled him to complete his studies in Rome. On the outbreak of the war between Spain and the emperor of Morocco in 1859 Fortuny was sent by the authorities of Barcelona to paint the most striking incidents of the campaign. He returned to Spain in 1860. He visited Paris in 1868 and shortly afterward married the daughter of Federico Madrazo, the director of the royal museum at Madrid. Another visit to Paris in 1870 was followed by a two years' stay at Granada, but then he returned to Rome where he died on Nov. 21, 1874.

The work which Fortuny accomplished during his short life is distinguished by facility of execution and cleverness in the arrangement of brilliant hues.

FORT WAYNE, a city of northeastern Indiana, U.S., and the seat of Allen county. Kekionga (Miami Town or Great Miami village), chief town of the Miami Indians, was located within the limits of the present city, where the St. Marys and St. Joseph rivers join to form the Maumee. Because of the natural advantage of the site for both travel and defense, French traders and soldiers built Fort Miami there. In 1760 the fort was occupied by the English, but in 1763 it was captured by the Indian chief, Pontiac. In 1790 Pres. George Washington sent Gen. Josiah Harmar to establish a post there. He was quickly defeated by Little Turtle, as was Gen. Arthur St. Clair a year later. In 1794 Gen. "Mad Anthony" Wayne defeated the Indians and built a stockade which came to be known as Fort Wayne.

From a crude military and commercial outpost, Fort Wayne turned into a fur-trading centre. It was incorporated as a town in 1829, and became a city in 1840. Although its industrial growth was stimulated by the building of the Wabash and Erie canal, true industrial and commercial development resulted in the 1850s with the coming of the railroads. Easy access to raw materials and to markets permitted diversification in industrial development. Manufactured products include wire, electrical machinery, pumps and tanks, radio and television equipment, motor trucks, pistons, dredges, mining machinery, oil burners, biscuits and beer. Pop. (1960) city 161,776; Fort Wayne standard metropolitan statistical area (Allen county) 232,196. (For comparative population figures for the city *see* table in INDIANA: *Population.*) A part of the growth between 1950 and 1960 is accounted for by annexations which doubled its area.

Among the city's buildings is the tower of the Lincoln National bank, and the home office building of the Lincoln National Life Insurance company, which houses a remarkable collection of Lincolniana. Fort Wayne is the site of Indiana Technical, a private college founded in 1930; St. Francis, a Roman Catholic coeducational college founded in 1940; Concordia Senior College (1957), a theological school of the Lutheran Church–Missouri Synod, the successor of Concordia College, closed in 1957; and centres of Purdue and Indiana universities. The Fort Wayne state school for the mentally retarded is there also. (I. G. G.)

FORT WILLIAM, a city of the Thunder Bay district, in southwestern Ontario, Can., is on Lake Superior at the mouth of the Kaministikwia river alongside its twin city Port Arthur (*q.v.*); the two cities comprise the area called the lakehead.

Fort William is a major transportation centre, on both the Canadian Pacific and Canadian National railways, it is also served regularly by air and by several Great Lakes steamship lines. There are more than 25 mi. of river front, with water-rail docks, coal docks, freight sheds and grain elevators. The grain storage facilities are among the largest in the world. Other industries in the second half of the 20th century included newsprint paper mills, marine and general engineering shops, foundry, sawmills and woodworking factories, bus and aircraft factories, brewery and brick and clay works. Plants on the Nipigon river and at Kakabeka falls provide hydroelectric power. Fort William is the centre of a rich mining area of gold, copper, silver and iron, and of an extensive fur-farming industry.

The site was probably first occupied as a French fur trading post in 1678. The North West Fur company built Fort William there (1801–05), and during the early 1800s company employees and partners met annually at Fort William. Pop. (1961) 44,563. (F. A. CK.)

FORT WILLIAM, a small burgh of Inverness-shire, Scot., at the northeastern end of Loch Linnhe, an arm of the sea, about 62 mi. S.S.W. of Inverness and 115 mi. N.N.W. of Glasgow by road. Pop. (1951) 2,674. The original fort, called Inverlochy, was built by Gen. George Monk in 1654 to keep the peace in the Highlands. It fell into ruins during the Restoration and in 1690 was rebuilt by Gen. Hugh Mackay, who named it Fort William after William III, calling the little village at its foot Maryburgh after his queen. The Jacobites unsuccessfully besieged it in 1715 and 1746. The fort was dismantled in the mid-19th century and demolished to provide room for the railway and freight yard, but the town had by then taken its name. Fort William is a touring centre for the west Highlands, and a starting point for the ascent of Ben Nevis, invisible from the town, although lying 4½ mi. E.S.E. Corpach, about 2 mi. N., stands at the head of the Caledonian canal. To the northeast are the modern Inverlochy castle, with extensive cattle rearing in the vicinity, and the ruins of old Inverlochy castle, near which was fought the battle of Inverlochy, when the marquess of Montrose defeated the earl of Argyll on Feb. 2, 1645. Fort William was the first town in the British Isles to light its streets by electricity entirely generated by water power. Water from Loch Treig, conveyed by a 15-mi. tunnel, provides electricity for the engines of a large aluminum works, which absorbs much local labour. The employees are housed in Inverlochy village. Other industries are cattle farming and distilling. The west Highland museum exhibits local crafts and historical relics, including the "secret portrait" of Prince Charles Edward.

FORT WORTH, the seat of Tarrant county, Tex., U.S., is located at the confluence of the Clear and West forks of the Trinity river, 30 mi. W. of Dallas. Pop. (1960), city, 356,268; standard metropolitan statistical area (ahich includes Tarrant and Johnson counties) 573,215. The average temperature in Fort Worth is 65.8° F.; average annual precipitation is 31.63 in.

History. — Fort Worth was founded May 8, 1849, by Maj. Ripley Arnold and the second dragoons on a site suggested by ranger officer Middleton Tait Johnson of Johnson's Station (present Arlington) as a frontier outpost against Comanche depredations, and was named for Maj. Gen. William J. Worth, commander of federal troops in Texas at that time.

A fort in name only and abandoned as a garrison in 1853, Fort Worth hovered on the ragged edge of disappearance until 1856, when by election it was chosen to succeed Birdville as seat of Tarrant county, named for Gen. Edward H. Tarrant, Indian fighter and legislator. According to some disgruntled citizens of Birdville, the outcome was determined by the generous use of whisky and by voting "every man as far West as the Rio Grande." A second election validated the choice, however, and Fort Worth was on its may from a crude frontier settlement to a cattle and rail centre. In the 20th century it was a sophisticated, cosmopolitan focus of transportation facilities, industry, commerce and the arts.

Early growth was accentuated by the cattle drives of the 1870s. Fort Worth was the last major population centre between the Brazos and the Kaw rivers, and it appealed to cowmen as a place where the cowboy "got a square deal from the merchants, and could have a high old time"; hence its names, "Cowtown," and "Where the West Begins." Boom, short-lived but exciting, came with the Texas and Pacific railroad, July 19, 1876. Anticipating its arrival, the city rejected scornfully a challenge from Dallas to a baseball game, replying that its young men were too busy to engage in such foolishness, an ironic twist since the Fort Worth Panthers subsequently were to establish an all-time record for successive Texas League pennants.

Another milestone was the opening of the great packing plants by Armour and Swift in 1902. A silver spade dug into wet soil, April 18, 1949, marked the beginning of a new chapter in the story of Fort Worth—the genesis of aviation manufacturing. Thereafter, the growth of population—and its concomitants—was phenomenal; for comparative figures *see* table in *TEXAS: Population.*

In the latter half of the 20th century Negroes made up somewhat over 10% of the population, Latins less than 5%; the rest was largely native-born white. Western gear goes unnoticed on the streets, yet 25,000 people build jet bombers and other thousands are white collar workers. Hospitality and friendliness of the old west accompany air-conditioned comfort and interest in the arts.

Government. — Incorporated in 1873, Fort Worth employed several forms of city government until the adoption in 1924 of the council-manager plan. The city has experimented with the recall, ousting six councilmen by the method in 1938.

Commerce, Industry and Transportation. — Within a 30-mi. radius Convair, Bell Helicopter, Chance Vought of "Crusader" fame, and Temco have written aviation history. General Motors is at nearby Arlington. Carswell air force base and the Fort Worth General depot are important. Carter field, international airport near Arlington, and Meacham field aid in making the city a centre of southwest aviation.

Packing houses and stockyards constitute the second major industry. Fort Worth is one of the most active oil areas in the U.S. It is a large grain milling and storage centre and is important in the production of air-conditioning equipment, work garments and quality candy. Other items processed in Fort Worth range from saddles to expensive jewelry and from serums to fertilizers.

Fort Worth is served by trunk line railroads, buses, intercontinental highways, a toll road, and an expanding series of expressways. The Trinity Industrial authority works with river cities to extend future ocean barge transportation to Dallas and Fort Worth.

Educational and Cultural **Activities.**—Fort Worth is the home of Texas Christian university, founded in 1873 and supervised by the Disciples of Christ; and Texas Wesleyan, a Methodist college founded in 1891. Arlington State college is 6 mi E , in Arlington. Cultural assets include the Children's museum; the Noble planetarium; the Fort Worth Art centre; the Woman's club; the Fort Worth Public library; the Opera association; the Civic Music association; and Fort Worth Symphony orchestra. Reactivated Casa Manana presents local and national theatre. Area colleges boast active fine arts groups. Two newspapers, the *Star-Telegram* and the *Press,* and the famous *Cattleman's Magazine* are Fort Worth publications.

Parks and Recreations. — Recreational facilities include over 60 parks; the famed Botanic gardens; an aquarium; a zoo; six inland lakes; North Fort Worth's western restoration, "Cowtown U.S.A."; the Will Rogers Memorial Coliseum and auditorium; and the annual Southwest Exposition and Fat Stock show with its world championship rodeo. Among the many area towns are Weatherford, 27 mi. W., a birthplace of the Populist party and home of Douglas Chandor, the artist, and Mary Martin, the actress; and Thurber, a ghost coal town. (E. C. BE.)

FORTY-SEVEN RŌNIN, the 47 loyal retainers of the lord of Akō, whose vendetta ranks as one of the most dramatic episodes of Japanese history. The incident began in April 1701, when imperial envoys from Kyōto arrived in Edo, the capital of the shogun. Three provincial *daimyō* were appointed to receive them, including Asano Naganori (1667–1701) from Akō. Because these men were ignorant of court etiquette they were directed to consult Kira Yoshinaka (1641–1703), an expert in such matters. The other two *daimyō* gave Kira lavish presents to ensure his cooperation, but Asano offered only a token gift. Kira mas apparently annoyed and expressed his displeasure by constantly taunting the inexperienced Asano. The latter finally gave way to his pent-up wrath, and on April 21, 1701, in the audience hall of the shogun's palace, he flew at Kira with his dirk. Kira escaped with minor wounds, but Asano's gross breach of etiquette enraged the shogun, who ordered Asano to commit suicide the same day.

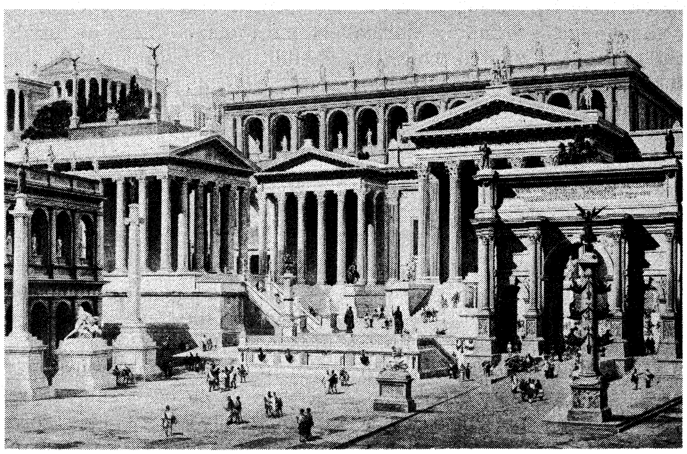
Word of the unhappy event reached Akō five days later. Asano's retainers, headed by Oishi Yoshio (1659–1703), at once met to determine their future actions. Some favoured resisting if the castle had to be yielded; others swore an oath to disembowel themselves before the castle gate; but Oishi counseled caution, and his view prevailed. The castle was surrendered on May 26.

For over a year Oishi and other retainers lived in apparent retirement. Ōishi passed much time in the gay quarters of Kyōto, leading so dissolute a life that Kira's spies were convinced that he entertained no thought of revenge. In the autumn of 1702 Ōishi decided to strike. He and the 46 other *rōnin,* including his son, gathered in Edo. On the night of Jan. 30, 1703, they attacked Kira's mansion, forced their way in and killed their hated adversary. That night they offered up his head at Asano's grave. When the shogun learned of the vendetta he was sympathetically disposed to Ōishi, but finally decided that the 47 *rōnin* could not be allowed to take the law into their own hands. They were accordingly ordered to disembowel themselves on March 20, 1703.

The incident created an immense stir in Japan. The samurai virtues, seemingly forgotten during long years of peace, asserted themselves again. Innumerable poems and essays described the vendetta, and by 1844 no fewer than 47 plays had been written about the *rōnin.* Of these the greatest was *Chūshingura* (1748), in 11 acts, by Takeda Izumo (1691–1756) and others, a work whose popularity has never flagged.

See Sakae Shioya, *Chûshingura: an Exposition* (1940); Jukichi Inouye, *Chushingura,* rev. ed. (1937). (Dᴅ. K.)

FORUM, an open place used, like the Greek agora (*q.v.*), for the transaction of mercantile, judicial or political business. It was level, rectangular in form, surrounded by porticoes, basilicas, courts of law and other public buildings. In the laws of the Twelve Tables the word is used of the vestibule of a tomb; in a Roman camp the forum was an open place immediately beside the *praetorium;* and the term was no doubt originally applied generally to the space in front of any public building or gateway. In



CULVER SERVICE

RESTORATION OF THE FORUM ROMANUM

Rome (*q.v.*) itself forum was almost a proper name, denoting the flat and formerly marshy space between the Palatine and Capitoline hills (also called Forum Romanum), which even during the regal period afforded the accommodation necessary for such public meetings as could not be held within the area Capitolina. In early times the Forum Romanum was used for athletic games, and over the porticoes were galleries for spectators; there were also shops of various kinds. But with the growth of the city, more than one forum became necessary, and under the empire a considerable number of *civilia* (judicial) and *venalia* (mercantile) forums came into existence. In addition to the Forum Romanum, the forums of Caesar and Augustus belonged to the former class; the forum *boarium* (cattle), *holitorium* (vegetable), etc., to the latter. The forum Nerva (also called *transitorium* or *pervium* because a road led through it to the Forum Romanum) and those of Trajan and Vespasian, although intended to facilitate the course of public business, were chiefly erected to embellish the city. In Pompeii, at the northeast end of the forum, there was a *macellum* (market) and shops for provisions, and on the east side a cloth-workers' exchange; at Timgad in north Africa (a military colony founded under Trajan) the whole of the south side of the forum was occupied by shops. The forum was paved, and although on festal occasions chariots were driven through, it was not a thoroughfare and was enclosed by gates at the entrances, of which traces have been found at Pompeii. The word forum frequently appears in the names of Roman market towns; as, for example, in Forum Appii, Forum Iulii (Fréjus), Forum Livii (Forli), Forum Sempronii (Fossombrone). These were distinguished from mere *vici* by the possession of a municipal organization, which, however, was less complete than that of a prefecture. In legal phraseology the word is practically equivalent to "court" or "jurisdiction."

FOSCARI, FRANCESCO (1373–1457), doge of Venice, belonged to a noble Venetian family, and held many of the highest offices of the republic—ambassador, president of the Forty, member of the Council of Ten, inquisitor, procurator of St. Mark, *avvogadore di comun,* etc. His first wife was Maria Priuli and his second Maria Nani; of his many children all save one son (Jacopo) died young. He was elected doge in 1423, and reigned for 34 years. In proclaiming the new doge the customary formula which recognized the people's share in the appointment and asked for their approval—the last vestige of popular government—was finally dropped. Through the doge's influence Venice joined the Florentines in their campaign against Milan, which was carried on with varying success for eight years. In 1444 began the domestic tragedy by which the name of Foscari has become famous. The doge's son Jacopo was accused of taking bribes. He escaped, but was tried in contumacy before the Council of Ten and banished to Treviso (1446). Four years later Ermolao Donato, who had been a member of the Ten at the time of the trial, was assassinated, and Jacopo Foscari was suspected of complicity in the deed. After a long inquiry he was brought to trial for a second time, and was banished to Candia for the rest of his life, with a pension of 200 ducats a year. In 1456 he was accused of treasonable correspondence with the duke of Milan and the sultan of Turkey. He was tried and condemned to a year's imprisonment, to be followed by a return to his place of exile. Jacopo died at Candia, in Jan. 1457. The doge was overwhelmed with grief at this bereavement and, incapable of attending to business, he was finally compelled to abdicate. and died two days later (Nov. 1, 1457).

FOSCOLO, UGO (originally Nɪᴄᴄᴏʟò) (1778–1827), Italian poet and novelist who expressed the aspirations of his compatriots during the French Revolutionary and Napoleonic wars and under the Restoration in some of the most perfect works of the national literature, was born of a Venetian father and a Greek mother on the Ionian island of Zante (Zakynthos) on Feb. 6 (Jan. 26 in the Greek calendar), 1778. He went to Venice about 1793, frequented the literary circles of the countess Isabella Teotochi-Albrizzi, Ippolito Pindemonte and Melchiorre Cesarotti and became famous in 1797 with his tragedy *Tieste.* His early enthusiasm for Napoleon, proclaimed in his ode *A Bonaparte liberatore* on the overthrow of the Venetian oligarchy in 1797, was followed by bitter resentment when the French ceded Venice to Austria under the treaty of Campoformio, and his novel *Le ultime lettere di Jacopo Ortis* (1798) contains a courageous denunciation of the transaction. However, when the Austrians and the Russians invaded Italy in 1799, Foscolo, with other Italian patriots, fought bravely on the French side; and after the battle of Marengo he became a captain in an Italian division of the French army.

After several commissions in Milan, Bologna and Florence and a brilliant. rather dissipated life which involved him in many love affairs (his love for Isabella Roncioni is expressed in a revised edition of *Ortis),* Foscolo in 1804 was sent to France. In the long vigil on the Channel coast with the French army expecting to invade England, he found time to translate Laurence Sterne's *Sentimental Journey.* The news of the battle of Trafalgar moved him to include open praise of Nelson in his poetical masterpiece *I sepolcri,* which was published in 1807. Returning to Italy in 1807, Foscolo became professor of Italian rhetoric at Pavia in 1808, but the chair was abolished before the end of that year and he went to Milan. Satirical references to Napoleon in his tragedy *Ajace* (1811; first printed 1828) brought suspicion on him there, and in 1812 he moved to Florence. There he composed another tragedy, *Ricciarda* (1813; printed 1820), and most of his great unfinished poem. *Le Grazie,* fragments of which he had already published in 1803. He returned to Milan in Nov. 1813.

After the fall of Napoleon, Foscolo refused to serve the Austrians and went into exile! going first to Switzerland and then, in 1816, to England. As an Italian patriot he was greeted with sympathy by the liberal circles in London and was for some time a frequent guest of Lord Holland; but Foscolo's difficult character and extravagant life gradually estranged most of his English friends. He tried to support himself by giving lessons and contributing to periodicals. including the *Edinburgh Review* and the *Quarterly Review,* in which he published some valuable essays on Italian literature; but his last years were spent in great poverty. He died at Turnham Green on Sept. 10, 1827. His remains were transferred to Florence in 1871 and buried in the Santa Croce church, close to the tombs of the great men whom he had sung.

If one does not count the numerous juvenile poems which he later repudiated, Foscolo's poetical output mas not large: 12 sonnets. 2 odes and 2 longer poems. These 16 poems, however, are among the masterpieces of Italian literature. The sonnets are the best in Italy since Tasso's and convey admirably the tumultuous feelings of the young lover, the soldier who despairs of his country, the exile longing for his distant home. The odes, "A Luigia Pallavicini" (1802) and "All' amica risanata" (1803) are colder in style. with a beauty of a neoclassic kind; both develop the idea that beauty is the only comfort granted by the gods to unhappy mortals; and both (the later one more felicitously than the earlier) exalt a woman with the attributions of a pagan goddess.

Foscolo's masterpiece, *I sepolcri,* begins with the supposition that Napoleon had forbidden inscriptions on tombs and so had violated one of the dearest illusions of mankind. 'The tombs of great men are an inspiration to the living; Florence is blessed because it keeps in Santa Croce the remains of Michelangelo, Machiavelli and Galileo; the dead heroes of Marathon revisit the battlefield; and from the tombs of the Trojan kings Homer derived power to sing their glory. With such themes the poet summons contemporary Italians to be worthy of their national heritage, and the poem is clearly patriotic. It helped to inspire the *Risorgimento* and is still very popular in Italy. Its sources include not only the Greek tradition (especially Homer and Pindar) but also the work of the English poets Edward Young, James Hervey and Thomas Gray.

Foscolo's second long poem, *Le Grazie* (fragments 1803 and 1818; 1822), partly mythological, partly biographical, has passages of surpassing beauty and is unparalleled in its formal perfection but has never attained the popularity of *I sepolcri.* His tragedies have little merit.

On the other hand *Le ultime letteve di Jacopo Ortis* has pleased generations of Italian readers. In this youthful novel the Venetian Ortis, who in some respects closely resembles Goethe's Werther, finally kills himself after recounting to a friend, in a series of letters full of patriotic eloquence and tragic pathos, the story of his decline from hope to despair as his country is sold by a tyrant and his beloved married to another man.

BIBLIOGRAPHY.—For the complete works of Foscolo *see* the edition by F. S. Orlandini and E. Mayer, 11 vol. (1850–62), with 1 vol. appendix (1890), and the "national edition" (1933–). The best English translation of *I sepolcri* is *The Sepulchres* by S. C. (?Sinclair Cullen; c. 1820). For biography *see* G. Chiarini, *La vita di Ugo Foscolo* (1927); D. Bulferetti, *Foscolo* (1952); also E. R. P. Vincent, *Ugo Foscolo* (1953). *See* also A. Ottolini, *Bibliografia foscoliana* (1921); G. Citanna, *La poesia di Ugo Foscolo* (1920); M. Fubini, *Ugo Foscolo, saggio critico* (1931). (F. DI.)

FOSSANO, a town and episcopal see of Piemonte. Italy, province of Cuneo, 1j mi. N.E. of the town of Cuneo by rail. 1,180 ft. above sea level. Pop. (1951) 11,017. It has an imposing castle with four toners, begun by Philip, prince of Achaea in 1314. The place appeared as a commune in 1237, but in 1251 it had to yield to Asti. It finally surrendered in 1314 to Philip, who brought it under the house of Savoy. Fossano lies on the main railroad line from Turin to Cuneo and has a branch line to Mondovi.

FOSSANUOVA, an abbey of Italy, province of Rome, near the railway station of Sonnino, 64 mi. S.E of Rome. It is the finest example of a Cistercian abbey. and of the Burgundian Early Gothic style, in Italy. The church (1187–1208) is similar to that of Casamari. The other conventual buildings also are noteworthy. St. Thomas Aquinas died there in 1274.

FOSSE (Foss) **WAY,** the early English name of a Roman road or series of roads in Britain used later by the English running from Lincoln (Roman Lindum) via Leicester (Ratae Coritanorum) and Bath (Aquae Sulis) to Exeter (Isca Damnoniorum). Almost all the Roman line is still in use as modern road. It passes from Lincoln through Newark and Leicester to High Cross (Venonae). where it intersects Watling Street (*q.v.*) at a point often called the "centre of England." Hence it runs to Moreton-in-Marsh, Cirencester, Bath and Ilchester, crosses the hills near Chard, Axminster and Honiton and enters Exeter.

See BRITAIN.

FOSSIL. The term fossil comes from the Latin word *fodere,* literally "to dig." In its early usage the word fossil referred to any curious object that was dug out of the earth, whether organic or not. Since about the middle of the 16th century it has been applied. for the most part, specifically to objects of the past geologic ages that provide evidence of organisms. Actual remains of organisms, remains replaced by minerals, casts, molds. impressions, such as those of leaves, skin and feathers, and tracks and trails, fall under the category of objects classed as fossils. Coal, petroleum, some limestones and some deposits of graphite have organic origin and thus give evidence of ancient life. Technically, they might be called fossils, but generally such deposits are excluded from the definition.

This article deals with the nature of fossils, including a brief history of concepts of fossils; the preservation of the fossil record, including hon remains are preserved; what fossils tell about evolution. hon they serve as a basis of stratigraphy and their economic importance; and major collections and exhibitions of fossils and the role of amateur collectors. Additional information on the subject will be found in the separate articles on the major orders and families of plants and animals, as EQUIDAE; on extinct plants and animals. as DINOSAURIA; and on the geologic systems and eras, as CAMBRIAN SYSTEM. *See* also EVOLUTION, ORGANIC; GEOLOGY; MAN, EVOLUTION OF; PALAEOBOTANY; PALAEONTOLOGY.

THE NATURE OF FOSSILS

Fossils appear to have attracted the attention of man even prior to the beginning of written history. Throughout the known history of man they have been the subject of innumerable speculations and have been given various shades of supernatural interpretation. Even in the pre-Christian era, however. their essential nature was recognized by some of the Greek scholars. In early writings there are hints of the present-day concept that fossils represent a record of an orderly evolution of life through the past ages. The modern version of this concept began to take form prior to the publication of the *Origin of Species* by Darain in 1859, in the work of such men as Lamark, Linnaeus and Cuvier among biologists and William Smith among geologists. With the advent of the theory of organic evolution, fossils came to assume an increasingly important place in the interpretation of earth history and the changes that life has undergone during geologic ages. In the second half of the 19th century, fossils played two dominant roles as man strove to extend his knowledge for both theoretical and practical ends. They served as a historical guide in the interpretation of the course and meaning of life. and as an essential basis for determination of age equivalencies and the nature of deposition of many of the sedimentary rocks accumulated in ages long past.

The Fossil Record. — The record of life on earth extends back over 1,000,000,000 years. The early part of the record is vague and difficult to decipher, but for the last 500,000,000 years it is written with amazing clarity by abundant, varied and well-preserved organic remains. Both plants and animals contribute to the record. Only an extremely small part of the total of all life has been preserved, but it seems remarkable that even this infinitesimal fraction has come donn to the present in view of the vicissitudes of time to which it has been subjected.

Persistence of organic remains occurs only when the organism, some part of it or some impression that it has made. has maintained sufficient equilibrium nith the environment of the encompassing rock to insure that its identity is not totally obliterated. This condition is met most commonly in sedimentary rocks (*q.v.*). The diagenetic changes, or alterations of sediments after they have been deposited, involved in the development of metamorphic rocks and the heat and chemical activities of igneous rocks usually destroy organic remains that may have been incorporated within them.

Buried impressions, such as footprints, skin and leaf impressions, as well as impressions of hard structures, tend to persist unless the sediments in which they are buried are drastically altered. Preservation of the organisms themselves, however, is a somewhat different matter. With notable exceptions, only hard parts, skeletal parts in a very broad sense, tend to be preserved. Hard parts may persist in their original state, but in rocks of appreciable age some degree of mineralization is the rule. Thus fossil remains are often said to be petrified.

Mineralization may merely involve filling of the interstices of skeletal elements by minerals carried by water. There may, however, be partial or total replacement of the original skeletal material by other mineral matter. Sometimes this is a crude process that preserves only the general outline of the structure, but in many cases the introduced minerals reproduce the details of both external and internal structure with remarkable fidelity, even to the extent that cell structure may be determined. One of the best-known examples of this type of preservation is found in the silicified trees in petrified forests, such as the one in Arizona in the United States. A wide variety of mineral compounds act as agents of replacement, but by far the most common are calcium carbonate, calcium phosphate and silica.

Although hard parts generally are essential to preservation, there are notable and highly instructive exceptions in the record. These have given special insight into the structure and age ranges of some groups of organisms which otherwise would have been very poorly known. From the very recent past have come frozen carcasses of mammoths in Siberia and hair and dung of ground sloths from a cave in New Mexico. The fossil ambers of the Baltic region have preserved mid-Tertiary insects, perfect in every detail. Much more ancient are records of such soft-bodied animals as worms in the Cambrian Burgess shales of British Columbia. Such finds are spectacular, but extremely rare.

The degree to which different organisms are subject to preservation is highly varied. This introduces a strong bias into studies designed to probe into the past history of life on our earth. A second important bias is produced by the obvious fact that rocks which provide the medium of preservation must persist to the present time and be accessible for study. This bias is partially time-dependent, since increasing remoteness in time affords increasing chances of removal of rock by erosion and obliteration of fossils by diagenetic activities. In general, deposits formed along sea margins, either on land or in relatively shallow marine waters of continental shelves and broad epicontinental seas, are the most likely to be preserved and later made available for study. Erosive forces tend to be at a minimum in such regions and many have displayed structural stability over the ages so that these deposits have been neither seriously altered nor destroyed. However, even where belts of deposition have been folded into mountain ranges, remnants of the sediments may remain and include excellent records of life.

The great majority of accessible deposits of fossils of the Paleozoic era and the early and middle Mesozoic era were formed on deltas, in vast, shallow coal swamps, in shallow epicontinental seas and in linear, subsiding basins known as geosynclines. The last in particular have been subject to strong structural deformation to provide many of the great mountain ranges of present and past time. The record of marine life now many thousands of feet above sea level is commonplace in the sediments of such ranges.

Because of this localization of the types of deposits likely to persist, records of organisms that lived under other circumstances, in higher continental interiors or in open seas, are rare. Only since the late part of the Mesozoic era have upland continental deposits been well preserved, and the percentage of preservation increases sharply from the late Mesozoic to the present. Through this time, the Cenozoic era, animals and plants that lived in these circumstances provide an increasingly important part of the fossil record. Thus, the nature of organisms, their geographic and ecological distribution, types of rocks, sites of deposition and geological time all play important roles in determination of the completeness and validity of the fossil record of ancient life. While much can be known, some facets of ancient life must always be denied for direct study through fossil remains.

FOSSIL STUDY

The study of fossils is called paleontology, but under this general term are grouped various subdisciplines such as paleozoology, paleoecology, paleobotany and micropaleontology. Fields of interest of the majority of paleontologists fall into two general categories, one in which concern is primarily with geological problems, and the other in which the biological aspects of fossils are uppermost.

Geological Research. — The uses of fossils in the area of geological research include the ordering of strata in time series, temporal correlation of formations in different parts of the world and studies of the conditions of sedimentation during deposition of the rocks that contain fossils. Late in the 18th century William ("Strata") Smith observed, in the course of his work in sedimentary strata in England, that each bed of rock contained a characteristic suite of fossils and that beds in vertical succession showed sequences of characteristic fossils from the base to the top. From these observations stemmed the concepts of temporal correlation of rock formation by use of the fossils that they contained. For the first time authoritative geological maps became a possibility.

Index Fossils. — Extension of the basic idea led to the concept of the index fossil, a particular species or genus which has a wide geographic range and limited temporal range, and thus is diagnostic over a short span of geological time. Over half a century elapsed before the concept of diagnostic faunas could be cast into the framework of the theory of evolution. Even without this integrating theory, by which successions find logical explanation, stratigraphic studies dependent upon fossils and geological maps made great strides.

Commercial Importance. — As industrialization increased, petroleum and other mineral resources that occur in sedimentary rocks, for example, coal, limestone, lead and zinc, became of great economic importance. The study of stratigraphy assumed a major role in the search for these mineral deposits and the use of fossils provided an essential tool for solution of problems in the industrial nations. Remains of marine invertebrates have played the dominant role in these studies. Particularly important are the fossil remains of very small organisms such as foraminifera and ostracoda (*qq.v.*). The subfield of micropaleontology, which deals with these small animals, has taken on a major significance.

Evolution. — Vertebrate animals and plants have been less important in the development of practical stratigraphy, since they are less characteristic of the important marine strata. Both have been used in the solutions of particular problems and in nonmarine stratigraphy. For the most part, however, students of fossil plants and vertebrates have directed their efforts to studies more specifically biological in nature. In their biological role fossils have provided a factual record of the past life of the earth. Irrespective of the interpretation that may be put upon them, they serve to answer many questions about the characteristics of life in times long past. The earliest fossils date back over 1,000,000,000 years. They represent very primitive plants and animals such as algae and sponges. Then, in grand succession, appear the various more complex phyla of invertebrate animals, the vertebrates, fish, amphibians, reptiles, mammals and birds, and the arrays of plants that show the early invasion of land, development of great forests, such as those of the Carboniferous coal measures, and the development of ancestors of the present forests and grasslands.

Beyond a mere recording of facts fossils have stimulated the development of many theories and hypotheses relating to the course of life. Foremost among these is the theory of organic evolution. Fossils provide the critical opportunity to view the changes of life over long periods of time. In effect, they provide the fourth dimension in the study of organic evolution. Neither the organisms that live today nor the record of the past, known from fossils, alone can give an adequate understanding of evolution. Together, however, they provide the basis for one of the most significant concepts yet revealed by the studies of man: the concept of the continuity of life on our earth, and of the patterns and causes of changes that have produced the myriads of divers plants and animals that lived through past geologic ages and are seen alive in our own fleeting glimpse of the passage of time.

Collections.—Fossils occur under such a wide variety of circumstances throughout the world that sites for collection are available to the great majority of its peoples. Major collections have been brought together and displayed to portray historical aspects of the theory of evolution by large and small museums of natural history and by colleges and universities in many parts of the world. The most striking displays are those of large vertebrates, such as dinosaurs, but equally significant are exhibits of small vertebrates, plants and invertebrate animals. Outstanding large exhibits are to be found in New York, Chicago, Washington, D.C., and Pittsburgh in the United States, and in London, Paris and Moscow in Europe. Smaller but excellent exhibits are to be found in the museums of such universities as Harvard, Yale and the University of California, at Berkeley, in municipal and state museums in the United States, as well as equivalent museums throughout much of the world.

The study of fossils is an important profession, but, unlike many areas of scientific endeavour, it provides a rewarding avocation for amateur paleontologists. Opportunities for collection of fossils, for study of semitechnical and popular literature and for use of outstanding collections in museums are available to a vast segment of the populations of North America and Europe and to significant parts of the populations of other continents. Amateurs who have taken advantage of these opportunities have made many truly significant contributions to the total knowledge of life as gleaned from the fossil record. (E. C. O.)

FOSSIL PLANTS: *see* PALAEOBOTANY.

FOSSOMBRONI, VITTORIO, COUNT (1754–1844), Tuscan statesman and mathematician, was born at Arezzo. In 1796 he was made minister for foreign affairs, but on the French occupation of Tuscany in 1799 he fled to Sicily. On the erection of the grand duchy into the ephemeral kingdom of Etruria, under the queen regent, Maria Louisa, he was appointed president of the commission of finance. In 1809 he went to Paris as one of the senators for Tuscany to pay homage to Napoleon. He was president of the legislative commission on the restoration of the grand duke Ferdinand III in 1814, and was prime minister for 30 years until his death in 1844.

He was the real master of Tuscany, and the bases of his rule were equality of all subjects before the law, honest administration of justice and toleration of opinion.

FOSTER, SIR CLEMENT LE NEVE (1841–1904), an eminent English authority on mining and mining legislation, was born at Camberwell, London, on March 23, 1841. After preliminary schooling at Camberwell and Boulogne, France, he studied in turn in France, where he took a science degree, in England at the Royal School of Mines and in Germany at the mining school at Freiberg. He joined the Geological survey in 1860, but resigned in 1865 to become lecturer to the Miners' association of Cornwall and Devon. From 1868 to 1872 he was engaged in mining and exploration work abroad, and was then appointed inspector of mines under the new Metalliferous Mines Regulation act. In 1890 he became professor of mining at the Royal School of Mines. While investigating the cause of an underground fire at Snaefell, Isle of Man, in 1897, the cage jammed at the bottom of the shaft and he was subjected to slow carbon monoxide poisoning. Although rescued, he never fully recovered, and he resigned the inspectorship in 1901. Elected a fellow of the Royal society in 1892 and knighted in 1903, Sir Clement Foster died at Earl's Court, London, on April 19, 1904. (C. W. D.)

FOSTER, SIR GEORGE EULAS (1847–1931), Canadian statesman, was born in New Brunswick Sept. 3, 1847. Educated in New Brunswick, Edinburgh and Heidelberg, he took up teaching in Canada. In 1882 he entered the Canadian parliament as Conservative member for New Brunswick, and in 1885 became minister of marine and fisheries. From 1888–96 he was minister of finance. In the Borden administration of 1911 he was minister of trade and commerce, retaining the portfolio in the union government of 1917, in which year he was summoned to the senate. He was a great advocate of preferential trade within the empire, and in 1903 made a series of speeches in England in support of Chamberlain's policy. Sworn into the imperial privy council in 1916, he was in the same year appointed one of Great Britain's four representatives at the Economic Conference at Paris. In 1918 Foster was created knight commander of St. Michael and St. George, and he represented Canada at the Peace Conference, 1919, at the first assembly of the League of Nations in 1921, when he was elected a vice-president, and at the 7th and 9th assemblies, 1926 and 1929.

FOSTER, SIR MICHAEL (1836–1907), English physiologist, who had a very large share in the organization and development of the Cambridge biological school, was born at Huntingdon on March 8, 1836, the son of a surgeon. After a brilliant career at University college, London, he studied in Paris, and then taught physiology for two years at University college. In 1870 he was appointed by Trinity college, Cambridge, to its praelectorship in physiology, and 13 years later he became the first occupant of the newly created chair of physiology in the university, holding it until 1903. From 1881 to 1903 Foster was biological secretary of the Royal society. In 1899 he was created knight commander of the Bath and in 1900 was returned to parliament as a Unionist for London university. In 1906 he stood as a Liberal, and was defeated. His chief writings were a *Textbook of Physiology* (1876), which became a standard work, and *Lectures on the History of Physiology in the 16th, 17th and 18th Centuries* (1901), lectures delivered at the Cooper Medical college, San Francisco, in 1900. He died in London on Jan. 29, 1907.

FOSTER, STEPHEN COLLINS (1826–1864), American composer, was born July 4, 1826 at Pittsburgh, Pa. In 1852 he "concluded . . . to pursue the Ethiopian business without fear or shame" and "to establish my name as the best Ethiopian song writer." This he said to E. P. Christy, who, with Foster's consent. originally figured as author and composer of "The Old Folks at Home," and whose minstrel troupe helped to popularize Foster's songs in America and Europe, among persons of all classes and qualities alike.

He was born of prosperous middle-class parentage of mainly Scotch-Irish stock. With the exception of two years spent at Athens academy, some restless months at Jefferson college, and the period (1846–50) when he was employed as a bookkeeper in Cincinnati, he spent most of his life in Pittsburgh. In July 1860. he finally took up his residence in New York city, where his death. due to an accident, occurred on Jan. 13, 1864.

His musical inclinations appeared at the age of six. His first recorded attempt at composition ("Tioga Waltz" for an ensemble of flutes!) occurred about 1840. More promising was the sentimental song "Open Thy Lattice, Love" (1842). Significantly enough, he became the star performer of a boyish "Thespian Society" in Negro-minstrel jingles (in trade jargon called Ethiopian), but Pittsburgh with its meagre fare of better music was sterile soil for higher creative attainments, especially since Foster, though enjoying great music never felt stirred to serious study of composition. Nor did his father, who in 1841 commented on Stephen's "strange talent" and "devotion to musick," ever comprehend that nature beckoned for its serious cultivation. Hence, Foster's technical equipment remained very slender, but it sufficed for his purposes and was supported by a keen ear for imperfections in first ideas.

Foster invented no new type of song, but with his occasionally magic gift for felicitous turns of melody or phrase, he outshone numerous competitors in his two chosen fields of simple song, then equally in vogue—the sentimentalized drawing-room "ballad" and the "Ethiopian" song. To the absurdities of the "Ethiopian" song he contributed freely, for example his once enormously popular "De Camptown Races" (1850), but the best of his Negroid songs contain something vitally distinctive. In them, to quote his competent biographer H. V. Milligan, "the Negro ceases to be a caricature and becomes a human being. . . . In this type of song, universal in the appeal of its naïve pathos, he has never had an equal. . . . This is not the Negro of 'Jump Jim Crow' and 'Zip Coon' but of Uncle Tom's Cabin."

By 1850 the popularity of his songs prompted Foster to derive a living from professional song writing. During the next four years his vogue spread with incredible rapidity, but also by then he had practically sung his song, though half of his 175 compositions, generally to his own words, were yet to come. They yielded substantial royalties, but after 1860 Foster apparently preferred to sell his songs outright for a few dollars. This trapped him into song-factory methods; for instance, almost all of his 40 odd compositions of 1863 are potboilers. Most of his songs merely humoured the market and became historically negligible. Among the exceptions, however, the following possess the power and function of imperishable American folk songs: "Uncle Ned" (1848), "Nelly Bly" (1849), "Swanee River" or "The Old Folks at Home" (1851), "Massa's in the Cold, Cold Ground" (1852), "My Old Kentucky Home" (1853), "Old Dog Tray" (1853) and "Old Black Joe" (1860). (O. G. So.)

FOSTER, WILLIAM Z. (1881–1961), U.S. Communist leader and presidential candidate in 1924, 1928 and 1932, was born at Taunton, Mass., on Feb. 25, 1881. He came to national attention as the American Federation of Labor leader in the 1919 steel strike. In 1921 the Russian Communists designated Foster's Trade Union Educational league, which he founded in 1920. as the U.S. branch of their Profintern (Red International of Labour Unions), thereby moving Foster into the U.S. Communist organization as a top leader. In 1932 he suffered a serious heart attack, and party leadership passed to Earl Browder. Foster disapproved of Browder's policies, especially during World War II, but did not assert his more extreme position until international Communist leadership indicated its dissatisfaction with Browder in 1945. Foster then became party chairman. In 1948 he was among the Communist leaders indicted under the Smith act, but because of his precarious health he was not brought to trial.

Foster's extreme position and control of the party were endangered in a conflict among Communists precipitated in 1956 by Soviet repudiation of Stalin and by Russian suppression of the Hungarian revolution. Foster, who steadfastly defended the Russian leadership, was made chairman emeritus, however, at the party's national convention in New York city in Feb. 1957. The Dec. 1959 convention retained him in that position. He died on Sept. 1, 1961, at Moscow.

See T. Draper, *The Roots of American Communism* (1957); D. A. Shannon, *The Decline of American Communism* (1959). (*D. A.* SN.)

FOTHERGILL, JOHN (1712–1780), English physician, was born on March 8, 1712, in Wensleydale, Yorkshire, of a Quaker family. He studied medicine at Edinburgh and later acquired a large practice in London. His "Account of the Sore Throat Attended With Ulcers" (1748), which contains his observations on a severe epidemic, probably of scarlatina, brought him into wide prominence. He was interested in botany and maintained a large botanical collection. He popularized the use of coffee and extended the use of cinchona bark. He died in London on Dec. 26, 1780.

FOTHERINGHAY, a parish in the Peterborough parliamentary division of Northamptonshire, Eng., picturesquely situated on the left bank of the river Nene, 4 mi. N.N.E. of Oundle. Pop. (1951) 199. The castle, of which nothing but the earthworks and foundations remain, is famous as the scene of the imprisonment of Mary, queen of Scots, from Sept. 25, 1586, to her trial and execution on Feb. 8, 1587. The earthworks, commanding a ford of the river, probably bore a castle from Norman times. It became an important stronghold of the Plantagenets from the time of Edward III, and was the birthplace of Richard III in 1452. The church of St. Mary and All Saints, originally collegiate, is Perpendicular; the nave with aisles, and the tower surmounted by an octagon, are in the best style of the period. Of the Plantagenets, Edward, and duke of York, who was killed at the battle of Agincourt in 1415, Richard, the 3rd duke, and his duchess. Cecily (d. 1495), as well as his son the earl of Rutland, who with Richard himself fell at the battle of Wakefield in 1460, are buried in the church. Their monuments were erected by Elizabeth I, who found the choir and tombs in ruins. The oak pulpit was given by Edward IV.

FOUCAULD. CHARLES EUGÈNE, VICOMTE DE (1858–1916), French soldier, explorer and ascetic, was born at Strasbourg on Sept. 15, 1858. After military training he led a dissolute life as an officer in Algeria until in 1882 he left the army and explored Morocco, then forbidden to Christians, disguised as a Jewish rabbi. His *Reconnaissance au Maroc* (1888) describes his discoveries there. In 1886 he was converted, and decided to devote his life to God. After visiting Palestine he became a Trappist monk in 1890 at Notre Dame des Neiges in the Cevennes and then in Syria. He left the order in 1897 to become a hermit, living first in Palestine as a convent servant, then. after ordination in France to the priesthood (1901), returning to Algeria. He spent several years at Beni Abbès before settling at Tamanrasset, in the Hoggar mountains. There he learned the Tuareg language, for which he wrote a grammar and a dictionary, and became endeared to the people. It was largely because of him that the Tuareg remained loyal to the French when the Senussi (*q.v.*) in Tripoli were inciting them to rebel. He was a valuable source of intelligence to the French authorities until he was assassinated by the Senussi on Dec. 1, 1916.

The process for his beatification was initiated in 1927.

See *Les écrits spirituels de C. de Foucauld*, ed. by R. Bazin (1923; Eng. trans. by C. Balfour, *Meditations of a Hermit*, 1930). R. Bazin, *C. de Foucauld* (1921; Eng. trans. by P. Keelan, 1923); A. Fremantle, *Desert Calling* (1949).

FOUCAULT, (JEAN BERNARD) LÉON (1819–1868), French physicist, best known for his experimental work in light and motion. He was the son of a publisher at Paris, where he was born on Sept. 18, 1819. After studying medicine he became interested in experimental physics. With A. H. L. Fizeau (*q.v.*) he carried on a series of investigations in light and heat. By the use of a revolving mirror, he was able in 1850 to establish that the velocity of light in different media varies inversely as the refractive indices of the media, and later to measure the velocity of light in air.

For his demonstration in 1851 of the diurnal motion of the earth by the rotation of the plane of oscillation of a freely suspended, long, heavy pendulum (later called the "Foucault pendulum"), and for his invention of the gyroscope, he received the Copley medal of the Royal society in 1855, and in the same year he was made physical assistant in the imperial observatory at Paris. He discovered the existence of eddy or "Foucault currents" induced in a copper disk moving in a strong magnetic field.

Foucault invented the polarizer which bears his name, and devised a method of giving to the speculum of reflecting telescopes the form of a spheroid or a paraboloid of revolution. He also introduced improvements in the electric arc.

Foucault received many honours during his life; he died of paralysis on Feb. 11, 1868, at Paris. From the year 1845 he edited the scientific portion of the *Journal des Débats.*

FOUCHE, JOSEPH, DUKE OF OTRANTO (1759–1820), French statesman, was born near Nantes on May 21, 1759. He was educated by the Oratorians at Nantes, and in Paris, and afterwards taught in various schools. At Arras he had some dealings with Robespierre in 1789.

In Oct. 1790 he was transferred by the Oratorians to their college at Nantes, where he became a leading member of the local Jacobin club; and on the dissolution of the college in May 1792, Fouché gave up all connection with the church, whose major vows he had not taken. In Aug. 1792 he was elected as deputy for the department of the Lower Loire to the National Convention. His sympathy with the Girondists soon gave way to an enthusiasm for the more violent doctrines of the Jacobins. After some preliminary hesitations, he demanded the immediate execution of Louis XVI. and denounced those who "wavered before the shadow of a king."

The crisis which resulted from the declaration of war by the

Convention against England and Holland (Feb. 1, 1793), and a little later against Spain, brought Fouché into notoriety as one of the fiercest of the Jacobins. The Convention deputed Fouché with a colleague, Villers, to proceed to the west as commissioners for the crushing of the revolt of "the whites" in La Vendée. He soon held the post of commissioner of the republic in the department of the Nikvre. With Chaumette, he helped to initiate the atheistical movement, which in the autumn of 1793 aimed at the extinction of Christianity in France. In the Nièvre he ransacked the churches, sent their spoils to the treasury and established the cult of the goddess of Reason.

Fouche then proceeded to Lyons with Collot d' Herbois (*q.v.*) to execute the vengeance of the Convention on that city, which had revolted against the Jacobins. Toward the end of the Lyons terror Fouché exercised a moderating influence, though outwardly his conduct was marked by the utmost rigpur. By that time Robespierre had struck down the other leaders of the atheistical party; but early in June 1794, at the time of the "Festival of the Supreme Being," Fouché ventured to mock at the theistic revival which Robespierre then inaugurated, and Robespierre procured his ejection from the Jacobin club (July 14, 1794). Fouché, however, was working with his customary skill and energy, and with Tallien and others, effected the overthrow of Robespierre on Thermidor 10 (July 28), 1794. In the intrigues which followed, a vigorous attack on him by Boissy d'Anglas, on Aug. 9, 1795, caused his arrest, but he was released by the amnesty which was passed on the proclamation of the new constitution of 1795.

Under the Directory (1795–1799), Fouché established contact with the communists, once headed by Chaumette and now by François N. ("Gracchus") Babeuf (*q.v.*); whether he betrayed to the director Barras the secret of the Babeuf plot of 1796 is uncertain. In 1797 he gained an appointment for the supply of military *matériel.* After offering his services to the royalists, whose movement was then gathering force, he again decided to support the Jacobins and the director Barras. In the *coup* d'ktat of Fructidor 1797 he made himself useful to Barras, who in 1798 appointed him to be French ambassador to the Cisalpine republic. At Milan he carried matters with so high a hand that he was removed. Early in 1799 he returned to Paris, and after serving as ambassador at The Hague, he became minister of police at Paris (July 20, 1799). The newly elected director, Sieyès (*q.v.*), desired to repress the Jacobins, who had recently reopened their club. Fouché closed the Jacobin club and hunted down the pamphleteers and editors, whether Jacobins or royalists, who were obnoxious to the government, so that at the time of the return of Bonaparte from Egypt (October 1799) the ex-Jacobin was one of the most powerful men in France.

Fouché now lent himself to the schemes of Bonaparte and Sieyès for their overthrow of the directors, and furthered the coup *d'état* of Brumaire 18–19 (Nov. 9–10), 1799. During the Consulate (1799–1804) Fouché was careful to temper as far as possible the arbitrary actions of Bonaparte. In this difficult task he acquitted himself with so much skill as to earn at times the gratitude even of the royalists, and he tried to save the Jacobins from the vengeance of the First. Consul, especially in the "Plot of the Placards" in the spring of 1802. In any case Bonaparte resolved to rid himself of a subordinate who had too much power and skill in intrigue. On the proclamation of Bonaparte as First Consul for life (Aug. 1, 1802) Fouché was deprived of his office; the ministry of police was suppressed, and most of its duties handed over to an extended ministry of justice. Fouché became a senator, and received half of the reserve funds of the police which had accumulated during his tenure of office. The information gained by his spies was so valuable to Napoleon at the time of the Cadoudal-Pichegru conspiracy (February–March 1804), that he now brought back Fouché to the re-constituted ministry of police (July 1804). Fouché later on became minister of the interior. His police agents were ubiquitous, and the terror which Napoleon and Fouché inspired, partly accounts for the absence of conspiracies after 1804. After Austerlitz (Dec. 1805) Fouché uttered the mot of the occasion: "Sire, Austerlitz has shattered the old aristocracy; the boulevard St. Germain no longer conspires."

While engaged in the campaign of Spain, the emperor heard rumours that Fouché and Talleyrand, once bitter enemies, were having interviews at Paris in which Murat, king of Naples, was concerned. Napoleon hurried to Paris, but found nothing to incriminate Fouché, who now became duke of Otranto. During the absence of Napoleon in Austria in the campaign of 1809, the British Walcheren expedition threatened for a time the safety of Antwerp. Fouché thereupon issued an order to the prefects of the northern departments of the empire for the mobilization of 60,000 National Guards, in which he gave offence by the words: "Let us prove to Europe that although the genius of Napoleon can throw lustre on France, his presence is not necessary to enable us to repulse the enemy." The next months brought further causes of friction between emperor and minister. Napoleon found that Fouché had forestalled him in making overtures for peace to the British ministry in 1809. Fouché was dismissed (June 3, 1810), but was made governor of Rome. Hearing of the emperor's anger at his refusal to give up certain documents of his former ministry, he prepared, soon after his arrival at Florence, to sail for the United States. But he found a mediator in Elisa Bonaparte, grand duchess of Tuscany, and was allowed to settle at Aix and finally to return to his domain at Point Carré. In 1812 he sought vainly to dissuade Napoleon from invading Russia; and on the return of the emperor to Paris at the close of that year, Fouché was suspected of complicity in the conspiracy of General Malet. From this suspicion he cleared himself and Napoleon sent him to administer the Illyrian provinces. On the break-up of the Napoleonic system in Oct. 1813 Fouché was ordered to Naples, to watch the movements of Murat. Before he arrived at Naples Murat threw off the mask and invaded Roman territory. Fouché returned to Paris on April 10, 1814, when Napoleon was being constrained by his marshals to abdicate.

At this crisis Fouché tried to gain favour with the new régime without compromising himself too deeply. When he found that there were no hopes of advancement, he entered into relations with Lafayette and Davout. Shortly before the return of Napoleon to Paris (March 19, 1815) Louis XVIII. offered Fouché the ministry of police, which he declined, saying, "It is too late; the only plan to adopt is to retreat." On the arrival of Napoleon he received for the third time the portfolio of police. Nevertheless he entered into secret relations with Metternich at Vienna, his aim being, as always, to prepare for all eventualities. Meanwhile he used all his powers to induce the emperor to popularise his rule, and is said to have caused the insertion of the words "The sovereignty resides in the people; it is the source of power" in the declaration of the council of state. On June 22 Napoleon abdicated for the second time, and Fouché was elected president of the commission which provisionally governed France. Already he was in touch with Louis XVIII., then at Ghent. While ostensibly working for the recognition of the duc de Reichstadt, he facilitated the success of the Bourbon cause. But he could not conciliate royalists who remembered his vote as regicide and his terrorist record. He resigned office, and after acting for a time as ambassador at Dresden, he retired to Prague. Finally he settled at Trieste, where he died on Dec. 25, 1820. He had accumulated great wealth.

In Fouché the enthusiasm of the revolutionary period appeared as a cold, selfish and remorseless fanaticism; in him the bureaucracy of the period 1795–1799 and the autocracy of Napoleon found their ablest instrument. Yet he was never a mere tool He multiplied the means of resistance even to Napoleon, so that though removed from office, he was never wholly disgraced. While appearing to be the servant of the victors, present or prospective, he never gave himself to any one party. In this versatility he resembles Talleyrand, of whom he was a coarse replica. Both professed, under all their shifts and turns, to be desirous of serving France. Talleyrand certainly did so in the sphere of diplomacy; Fouché may occasionally have done so in the sphere of intrigue.

BIBLIOGRAPHY.—Fouché wrote some political pamphlets and reports, the chief of which are *Réflexions sur le jugement de Louis Capet* (1793); *Réflexions sur l'éducation publique* (1793); *Rapport et projet de loi relatif aux collèges* (1793); *Rapport sur la situation de Commune-Affranchie* [Lyons] (1794); *Lettre aux préfets concernant les*

prêtres, etc. (1801); also the letters of 1815 noted above, and a *Lettre au duc de Wellington* (1817). The best life of Fouché is that by L. Madelin, *Fouché,* 2 vol. (1901). The so-called *Fouché Memoirs* are not genuine, but they were apparently compiled, at least in part, from notes written by Fouché, and are often valuable, though their account of the negotiations of 1809–1810 is untrustworthy. For those negotiations *see* Coquelle, *Napoléon et l'Angleterre* (1903; Eng. trans., 1904).

FOUGÈRES, town of northwestern France. capital of an arrondissement in the *département* of Ille-et-Vilaine, 30 mi. N.E. of Rennes by rail. Pop. (1954) 22,111. Fougitres frequently figurts in Breton history from the 11th to the 15th century. It was taken by the English in 1166, and again in 1448. In 1488 it was taken by the troops of Charles VIII. In the middle ages Fougères was a lordship of some importance, which in the 13th century passed into the possession of the family of Lusignan, and in 1307 was confiscated by the crown and afterwards changed hands many times. In 1793, during the wars of the Vendée, it was occupied by the insurgents. It was formerly on the frontier towards Normandy, and, of its mediaeval fortifications, the 15th century Porte St. Sulpice still exists. The castle, situated in the lower part of the town, overlooking the Nançon, is now in ruins, but its ruined towers and outworks give evidence of its strength. The finest of the towers was erected in 1242 by Hugues of Lusignan, and named after Mélusine, the mythical foundress of the family. The churches of St. Léonard and St. Sulpice both date, partly at least, from the 15th century. An hôtel de ville and a belfry, both of the 1jth century, are of architectural interest, and the town possesses many curious old houses. Fougitres is the seat of a subprefect, and has a tribunal of first instance, a chamber of commerce. It manufactures boots and shoes; tanning and leather-dressing and the manufacture of sail-cloth and other fabrics are also important. Trade is in butter and salted goods and in the granite of the neighbouring quarries.

FOULARD. A light silk fabric, having a distinctive soft finish and of the plain or simple twill weave. It is said to come originally from the Far East. In French, the word "foulard" signifies a silk handkerchief. The fabric is figured with a pattern printed in various colours, and used for dress material, handkerchiefs, scarves and neckties. Fine cotton textures of good quality and produced from yarn spun from superior grades of cotton (as Egyptian and Sea Islands), are also sold as "foulard." Cotton foulard, which is usually of the plain calico or simple twill weave, is mercerized, and printed with patterns in styles and colourings similar to those of silk foulard, and employed for similar purposes.

FOULD, ACHILLE (1800–1867), French banker and politician, was born in Paris on Nov. 17, 1800. He belonged to a Jewish family of bankers, and as minister of finance under Louis Napoleon (as president and as Napoleon III.), from 1849 to 1852, and again from 1861 to 1867, carried out important financial and administrative reforms.

During his last tenure of office. he reduced the floating debt, which the Mexican a ar had considerably increased. by the negotiation of a loan of 300,000,000 francs (1863). Fould had a taste for the fine arts. and during his youth he visited Italy and the eastern coasts of the Mediterranean. In 1857 he was made a member of the Academy of Fine Arts. He died at Tarbes, Fr., on Oct. 5, 1867.

FOULIS, ANDREW (1712–1775) and **ROBERT** (1707–1776), Scottish printers and publishers, were the sons of a Glasgow maltman. Robert was apprenticed to a barber; but his ability attracted the attention of Dr. Francis Hutcheson, who strongly recommended him to establish a printing press. He started business in 1741 in Glasgow, and in 1743 was appointed printer to the university. In this same year he brought out Demetrius Phalereus de elocutione, in Greek and Latin, the first Greek book ever printed in Glasgow; and this was followed in 1774 by the famous 12mo edition of Horace which was long believed to be immaculate: though the successive sheets were exposed in the university and a reward offered for the discovery of any inaccuracy, six errors at least, according to T. F. Dibdin, escaped detection. Soon afterwards Robert went into partnership with Andrew, who had been educated far the church, and they continued for about thirty years to issue carefully corrected and beautifully printed editions of classical works in Latin, Greek, English, French and Italian. They printed more than five hundred separate publications, among them the small editions of Cicero, Tacitus, Cornelius Nepos, Virgil, Tibullus and Propertius, Lucretius and Juvenal; a beautiful edition of the Greek Testament, in small 4to; Homer (4 vols. fol., 1756–58); Herodotus, Greek and Latin (g vols. 12mo, 1761); Xenophon, Greek and Latin (12 vols. 12mo, 1762–67); Gray's poems; Pope's works; Milton's poems. The Homer, for which Flaxman's designs were executed, is perhaps the most famous production of the Foulis press. The brothers spared no pains, and Robert went to France to procure manuscripts of the classics, and to engage a skilled engraver and a copper-plate printer. Unfortunately it became their ambition to establish an institution for the encouragement of the fine arts. Their countrymen were not ripe for such an attempt, and the "Academy" involved the projectors in ruin. Andrew died on Sept. 18, 1775, and Robert on June 2, 1776. Robert was the author of a Catalogue of Paintings with *Critical* Remarks. The business was afterwards carried on under the same name by Robert's son Andrew.

See W. J. Duncan, *Notices and Documents illustrative* of *the Literary History of Glasgow,* printed for the Maitland Club (1831), which *inter alia* contains *a* catalogue of the works printed at the Foulis press, and another of the pictures, statues and busts in plaster of Paris produced at the "Academy" in the University of Glasgow. *See* also J. Ferguson, *The Brothers Foulis and early Glasgow Printing* (1889); D. Murray, *Robert and Andrew Foulis and the Glasgow Press* (Glasgow, 1913); *Letters of Robert Foulis* (Glasgow, 1917).

FOUNDATIONS, as referred to building and construction, is appropriately applied to all those portions of the structure below the footings of walls, piers and columns. Foundations are designed to transmit the weight of the superstructure to that portion of the earth's surface on which it rests and which may be called the foundation bed. Foundation beds vary in bearing capacity. All are compressible, hence the erection and loading of any superstructure is accompanied by settlement, though the amount for solid rock is negligible. The object of foundations is to transmit the entire load to the foundation bed at a safe pressure and with small and uniform settlement.

Foundation Beds.—Corresponding geological surface formations may show marked local variations, hence, though foundation beds may be scientifically classified, practical experience of a locality often decides the ultimate treatment.

Rock.—In some districts massive rock formations may occur near the surface, in others they may be exposed by excavation or otherwise reached. Massive rocks provide good foundation beds. Igneous rocks, dense limestones and sandstones can easily bear pressures of 15 tons per square foot, but on softer rocks the limit may be 8 tons. Many foundation beds are products of rock-disintegration; these include gravel, sand, clay, silt, etc.

Gravel.—Gravel consists of water-worn rock fragments varying much in size. Well-compacted gravel overlying a strong substratum, offers a dependable foundation bed which will support at least 4 tons per square foot.

Sand consists of fine rock particles, from $\frac{1}{4}$ in. downwards in diameter. Sand foundations need protection from running water, to prevent lateral escape. Confined sand may support from 2 to 4 tons per square foot.

Clay.—This term embraces cohesive soils, in which the characteristics vary with the composition. Pure clay contributes to plasticity, sand reduces it. Clay becomes plastic with moisture and changes in volume with plasticity; the moisture-content of clay should, therefore, be kept low and uniform; actual contact with water is to be avoided. Drainage of and diversion of water from the site are the usual precautions. Clay foundations need protection from seasonal variations of temperature and humidity; otherwise changes in volume may lead to structural fractures. Such foundations should be 3 to 4 ft. below ground. Bearing pressures on dry yellow clays are usually limited to 2 tons per square foot and on blue clays to 4 tons per square foot.

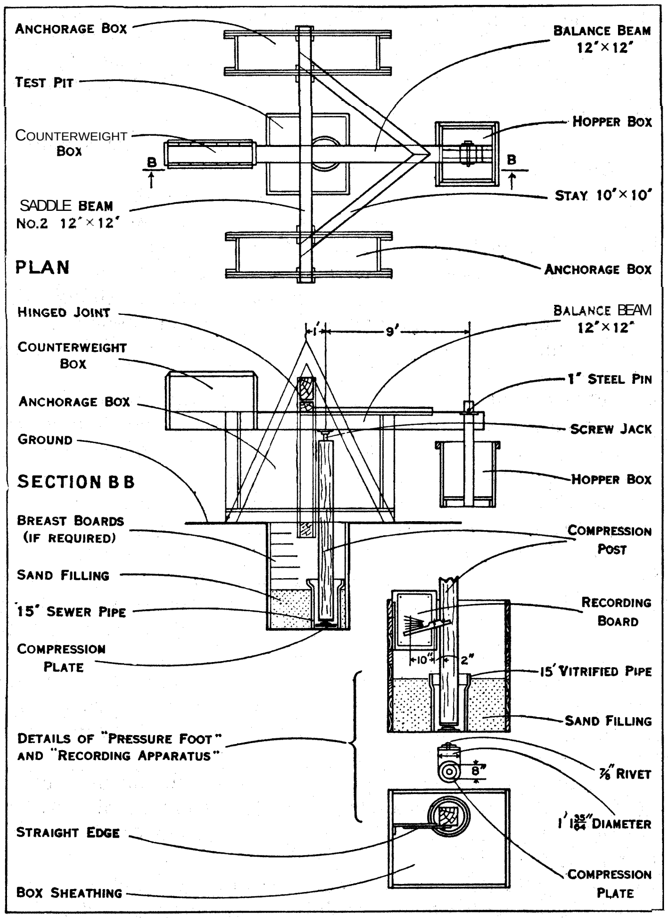
Made or Filled Ground; Silt.—Depressions and excavations are often filled artificially. "Filled" ground continues to consolidate over many years. Building over such ground requires excavation or penetration of the filling to a solid bed, and sites with a soft overlying bed may be similarly treated. On low-lying soft ground, buildings may be "floated" on "rafts," *i.e.*, timber or reinforced concrete slabs continuous over the site. Settlement is thus controlled and rendered uniform.

Other foundation beds may be mixtures of materials and will possess intermediate characteristics.

Protection of Foundation Beds.—Lateral support and protection are often required. Friable earths crumble on upright faces and soft rocks disintegrate. These may be protected by retention walls. Underlying streams of water should be enclosed in a culvert. Where "ground water" is freely rising and falling basements should be constructed as watertight tanks to resist external hydrostatic pressure and prevent the incursion of water.

Bearing Capacity.—Before planning the foundations of an important building an investigation of the site is usually necessary; experience of adjacent sites will assist the investigation If examination of the underlying strata is found necessary a trial pit would be sunk, or "boring" adopted, and samples of the strata raised to the surface and examined.

Allowable bearing capacities for foundation beds in any one locality are often scheduled as in the London Steel Framed Build-



FROM HOOLE AND KINNE, "FOUNDATIONS" (MCGRAW-HILL)

FIG. 1.—LOAD-TESTING APPARATUS FOR FOUNDATION SOILS

ings Act of 1909. Many American building codes include similar schedules. In doubtful cases experiments may have to be employed to determine the bearing capacity.

British regulations do not impose bearing tests, but the Building Code of New York City details a test to be conducted on a minimum area of 4 sq.ft. and after four days 50% more pressure than the proposed bearing capacity must not produce settlement. Fig. 1 shows the apparatus designed for this test by the American Society of Civil Engineers.

Loads Carried.—The constant load is the weight of the structure; its magnitude and distribution are readily determinable.

The movable load fluctuates with occupancy and use, with wind-pressure and snow, and varies from zero to a maximum value. It is difficult to estimate designing loads on foundations but usually when the movable load forms a substantial part of the possible foundation load, the foundations may be designed to carry about 60% of the sum of the loads for which the structural units have been designed This percentage is specified, with qualifications, for certain types of American buildings

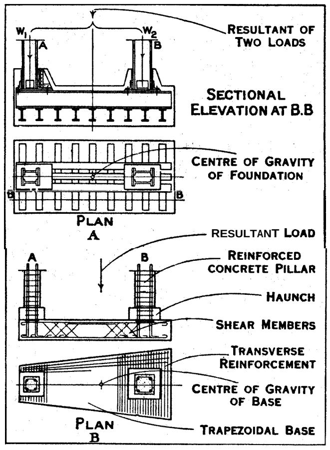


FIG 2—SPECIAL FOUNDATIONS

(A) Compound steel grillage foundation, parallel base; (B) Compound reinforced concrete foundation, trapezoidal base. These methods are applicable where projection beyond the external pillar (A) is strictly limited

Types of Foundations.—There are two general classes. (a) spread foundations, constructed near the surface and having a base area proportional to the load; and (b) deep foundations, excavated or driven to considerable depth, the horizontal area occupied having little relation to the load carried. Cement concrete (see CONCRETE) is used almost universally for foundations. It is strong and conforms to the inaccuracies of the foundation bed

Grillage Foundations.—Projections in foundation concrete may be reinforced with steel, the thickness being then reduced; or steel may be employed as the principal material. In the latter type, steel beams are used to form a "grillage" in two or more tiers. The load is transmitted through a steel or cast iron base to the tiers of the beams, which are bound together transversely by steel sections or by metal packings and bolts.

The foundation steelwork is bedded upon and encased in concrete.

Reinforced Concrete Foundations.—A foundation having the same function as the steel grillage is also shown in fig. 2. Reinforced concrete (*q.v.*) is employed.

Cantilevered Foundations.—When a large pillar occurs at a boundary adjoining an existing building. and an ordinary foundation is impossible, an external pillar is linked with an internal one by a heavy beam, having one end projecting as a cantilever. The outer foundation is well within the boundary. Load from the external pillar is transferred to the cantilever. which bears on the foundation and is balanced by the load on the internal pillar. The foundation is designed to exert uniform pressure on the bed when fully loaded.

In another method two pillars may have a common foundation. The base may be parallel or trapezoidal, and so arranged that the resultant of the two loads lies over the centre of gravity of the base. The trapezoidal base is more suitable for reinforced concrete construction.

Stepped Foundations.—Changes in foundation level should be made in small "steps" to avoid (a) the diagonal shearing of the foundation bed between levels; and (b) fracture at the vertical junction of the higher and lower sections. The concrete bed should be stepped and made continuous by vertical "ramps."

Deep Foundations— Extensive foundation beds, otherwise good, may reveal soft pockets, which can be bridged over by beams or arches. Foundations on soft strata or filled material may be supported on brick or concrete piers erected in deep excavations, on a firm bed. The piers are connected by arches or beams.

Pile Foundations.—A stout pillar of any material driven into the ground is known as a pile. It is generally more economical to use piles than piers, and they may be of round timber, or of square timber shod and banded with iron. Piles may be driven by mechanical devices worked either by man or steam Dower. Steam hammers for rapid driving, give light and quick blows, so reducing damage to the head of the pile. Piles are conveniently grouped to support concentrated loads as at bridge abutments, or under columns in a building. They may be driven until either (a) their points are embedded in a firm substratum (*bearing* piles), or (b) the friction on their sides is sufficient to provide resistance (friction piles). To distribute the load, timber frarnes or masses of concrete are laid on the piles.

Concrete Piles.—Concrete piles are mainly of two kinds, viz. (a) pre-cast and (b) cast in-situ. The former have vertical steel bars, bent in at the point, hooped transversely and diagonally and enveloped in concrete. Reinforcement adds to the compressional strength and provides resistance to end blows and to possible side bending when driving. The points are shod with steel or cast iron. Modern rapid-hardening cement permits of moulding and driving in a few days. The "cast in-situ" piles have marked advantages over those pre-cast; space for moulding 'is not required, work is rapid and piles can be loaded soon after driving. This type may be classified into (a) systems in which a tapered tube is driven, withdrawn, and the space filled with concrete, or in which a mandrel and sheath are driven, the mandrel being withdrawn and the sheath left and filled with concrete; (b) systems in which a parallel tube, shod with solid metal, is driven, the tube being gradually withdrawn and concrete poured to fill the hole and enclosing a frame of reinforcement if desired; (cj systems designed for enlarged bases to increase the load .capacity; and (d) systems in which tubes are sunk into the ground, the earth withdrawn from the inside, and the tubes filled with concrete. In one patent form, the tube employed is vibrated on withdrawal to assist the consolidation of the concrete.

The supporting power of piles is a difficult and controversial subject and cannot be included here.

Special Foundations.— Exceptional forms of foundation occur in large and heavy structures, bridge piers, dock walls and harbour work, in which large excavations may cover an entire building site. The vertical sides of the cutting must usually be maintained by temporary supports provided by shoring (see SHORING).

Deep Foundations for Piers.—Timber is usually employed to strut the sides of deep excavations for piers, the timber being inserted in short stages. In the U.S.A. a circular excavation is often made and the sides supported by short vertical poling boards wedged against cast iron circular frames.

The Open *Caisson.*—Danger to property may occur if adjacent excavations cause withdrawal of running sand, hence for excavations through wet strata, water and fine sand must be kept out of the cutting. In vertical shafts the sides may be supported by steel or concrete linings added in short lengths at the top, as the excavation proceeds. An enlarged base is usually formed to increase the bearing area; and the lining is filled with concrete upon which the surface foundation is laid.

The Pneumatic Caisson.—For preventing the incursion of water to excavations in wet strata and in river beds, the pneumatic caisson is employed, this being a cylinder of steel or reinforced concrete of the same size as the foundation. The caisson is a rigid casing without base and having cutting edges. Units are added above water level as the caisson sinks. A working chamber is formed in the base, isolated by an "air-lock." The men work in compressed air, which must resist the incursion of water. To admit and withdraw men and materials the air-lock chamber has two doors at different levels. The air pressure is maintained by re-sealing one door before opening the other; at the required depth the space of the working chamber is sealed with concrete. Steel caissons are usually filled or lined with concrete, and reinforced concrete shells are bridged over to receive the superstructure.

Sheet Piling.—One function of sheet piling is to support laterally foundation beds which would spread under pressure; sites are occasionally *surrounded* by sheet piling. It also gives continuous support to very soft ground, as in water-bearing strata, where shallow excavations and conditions do not make a closed caisson imperative. For much ordinary work timber sheet piles are used, driven between horizontal walings secured to square guide piles. Sheet piles formed by special sections of rolled steel are in common use, and various forms of reinforced concrete sheet pile are also employed.

A patented type of reinforced square pile has two wings Driven edge to edge these piles may be used as sheeting or for retaining "made" earth, assisted by reinforced ties anchored to the earth behind the wall. The piles are designed to resist the consequent bending moments. Sheet piles have the feet splayed to induce the entering pile to close against the edge of its neighbour.

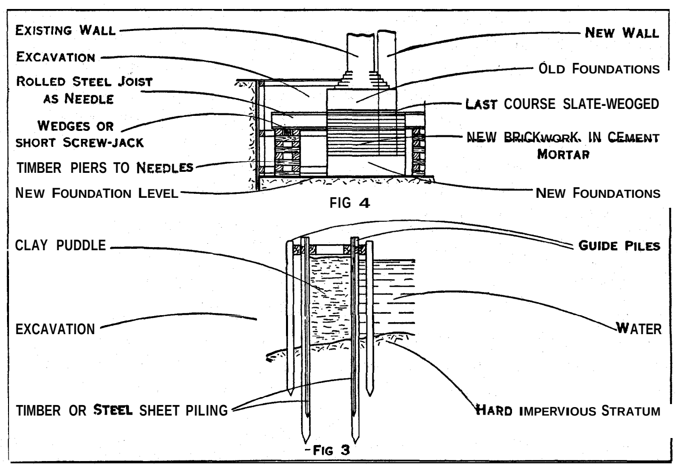
The Coffer Dam is a substantial temporary dam, used where the hydrostatic head is considerable and simple sheet piling is inadequate. A coffer dam may surround an enclosure for the removal of water and soil and the insertion of a foundation or, for quay walls, may be on the water side only. In modern practice two rows of close piling are used, 5 ft. and upwards apart, driven to impervious ground. The space within the piles is cleared and filled with puddled clay. On completion the water is pumped from the enclosure and excavation or construction may proceed. For deep interior excavation after withdrawal of water the coffer dam is supported by transverse strutting or by inclined shoring.

PROTECTION OF ADJOINING STRUCTURES

When inserting foundations for new buildings the foundations of adjoining structures must not be disturbed. Most laws recognize the rights of adjoining owners, and impose penalties for damages to existing property. The upper portions of existing structures must be supported by shoring while adjacent excavations are in progress (see SHORING).

If the new foundations are to be lower, to admit of deeper basements, then the old structure must be re-supported at the lower level. The process of inserting new supports is known as under-pinning.

Under-pinning.— The problem in under-pinning is to place solid supports underneath the old foundations and to avoid settlement of the existing building in the process. Methods of underpinning cannot be standardized; fig. 3 shows one method in which short lengths of foundation are exposed by pits sunk to the new level. In heavy structures, dead shoring is required which consists of "needles" passed beneath the foundations and supported on short uprights or from the adjacent ground. The excavations are then extended and portions of the new foundations

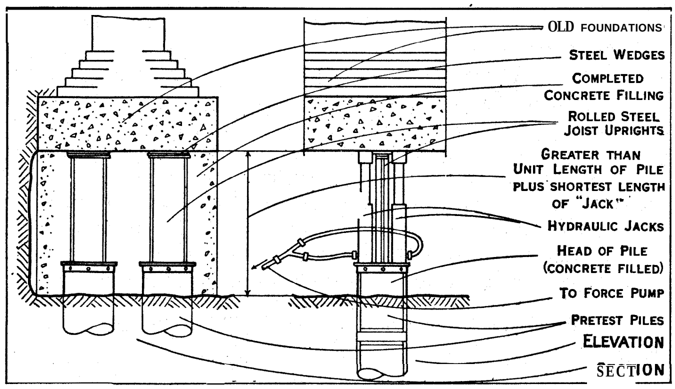


FROM "THE STRUCTURAL ENGINEER"

FIG. 3.— COFFERDAM. SUPPORTING WATER PRESSURE ON ONE SIDE
FIG. 4.— USUAL METHOD OF UNDERPINNING OLD FOUNDATIONS

erected. For brickwork, cement mortar is used and the last joint wedged with slate. If in concrete the top clearance'is grouted solid with cement. When the new work may receive load the intervening portions of foundation are inserted. For small buildings, on firm ground, under-pinning can sometimes be done without temporary 'support.

Pre-test Piles.—A method of pile under-pinning has been patented in America (1917) and in England known as "pre-test" piling Pre-test piles may also be used for new buildings. For the purpose of under-pinning, short lengths of the old foundations are exposed to allow of the insertion of a short length of steel tube, 14 in. to 20 in. diameter and $\frac{3}{8}$ in. thick, which becomes the casing to a complete pile—afterwards concrete filled. The short tube is forced into the ground by a pair of powerful hydraulic jacks operated by a force pump working at high pressure. The tube is cleared of earth by grabbing or otherwise. Another length is added and the process repeated, additions being made by sleeve-



FROM HOOLE AND KINNE, "FOUNDATIONS" (MCGRAW-HILL)

FIG. 5.— THE PRE-TEST METHOD OF UNDERPINNING, DEVELOPED AND PATENTED IN THE UNITED STATES OF AMERICA

jointed sections until the hard substratum is reached. The interior of the steel tube is filled with concrete and the pile completed. In the space between the old foundation and the head of the pile, a steel joist packing is inserted and wedged tight while two jacks keep the full load on the pile (*see* fig. 4).

By wedging tight while the pressure is maintained on the pile, a great advantage in supporting power is gained. When the pressure on such a pile is being increased, a "bulb of pressure" develops in the earth beneath the base of the pile and opposes its further penetration. If the load be released this "bulb" disappears and will only be re-formed if the pile be once more forced forward into the ground. Hence, if the under-pinning be completed while the pile is not under pressure, the full resistance can only be developed by further settlement. The pre-test method eliminates this settlement and may also ensure a known factor of safety, since the jacks can be made to develop a definite and known thrust.. Care is required in packing the bearings of the jacks on the concrete both of the pile and the old foundation and in wedging up the new support to avoid local damage to the concrete. The steel support and the heads of the piles are finally encased in concrete.

Papers referred to in preparing this article:—Hoole and Kinne, *Foundations, Abutments and Footings;* Fowler, *Engineering and Building Foundations,* vol. i.; W. M. Patton, *Practical Treatise on Foundations;* White and Prentis, *Modern Under-pinning* (1929); M. J. McCarthy, "Piling in the Service of Structural Engineering," *Structural Engineer* (1927). (F. E. D.; J. L. M.)

FOUNDATIONS, PHILANTHROPIC. The philanthropic foundation, broadly defined, is a legal and social instrument for applying private wealth to public purposes. Although charitable endowments existed in antiquity, the modern foundation is predominantly a 20th-century American phenomenon. It is a large, autonomous organization formed to support research or public service in such fields as education, science, medicine, public health and social welfare. It may be an operating foundation with a service and research staff but it is usually a grant-making organization. Its legal form may be that of a charitable trust or a nonprofit corporation. It may be either a perpetuity with only its income distributed, a discretionary perpetuity with capital also expendable, or a liquidating fund with mandatory distribution of capital. An individual may endow a foundation by bequest or by a gift made during his lifetime; a business corporation or a family may create and support a foundation through continued giving.

In ancient Greece, Egypt and Rome a foundation was usually a single-purpose perpetuity supporting an academy, library or local charity. The typical medieval foundation was an ecclesiastical perpetuity operating a monastery, almshouse, orphanage or school. Many early hospitals, colleges and universities in western Europe and in the United States were supported by foundations. usually under religious control. During the Elizabethan period and afterward, thriving English merchants created numerous special foundations for educational and local charitable purposes. notably for poor relief. These small perpetuities, both in Great Britain and on the continent, drew increased criticism after 1750 for their mismanagement, narrowness or obsolescence of purpose, and their palliative character. Adam Smith in England and Turgot in France were among their early critics.

Although foundations or charitable trusts with narrow, local purposes have survived, they are overshadowed by large foundations possessing broad purposes and flexibility of action. Among the first of these in the United States was the Smithsonian institution (*q.v.*), created in 1846 "for the increase and diffusion of knowledge among men." In 1867 the Peabody Education fund was founded in the U.S. to promote education in the south. As business fortunes and organized philanthropy developed, other general foundations were created, notably by Andrew Carnegie (*q.v.*) and John D. Rockefeller (*see* ROCKEFELLER) after 1900. As a result of the publicity and success attending these foundations. many others appeared in the United States; a number also appeared in Canada and Great Britain and a few on the continent. After 1914 the United States also witnessed a substantial growth of community foundations and after 1940 a wave of personal, family and company-sponsored foundations.

Modern foundations are usually tax-exempt and have independent, self-perpetuating boards of trustees with considerable freedom of action. They stress studies and experiments to determine the fundamental causes and solutions of the problems of mankind. They often act as pioneers in social betterment by investigating basic problems that lie beyond the reach of local philanthropy or government and by using philanthropic "venture capital" to start programs that are later taken up by other private or public agencies.

UNITED STATES

Foundation directories show that there were at least 27 philanthropic foundations in the United States in 1915, 179 in 1926, 243 in 1939, 505 in 1946, 4,162 in 1955. and approximately 12.000 in 1960. New ones were being created at a rate exceeding 1,000 a year by 1960. Over 90% of them had assets of less than $1,000,000 each in 1960; fewer than 1,000 had assets exceeding $1,000,000.

Types **of** Foundations.— Despite their diversity, four general types of foundations may be identified: general research, family or personal, company-sponsored and community foundations.

Research foundations are the large, well endowed organizations that are noted for their research programs in education, health, social welfare and the sciences. They are usually grant-making organizations but a few are partly or wholly operating foundations. In 1960 there were 178 such foundations. 129 of which had assets of $10,000,000 or more. They possessed more than half of all foundation assets and played a pioneering role in social betterment through research and experimentation.

Family or personal foundations are created by bequest or, more commonly, by living donors to facilitate their charitable giving. A few, such as the Ford foundation, have become huge through continued gifts and bequests. The larger family or personal foundations have broad philanthropic programs resembling major research foundations; the smaller ones have local, specialized programs resembling ordinary family giving. They have multiplied in number because they carry prestige, provide a convenient means for systematic philanthropy and offer income tax exemption for sponsors' gifts,

Corporation foundations, or those sponsored by individual companies, multiplied rapidly after World War II. They were created by many large concerns to systematize corporate giving and several have assets exceeding $10,000.000 each. Company-sponsored foundations are tax-exempt, independent legal entities whose trustees are almost exclusively officers of the sponsoring firm. Since their sponsors' profits and gifts may fluctuate, they use a reserve fund to regularize this "in-and-out" giving. Although small foundations stress local charity, most large corporation foundations support education, especially scholarships and fellowships, and also health, scientific research and social welfare. Several have distinctive programs keyed to the interests of their industry. The Bulova Watch Company foundation, for example, trains disabled veterans to be watch repairmen. The Nutrition foundation, supported mainly by food manufacturers, promotes basic research and education in nutrition. The Statler foundation finances research on hotel construction, operation and personnel training.

Community foundations or community trusts are charitable organizations that operate in individual cities or areas. They receive gifts and bequests from many persons and apply these funds as the donors stipulate or as a distribution committee of representative community leaders decides. They stress local philanthropic activities, especially education and social welfare The community trust movement began in Cleveland in 1914 with the creation of the Cleveland foundation. New ones have appeared regularly, especially in large eastern cities. By mid-century there were about 100 and their aggregate assets approached $150,-000.000. At least eight had assets exceeding $10,000,000 each.

The government foundation is another type worth noting The National Science foundation was established in 1950 to advance fundamental scientific research. Although tax-supported, it has an independent governing board and makes grants for research projects, fellowships and related programs.

Peabody and Slater Funds.—The Peabody Education fund mentioned above is often called the first modern American foundation. George Peabody, an American who became a wealthy banker in England, endowed it in 1867 with $2,000,000 primarily to advance public education in the south. It was an optional perpetuity and was liquidated in 1914. The John F. Slater fund was established in 1882 and promoted southern education until it was terminated in 1937. Influenced by the Peabody and Slater funds, by growing concern over educational, medical and social problems, by the philanthropic possibilities of great family fortunes, and by Carnegie's "gospel of wealth," millionaire philanthropists created foundations at an increasing rate after 1900.

Carnegie Trusts.—With his concept of the stewardship of wealth, Andrew Carnegie deemed it a disgrace to die wealthy. The philanthropic foundation was his favourite means of employing personal riches for long-run social good His gifts and bequests, exceeding $330,000,000, went mainly to endow several perpetuities whose income was applicable to broad purposes as interpreted by the trustees.

The Carnegie Institute of Pittsburgh was created in 1896 with original grants of $11,700,000. It serves the Pittsburgh, Pa., area as a general educational agency, including libraries, museums of fine arts and natural history, a music hall and the Carnegie Institute of Technology.

The Carnegie Institution of Washington was established in 1902 with a $10,000,000 grant "to encourage, in the broadest and most liberal manner, investigation, research, and discovery, and the application of knowledge to the improvement of mankind." It conducts fundamental research in various scientific fields.

The Carnegie Hero Fund commission was endowed in 1904 with $5,000,000 to recognize heroic deeds in civil life through awards and grants to heroes or their survivors.

The Carnegie Foundation for the Advancement of Teaching was created in 1905 with an original gift of $10,000,000, primarily to provide retirement pensions for professors at nonsectarian colleges and universities. It pioneered in the pension field, raised educational standards, and helped free many institutions from strict denominational control. Its noncontributory pension scheme taxed its resources and in 1918 it established the Teachers Insurance and Annuity Association of America to handle these pension commitments and develop contributory retirement plans. These activities influenced the retirement plans developed by insurance companies. private industry and the federal government. Among this foundation's important educational studies was the famous Flexner report of 1910 on *Medical Education in the United States and Canada*, which produced a revolution in medical education.

The Carnegie Endowment for International Peace was founded in 1910 with a $10,000,000 fund to promote world peace. It attempts to increase international understanding by conducting research on international law, history, economics and other aspects of foreign relations.

The Carnegie Corporation of New York, established in 1911 with gifts of $135,000,000, is a grant-making organization promoting "the advancement and diffusion of knowledge and understanding among the people of the United States and of the British dominions and colonies." It has made large gifts to the other Carnegie trusts and to many colleges, universities and research organizations for educational and research programs. It created the Church Peace union and materially supported the National Research council. It has made substantial grants for adult education, the fine arts, modern languages, engineering education, international affairs, and fellowship programs.

Carnegie created several philanthropic trusts in Europe, including ten hero funds, the Carnegie Trust for the Universities of Scotland (1901) with a $10,000,000 endowment, a $3,750,000 trust (1903) for the benefit of Dunfermline, Scot., his birthplace, and the Carnegie United Kingdom trust (1913) with a $10,000,000 grant.

Rockefeller Benefactions.—Three generations of Rockefellers have given well over $1,000,000,000 to philanthropy. The elder John D. Rockefeller gave more than $530,000,000, primarily to four large foundations. He helped build the University of Chicago and gave to several colleges. He believed, in general endowment gifts on a matching basis, to encourage further philanthropy. Prior to 1928 the foundations he created made extensive endowment gifts on this basis. They were independent charitable corporations with broad powers and self-perpetuating trustees. Rockefeller disliked perpetuities and empowered his trustees to expend both capital and income.

The Rockefeller Institute for Medical Research (1901), the only operating foundation created by Rockefeller, received gifts totaling $60,000,000 to advance and disseminate knowledge about the nature, causes, treatment and prevention of diseases. Located in New York city, it has become a well equipped medical research centre. In 1908 its charter was amended to allow educational activities. A further amendment in 1954 permitted it to be incorporated into the University of the State of New York as a degree-granting institution for graduate training and research in the medical and biological sciences.

The General Education board was founded by Rockefeller in 1902 as a discretionary perpetuity of nearly $130,000,000. In 1903 it was chartered by congress for "the promotion of education within the United States of America, without distinction of race, sex or creed." By 1952, it had distributed nearly $316,000,000 to strengthen educational institutions. It promoted agricultural education in the south by instituting a farm demonstration program in collaboration with the U S. department of agriculture. It worked with southern educational officials to establish and improve rural schools and public high schools. It helped establish normal schools for Negro teachers and public schools for Negro children, spending nearly $30,000,000 on Negro education in its first three decades. Prior to 1928 it made matching endowment gifts of $60,000,000 to nearly 300 colleges and universities and $90,000,-000 to various medical schools.

The Rockefeller foundation was created in 1913 "to promote the well-being of mankind throughout the world." Directly and indirectly it received nearly $242,000,000 from the founder. By 1960 it had distributed well over $500,000,000, one-third of it abroad. Until 1928 it emphasized public health and medical education. In 1909 Rockefeller personally financed the Rockefeller Sanitary commission to help health departments curb hookworm in 11 southern states. The foundation assumed this work in 1913 and created the International Health board. The two organizations co-operated in the south to combat hookworm. yellow fever, malaria, pellagra, smallpox, tuberculosis, etc., and to strengthen county and state public health departments. They extended this program to many other countries and the Rockefeller foundation spent $94,000.000 on public health abroad in its first 40 years. It co-operated with the General Education board to improve American medical schools and made grants to several American and foreign universities to create schools of public health. Directly and through the China Medical Board of New York which it created, it provided nearly $45,000,000 to develop the Peking Union Medical college.

When the Rockefeller philanthropies were reorganized in 1928, the Rockefeller foundation mas broadened in scope and thereafter liberally financed pure research. It created divisions of public health, medical sciences, natural sciences: social sciences and humanities, each of which supported fellowship programs, special research projects and independent research agencies. The medical sciences division also supported psychiatry and mental hygiene. The natural sciences division financed costly research tools such as marine biology laboratories, telescopes and cyclotrons. The social sciences division continued the work of the Laura Spelman Rockefeller memorial, on which the two spent about $100,000,000 in a 25-year period. It helped support university and independent research agencies, including the National Bureau of Economic Research. Brookings institution, and Social Science Research council. It also helped finance publication of the *Encyclopaedia of the Social Sciences*. The humanities division made special grants to individual universities, museums; and libraries, to the American Council of Learned Societies, and for publication of the *Dictionary of American Biography*. In its first 35 years the Rockefeller foundation spent $28,000,000 for 10.000 fellowships in 75 countries and $10,000,000 on research grants-in-aid.

Laura Spelman Rockefeller memorial was endowed with nearly $74,000,000 by Rockefeller in 1918. Before being merged into the Rockefeller foundation in 1929, it made grants exceeding $55.000.000, of which $41,000,000 was for social science research.

In addition to its international public health work, the Rockefeller foundation developed technical, educational and research programs to aid agriculture in several Latin-American countries and. since 1957, in India and other eastern countries. The Rockefeller Brothers fund also supports foreign aid programs, especially in Latin America. In 1946 it created the American International Association for Economic and Social Development and the two have since founded the Association for Credit and Rural Assistance (providing supervised credit and technical assistance to farmers), International Basic Economy corporation (investing in developmental enterprises in Latin America), and IBEC Research institute (studying agricultural problems). These agencies have been operating in Brazil, Venezuela and other Latin-American countries; in the late 1950s they entered India and Africa.

John D. Rockefeller, Jr., helped administer these foundations and made additional charitable gifts of $473,000,000. In 1923 he endowed the International Education hoard. with $20,000,000. It supported research in the natural sciences! agriculture and humanities, and spent more than $18,000.000 before merging with the Rockefeller foundation in 1928. He also endowed the Bureau of Social Hygiene, Institute of Social and Religious Research, and Sealantic Fund. Inc. He died in 1960. leaving half of an estate valued at $150,000,000 to the Rockefeller Brothers fund, created in 1940, to which he had previously given $58,000,000.

Ford Foundation.— In 1960 the Ford foundation held about one-fourth of all U.S. foundation assets. It was created with an initial $25.000 gift in 1936 to facilitate the Ford family's charitable giving. Later gifts and bequests from Edsel and Henry Ford II made it very wealthy and by 1960 it had distributed pearly $1,200~000,000. It made grants to existing organizations and to 11 autonomous funds of its own creation. including the Fund for the Advancement of Education (1951), Fund for Adult Education (1951), Fund for the Republic (1952) and National Merit Scholarship Corp. (1955). In 1954 it established the Center for Advanced Study in the Behavioral Sciences at Stanford. Calif. In 1956–57 it distributed $500,000.000 from capital funds among 615 private colleges and universities, 3.500 nonprofit hospitals and 42 privately supported medical schools. In 1959 its annual expenditures reached $110,000,000.

The Ford foundation's chief concern is education and it is the leading foundation contributor to social science research. It makes grants to groups engaged in international affairs and to universities and research institutes for intensive study of foreign areas. Its technical assistance programs are designed to improve farming, local industry, public administration and education in underdeveloped countries. It spent $78,000,000 on overseas development between 1951 and 1958; $28,000,000 was for India and smaller amounts for other countries of south and southeast Asia, the middle east. Africa and Latin America.

Other Foundations.— Charitable foundations created by other wealthy philanthropists help to illustrate their diversity.

The Russell Sage foundation is a perpetuity chartered in 1907 with a $10,000,000 endowment to promote better social and living conditions, in the United States. It is primarily an operating foundation, conducting research, demonstrations, publication and other educational endeavours. Its work has greatly advanced the professions of social work and city planning.

The Julius Rosenwald fund was created in 1917 as a liquidating fund to be ,terminated within 25 years after Rosenwald's death, reflecting his dislike of perpetual endowments. He died in 1932 and it was liquidated in 1948. Its charter purpose was to serve "the well-being of mankind," and it aided southern rural education, race relations and the health and education of Negroes.

The Twentieth Century fund is a discretionary perpetuity chartered by Edward A. Filene in 1919 to improve economic, industrial, civic and educational conditions through research and publication. It pioneered in studying economic and social problems and became strictly an operating foundation.

The John Simon Guggenheim Memorial foundation was created in 1925. It awards fellowships each year to further the development of scholars and authors.

The Duke endowment is a charitable trust created by James B. Duke in 1924 to establish Duke university and serve other educational, health and religious needs in North and South Carolina. Duke required that 20% of the annual income be reinvested to double his original gift of $40,000,000, thus making it an accumulating fund. The trust indenture allocated the available income among Duke university, nonprofit hospitals, orphanages, three other colleges and universities, and support of certain retired ministers and rural churches. Duke bequeathed additional funds to this trust.

The largest foundations in the United States include:

Name	Date founded	Assets (approximate; 1959)
Ford foundation	1936	$3,316,000,000
Rockefeller foundation	1913	648,000,000
Duke endowment	1924	414,000.000
John A. Hartford foundation	1942	414,000,000
Carnegie Corporation of New York	1911	261,000.000
W. K. Kellogg foundation	1930	215,000,000
Alfred P. Sloan foundation	1934	176,000.000
Lilly endowment	1937	157,000,000
Commonwealth fund	1918	120,000,000
Danforth foundation	1927	110,000,000

Other foundations which reportedly had assets approaching the $100,000,000 class in 1960 included the Vincent Astor foundation (1948). Charles F. Kettering foundation (1927), Moody foundation (1942) and Sid W. Richardson foundation (1947).

The 12,000 foundations in existence in the U.S. by 1960 had combined assets of about $11,500,000,000 and total annual expenditures of approximately $625,000,000. This slightly exceeded all direct corporate giving but was less than 10% of total private charitable giving. The foundations' support of new ideas. research and social experimentation in neglected or controversial areas has had great significance despite the fact that their expenditures are dwarfed by federal spending.

Tax and Regulatory Aspects.—The most significant and direct influence of government on foundations is through tax legislation. Foundations are exempt from federal and state income taxes on their investment-type income. They are also usually exempt from local property taxes. Gifts of property to foundations are not subject to gift taxes and bequests are exempt from estate and inheritance taxes. Charitable contributions to them are deductible within limits in determining taxable income for a person or corporation. A person's charitable contributions (including gifts to a foundation) are tax-exempt to an amount equal to 20% (30% under special conditions) of his adjusted gross income. High surtax rates encourage tax-exempt giving; an individual with income subject to the 91% tax rate may give to charity at a net cost in spendable income of nine cents on the dollar. An individual or firm may give appreciated assets such as securities and make a charitable deduction at their market value without incurring capital-gains taxes. Since 1935 a corporation's contributions (including gifts to a foundation) have been tax-exempt up to 5% of its taxable income. During World War II and the Korean war a corporation with income subject to the excess-profits tax then prevailing could supply charitable dollars costing as little as 18 cents (or even less if also subject to state income tax).

As noted above, these tax provisions have encouraged some companies and individuals to create foundations and make tax-exempt gifts to them. However, several large foundations were created before the federal income tax was enacted in 1913 and many more before tax rates became high. Factors other than the income tax exemption have been important in the growth of foundations; these include the pure philanthropic motive, desire to perpetuate a family name or improve a "corporate image," prestige value of foundations, their advantages in making family or corporate giving more regular and effective, and their use to maintain control of a family-o ned corporation upon the death of a principal owner by avoiding forced sale of the firm or its assets or stocks to pay estate and inheritance taxes.

The privilege of tax exemption as an encouragement to charitable giving has been preserved and protected from abuse through a long series of tax laws, court decisions and internal revenue service (IRS) regulations. Federal tax law, particularly the exemption privilege, has actually become the chief instrument of public control over foundations. A foundation must apply for tax exemption, giving prescribed information as to its purposes, intended activities, finances and sponsorship. This application is open to public inspection. The IRS will approve it only if the foundation's purposes are genuinely charitable and if its intended activities conform to its declared purposes. Every foundation must file with the IRS an annual report of its assets, liabilities, net worth, accumulation, gross income, total gifts received and total disbursements for tax-exempt purposes. Most of this annual report is open to public inspection. The IRS annually audits these reports to see that foundations conform to their declared purposes. A foundation may forfeit its tax-exempt status if it engages in propaganda or lobbying, makes an unreasonable accumulation of income, invests capital recklessly. uses a substantial part of its income for nonexempt purposes, or engages in certain "prohibited transactions" benefiting its donors or directors. The IRS also scrutinizes a foundation's sources of income. Its income (in excess of $1,000) from business activities not substantially related to its exempt purposes is taxable, as is a "feeder" corporation's income which is devoted entirely to a sponsored foundation.

Officials of large foundations believe that they have an obligation to make voluntary public reports of their operations. While most large foundations published periodic reports in the late 1950s, less than 5% of those with assets of less than $10,000,000 did so. In 1956 the Foundation Library Center was established in New York city to encourage foundation reporting and to collect and disseminate information about foundations.

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(F. G. H.)

GREAT BRITAIN

In Great Britain, unlike the United States, no special meaning attaches to the word "foundation." It is simply a name given to certain charitable trusts, and the words "trust" and "foundation" are used interchangeably. Foundations' vary in size and scope from the Barlboro (Old Infant school) foundation for the educational benefit of children in a particular parish, to the Nuffield foundation which distributes funds to a wide variety of causes in a large number of countries.

In Britain a foundation as a charitable trust was defined originally by the Statute of Charitable Uses (1601). This statute was repealed in 1888 by the Mortmain and Charitable Uses act which, however, retained the preamble to the Elizabethan statute in which were listed the charitable uses which the law recognized. Chief among these were relief of aged, impotent and poor people; the maintenance of sick and maimed soldiers and mariners, schools of learning, free schools, scholars in universities; the repair of bridges, ports, havens, causeways, churches, sea banks and highways The English judge Edward Macnaghten further added to this list of charitable uses the legal definition of a charity: "Charity in its legal sense comprises four principal divisions—trusts for the relief of poverty; trusts for the advancement of education; trusts for the advancement of religion; and trusts for other purposes beneficial to the community. not falling under any one of the preceding heads " Certain statutes also contain special definitions of charity; *e.g.*, the War Damage act of 1943 The fourth heading of the Macnaghten classification is indefinite, leaving ample room for ambiguities in defining a charity and resolvable only by litigation. A large fund of case law therefore exists which is relevant in determining whether or not the object of a foundation is charitable. The *Report* of the committee on charitable trusts, published in 1952, recommended that a definition should be enacted based upon the Macnaghten classification, which should itself be ended, but preserving the case law as it stands. The only law to be passed as a result of the committee's recommendations, however, was the partial adoption of their views on the retrospective validation of certain imperfect trust provisions in the Charitable Trusts (Validation) act, 1954. The legal basis of a foundation thus remained unaltered at the beginning of the 1960s.

Legal Position. — The legal recognition of a foundation as a charity carries several important privileges. In the first place, gifts to charity have always enjoyed a privileged position in the law of testamentary dispositions. A charity is treated as an artificial legatee with the right to hold property in perpetuity and with the additional important advantage that the courts are willing to provide new purposes as near as possible to the original objects of a charity if these become incapable of fulfillment. This latter doctrine, known in law as cy pres has, however, been widely criticized in that it does not allow changes in the purposes of charitable trusts and foundations sufficient to enable them to keep in step with a rapidly changing social environment. Thus, for example, the doctrine would be difficult to apply to a foundation which had originally had as its object the abolition of slavery. After the 1860s, parliament was willing to relax the doctrine of cy pres for some particular kinds of charity, notably in the case of educational endowments under the various Endowed Schools acts passed between 1869 and 1948 and in the case of parochial endowments in the city of London. The economic changes and especially the wide extension of the social services in the 20th century made urgent the need for its more general relaxation and the 1952 *Report* on charitable trusts recommended that the doctrine be relaxed for all trusts and foundations.

As against the special position which charitable trusts and foundations enjoy in law, various attempts were made to check the possible abuses and maladministration which might arise as a result of their perpetual legal existence. The Statute of Charitable Uses (1601) authorized the appointment of ad *hoc* commissioners to inquire into malpractices, but these appointments became infrequent during the 18th century and finally died out in 1803. The Charities Procedure act and the Charitable Donations Registration act; both passed in 1812, were further attempts (largely ineffective) to correct abuses and in 1818 a parliamentary commission was created to record and investigate the charitable trusts of England and Wales. The 1835 select committee on public charities recommended the creation of an independent authority with powers to investigate any trust. It was not until 1853, however, that the Charitable Trusts act was passed "for securing the due administration of charitable trusts and for the more beneficial application of charitable funds in certain cases" and it led to the naming of the Charity commissioners. The act of 1853 was of additional importance in that it created the official trustee of charity lands and the official trustee of charitable funds, thus providing a way in which lands and securities could be held by charitable foundations having perpetual succession, without cost to their trustees and without interfering in their administration of their trust. Trust funds were further relieved of the constant expense of transferring their property on the death or retirement of a trustee and the appointment of a new one. The *Report* of the committee of charitable trusts of 1952 made several recommendations intended to reinforce the powers conferred by the Charitable Trusts acts; *e.g.,* it was recommended that the statutory provisions for recording trusts should be re-established.

Foundations are also subject to restrictions on the assets they hold in the form of land and investments in securities. By the Charitable Trusts Amendment act of 1855, trustees are forbidden to sell, mortgage or charge charitable property, or to grant a lease in reversion after more than three years or for a term of more than 21 years, unless. expressly authorized by the commissioners. Restrictions upon the acquisition of land are imposed by the Mortmain and Charitable Uses act of 1888 and the amending acts of 1891 and 1892. Investments in securities can be made by foundations only if they are permitted by the terms of the trust instrument, by the provisions of the Trustees act of 1925, or by a high court order. The trustees are personally liable for loss from unauthorized investment and the range of securities in which investment is authorized is limited by the Trustees act. The financial position of trust funds thus suffers from a rigidity of income particularly onerous in a world prone to inflation.

Trusts and foundations enjoy a privileged position in the levying of rates and income tax. During the late 18th and early 19th centuries, properties provided and used for charitable purposes were frequently omitted from the poor rate: while the Scientific Societies act of 1843 specifically exempted such bodies from rate paying. In 1865, however, as the result of the decision in the case of *The Mersey Docks and Harbour Board Trustees* v. *Cameron,* public charities were held not to be exempt from the payment of taxes. Although the law quickly placed some charitable foundations in a more favourable position, as in the Sunday and Ragged Schools (Exemption from Rating) act, 1869, and subsequently extended rate relief to others, most charitable foundations between 1865 and 1955 were dependent upon sympathetic treatment by local rating authorities for which there was no statutory sanction. In 1955, however, charities were granted statutory relief from rates by the Rating and Valuation (Miscellaneous Provisions) act, though the relevant provisions were regarded as only temporary.

A foundation which is legally recognized as a charity is also. under the 1952 Income Tax act, able to claim tax exemption upon its income from land, interest, dividends or other annual payments and from the profits of a trade carried on by it. In effect this amounts to approximately doubling the taxed income of all charitable trusts and foundations.

Existing Foundations.— The precise number of foundations and trusts in Great Britain is unknown. It was estimated in 1952 to be at least 110.000: as compared with about 29.000 known to the Brougham commissioners in 1837, and new foundations were being created at the rate of about ten a week. Œ the 110,000, about 30.000 were educational and about 40.000 catered for the needs of the poor. sick and needy. It was further estimated that more than one-third of the total number of trusts had an annual income of F25 or less. Excluding their considerable holdings of land. the assets of the 110,000 trusts existing in 1952 were estimated at £200,000,000, or about 5% of the estimated value of the national productive capital.

As opposed to the great mass of small foundations, there was an increasing tendency in the 20th century to emulate the U.S. practice of creating great charitable foundations with wide objectives, exercising their benevolence within and even beyond the country as a whole. Some of these giant foundations are, indeed, of U.S. origin as, for example, the Carnegie United Kingdom trust or the Pilgrim trust. The latter was founded in 1930 by E. S. Harkness and during the 1930s equally supported schemes to alleviate unemployment and to preserve the national heritage. Others are foundations with headquarters abroad such as the Commonwealth fund, founded in 1918, or the Gulbenkian foundation, founded in 1955 to support artistic, scientific, educational and charitable projects. In addition to these there are the great British foundations such as King George's Jubilee trust, founded in 1935; the King Edward's Hospital fund. London; and the series of Lord Nuffield's foundations, culminating in the creation of the Nuffield foundation in 1943 with an initial capital of £10,000,000.

Foundations make a valuable contribution to contemporary society, not only in their charitable disbursements but in the scope which they provide for voluntary service. Even with the greatly increased scale of provision by the state of education and of help for individuals faced with poverty, sickness, old age and unemployment, foundations supplement state activity. Thanks to the greater flexibility which they enjoy the foundations carry the fruits of philanthropy into areas in which the state does not function. The state tends to support existing activities and there is, therefore, room for the foundations in pioneering new ventures and in supporting new ideas which would otherwise remain untried for lack of funds. *See* also CHARITY; PHILANTHROPY; TRUST.

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FOUNDING, the process of melting metal and pouring it into a cavity that has been molded on a pattern of the desired shape. When the metal solidifies the result is a casting—a metal object conforming to the shape of the cavity. This process is practised by foundries all over the world as a basic method for the production of metal shapes, utilizing in one form or another almost all of the metals known to man.

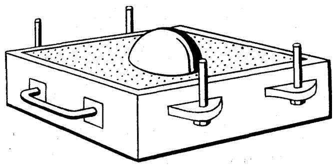


FIG. 1.—MOLD BOX AND PATTERN

This article deals with the materials and processes used in foundries: for a discussion of metallurgical aspects of these processes *see* METALLURGY: *Cast and Wrought Metal.*

The Mold.—A variety of materials is used in making molds, the most common being a mixture of sand and clay moistened with water. This mixture is firmly packed over the face of the pattern forming the cavity in which the casting is to be made. The whole is enclosed by a receptacle called a box or flask. (*See* fig. 1.)

The mold must be strong enough to resist the pressure of the metal and at the same time sufficiently permeable to permit the escape of air and gas from the mold cavity. Otherwise, these would remain as holes in the casting. The mold material must resist fusion by the heat of the metal and the surface next to the pattern be so closely knit as to avoid a rough casting surface.

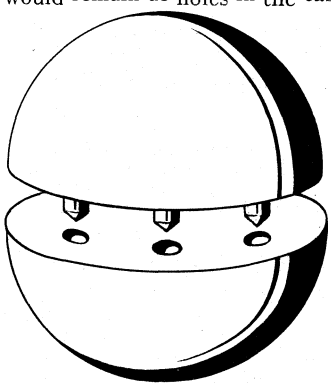


FIG. 2.— DIVISION OF PATTERN

The mold is made in two halves, each formed as described above and each contained in its own box. The upper half is known as the cope, the lower as the drag. The pattern must be so designed that the half mold can be lifted from its surface without breaking or tearing the mold materi'al. (See fig. 2.) This requirement can be modified by the use of loose pattern

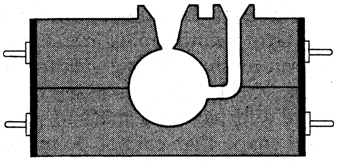


FIG. 3.—SECTION, COMPLETE MOLD

pieces, withdrawn after the mold has been lifted.

After removal from the patterns the cope and drag halves are joined, as shown in fig. 3, to make a complete mold.

The two halves are aligned so that the pattern cavities match exactly. This is accomplished by pins and bushings that are close fitting and located with precision. In forming the mold, provision is made for channels or gates through which the metal flows to the casting. Since the metal shrinks appreciably in volume as it solidifies, it is sometimes necessary to provide an additional reservoir of metal, called a riser, which stays fluid long enough to feed metal to the casting during this critical period.

Patterns of unusual or more complicated contour require the use of multiple boxes (fig. 4). In molding boxes of more than 14 in. square, crossbars serve to carry the sand; fig. 5 shows a drawing of the sections of this type box.

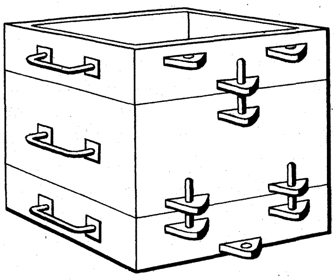


FIG. 4.—MULTIPLE MOLDING BOX

Mold Materials.—Suitable molding sands are found in natural deposits from which they can be mined and used without much alteration. The size and shape of sand grain is important and requirements vary for different metals. Comparatively coarse sands are employed for casting steel and iron; finer sands are needed for copper and aluminum alloys. Molding sand deposits contain sufficient clay to serve as a bond.

As natural deposits of good molding sand have become exhausted or less accessible, there has resulted a practice of using what are called synthetic sands. In this process, sands containing little or no clay are blended with clay or a claylike material such as bentonite (*q.v.*). Sand is prepared for use by mixing with the desired amount of water in a muller which coats each grain of sand with moistened clay by a kneading action. At this point certain other materials may also be added, such as flour to give the molded sand a certain amount of elasticity. Finally the mixture is aerated in a machine that breaks up lumps and gives the sand a fluffy texture. These operations are sometimes performed by hand with a shovel, but even in small foundries the use of machines is more common. For best results the physical character of the sand must be closely controlled; this is accomplished by testing equipment designed to measure strength, moisture content and porosity or permeability. These properties need to be held within narrow limits, whether the sand in use is natural or synthetic.

While clay and water are most often used to bond the sand, other bonds are sometimes employed. Molds can be made from sand mixed with a petroleum product or with man-made materials such as the synthetic resins or plastics. These are used only when their greater cost is offset by special advantages or unusual molding requirements. Several less generally used molding methods, described below, are based on a variety of differing materials.

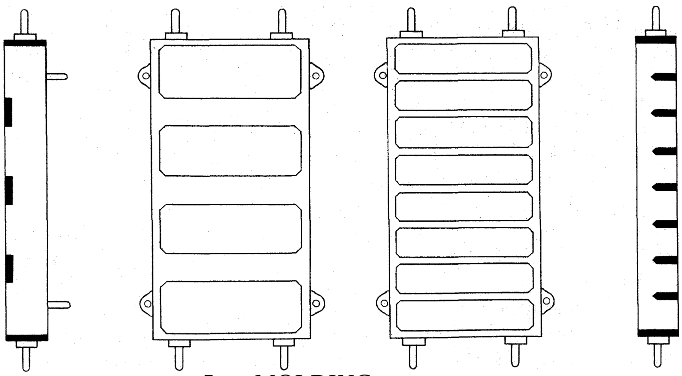


FIG. 5.—MOLDING BOX WITH CROSSBARS

Patterns.—If an accurate casting is to be obtained it is evident that an accurate pattern must be used in forming the mold. The making of such a pattern is a craft requiring great skill. When a considerable number of castings is needed it is usual to make a master pattern of wood from which working patterns can be cast in metal. Otherwise, the original pattern of wood or metal may be used in the foundry.

Since the metal in the casting will shrink as it solidifies, the pattern must be larger than the desired casting. Different metals have different shrinkage characteristics and allowance for this is made in making the pattern. Also the shrinkage is not always uniform in different directions, a variation which is sometimes unpredictable.

Sample castings have to be made before the pattern is actually put in service. When several pattern pieces are mounted on one plate for machine molding, their position on the plate must be perfectly matched so that the cope and drag halves of the mold will have an exact fit at the parting line. All pattern pieces must taper away from the parting line so that the pattern can be withdrawn from the mold without disturbing the mold material. Because of this taper some patterns must be formed of several loose pieces temporarily held in position by pegs, as shown in fig. 6 (left), or without pegs as in fig. 6 (right). Removal of the pattern may be facilitated by sprinkling it with a fine parting sand or compound to prevent adhesions.

When a metal pattern is employed, the need for a parting compound may be avoided by heating the pattern while in use, commonly by means of electrical heating elements.

Cores.—While many castings are solid, it more often happens that a hollow space is desired within the casting. Obviously this cannot be accomplished by the pattern, which must be removed without breaking the mold. To form the hollow, it is necessary to set a core in the drag. The core is so placed that there is an open space for the flow of metal between it and the face of the mold. In the finished casting the core is surrounded by metal except at openings through the casting wall, which form orifices from the hollow centre to the outside. The core material is removed through these openings and consequently must be so constituted that it loses strength when exposed to the heat of the metal and can easily be broken up.

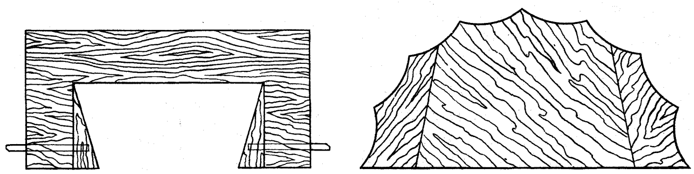


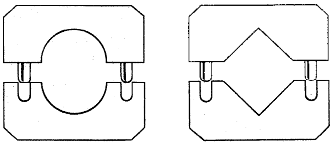
FIG. 6.—PATTERNS

(Left) with loose pieces, (right) for fluted column

Like molds, cores are made from a variety of materials, but most cores consist of clean sand mixed with an organic binder, often linseed oil or a blend of linseed oil with rosin, fish oil, vegetable oils or petroleum oils. Other substances such as cereal flours or bentonite are sometimes used. The core is very fragile when first made but is hardened by baking in an oven at 400° F. or more. Cores of the linseed oil type require slow baking in the presence of air since the hardening process is one of oxidation. A synthetic plastic resin is sometimes used as a binder and, when this is the case, the core can be baked very rapidly by an electrothermic process. In this method the core is heated from the inside out, the oven itself remaining comparatively cool. The hardening of the binder is a chemical change which takes place within the resin itself as a result of heat.

Simple core boxes built in sections to allow removal of the core are illustrated in fig. 7. Sometimes, as in fig. 8, loose pieces are employed that are withdrawn separately. Cores may take various curved forms as shown in fig. 9, a half-core box for an elbow pipe. Freshly made cores are so weak that they may have to be transferred to supporting frames or driers to hold them in shape until after baking.

Cores are made manually by packing the sand mixture into an open core box or, if the shape of the core and the quantity re-



7.—SIMPLE CORE BOXES

quired permit, they are made in machines. In the latter case, the core box is clamped in place underneath a reservoir of the sand mixture which is then blown into the box by compressed air at a pressure of about 100 lb. per square inch. Often the box contains several core cavities that are thus filled at the same time. Since filling is almost instantaneous, provision must be made for rapid escape of air; otherwise the cavity will not fill completely. This is accomplished by means of orifices with screens so fine as to prevent the passage of sand.

Patterns have core prints and the cores are placed in the imprints so that alignment is assured (see fig. 10).

Mold Making.—Molds may be made by hand and, in the case of very large molds, this is a common practice. Molds of medium or large size are often packed by a machine called a slinger. This has a head which can be moved to apply sand, by blowing or throwing, with equal force on all parts of the pattern. When the molds are not baked or dried they are known as green sand molds.

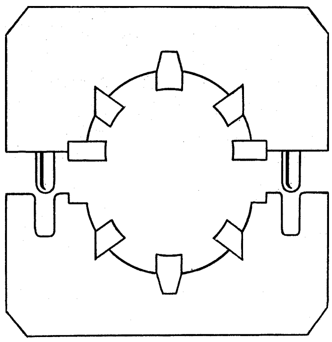


FIG. 8.—CORE BOX PIECES

Unless the number required is small, or unusual molding skill is needed, small molds are made in machines that compact the sand by squeezing with air pressure, by mechanically jolting the sand into place, or by a combination of these methods. When a machine is used the molder is a machine operator rather than a craftsman; a minimum of skill is required and rapid production is possible.

Methods of Molding.—In large-scale production, where a great many identical small castings are to be made, the whole operation of sand conditioning and molding is sometimes almost completely automatic. The sand is carried by conveyers to conditioning units where water, clay, new sand and other additions are mechanically made in predetermined amounts. At the molding machines measured quantities of sand pour into the flasks; the flasks themselves and completed half molds are handled mechanically. Both cope and drag are conveyed to a closing position, where they are accurately joined. The finished green sand molds, on a moving conveyer proceed to the pouring area and then to the shakeout, also mechanized, where the castings are removed from the molds. Broken moldings, reduced to sand, leaves the shakeout on one conveyer, castings on another.

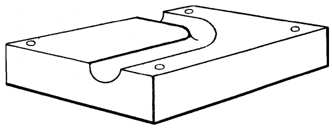


FIG. 9.—ELBOW CORE BOX

Cope flasks automatically go back to the cope machine and drag flasks to the drag machine. An outfit of this kind results in spectacular laboursaving but the investment is so great that it can be justified in only the largest operations. Smaller foundries make such use as they can afford of conveyers and laboursaving machinery.

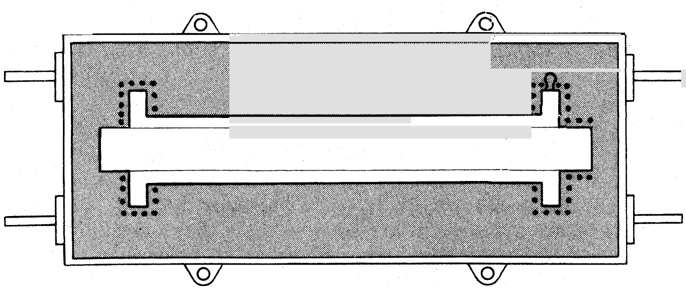


FIG. 10.—HALF-MOLD FLANGED PIPE READY FOR CORE
Core placed on two prints will leave space as shown

Although most molding is done by the green sand method, a number of other methods are in use. Green sand molds are sometimes strengthened by baking in an oven or the working surface is hardened by going over it with a torch. Molds may be assembled with shapes made from a core mixture and baked, a method particularly applicable for castings of odd shape that cannot be made in a conventional mold. Sand may be bonded with a synthetic resin, in place of clay and water, and used in the shell molding process. For this purpose a dry mixture of sand and powdered resin is spread over a heated pattern. The heat of the pattern melts the resin and then hardens it, forming a thin shell in the shape of the pattern.

The shell, after curing at a somewhat higher temperature, has considerable strength and can be stored indefinitely. The finished mold is formed by clamping or cementing together the cope and drag shells. In this manner more accurate dimensions and an improved surface can be obtained in casting some metals, notably the stainless steels. Cores, hollow instead of solid, are also made by the shell process.

For certain special applications, cements are used in place of clay. Iron and steel castings weighing many tons are sometimes made in sand bonded with portland cement. Time must be allowed for the cement to set before metal can be poured into the mold. Small castings of intricate shape, where a smooth finish and a minimum of machining are important, are often made in plaster of paris molds. The properties of the mold are augmented by mixing the plaster of paris with talc, asbestos and sometimes sand. The molds must be baked and should be poured while still warm from the oven.

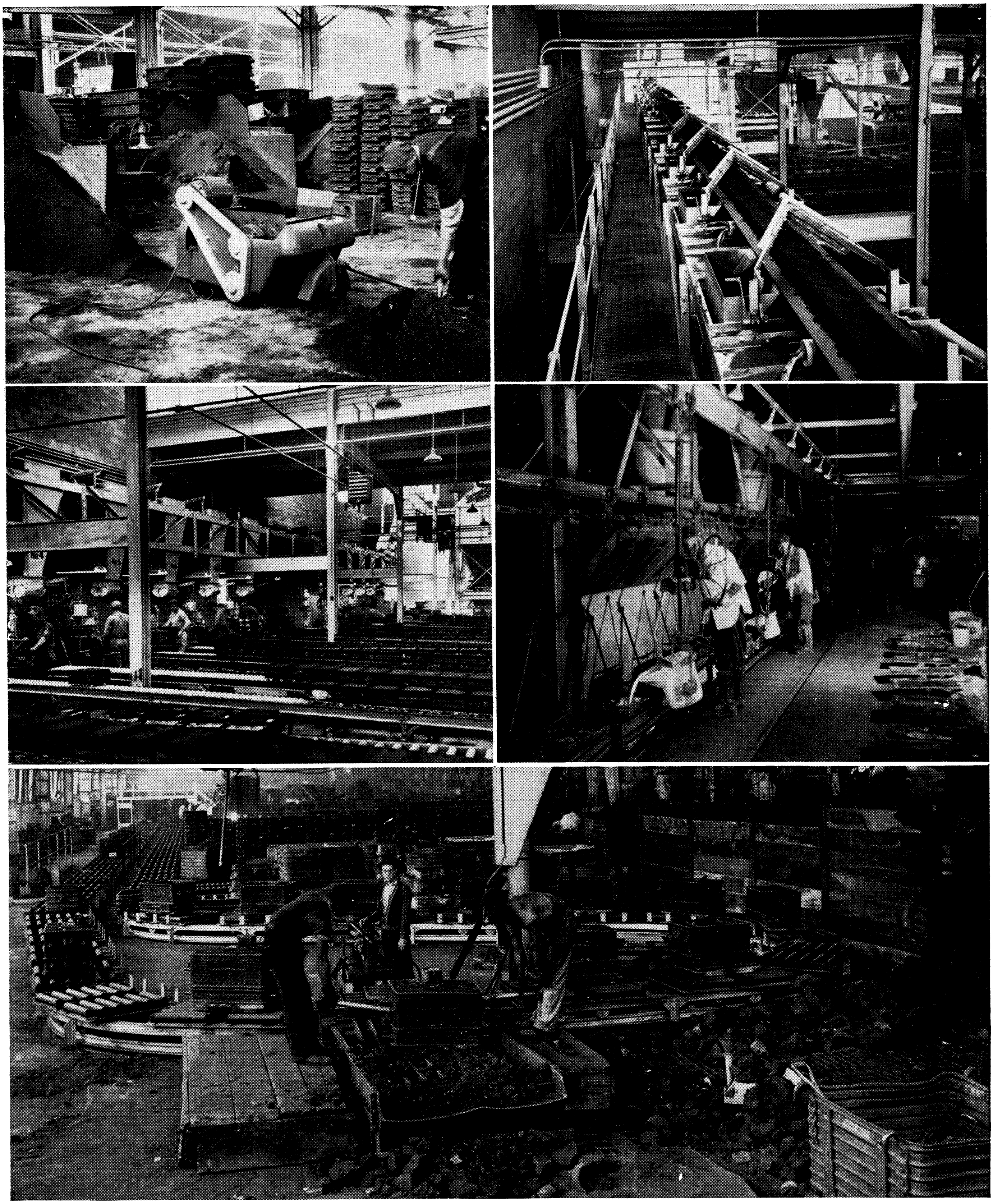
Castings with very delicate parts, or so shaped that they cannot be made by conventianal methods, can be produced by what was once known as the lost-wax process, more often called precision or investment casting. (See also SCULPTURE TECHNIQUE: *Casting* and *Finishing.)* The desired shape is formed from wax or a synthetic plastic and is coated with a refractory cement. After drying, this is placed in a box and enveloped in a porous cement which makes up the main body of the mold. When the cement has set and is sufficiently dry the mold is heated to a temperature sufficient to melt the wax which drains out, leaving cavities to be filled with metal for the finished casting. Alloys with low melting points or even frozen mercury are sometimes substituted for the wax.

If sand is mixed with sodium silicate (water glass) and formed into a mold which is then treated with carbon-dioxide gas, a reaction takes place between the gas and the silicate forming a colloidal or jellylike silica gel that acts as a firm binder for the sand. While this method is in use for molding, it is especially applicable for the making of cores that are so strong when first made that they do not require baking.

Metal molds which can be used over and over again are widely employed for casting alloys of aluminum and magnesium when a large number of identical castings are to be produced. Some cast iron is also made in this manner and to a limited extent brass and bronze. The molds are coated with a refractory wash to protect them from the action of the molten metal. These molds are poured by gravity just as when expendable molds are used. Such low-melting alloys as those composed principally of zinc or aluminum lend themselves well to what is called pressure die casting. In this process a metal mold is mounted in a machine equipped with automatic controls. The [illegible] metal is forced into the die under high pr[illegible] and solidifies in [illegible] di[illegible]el[illegible]

This [illegible] th[illegible] is particularly applicable when many [illegible]ll intri[illegible] cate castings are t[illegible] be [illegible] rather la[illegible]g[illegible] castings, [illegible] as [illegible] frames and grillwork, where there is an exte[illegible]d area of thin cross section. The dies are costly and at high temperatures are too short lived for use with such metals as iron and steel. To a limited extent the process is used with the copper alloys.

In the manufacture of small castings "stack molding" is sometimes employed. Half molds are stacked one on too of another to form a multiple mold that is poured at one operation from a common feed. Large cast-iron pipe, or cylinders of other metals, are



BY COURTESY OF THE JEFFREY MANUFACTURING COMPANY

ESSENTIAL STEPS IN FOUNDING

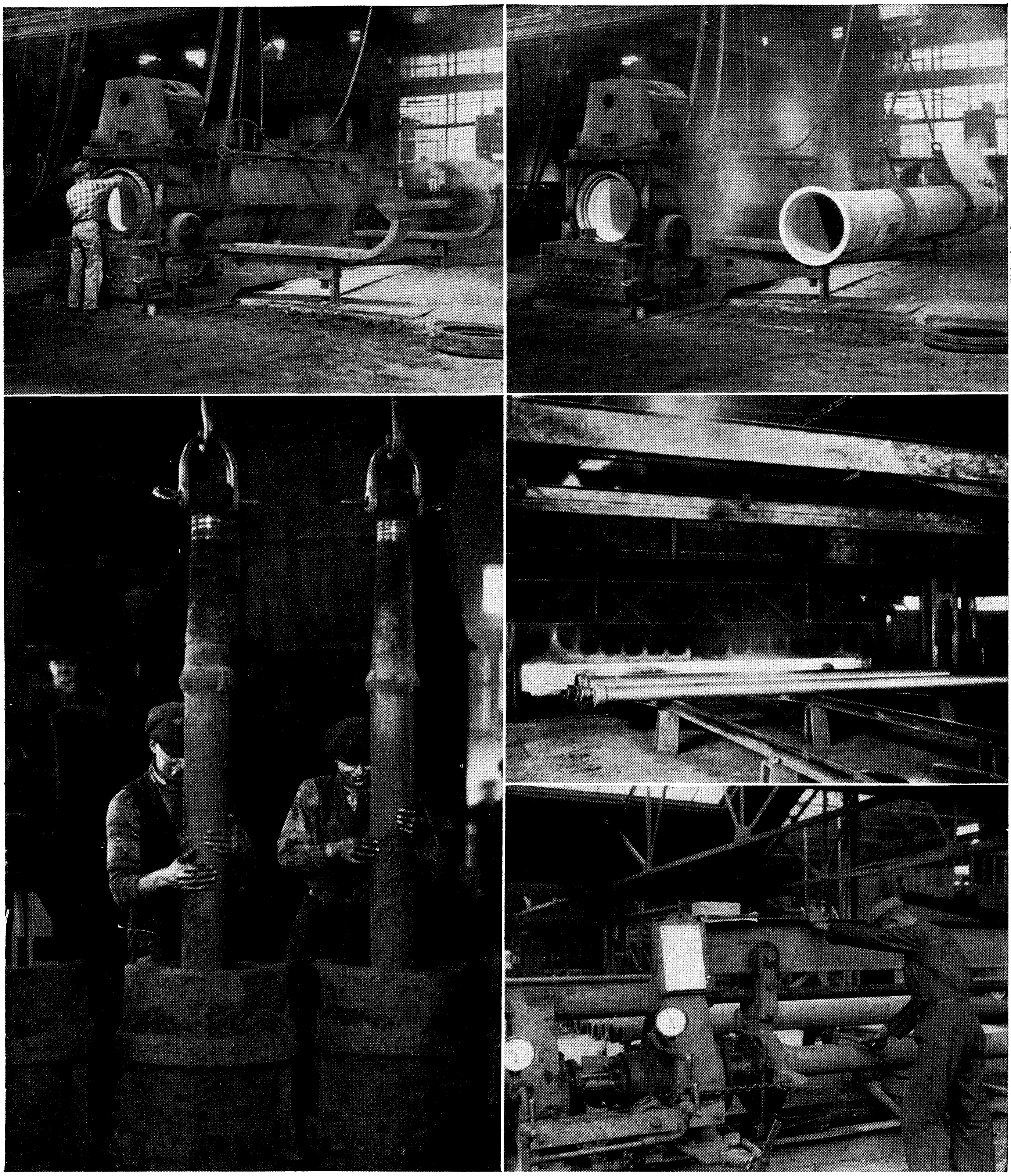
Top *left:* Preparing sand for moulding. The sand, when moistened and placed in the moulding flasks, or boxes, must be able to resist the temperature of hot metal and retain perfectly the shape of the pattern impressed into it

Top right: Prepared sand being delivered to moulder's hoppers on a distributino belt which carries the sand over the moulding stations in the production line. Belt ploughs remove sand when needed

Centre **left:** Hoppers (above left) which drop the sand to the moulding stations. After the pattern has been pressed into the wet sand and withdrawn, the flasks on the conveyor in the foreground receive the molten metal

Centre right: Pouring liquid metal into moulding flasks on a continuous conveyor

Bottom: Shaking out the moulding flasks and removing the castings



BY COURTESY OF (TOP LEFT, TOP RIGHT) U.S. PIPE AND FOUNDRY CO., (CENTRE LEFT, CENTRE RIGHT BOTTOM RIGHT) THE STANTON IRONWORKS CO. LTD., NEAR NOTTINGHAM, ENG.

OPERATIONS IN THE MANUFACTURE OF CAST-IRON PIPE

Top left: Setting bell core in mould preparatory to centrifugal casting
Top *right:* Completed cast pipe removed from centrifugal casting machine
Centre left: Inserting cores to form the bore of the pipes
Centre right: Cast pipes entering the normalizing furnace
Bottom *right:* Finished pipes undergoing hydraulic testing

cast by a centrifugal method, in which a metal or baked sand mold is rotated rapidly enough to overcome the action of gravity. The liquid metal is forced against the face of the mold to form a spun casting of high density. Some progress has been made in the application of this process to smaller castings, not necessarily cylindrical, arranged around a central feed.

Furnaces.—Various steel composition, alloys of nickel and some of the complex alloys required for high-temperature service are melted and superheated to temperatures in the range of 2,500° to 3,000° F. or even higher. While certain types of fuel-fired furnaces, such as the open hearth, can be employed at these temperatures, foundries commonly use electric furnaces.

In the direct arc furnace intense heat is generated by bringing a carbon or graphite electrode directly into contact with the metal to be melted. Passage of electric current forms an arc at the point of contact. In the induction furnace the metal to be melted is separated by a refractory wall from a coil carrying electric current. The arrangement is such that passage of current through the coil induces a flow of current in the metal itself. The temperature attainable is limited only by the electrical resistance of the metal as it melts. For relatively small melts of stainless steel and the like this is a favourite method.

Cast iron is most commonly melted in a cupola, a sort of chimney in which the iron is mixed with burning coke. The mixture of iron and coke is charged at the top of the cupola. The iron melts as it progresses downward and is eventually drained through a tap hole at the bottom.

The copper alloys, such as brass and bronze, melt at lower temperatures and contain volatile constituents that cannot tolerate the high temperature of the direct arc or, in most cases, direct contact with fuel. A variety of furnaces is employed. One is the indirect arc, in which the source of heat is an electric arc between two graphite electrodes above the surface of the metal. Electric induction furnaces are also widely used.

In some fuel-fired furnaces burning gas or vapourized oil strikes directly against the surface of the metal. In others the metal is enclosed in a crucible or melting pot surrounded by burning fuel. For aluminum and magnesium alloys cast-iron melting pots are commonly employed. Many of the metals will not produce satisfactory castings unless the temperature at which they are poured is closely controlled. This is accomplished by temperature measuring instruments known as pyrometers.

For descriptions of various furnaces and their operation see FURNACE, METALLURGICAL.

See also CAST IRON; CRUCIBLE STEEL; CUPOLA FURNACE; DIE CASTING; and articles on various metals and alloys as ALUMINUM; COPPER; etc.

BIBLIOGRAPHY.—B. L. Simpson, *Development of the Metal Castings Industry* (1948). *See* also Institute of British Foundrymen, *Proceedings* (1898 *et. seq.)*; American Foundrymen's Society, *Transaction?* (1896 *et. seq.)*; *Foundry* (monthly, *1892 et. seq.).* (H. M. S. J.)

FOUNDLING HOSPITALS. It is significant that by the mid-19 jos there were few countries left in which hospitals existed solely for the purpose of receiving foundlings; *i.e.,* children who have been abandoned or exposed and left for the public to find and save. Definite institutions for the care of foundlings were established during the 7th and 8th centuries in Trèves, Milan and Montpellier, followed by others in Venice during the 14th and in Paris and Lyons during the 17th centuries. The celebrated Foundling hospital of London was established by Capt. Thomas Coram in 1739, and has since completely changed its original character.

The modem method of dealing with illegitimate children—and nearly all those who were placed in foundling hospitals were born out of wedlock—is based on the proved advantage both to the mother and child of keeping them together, at any rate for the first year, thereby greatly reducing the infant mortality rate, strengthening the natural ties and lessening the chance of the mother's erring a second time. There is also an increasing reluctance to herd very young children together in large institutions, not only because of the risk of infection with small children but also because an institutional environment, except for short periods, is today recognized as being bad for any child unless he is in need of some specialized treatment; so that the boarding-out or foster-mother system of caring for these children is being more and more employed in all countries.

The London Foundling hospital can be said to be a pioneer in boarding out and today all children admitted to that foundation, now known as the Thomas Coram Foundation for Children, are boarded out.

At first the London Foundling hospital admitted any child under two months of age who was free from certain specified diseases, without any questions being asked or any attempt made to identify its parents. Indeed, a basket was hung outside the entrance gate and unwanted infants were deposited there and admitted without question; this resulted in angry scenes outside the gates and in 1742 a system of balloting for admission was introduced. Grants were made by parliament to the hospital from 1756 onward, £10,000 being paid to the governors in that year, on condition that all children offered were received. In 1757 no fewer than 3,727 children were admitted and branch hospitals at Ackworth, Shrewsbury, Westerham, Aylesbury and Barnet were opened to cope with the number of children for whom admission was sought.

This general admission was soon found to be a serious error, for the social evil of illegitimate birth received no discouragement, while of the 14,934 children received during the three years and ten months it was in force, no less than 10,389 died in early infancy. Parents even brought dying children for the purpose of having them buried at the expense of the hospital, and strangers were employed to bring children from all parts of the country to the hospital in London, for payment; many such children, through the brutality or criminal negligence of those to whom they were entrusted, never reached their destination alive. State grants and indiscriminate admission ceased in 1771. From that time onward the hospital has had to depend on private philanthropy for its funds; admission had perforce to be by a process of selection, and gradually the rules and conditions of admission in force at mid-20th century were evolved, as follows: a child can only be received upon the personal application of the mother. The children of married women and widows are not received. The petitions must set forth the true state of the mother's case. No application can be received previous to the birth of the child, nor after it is 12 months old. No child can be admitted unless the committee is satisfied, after due inquiry, of the previous good character and present necessity of the mother. and that both mother and child have been deserted by the father. A liberal interpretation is placed upon the term deserted, which covers cases where no payment, or insufficient contribution, is obtainable from the child's father to provide for the maintenance of the child.

On admission children are taken in to the Coram Residential nursery for about a month and are then boarded out in foster homes, found in the home counties. There the children are visited regularly and supervised by qualified child welfare officers, working from headquarters in London.

The charity's substantial capital fund (nearly £2,000,000 in the mid-1950s) is principally the outcome of the purchase in 1741 of 56 ac. of land in Bloomsbury. London, for the first hospital for a sum of £6,500. The property was let on ground rents, and sale of the property in 1926, when the hospital was removed to the country, realized f 1,650,000. After a temporary home at Redhill, Surrey, the children were moved to new premises at Berkhamsted, Hertfordshire, in 1935; there they remained until July 1954, though the education was taken over by the local authority in 1951. In 1954 the governors were planning to sell the school and thereafter all children would remain in their foster homes, going to local schools, their welfare being supervised by visiting child welfare officers appointed by the foundation governors. There were then more than 600 children under the age of 21 in care of the foundation; and on the average 60 children are admitted to care each year—of this number a large percentage are restored to their mothers before reaching the age of three. (H. H. Ns.)

United States.—Foundling hospital and foundling are terms no longer common in the United States despite the continued existence of a number of institutions for abandoned and deserted children. The foundling hospital in America was instituted about 1850–60 by Catholic nuns. Protestant churches or private individuals such as George E. Shipman in Chicago and John S. Parry in Philadelphia. Pa.. doctors appalled at the high mortality among exposed infants; records covering a period of 20 years in one hospital show that of a yearly average of 52 admittances there were 35 deaths, The first institution designated for foundlings seems to have been St. Vincent's Infant asylum (448 children), established by the Sisters of Charity (St. Vincent de Paul) in Baltimore. Md., in 1856. Between 1860 and 1873 six others were founded; two in Washington, D.C.. and one each in San Francisco. Calif.. New York city. Chicago. and Cleveland. O. Within the last three decades. many of the babies formerly referred to as "foundlings" or "deserted" have been cared for by legal adoption.

In the latter part of the 19th century several persons in New York city were aroused to the tragic situation of the babies harboured in foundling hospitals. Quoting from the book *The Adopted Child,* written by Eleanor Garrigue Gallagher and published by John Day in association with Reynal and Hitchcock in 1936, "One of the first women in this country to recognize the need of organized work for the saving of babies was Miss Clara B. Spence. who in 1895 became interested in the subject of adoption. and worked in close co-operation with her friend Miss Josephine Plows-Day. of London — founder of the National Children's Adoption Society of England. The Spence Alumnae Association was formed to carry on her work."

Henry Dwight Chapin, one-time president of the American Pediatric society. and his wife were also much interested in the subject of the adoption of children and organized the Alice Chapin Adoption nursery in New York city. Most of their babies were cared for in supervised boarding homes — designated as Speedwell units.

In 1923 the Cradle society was organized in Evanston. Ill., by Florence Dahl Walrath. The Cradle is a model adoption nursery for babies deprived by whatever circumstances of proper care. During the first few years of 'its existence, the mortality rate of infants cared for at the Cradle was remarkably low, in comparison with the 10% which had long been accepted as an irreducible minimum for institutions caring for babies. In 1927, however, there was throughout the United States an epidemic of enteritis with a high mortality rate. It baffled the best medical minds. This problem was solved by work done at the Cradle by George and Gladys Dick and J. Lisle Williams. As a result. a new aseptic nursery technique was evolved at the Cradle by Gladys Dick. It was put into effect in 1928 and has been rigidly adhered to ever since, resulting in a mortality rate of less than .05% and no instance of hand-borne cross infection. In 193j Louis W. Sauer gave a detailed report on the Dick diet kitchen and nursery technique. Following this. the New York city and Chicago departments of health passed new regulations requiring all maternity hospitals to use a similar aseptic technique in their newborn nurseries.

In 1938 the Cradle society erected a building designed to further scientific research on the prevention of air-borne cross infections. The Cradle showed that nearly all infants who are given up for adoption are adoptable. More than 7.000 infants were cared for by the Cradle and 6.090 of them placed in adoption between its founding in March 1923 and June 30, 1954. There were 95 deaths and the remainder were claimed by their parent(s) or placed in institutions' for needed care. Adoption nurseries properly equipped. like the Cradie. for the scientific care of infants during the first few months of life. when they are under the close observation of pediatricians. can remove the need for institutions for the care of the majority of babies who formerly were reared in foundling hospitals and orphanages. (F. D. W.; H. R. F.)

FOUNDRY TYPE, in printing, is reusable metal type cast from an alloy of 62% lead, 13% tin and 25% antimony. Sometimes up to 2% of copper is also added *(see* TYPE METAL). With a melting point of 32j° C. and a Brinell hardness number of 34— higher than any hot-metal, machine-set type — foundry type is used for the highest quality of printing work since it will retain its clarity for long periods without causing the impression to become light. The greatest disadvantage of foundry type is the slowness of setting and justifying it by hand *(see* PRINTING TYPE: *Composition).* Because of this it has given way in most instances to the use of hot-metal, machine-set type. It is still used, however, by many job printers as well as for large headlines on many newspapers.

FOUNTAIN, a term applied to simple arrangements for letting water gush into a basin, and to more elaborate ones in which water is forced mechanically in high jets. The term is applied equally to the ornamental receptacle and to the jet of water itself.

An early example is preserved in the carved Babylonian basin (*c.* 3000 B.C.) found at Tello, the ancient Lagash in Mesopotamia. An Assyrian fountain discovered in the gorge of the Gomel river consists of basins cut in solid rock and descending in steps to the stream. Small conduits led the water from one basin to the other, the lowest of which uas ornamented by tuo rampant lions in relief.

Greek. — During the Aegean civilization, as in later Hellenic Greece, springs were frequently considered sacred and shrines were built around them, the water often emerging into artificial basins.

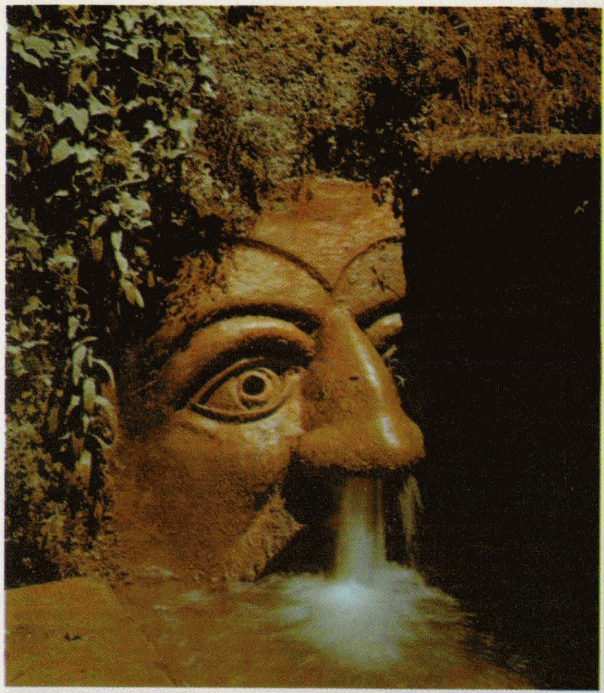
In historic Greece, more highly developed fountains existed; both literary references and excavated remains abound. Sometimes a planted grove or architectural setting provided for nearby shrines. Some were surrounded by columns; as at Lerna. The city of Corinth was noted for its fountains, particularly the spring dedicated to the nymph Pirene. Greek fountains were utilitarian as well, being provided with ample draw basins and reservoir supply and often shaded by a portico.

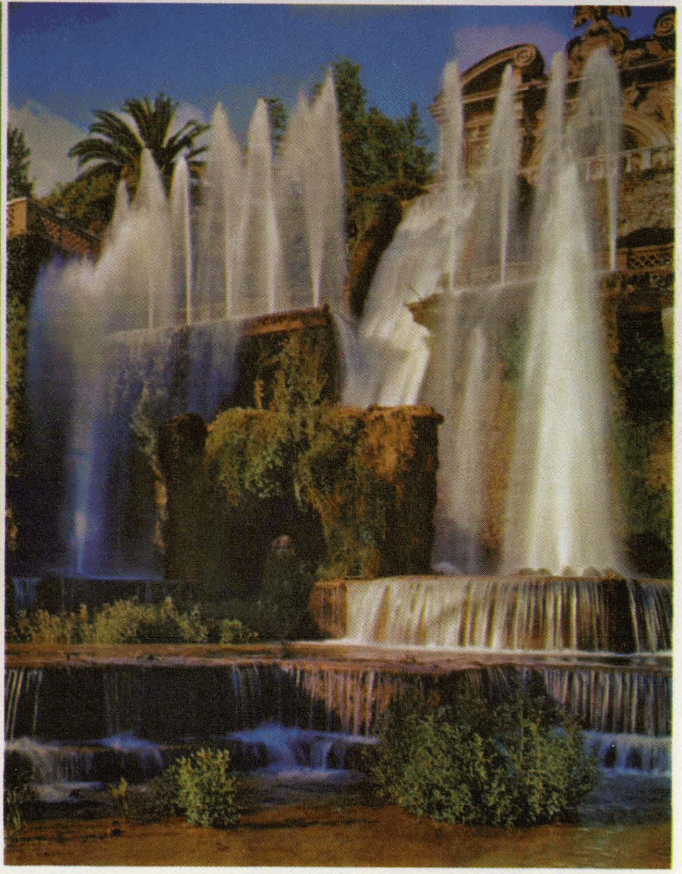
Roman. — In Roman civilization, water was distributed from each terminal reservoir, or *castellum,* to baths and large houses as well as to many public fountains which supplied the bulk of the population. Examples uncovered at Pompeii illustrate both types, the more decorative courtyard fountain of the aristocratic house and the utilitarian public street fountain. The latter consisted of a simple rectangular stone basin with a small pedestal above it carved with a human or animal head from whose mouth water flowed. The lip of the basin was notched for overflow.

In addition to the above types, the Romans developed the nymphaeum (*q.v.*), a purely decorative type of fountain originating in Hellenistic times. Roman nymphaea became monumental pleasure houses. often in the shape of an exedra covered by a half dome. The details of the fountain proper varied from multiple basin arrangements to the jet of water issuing from a sculptured figure. The architectural decoration was rich, often in mosaic. In addition to actual remains. wall paintings of the period illustrate Roman fountains and testify to their popularity as garden decorations.

In early Christian times. fountains were placed in the atrium court of the Christian basilica as symbols of purification; *e.g.,* old St. Peter's, Rome. Similar courtyard fountains continued to be used in the monasteries of western Europe and the Byzantine empire (*e.g.,* Cluny; Vatopedi on Mt. Athos).

Medieval. — In the earlier middle ages, ornamental and architectural treatment of fountains passed out of use; wells furnished the greater part of the necessary water. From the 12th century, however, public fountains began to reappear and the spring fountains received architectural treatment. The usual form of the latter consisted of a large basin reached by a descending stairway and covered over with a vault, sometimes enclosed and sometimes supported only on piers. At Poitiers, the Fontaine Joubert (14th century, restored 1597) was originally of this type. Other crude examples are common in Brittany. The public fountains of the medieval towns usually had a polygonal or circular basin, occasionally lobed, in the centre of which rose a column or pier carrying a series of spouts. The architectural details are of infinite variety. From the simple hexagonal vase and column of the 12th-century fountain at Provins to the elaborate richness of the 15th-century fountains of southern Germany, every kind of Gothic detail is found. Fountains were a peculiar feature of the communal building activities of the late middle ages, often commissioned by guilds. Few of these survive. A noteworthy example is the Schone





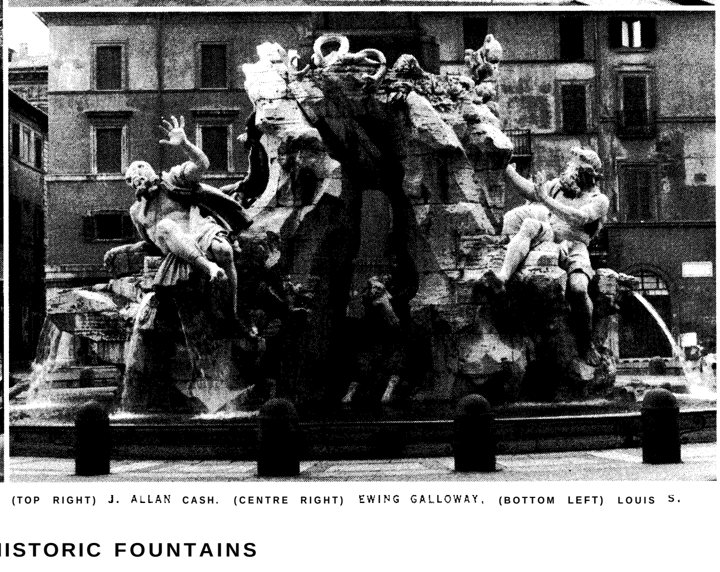
FOUNTAINS OF EUROPE

Top left: Fountain in one of the grottos of the Villa d'Este at Tivoli, Italy. The villa was built in the 16th century by Pirro Ligorio for Cardinal Ippolito d'Este the younger

Top right: The Trevi fountain of Rome, designed and begun by Nicola Salvi (1697–1751), and completed by Giuseppe Pannini in 1762. It is traditional to drop coins in tho fountain on the eve of departure to ensure a return to Rome

Bottom left: Fountain of the Linderhof palace built by Louis II (1845–86), king of Bavaria. The palace is near Garmisch-Partenkirchen, Germany, close to the Austrian border

Bottom right: The water-organ fountain and waterfalls of the Villa d'Este. A hydraulically operated organ was originally housed in the building shown above the fountain. The organ played when one stepped on certain pavement stones on the terrace



BY COURTESY OF (TOP LEFT) MASSIE—MISSOURI RESOURCES DIVISION; PHOTOGRAPHS (TOP RIGHT) J. ALLAN CASH. (CENTRE RIGHT) EWING GALLOWAY, (BOTTOM LEFT) LOUIS S. DAVIDSON FROM FPG. (BOTTOM RIGHT) PAUL M. JEFFREY FROM FPG

MODERN AND HISTORIC FOUNTAINS

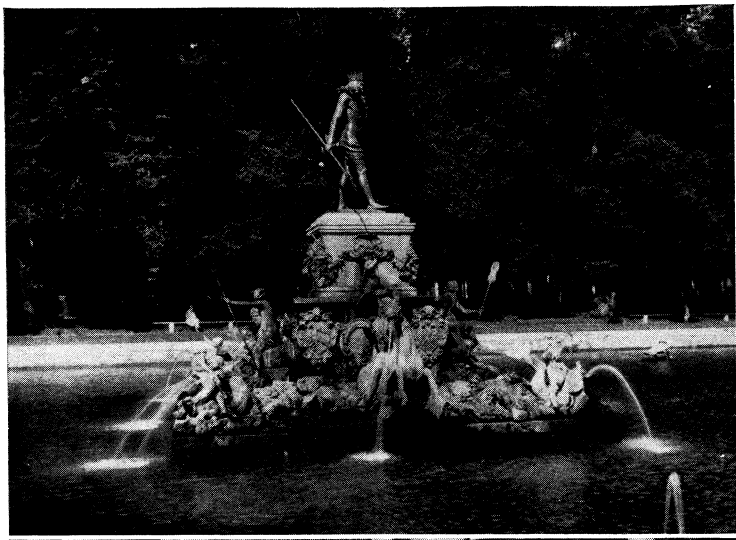
Top left: "Marriage of the Rivers" by Carl Milles at St. Louis, Mo., 1936–40

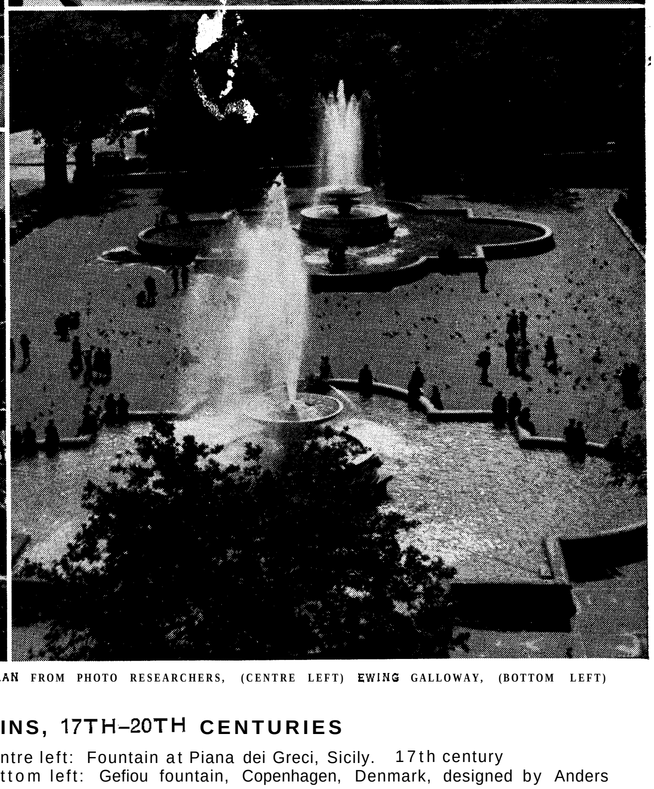
Top right: Fountain of the Sixteen Republics at the permanent Soviet Agricultural exhibition, Moscow

Centre right: Fountain oi the Lions at the Alhambra, Spain. 14th century

Bottom left: Fonte Maggiore, Perugia, Italy, by Niccola and Giovanni Pisano. 13th century

Bottom right: Fountain of the Four Rivers in the Piazza Navona, Rome. By G. L. Bernini, 1647–52





PHOTOGRAPHS, (TOP LEFT, BOTTOM RIGHT) PAUL POPPER LTD., (TOP RIGHT) THOMAS HOLLYMAN FROM PHOTO RESEARCHERS, (CENTRE LEFT) EWING GALLOWAY, (BOTTOM LEFT) J ALLAN CASH

BRITISH AND EUROPEAN FOUNTAINS, 17TH–20TH CENTURIES

Top **left:** Neptune fountain at Peterhof, palace of Peter the Great, Leningrad, U.S.S.R. Peterhof was the work of the French architect Jean Baptiste Leblond (1679–1719)

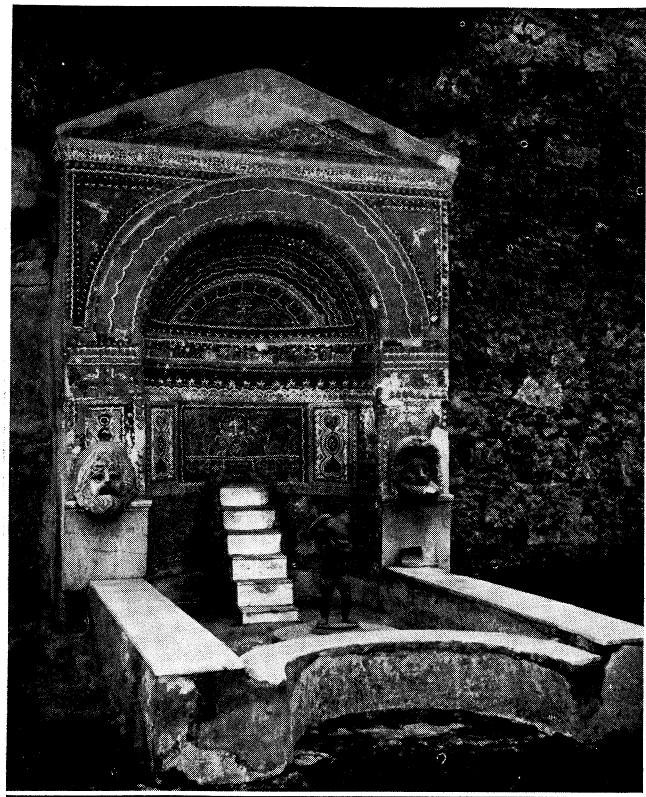
Top right: Brabo fountain in the Grand' Place, Antwerp, Belgium, built in 1887 from the plans of Jef Lambeaux

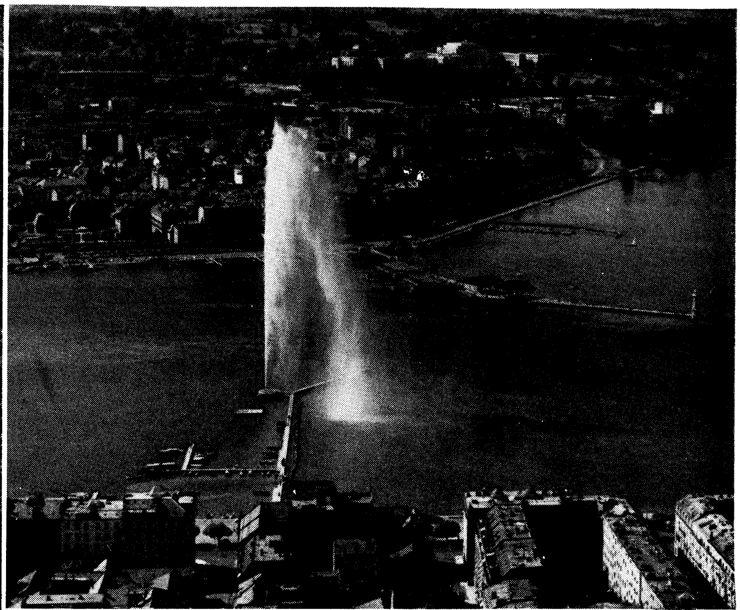
Centre left: Fountain at Piana dei Greci, Sicily. 17th century

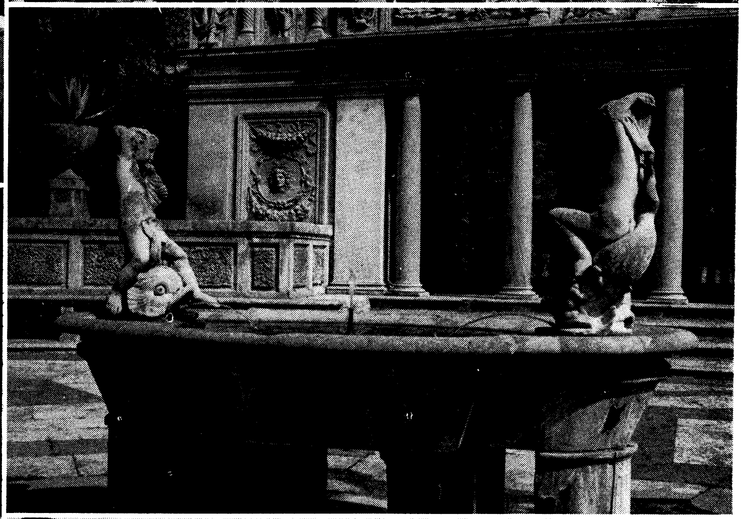
Bottom left: Gefiou fountain, Copenhagen, Denmark, designed by Anders Bundgaard in 1907

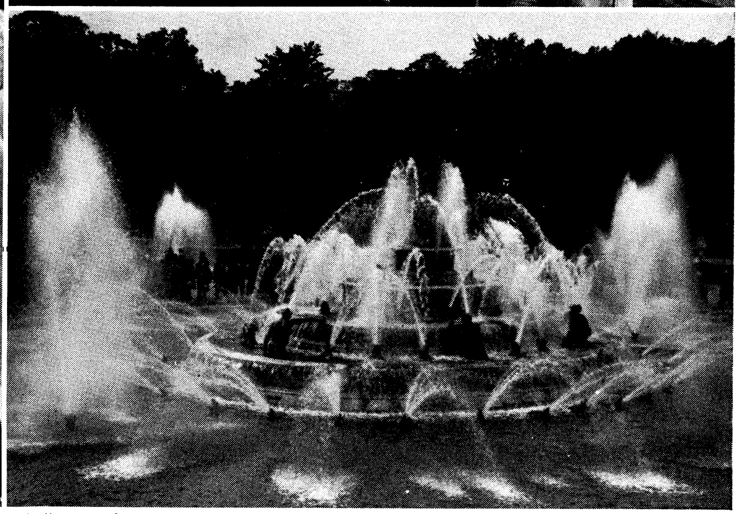
Bottom right: The fountain; of Trafalgar square, London, by Sir Charles Barry (1795–1860)

FOUNTAIN









BY COURTESY OF (TOP RIGHT) SWISS FEDERAL RAILROADS; PHOTOGRAPHS. (TOP LEFT) DONALD MCLEISH, (CENTRE RIGHT) ERNEST NASH FROM PHOTO RESEARCHERS, (BOTTOM LEFT) WOLF A KUEHLEN FROM FPG, (BOTTOM RIGHT) BURTON HOLMES FROM EWING GALLOWAY

EUROPEAN FOUNTAINS

Top left: House of the Great Fountain, Pompeii. 1st century

Top right: Jetée des Eaux-Vives fountain at Geneva, Switz. The jet throws water about 300 ft. into the air

Centre right: Fountain in the casino of Pope Pius IV, Vatican City, by Bartolomeo Ammanati, 1555

Bottom left: Detail of one of the fountains of the Place de la Concorde, Paris, designed in 1854 by J. I. Hittorff

Bottom right: Fountain in the gardens at Versailles. Period of Louis XIV

Brunnen at Nürnberg (1398), distinguished by its high, rich Gothic spirelet with many statues and ironwork railing.

The late middle ages developed decorative table fountains as extravagant toys. Also, contemporary Byzantine court versions of table fountains running with spiced wines are recorded. Unfortunately no examples of this type have survived.

Islamic. — The fountains of Moslem countries are of great importance, especially the public drinking fountains, called sebeels. They are an institution in the east. A common type is the simple spout and basin enclosed within a graceful niche. The more ambitious designs take the form of a richly decorated pavilion.

Renaissance and Baroque. — The Renaissance in Italy began a new phase of fountain design in which sculpture became prominent. A common type was a sequence of circular or polygonal basins on a vertical support topped by a fountain figure from which water spouted. Leonardo da Vinci did designs for fountains. During the following period of the Italian baroque, fountains became complex compositions of basins, sculpture and water display. Rome is noted for its many fountains of baroque design, notably the Fountain of the Rivers (1647) in the Piazza di Navona by Giovanni Bernini and the Trevi fountain (completed 1762) by Nicola Salvi. Such fountains dramatized the rebuilding of the city, its piazzas and its churches, done under papal direction.

In addition to these public fountains, the Italian development included an enormous number of original villa garden fountains of spectacular and sometimes amusing designs. Trick effects were made possible by elaborate mechanical devices. For example, the water organ at the Villa d'Este, Tivoli (1549), played only when certain pavement stones were stepped on. The hillside location of most villas was utilized, upper fountains supplying the lower ones in turn as at the Villa d'Este and the cascade at Villa Aldobrandini, Frascati.

Italian precedent set the design for monumental civic fountains and for ornamental garden fountains in northern and western Europe.

An early example of an ornamental fountain in France is the Fountain of the Innocents (1550) in Paris by Jean Goujon, an original work which does not follow Italian models. The Medici fountain in the Luxembourg gardens in Paris by Salomon de Brosse is a fine example of the niche type. The most spectacular and ambitious fountains in France are those at Versailles, part of the vast garden complex designed by André Lenôtre (1661). Large reflecting pools were part of the axial scheme and fireworks often accompanied the fountain display. Hardly secondary to the artistic achievement was the engineering feat of supplying water in volume and pressure to run the numerous fountains at Versailles. Purely ornamental fountains continued to be popular in the 18th century as focal points for civic design in large cities and as decoration for royal palaces and country seats.

Modern.—Chatsworth in England was noted for its fountains designed by Sir Joseph Paxton in the 19th century, especially the single jet of water 260 ft. high issuing from a formal reflecting pool. Elsewhere at Chatsworth, a false willow tree of copper rained water on the unsuspecting beneath its branches.

In the 19th and 20th centuries fountains did not lose their popularity although quality and imagination is less evident. Expositions have provided occasion for ambitious fountain displays. Among the many examples are the Crystal palace at Sydenham, London; the World's Columbian exposition at Chicago, Ill. (1893) and the New York World's fair (1938). At the Festival of Britain, London (1951), a mobile water sculpture composed of pivoted receptacles was set in motion by changing points of gravity. When each receptacle was filled, it would overturn only to right itself and be filled again with water from above. Of permanent fountains, a fine modern example, although derivative in design, is the Buckingham Memorial fountain in Chicago (1927) by Jacques Lambert. (T. F. H.; H. F. K.)

FOUNTAIN **PEN,** a writing instrument in which a quantity of writing fluid is contained in a reservoir in a holder, the fluid communicating with a writing point or nib through a channel in a fluid control called a feed. The nib extends from one end of the holder and is covered by a cap when the fountain pen is not in use, the cap being detachably engaged with the holder.

While the fountain pen had its origin much earlier, the beginning of its popularity was in the 1880s, and it became one of the most essential items of use, with millions being produced and sold each year.

The writing point or nib is the heart of the fountain pen, and its writing expresses the individuality of the user. Nibs are generally made in various point gradations ranging from a needlelike point to one which produces a line about $\frac{1}{16}''$ in width. About 90% of the nibs sold are in the fine and the medium nib gradations although a full line would include the following types: accountants, extra fine, shorthand, fine, medium, coarse, stub, broad stub, left oblique, right oblique and music points. Also, the nibs are produced in various degrees of flexibility ranging from manifold to flexible, the manifold being an almost rigid point and the flexible one bending with the least amount of pressure.

Because of the expected long life of a fountain pen, a metal highly resistant to the corrosive action of writing fluids is preferably used for the nibs, the most popular being stainless steel and 14-carat gold. Because these materials are relatively soft, that portion of the nib which contacts the writing surface in writing is provided with a relatively hard tipping material, preferably an alloy of metals of the platinum group, in order to resist wear and thus to obtain a long life.

The feed for controlling the movement of the writing fluid is made of plastic or of hard rubber and underlies and in most instances supports the nib. Air and writing fluid channels in the feed communicate between the reservoir of the holder and the nib, fluid from the reservoir moving down the fluid channel to supply the nib as air moves up the air channel to take the place of the fluid in the reservoir. These channels are of capillary dimensions, and a delicate balance of pressures outside and inside the reservoir holds the fluid in the reservoir and overcomes the force of gravity. This balance is broken when. in writing, the capillary cells in the paper or other writing surface draw fluid from the slit in the nib, the slit being supplied from the fluid channel of the feed.

Because the reservoir is seldom completely full of fluid, it contains air and frequently in a substantial amount. Temperature and pressure conditions act to expand or contract the air in the reservoir. For example. a rise in temperature caused by body temperature in holding the pen or a decrease in pressure by gaining altitude in air travel causes an expansion of the air in the reservoir. If the pen is held in a writing position, the expanding air is behind the fluid and forces it out of the reservoir. Comb cuts in the feed forming capillary chambers in communication with the air and fluid channels accommodate the fluid in excess of that needed for writing. Continued writing uses the oversupply in the comb cuts before fluid is again withdrawn from the reservoir.

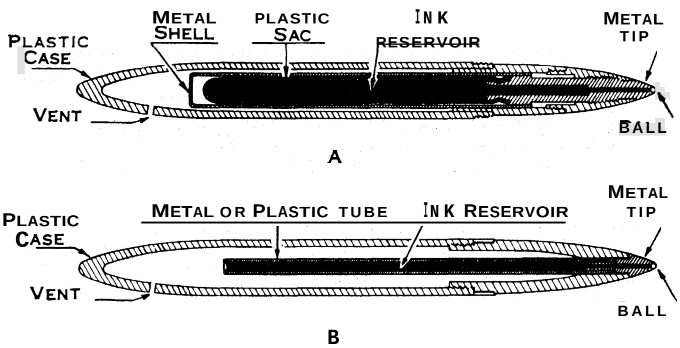
The filling of the reservoir, initially done manually with an eye-dropper, is now done automatically in different ways. One common type of reservoir is a flexible rubber sac which is deflated mechanically or pneumatically. Upon release of the deflating means, the sac inflates by its own resiliency and fills itself by suction as the nib is immersed in writing fluid. The other common type of automatic filling means is that by which the bore of the holder is the reservoir, and the movement of a piston fitted to the bore creates a suction to fill the bore as the nib is immersed in writing fluid.

The holder, originally made of vulcanized rubber, is made of a plastic. There are several different plastics used, each depending on the quality of the product or the facilities of the manufacturer. The early plastic holders were drilled from solid plastic rod. Later the holders were wrapped into cylindrical form from sheet material, and still later most holders were moulded from plastic moulding powders. The plastic materials have the advantage of appearance appeal and are structurally stronger than the vulcanized rubber originally used.

Caps of fountain pens. while protecting the nibs from damage, have the principal function of preventing evaporation of the water from the water-based inks used in them. The caps are frictionally or threadedly engaged with the barrel for detachable engagement therewith. Usually there is a hermetically sealed relation between the cap and the barrel to prevent an accumulation of dried dye from the writing fluid clogging the ink channels and preventing normal writing action.

Ball Point Pen.—In this type of instrument a ball, housed within a socket of a tip, transfers a viscous ink from a reservoir onto a writing surface.

Patents on ball point pens in several countries date back to the late 1800s, and commercial constructions appeared as early as 1895. It was not until 1944, however, that the ball point pen be-



FOUNTAIN PEN AND MECHANICAL PENCIL MFRS. ASSB., INC.

BALL POINT PENS: (A) SAC TYPE: (B) STANDPIPE TYPE

gan its ascendency in the writing instrument field. The impetus was supplied by the office of the quartermaster general of the United States which had requested of industry a writing instrument which would not leak in high altitudes, having an ink which would be unaffected by climatic changes and be quick drying, and which would have a sufficient supply of ink in the reservoir to last a considerable length of time.

The ball point pen usually comprises a holder for containing a replaceable writing unit although in some instances the holder itself is the writing unit and is discarded after the ink is used up. In either event the writing unit consists of a metal tip having at the point a socket which contains a ball. The lip of the socket is constructed so that the ball cannot fall out, yet can rotate freely when in contact with the writing surface. The inner construction of the socket is such that the ball is constantly bathed in ink from a reservoir.

The ink reservoirs of ball point pens are of two types. One comprises a flexible synthetic resin sac housed in a metal shell and the other a metal or plastic rigid tube, one end of which is open and is attached to the writing tip. The ink capacity of ball point pen reservoirs generally ranges from 0.5 to 1.5 ml.

The balls used are steel bearing and in some instances synthetic sapphire balls which are very hard and highly accurate as to sphericity. Most manufacturers use a ball 1 mm. in diameter, although a few special purpose pens have been made using larger as well as smaller balls.

Satisfactory ball point pen inks are highly specialized materials. They are viscous liquids having either oil-soluble dyes or spirit-soluble dyes. The type of ink containing the oil-soluble dyes dries by absorption into the paper or other writing surface while the type of ink containing spirit-soluble dyes dries by evaporation.

(F. L. KG.)

FOUQUÉ, FERDINAND ANDRÉ (1828–1904), French geologist and petrologist, was born at Mortain, La Manche, on June 21, 1828. In 1877 he became professor of natural history at the Collège de France, in Paris. As a stratigraphical geologist he rendered much assistance on the geological survey of France, and he was the first to introduce modern petrographical methods into France.

Fouqué died on March 7,1904.

His chief publications were: *Santorin et ses éruptions* (1879); with A. Michel Lévy *Minkralogie micrographique, Roches éruptives françaises,* 2 vol. (1879); and *Synthèse des minkraux et des roches* (1882).

FOUQUE, FRIEDRICH HEINRICH KARL DE LA MOTTE, BARON (1777–1843), one of the early German romantic writers, was born of French Huguenot stock in Brandenburg, Feb. 12. 1777. A godson of Frederick the Great, and loyal to the Hohenzollern house, he composed most of his works with the patriotic intention of awakening in his contemporaries during the Napoleonic era an awareness of German tradition and national character. He also tried to re-establish confidence in aristocratic government. His ideas were based on the view of linguistic development developed by J. G. Fichte, and he stressed the influence of the mother tongue in shaping the mind. At first his romantic allegories and popular versions of Germanic myth were enthusiastically received, but after 1820 his ideas were increasingly rejected as outmoded, his approach as unrealistic. Of his prolific writings only the fairy tale *Undine* (1811; modern edition by W. W. Chambers, 1956; Eng. trans., with other stories, by E. Gosse, 1932) is still widely known. For the literary historian, *Der Held des Nordens* (1810), the first modern dramatic treatment of the *Nibelungen* story, and *Der Zauberring* (18'13; Eng. trans., 1846), a popular allegorical novel describing the racial complex of Europe, are, however, of interest. The conventional rating of Fouqué dismisses him as an unpractical dreamer, underestimating his thorough scholarship in the matters of Germanic folklore and even more his effective writing between 1810 and 1820. During that decade he was highly esteemed by A. W. Schlegel, among many others, and was chosen as their literary sponsor by Adelbert von Chamisso and Joseph Eichendorff. He died in Berlin (Jan. 23, 1843) in poverty, after belated recognition by Frederick William IV.

BIBLIOGRAPHY.—*Ausgewählte Werke*, 12 vol. (1841); *Fouqués Werke*, ed. by W. Ziesemer (n.d.). *See* also O. E. Schmidt, *Fouqut, Apel, Miltitz* (1908); T. Kramer, *Das romantische Ritterepos bei Fouqut* (1913); J. Haupt, *Elementargeister bei Fouque, Immermann und Hoffmann* (1923). (W. W. Cs.)

FOUQUET, JEAN (*c.* 1415–1485), French painter remembered especially for his miniatures, was born at Tours. He visited Italy before 1447, since he executed the portrait of Pope Eugenius IV, who died in that year at Rome. There he absorbed the progress that such Italian painters as Tommaso Masaccio. Fra Angeliro and Piero della Francesca had made in the handling of central

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"CHARLES VII" BY JEAN FOUQUET. IN THE LOUVRE, PARIS perspective and foreshortening and in the rendering of plasticity and volume.

Upon his return to Tours Fouquet created a new, realistic art similar to that of Jan van Eyck in Flanders, with the same exquisite precision of characterization and detail. He was soon favoured in court circles by the king and high nobility. Like other great painters of the 15th century, he worked both as a panel and a miniature painter. He even worked in enamel, as his remarkable medallion with the self-portrait in the Louvre proves. For the royal secretary and lord treasurer, Étienne Chevalier, he executed between 1450 and 1460 his most famous works: a large "Book of Hours" with about 60 full-page miniatures, of which 40. now dismembered, are among the great treasures of the castle of Chantilly; the diptych from Notre Dame at Melun with Chevalier's portrait (Kaiser Friedrich museum); and a Madonna with the features of Agnes Sorel, the king's mistress (Antwerp museum). In these works he revealed his unsurpassed mastery of the new monumental representation which permeated European art in this century. In the same decade he also painted the portrait of King Charles VII (Louvre, Paris) and his queen (now lost), and that of the royal chancellor, Guillaume Jouvenel des Ursins (Louvre). Also to this last decade of the reign of Charles VII belong the two richly illuminated manuscripts, Boccaccio's *Cas des Nobles Hommes et Femmes* (1458, Munich library), and a copy of the *Grandes Chroniques des Rois de France* (Bibliothèque Nationale, Paris); and finally, the large altarpiece of the "Pietà," which was discovered in the church at Nouans. The latter represents his only monumental painting, since his "Ascension of the Virgin," painted for the archbishop of Tours in 1763, was destroyed by the iconoclasts.

In 1469 King Louis XI founded the Order of Saint Michael, and Fouquet was charged to illuminate the statutes of the order (Bibliothèque Nationale, Paris). In 1474 he worked with the sculptor Michel Colombe on the design of the king's tomb, and in the same year received the official title of royal painter. About the same time he completed the illustration of two volumes of Josephus' *Antiquités judaïques* (Bibliothèque Nationale, Paris). *See* also ILLUMINATED MANUSCRIPTS: *15th- and 16th-Century.*

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(P. W.)

FOUQUET (or FOUCQUET), **NICOLAS** (1615–1680), viscount of Melun and of Vaux, marquis of Belle-Isle, superintendent of finance in France under Louis XIV, was born in Paris in 1615. He belonged to an influential family of the *noblesse de la robe*, and was admitted as *avocat* at the parliament of Paris at the age of 13. In 1636 he bought the post of *maître des requêtes*. From 1642 to 1650 he held various intendances at first in the provinces and then with the army of Jules Mazarin, and, coming thus in touch with the court, was permitted in 1650 to buy the important position of *procureur général* to the parliament of Paris. During Mazarin's exile Fouquet shrowdly remained loyal to him, protecting his property and keeping him informed of the situation at court.

Upon the cardinal's return, Fouquet demanded and received as reward the office of superintendent of the finances (1653). The appointment was a popular one with the moneyed class, for Fouquet's great wealth had been largely augmented by his marriage in 1651 with Marie de Castille, who also belonged to a wealthy family of the legal nobility. His own credit, and his unfailing confidence in himself, strengthened the credit of the government, while his high position as *procureur général* secured financial transactions from investigation. As minister of finance, he soon had Mazarin almost in the position of a suppliant. The long wars, and the greed of the courtiers, made it necessary at times for Fouquet to borrow upon his own credit, but he soon turned this confusion of the public purse with his own to good account. The disorder in the accounts became hopeless; fraudulent operations were entered into with impunity, and the financiers were kept in the position of clients by official favours and by generous aid whenever they needed it. Mazarin was too deeply implicated in similar operations to interfere, and was obliged to leave the day of reckoning to his agent and successor Jean Baptiste Colbert. Upon Mazarin's death Fouquet expected to be made head of the government; but Louis XIV decided otherwise. In Aug. 1661 Louis XIV, already set upon his destruction, was entertained at Fouquet's great house at Vaux with a *fête* rivalled in magnificence by only one or two in French history. The splendour of the entertainment sealed Fouquet's fate. Three weeks after his visit to Vaux the king took Fouquet with him to Nantes and had him arrested on the charge of embezzlement. His trial lasted almost three years, and violated the forms of justice. Public sympathy was strongly with Fouquet, and Lafontaine, Madame de Sévigné and many others wrote on his behalf; but when Fouquet was sentenced to banishment, the king, disappointed, "commuted" the sentence to life imprisonment. He was sent at the beginning of 1665 to the fortress of Pignerol, where he died on March 23, 1680.

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FOUQUIER-TINVILLE, ANTOINE QUENTIN (1746–1795), French revolutionary, was born at Hérouel, Aisne. Originally a *procureur* attached to the Chatelet at Paris, he sold his office in 1783 and became a clerk under the lieutenant-general of police. He was public prosecutor to the Revolutionary Tribunal of Paris (March 10, 1793, to July 28, 1794). His function was not so much to convict the guilty as to see that the proscriptions ordered by the faction for the time being in power were carried out with due regard to a show of legality. He was as ruthless and as incorrupt as Robespierre himself; he could be moved from his purpose neither by pity nor by bribes. His passionless detachment made him an effective instrument of the Terror. He had no forensic eloquence; but the cold obstinacy with which he pressed his charges was more convincing than any rhetoric, and he seldom failed to secure a conviction.

His horrible career ended with the fall of Robespierre and the Terrorists on 9 Thermidor. On Aug. 1, 1794, he was imprisoned by order of the Convention and brought to trial. His defense was that he had only obeyed the orders of the Committee of Public Safety; but, after a trial which lasted 41 days, he was condemned to death, and guillotined on May 7, 1795.

See the documents relating to his trial enumerated by M. Tourneux in *Bibliographie de l'histoire de Paris pendant la Révolution Française*, vol. i, no. 4445–4454 (1890); also F. Dunoyer, *Fouquier-Tinville . . .* (1913).

FOURCHAMBAULT, a town of central France in the *département* of Nièvre, on the right bank of the Loire, 4½ mi. N.W. of Nevers, on the Paris-Lyon railway. Pop. (1954) 4,641. It has large iron-works, established in 1821, which produce engineering material for railway, military and other purposes. Among the more remarkable *chefs-d'oeuvre* of the town are the metal portions of the Pont du Carrousel, the iron beams of the roof of Chartres cathedral, and the vast spans of the bridge over the Dordogne at Cubzac. A small canal joins the works to the Lateral canal of the Loire.

FOUR FREEDOMS, a formulation of social and political objectives for the people of the U.S. and, ultimately, the world, as defined by Pres. Franklin D. Roosevelt in his "state of the union" message to congress Jan. 6, 1941. Roosevelt stated these freedoms to be: the freedom of speech and expression, the freedom of every person to worship God in his own way, the freedom from want and the freedom from fear.

An integral part of freedom from fear was Roosevelt's plea for "a world-wide reduction of armaments to such a point and in such a thorough fashion that no nation will be in a position to commit an act of physical aggression against any neighbor—anywhere in the world."

FOUR-H CLUBS. In the early 1900's the sporadic organization of a few corn, canning and poultry clubs in central and southern U.S. states gave rural school children "learning by doing" experience. These clubs were the beginning of the largest volunteer youth organization in the world—the 4-H clubs. By mid-20th century the organization had a membership of more than 2,000,000 rural boys and girls between the ages of 10 and 21, and nearly 300.000 adult and junior leaders in 85,000 clubs throughout the United States and Puerto Rico. Outstanding farmers and homemakers, together with clergymen, teachers and other professional men and women play an important part as volunteer local leaders in the development of 4-H club work.

The 4-H program is conducted under the supervision of the extension service of the state agricultural colleges, the U.S. department of agriculture and county governments co-operating, under the provisions of the Smith-Lever act of 1914 and other acts of congress and of state legislatures authorizing the establishment of agricultural extension work and making appropriations for it.

Each local club is composed of voluntary members who elect their own officers and receive instruction from a volunteer adult or junior leader. Because of the varying types of agriculture in the United States, more than 50 different phases of homemaking and agricultural projects may be undertaken by 4-H club members. For example, in agricultural club activities a club member may voluntarily, under the direction of his local leader and county extension agent and in accordance with recognized improved practices. grow a crop; raise a garden or a flock of poultry; purchase, breed and care for a sow and for her litter of pigs; care for a dairy calf to maturity and build a dairy herd; or run and maintain tractors and other farm machinery.

Much emphasis is placed on the development of constructive citizenship. leadership and intelligent ability to co-operate. the improvement of the health of the individual and the community. and the services that may be rendered in the home, on the farm and in the local community.

The 4-H club emblem is the four-leaf clover with the letter H on each leaf. The club colours are green and white. The white background of the 4-H flag symbolizes purity; the green of the 4-H emblem represents nature's most common colour and also is emblematic of youth. life and growth.

At regular 4-H meetings. achievement days and other club events, the giving of the 4-H pledge has a prominent place. It is as follows:

I pledge

My Head to clearer thinking,
My Heart to greater loyalty,
My Hands to larger service, and
My Health to better living, for
My Club, my Community, and my Country.

The U.S. department of agriculture sponsors and directs annually a National 4-H camp in Washington, D C.. during which member delegates become acquainted with the functions of the government in general and those of the department of agriculture in particular. Youth leaders of many lands are special guests at the National 4-H Camp. This is in line nith the 4-H effort to share world friendships with rural youth of the cultures.

A major annual event is the National 4-H Club congress. to which members are named delegates as rewards for outstanding records of achievement in 4-H club work. This event is conducted jointly by the co-operative extension service and the National Committee on Boys and Girls Club Work, Inc. The committee, which publishes *National 4-H News,* a monthly magazine. and provides incentives for meritorious 4-H work. is a privately supported voluntary group of citizens, incorporated not for profit.

(G. L. NE.)

FOUR HUNDRED, in the United States, the expression popularly used to denote the inner circle of highest society. The term originally applied to New York city society and is said to have arisen in 1892 when Mrs. William Astor asked Ward McAllister, a celebrated leader of society in New York city, to assist her in cutting down the invitation list of her annual ball to 400 persons as that was as many as her ballroom would accommodate. McAllister, who held a unique though self-appointed position as directing executive of New York society functions at that time, was heard to remark afterward at one of his clubs that there were really only 400 people living in New York city who had any claim to be called "society." The remark nas repeated and spread rapidly until newspapers and magazines were full of discussions on it. From that time on the term became commonly used. It has, however, lost all meaning in recent years. There is no New Tork society in McAllister's sense of the term. There are scores of social groups and levels but no hierarchy.

FOURIER, FRANÇOIS MARIE CHARLES (1772–1837), French socialist writer. was born at Besançon, Franche-Comté, on April 7, 1772. After completing his studies there he travelled for some time in France, Germany and Holland. Fourier entered the army, but after two years' service as a chasseur was discharged because of ill-health. In 1803 he published a remarkable article on European politics which attracted the notice of Napoleon. some of whose ideas were foreshadowed in it. Inquiries were made after the author, but nothing seems to have come of them.

After leaving the army Fourier entered a merchant's office in Lyons. and some years later undertook on his own account a small business as broker, devoting his leisure time to study.

He had become deeply impressed with the conviction that social arrangements resulting from the principles of individualism and competition mere essentially imperfect and immoral. He proposed to substitute for these principles co-operation or united effort, by means of which full and harmonious development might be given to human nature. The scheme, worked out in detail in his first work, *The'orie des quatre mouvements* (2 vol., Lyons, 1808, published anonymously), has for foundation a particular psychological proposition and a special economical doctrine. Psychologically Fourier held what may with some laxity of language be called natural optimism — the view that the full. free development of human nature or the unrestrained indulgence of human passion is the only possible way to happiness and virtue, and that misery and vice spring from the unnatural restraints imposed by society on the gratification of desire. This principle of harmony among the passions he regarded as his grandest discovery. Throughout his works, in uncouth, obscure and often unintelligible language, he demonstrates the fundamental harmony to be found in the four great departments — society! animal life, organic life and the material universe. In order to give effect to this principle and obtain the resulting social harmony, society should be reconstructed; for, in the existing drganization of society innumerable restrictions are imposed upon the free development .of human desire. As practical principle for such a reconstruction Fourier advocated co-operative or united industry. But the full realization of his scheme demanded much more than the mere admission that co-operation is economically more efficacious than individualism. Society as a whole must be organized on the lines requisite to give full scope to co-operation and to the harmonious evolution of human nature.

Society. on his scheme, is to be divided into departments or *phalanges*, each *phalange* numbering about 1.600 persons. Each *phalange* inhabits a *phalanstère* or common building. and has a certain portion of soil allotted to it for cultivation. The *phalanstères* are built after a uniform plan, and the domestic arrangements are laid down very elaborately. The staple industry of the *phalanges* is, of course, agriculture. but the various *séries* and *groupes* into which the members are divided may devote themselves to such occupations as are most to their taste; nor need any occupation become irksome from constant devotion to it. Any member of a group may vary his employment at pleasure. may pass from one task to another. The task regarded as menial or degrading in ordinary society can be rendered attractive if advantage is taken of the proper principles of human nature. It is not, on Fourier's scheme, necessary that private property should be abolished, nor is the privacy of farnily life impossible within the *phalanstère*. Each family may have separate apartments, and there may be richer and poorer members. But the rich and poor are to be locally intermingled, in order that the broad .distinction between them, which is so painful a feature in actual society. may become almost imperceptible. Out of the common gain of the *phalange* a certain portion is deducted to furnish to each member the minimum of subsistence; the remainder is distributed in shares to labour, capital and talent — five-twelfths going to the first; fourtwelfths to the second and three-twelfths to the third. Upon the changes requisite in the private life of the members Fourier was in his first work more explicit than in his later writings. The institution of marriage is of necessity abolished; a new and ingeniously constructed system of licence is substituted.

The scheme thus sketched attracted no attention when the *Théorie* first appeared, and for some years Fourier remained in his obscure position at Lyons. In 1812 the death of his mother put him in possession of a small sum of money, with which he retired to Bellay in order to perfect his second work. The *Traité de l'association agricole domestique* was published in two volumes at Paris in 1822, and a summary appeared in the following year. After its publication the author proceeded to Paris in the hope that some wealthy capitalist might be induced to attempt the realization of the projected scheme. Disappointed in this expectation he returned to Lyons. In 1826 he again visited Paris, and as a considerable portion of his means had been expended in the publication of his book, he accepted a clerkship in an American firm. In 1829 and 1830 appeared what is probably the most finished exposition of his views, *Le Nouveau monde industriel.* In 1831 he attacked the rival socialist doctrines of Saint-Simon and Owen in the small work *Pièges et charlatanisme de deux sectes, St. Simon et Owen.* His writings now began to attract some attention. A small body of adherents gathered around him, and the most ardent of them was Victor Considérant (*q.v.*). In 1832 a newspaper, Le *Phalanstdve ou la rtforme industrielle* was started to propagate the views of the school, but its success was not great. In 1833 it declined from a weekly to a monthly, and in 1834 it died of inanition. It was revived in 1836 as *Le Phalange,* and in 1843 became a daily paper, *La Ddmocratie pacifique.* In 1850 it was suppressed Fourier did not live to see the success of his newspaper, and the only practical attempt during his lifetime to establish a *phalanstdre* was a complete failure In 1832 M Baudet Dulary, Deputy for Seine-et-Oise, who had become a convert, purchased an estate at Condé-sur-Vesgre, near the forest of Rambouillet, and proceeded to establish a socialist community. The capital supplied was, however, inadequate, and the community broke up in disgust. Fourier was in no way discouraged by this failure, and until his death, on Oct 10, 1837, he lived in daily expectation of the realization of his scheme.

Several experiments on the lines laid down by Fourier were made in the United States by American followers of Fourier, whose doctrines were introduced there by Albert Brisbane (1809–1890). Indeed, in the years between 1840 and 1850, during which the movement waxed and waned, no fewer than 41 *phalanges* were founded, of which some definite record can be found. The most interesting of all the experiments, not alone from its own history, but also from the fact that it attracted the support of many of the most intellectual and cultured Americans, was that of Brook Farm (*q.v*).

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FOURIER, JEAN BAPTISTE JOSEPH, BARON (1768–1830), French mathematician and physicist famous for his pioneer work on the representation of functions by trigonometric series, was born at Auxerre, France, on March 21, 1768, the son of a tailor. Left an orphan at eight years, he was admitted. through the influence of the bishop, to the military school at Auxerre, where he revealed his mathematical talent. Unable to enter the artillery because of his low birth, he became a teacher in mathematics at the military school in 1784 and later took a prominent part locally in promoting the Revolution, although he objected to the Terror. He taught at the Bcole Normale at Paris from its institution in 1795, where his success soon led to the offer of the chair of analysis at the École Polytechnique. He was one of the savants who accompanied Bonaparte to Egypt in 1798 and was made governor of lower Egypt. Returning to France in 1801 he became prefect of Isère, with headquarters at Grenoble. M'hile there he carried on elaborate investigations into the conduction of heat. In 1815 he rejoined Napoleon during the Hundred Days. Following the second restoration he settled in Paris in 1816. He was made a member of the Academy of Sciences in 1817 and he became joint secretary with G. Cuvier in 1822. Believing that desert heat was ideal for health, he lived swathed like a mummy in overheated rooms.

Fourier died in Paris on May 16, 1830.

Fourier's masterpiece was his mathematical theory of heat conduction stated in *Théorie Analytique de la Chaleur* (1822; trans. by A. Freeman, 1872), one of the most important books published in the 19th century. It marked an epoch both in the history of pure and of applied mathematics, for in it Fourier developed the theory of the series known by his name and applied it to the solution of boundary-value problems in partial differential equations *(see* FOURIER SERIES). This work brought to a close a long controversy, and henceforth it was generally agreed that almost any function of a real variable can be represented by a series involving the sines and cosines of integral multiples of the variable. The first announcement of this discovery was made by Fourier in 1807. By his method the coefficients in any series of this type can be expressed in a form suitable for computation. The process is the same mathematically as the analysis of a musical sound into its fundamental and successive harmonics. Fourier's work was not received without criticism, the weak point in his analysis being his failure to provide a general proof that the Fourier series actually converges to the value of the function concerned.

This difficulty was not satisfactorily resolved until the development of the Lebesgue integral nearly a century later.

(G. J. Ww.)

FOURIER SERIES. Let us consider first an infinite series *(see* SERIES)

$$(1)\quad \tfrac{1}{2}a_0+(a_1\cos x+b_1\sin x)+(a_2\cos 2x+b_2\sin 2x)+\dots,$$

where the quantities a_0, a_1, b_1, a_2, b_2, ... are constants, and x is a variable taking any value between $-\infty$ and $+\infty$. Such series are called *trigonometric.* Suppose now that series (1) converges for all values of x, and let $f(x)$ denote the sum of the series. The function $f(x)$ is periodic, of period 2π, since replacing x by $x+2\pi$ does not change the series. If we multiply both sides of the equation $f(x)=\tfrac{1}{2}a_0+(a_1\cos x+b_1\sin x)+\dots$ by $\cos nx$ or $\sin nx$ and integrate the result over the interval $(0, 2\pi)$, we obtain that

$$(2)\qquad a_n=\frac{1}{\pi}\int_0^{2\pi}f(x)\cos nx\,dx,\quad b_n=\frac{1}{\pi}\int_0^{2\pi}f(x)\sin nx\,dx,$$

for all n. Though this argument is purely formal (it is justified, if series (1) converges uniformly, or even in some more general cases), it suggests the following important problem. Suppose we take any function $f(x)$ of period 2π, compute the numbers a_n, b_n by means of formulas (2), and form the series (1). Does the series so defined represent the function $f(x)$? The numbers (2) are called the *Fourier coefficients* of the function $f(x)$, and the series (1) just obtained is the *Fourier series* of $f(x)$. The fact that, under suitable conditions concerning $f(x)$, the problem just stated admits of an affirmative answer, is one of the main achievements of the theory of Fourier series. The latter take their name from Jean Baptiste Fourier, who based on them his mathematical theory of conduction of heat. Fourier's work *Théorie Analytique de la Chaleur* was published in 1822, but the discovery of Fourier series dates back to the first half of the 18th century, in connection with the problem of vibrating chords (Daniel Bernoulli, Leonhard Euler). Thus Fourier series originated in problems of mathematical physics, and they continue to be a very valuable tool there.

Not less important are Fourier series in mathematical analysis. Very often they appear there in a more general form, as *orthogonal* series *(see* below), and provide a unifying link of various mathematical theories, like differential and integral equations, analytic functions, etc. Especially important are trigonometric (and, in particular, Fourier) series for the theory of analytic functions, since for $z=e^{ix}$ the real part of the power series *(see* SERIES)

$$(3)\qquad \tfrac{1}{2}a_0+(a_1-ib_1)z+(a_2-ib_2)z^2+$$

is the series (1). Thus trigonometric series are real parts of power series, and so form a bridge between real and complex functions. However, while stressing the value of trigonometric series as a method of investigation, we should also be aware of the great role it played in the historic development and clarification of various mathematical concepts, some of them quite abstract. A few examples may suffice.

Already in the days of its inception, in the 18th century, the theory of Fourier series stirred controversies in connection with the notion of mathematical function (see FUNCTION). The general attitude at that time was to call $f(x)$ a function, if $f(x)$ could be represented by a single analytic expression, like a polynomial, a power series, a trigonometric series, etc. If the graph of f(x) were "arbitrary," *e.g.* a polygonal line, f(x) would not have been accepted as a function. So it came as a shock to many when the discovery of Fourier series showed that many such ('arbitrary" graphs could be represented by trigonometric series, and so should be treated as functions. It took a long time before the matter was completely clarified, and it was not merely a coincidence that the now universally adopted definition was first formulated in a memoir of Lejeune-Dirichlet (1837) devoted to the theory of Fourier series. (Incidentally, this memoir contains the first rigorous proofs of the representation of functions by their Fourier series. The work of Fourier himself and of his predecessors was rather formal.) Another instance of application of trigonometric series to the theory of functions is due to Karl Weierstrass, who gave the first example of a continuous function without a derivative at any point. Weierstrass' function was given in the form of a trigonometric series, and it exemplified the general fact that trigonometric series are particularly useful in the construction of functions with various peculiarities. Another much more imvortant example of the influence of Fourier series may be found in the history of the notion of integral. On account of formulas (2), this notion is a prerequisite to that of Fourier series. It is therefore interesting to note that the classical definition of integral, due to Bernhard Riemann (usually given in the textbooks of Calculus) was for the first time expounded in the latter's fundamental paper Ueber die Darstellbarkeit einer *Funktion durch eine* Trigonometrische Reihe (1854). The ideas contained in that paper influenced the work of Georg Cantor concerning the uniqueness of the representation of a function by a trigonometric series. Cantor had to consider various sets of points which would not interfere with the uniqueness of representation. Starting from simplest cases he tried to master the structure of such sets—"sets of uniqueness" (see below). He was not completely successful, and the problem is still open, but his investigations led him to the general theory *of* sets, and in particular of point sets, which was one of the greatest mathematical discoveries of the 19th century. His results have permeated, and changed the aspect of many mathematical theories. The theories of measure and of integral developed later by Emile Borel and Henri Lebesgue, which are so fundamental in mathematical analysis, find their roots in Cantor's work on the theory of sets.

Particularly important is the work of Lebesgue, who through his theory of integral put Fourier series on a new basis. Though more general definitions of integral are possible, and though some of them are of interest for Fourier series, Lebesgue's definition is the most appropriate and almost universally adopted in research. In this connection, mention should be made of work of Arnaud Denjoy who showed that, with a definition of integral more general than that of Lebesgue, an everywhere convergent trigonometric series is always the Fourier series of its sum. Important for Lebesgue's theory is the notion of set of measure zero. A point set S situated, for example, on a straight line is said to be of measure zero if S can be covered by a finite or infinite system of intervals of total length arbitrarily small. In Lebesgue's theory sets of measure zero are considered as negligible, and if a certain property holds for all points except those forming a set of measure zero, that property is said to hold almost everywhere.

Convergence and Divergence of Fourier Series.—Let $s_n(x)$ denote the sum of the first $n+1$ terms of series (1). Using (2), we get

$$(4) \qquad s_n(x)=\frac{1}{\pi}\int_0^{2\pi} f(x+t)\,\frac{\sin\,(n+\frac{1}{2})t}{2\,\sin\,\frac{1}{2}t}\,dt,$$

a formula basic for Fourier series. It may be proved that, as n increases indefinitely, $s_n(x)$ tends to $f(x)$, provided the function f(x) satisfies certain conditions. For example, if the graph of the function $f(x)$ in the interval $0\leq x\leqq 2\pi$ has only a finite number of maxima and minima (Dirichlet's condition), the Fourier series of $f(x)$ converges to $f(x)$ at every point of continuity of the function. At the points x where such a function is discontinuous, the Fourier series also converges, its sum being &$[f(x+0)+f(x-0)]$ (where $f(x+0)$ is the limit of the function at the point x from the right, and $f(x-0)$, a similar limit from the left). Another condition ensuring the convergence of the Fourier series, to sum f(x), is the convergence of the integral

$$\int_0^{\pi}\frac{|f(x+t)+f(x-t)-2f(x)|}{t}\,dt$$

(the Dini condition). It certainly is satisfied at every point where the function f(x) is differentiable. These and all other known conditions for convergence are *sufficient* conditions only. Conditions which would be both necessary and sufficient (and would not be trivial tautologies) are not known. That mere continuity of the function is not sufficient to ensure the convergence of the Fourier series was shown by Paul du Bois-Reymond (1872). He constructed a continuous function whose Fourier series diverges at some points. Whether there is a continuous function whose Fourier series diverges at every point, is the most outstanding and still, in 1945, the unsolved problem of the theory. That there exist integrable (in the Lebesgue sense) functions whose Fourier series diverge everywhere, was shown by Andrei N. Kolmogoroff (1926).

Summability of Fourier Series.—The fact that Fourier series of continuous functions need not converge everywhere, endangered the whole theory of the representation of functions by their Fourier series. The situation was salvaged by Leopold Fejér (1900), who showed that the Fourier series of a continuous function $f(x)$ is summable to $f(x)$ by the method of the arithmetic mean (see SERIES). More precisely, if $s_n(x)$ has the same meaning as above, the expression

$$\sigma_n(x)=\frac{s_0(x)+s_1(x)+\cdots+s_n(x)}{n+1}$$

tends to $f(x)$ at every point of continuity of the function. Following this, Lebesgue proved that for every integrable function $f(x)$ the expression $\sigma_n(x)$ tends to $f(x)$ almost everywhere. This again put the theory on a firm basis, and at the same time showed that summability rather than convergence is important for Fourier series. Using (4), one obtains the formula

$$(5) \qquad \sigma_n(x)=\frac{1}{\pi(n+1)}\int_0^{2\pi} f(x+t)\frac{\sin^2\frac{1}{2}(n+1)t}{2\,\sin^2\frac{1}{2}t}dt$$

It is not unlike (4), but there is one essential difference. The factor $\sin^2$&$(n+1)t/2(n+1)\sin^2\frac{1}{2}t$ in (5) called *Fejér's* kernel, is non-negative, whereas the factor $\sin(n+\frac{1}{2})t/2\sin\frac{1}{2}t$ in (3) *Dirichlet's* kernel) is of variable sign. This positive character of Fejér's kernel is responsible for many interesting properties of the expressions $\sigma_n(x)$, and in particular for the fact that they represent $f(x)$ so much better than the $s_n(x)$ do.

Besides the method of the arithmetic mean, many other methods of summability have been applied to Fourier series. The most important of them is the method of Niels Abel (see SERIES), which defines the sum of series (1) as the limit of the expression

$$\tfrac{1}{2}a_0+(a_1\cos x+b_1\sin x)r+(a_2\cos 2x+b_2\sin 2x)r^2+\ldots,$$

where r tends to 1 through values less than 1. If (1) is the Fourier series of $f(x)$, the last expression may be written

$$\frac{1}{2\pi}\int_0^{2\pi} f(x+t)\,\frac{1-r^2}{1-2r\cos t+r^2}\,dt,$$

and is called the Poisson integral of f(x). As $r\rightarrow 1$, it tends to $f(x)$ at every point of continuity of the function (or almost everywhere, if f(x) is merely integrable).

Conjugate Series and Functions.—For $z=e^{ix}$, the real part of the power series (3) is the trigonometric series (1). The imaginary part of (3) is the trigonometric series

$$(a_1 \sin x - b_1 \cos x) + (a_2 \sin 2x - b_2 \cos 2x) + \ldots$$

which is called the *conjugate* of the series *(1)*. Suppose that *(1)* is the Fourier series of a function $f(x)$; the conjugate series is then almost everywhere summable by the method of the arithmetic mean, or by the method of Abel, the generalized sum being equal to the integral

$$(6)\qquad -\frac{1}{\pi}\int_0^{\pi}\frac{f(x+t)-f(x-t)}{2\tan\frac{1}{2}t}\,dt,\ \text{defined as}\ \lim_{\epsilon\to 0}\left\{-\frac{1}{\pi}\int_{\epsilon}^{\pi}\right\}$$

This integral is called the *function conjugate* to $f(x)$ and will be denoted by $f(x)$. The fact that for every integrable function $f(x)$ the integral *(6)* exists almost everywhere. is a very remarkable property of integrable functions, a property which is far from obvious even in the case when $f(x)$ is continuous. Conjugate series are a link between trigonometric series and power series. They are also of importance for the theory of Fourier series, since there seems to be a close relation between the behaviour of the partial sums of Fourier series and the behaviour of certain conjugate functions. The function conjugate to an integrable function $f(x)$ need not be integrable. Thus the series conjugate to the Fourier series of $f(x)$ need not be a Fourier series.

Parseval's Formula.—Suppose that *(1)* is the Fourier series of $f(x)$. If in the formula $f(x) = \frac{1}{2}a_0 + (a_1\cos x + b_1\sin x) + \ldots$ we square both sides and integrate the result over the interval $0 \leq x \leq 2\pi$, we get the equation

$$\frac{1}{\pi}\int_0^{2\pi} f^2(x)dx = \tfrac{1}{2}\,a_0^2 + (a_1^2+b_1^2) + (a_2^2+b_2^2) + \cdots$$

called *Parseval's formula.* The above argument was formal, but rigorous proofs are available and show that the formula is valid for any function $f(x)$ such that $f^2(x)$ is integrable. Thus the Fourier coefficients $a_0, a_1, b_1, \ldots$ of any such function have the property that the sum $\sum(a^2{}_n + b^2{}_n)$ is finite. That the converse is true, was proved by F. Riesz and E. Fischer (1907). The Riesz-Fischer theorem, one of the great achievements of the Lebesgue theory of integration, asserts that, given any sequence of numbers $a_0, a_1, b_1, a_2, b_2, \ldots$ such that the series $\sum(a_n^2+b_n^2)$ converges, there is always a function $f(x)$ having the numbers $a_0, a_1, b_1, \ldots$ for Fourier coefficients and such that $f^2(x)$ is integrable. This function is unique. Thus the theorems of Parseval and of Riesz-Fischer give a very simple characterization of function with integrable square in terms of their Fourier coefficients. No other class of function has a characterization of comparable simplicity and completeness.

Uniqueness of Representation by Trigonometric Series.—Can a function be represented by two different and everywhere convergent trigonometric series? By taking the difference of two such series we may restate the problem as follows. Can a trigonometric series not identically zero (*i.e.* a series whose coefficients a,, b_n are not all zero) converge everywhere to *o?* That this is impossible was proved by Georg Cantor. His result is the simplest theorem on the uniqueness of the representation of a function by a trigonometric series. Let us call a point set S situated in the interval $0 \leq x \leq 2\pi$ a *set of uniqueness* (set U, for brevity), if every trigonometric series convergent to *o* outside S is identically zero. Otherwise, the set S will be called a *set of multiplicity* (set M), and there will be trigonometric series convergent to o outside S, but not identically zero. Generalizing the result just stated. Cantor proved that every set S consisting of a finite number of points, and even certain infinite sets, are sets U. It may be shown that every set U must be of measure zero, but it is remarkable that among sets of measure o we find sets U as well as sets M. The problem of characterizing sets U and M in structural terms was in 1945 still unsolved. One of its implications is that from the point of view of trigonometric series the notion of set of measure zero is too general, and that special classes of such sets may be of particular importance.

Orthogonal Series.—Fourier series as defined above are a special class of more general series. Suppose that in an interval $a \leq x \leq b$ we have a fixed set of functions $\varphi_1(x)$, $\varphi_2(x), \ldots$ with the following properties

$$(7)\qquad \int_a^b \varphi_m\varphi_n dx = 0,\ \text{if}\ m\neq n;\quad \int_a^b \varphi_n^2 dx = \lambda_n \neq 0,$$

for all m and n. Such sets of functions are called *orthogonal.* If a function $f(x)$ has a representation $f(x) = c_1\varphi_1(x) + c_2\varphi_2(x) + \ldots$, then, multiplying both sides by $\varphi_n(x)$, integrating over x the interval (a, b), and using (7), we are formally led to the equations $c_n = \frac{1}{\lambda_n}\int_a^b f(x)\ \varphi_n(x)\ d\,x$, for all n. Conversely, given any function $f(x)$, we may use the latter formulas to construct the series $c_1\varphi_1(x) + c_2\varphi_2(x) + \ldots$, and ask whether this series actually represents $f(x)$. This last series is called the *Fourier series of $f(x)$ with respect to the orthogonal system $\varphi_1, \varphi_2, \ldots$.* Trigonometric Fourier series are obtained if for φ_1, $\varphi_2, \ldots$ we take the system *1*, cos x, sin x, cos 2 x, sin 2 x, . . . , and for *(a, b)* the interval $(0, 2\pi)$. Many other orthogonal systems are of considerable importance for mathematics.

Fourier Integrals.—Fourier series are used for the representation of periodic functions. For the study of a nonperiodic function $f(x)$ we use the *Fourier integral* of $f(x)$. It has the form

$$(8)\qquad \int_0^{\infty}\{a(u)\ \cos\ ux + b(u)\ \sin\ ux\}du,$$

where $a(u)$ and $b(u)$ are defined by the formulas

$$a(u) = \frac{1}{\pi}\int_{-\infty}^{+\infty} f(t)\cos\,ut\,dt,\ b(u) = \frac{1}{\pi}\int_{-\infty}^{+\infty} f(t)\ \sin\ ut\,dt$$

The integral *(8)* is analogous to the series *(1)*, the only difference being that instead of summation we have integration. The functions $a(u)$ and $b(u)$ are analogues of Fourier coefficients, and are called the *Fourier transforms of $f(x)$.* Under very general conditions, the integral *(8)* actually represents $f(x)$, the proofs being similar to the corresponding proofs in the case of Fourier series.

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FOURMIES, a town of northern France, in the *département* of Nord, on an affluent of the Sambre, *39* mi. S.E. of Valenciennes by rail. Pop. *(1946) 12,694.* Wool combing and spinning are important, and a great variety of cloths is produced. The glassworks of Fourmies date from *1*599, and were the first established in the north of France. Iron is worked in the vicinity, and there are important forges and foundries. Enamelware is also manufactured.

FOURNIER, PIERRE SIMON *(1712*–1768), French engraver and typefounder, was born at Paris on Sept. 15, *1712.* He designed many new characters, and his foundry became celebrated not only in France; but in foreign countries. .His *Table des proportions qu'il faut observer entre les caractkres* (1737) was followed by several other technical treatises. His principal work, however, was the *Manuel typographique* (2 vol., 1764), the first volume treating of engraving and type founding, the second of printing, with examples of different alphabets. He died in Paris on Oct. *8, 1*768.

See also Printing Type: *Type Design.*

FOURTEEN POINTS, THE. On Jan. *8, 1918,*Pres. Woodrow Wilson, in his address to the joint session of congress, formulated under *14* separate heads his ideas of the essential nature of a post-World War I settlement. Before the delivery of his address he had received from a committee of inquiry, set up by Col. Edward House in Sept. 1917, a report upon the territorial settlement that should follow the conclusion of the war. It has been stated that no fewer than six, and these the territorial points, of Wilson's Fourteen Points were "directly framed" upon the recommendations contained in the report. It has also been stated by Ray S. Baker in his *Woodrow Wilson* that the report was drawn up by S. Mezes, D. H. Miller and Walter Lippmann.

The text of the Fourteen Points was as follows:

1. Open covenants of peace, openly arrived at, after which there shall be no private international understandings of any kind but diplomacy shall proceed always frankly and in the public view.

2. Absolute freedom of navigation upon the seas, outside territorial waters, alike in peace and in war, except as the seas may be closed in whole or in part by international action for the enforcement of international covenants.

3. The removal, so far as possible, of all economic barriers and the establishment of an equality of trade conditions among all the nations consenting to the peace and associating themselves for its maintenance.

4. Adequate guarantees given and taken that national armaments will be reduced to the lowest point consistent with domestic safety.

5. A free, open-minded, and absolutely impartial adjustment of all colonial claims, based upon a strict observance of the principle that in determining all such questions of sovereignty the interests of the populations concerned must have equal weight with the equitable claims of the government whose title is to be determined.

6. The evacuation of all Russian territory and such a settlement of all questions affecting Russia as will secure the best and freest cooperation of the other nations of the world in obtaining for her an unhampered and unembarrassed opportunity for the independent determination of her own political development and national policy and assure her of a sincere welcome into the society of free nations under institutions of her own choosing; and, more than a welcome, assistance also of every kind that she may need and may herself desire. The treatment accorded Russia by her sister nations in the months to come will be the acid test of their good will, of their comprehension of her needs as distinguished from their own interests, and of their intelligent and unselfish sympathy.

7. Belgium, the whole world will agree, must be evacuated and restored, without any attempt to limit the sovereignty which she enjoys in common with all other free nations. No other single act will serve as this will serve to restore confidence among the nations in the laws which they have themselves set and determined for the government of their relations with one another. Without this healing act the whole structure and validity of international law is forever impaired.

8. All French territory should be freed and the invaded portions restored, and the wrong done to France by Prussia in 1871 in the matter of Alsace-Lorraine, which has unsettled the peace of the world for nearly fifty years, should be righted, in order that peace may once more be made secure in the interest of all.

9. A readjustment of the frontiers of Italy should be effected along clearly recognizable lines of nationality.

10. The peoples of Austria-Hungary, whose place among the nations we wish to see safeguarded and assured, should be accorded the freest opportunity of autonomous development.

11. Rumania, Serbia, and Montenegro should be evacuated; occupied territories restored; Serbia accorded free and secure access to the sea; and the relations of the several Balkan states to one another determined by friendly counsel along historically established lines of allegiance and nationality; and international guarantees of the political and economic independence and territorial integrity of the several Balkan states should be entered into.

12. The Turkish portions of the present Ottoman Empire should be assured a secure sovereignty, but the other nationalities which are now under Turkish rule should be assured an undoubted security of life and an absolutely unmolested opportunity of autonomous development, and the Dardanelles should be permanently opened as a free passage to the ships and commerce of all nations under international guarantees.

13. An independent Polish state should be erected which should include the territories inhabited by indisputably Polish populations, which should be assured a free and secure access to the sea, and whose political and economic independence and territorial integrity should be guaranteed by international covenant.

14. A general association of nations must be formed under specific covenants for the purpose of affording mutual guarantees of political independence and territorial integrity to great and small states alike.

President Wilson developed these theories during 1918 in a series of speeches, to which reference was subsequently made during the Armistice negotiations. These are generally known as the "Four Principles." "Four Ends" and "Five Particulars."

The Four Principles.—In the "Four Principles" speech in congress, Feb. 11. 1918, he declared:

1. That each part of the final settlement must be based upon the essential justice of that particular case and upon such adjustments as are most likely to bring a peace that will be permanent;

2. That peoples and provinces are not to be bartered about from sovereignty to sovereignty as if they were mere chattels and pawns in a game, even the great game, now forever discredited, of the Balance of Power; but that

3. Every territorial settlement involved in this war must be made in the interest and for the benefit of the populations concerned, and not as a part of any mere adjustment or compromise of claims amongst rival states; and

4. That all well-defined national aspirations shall be accorded the utmost satisfaction that can be accorded them without introducing new or perpetuating old elements of discord and antagonism that would be likely in time to break the peace of Europe and consequently of the world.

The Four Ends.—In the "Four Ends" speech of July 4, 1918, occurs the following passage:

These are the ends for which the associated peoples of the world are fighting and which must be conceded them before there can be peace:

1. The destruction of every arbitrary power anywhere that can separately, secretly, and of its single choice disturb the peace of the world; or, if it cannot be presently destroyed, at the least its reduction to virtual impotence.

2. The settlement of every question, whether of territory, of sovereignty, of economic arrangement, or of political relationship, upon the basis of the free acceptance of that settlement by the people immediately concerned, and not upon the basis of the material interest or advantage of any other nation or people which may desire a different settlement for the sake of its own exterior influence or mastery.

3. The consent of all nations to be governed in their conduct towards each other by the same principles of honor and of respect for the common law of civilized society that govern the individual citizens of all modern states in their relations with one another; to the end that all promises and covenants may be sacredly observed, no private plots or conspiracies hatched, no selfish injuries wrought with impunity, and a mutual trust established upon the handsome foundation of a mutual respect for right.

4. The establishment of an organization of peace which shall make it certain that the combined power of free nations will check every invasion of right and serve to make peace and justice the more secure by affording a definite tribunal of opinion to which all must submit and by which every international readjustment that cannot be amicably agreed upon by the peoples directly concerned shall be sanctioned.

These great objects can be put into a single sentence. *What we seek is the reign of law, based upon the consent of the governed and sustained by the organized opinion of mankind.*

The Five Particulars.—The "Five Particulars" (speech of Sept. 27, 1918) were as follows:

1. The impartial justice meted out must involve no discrimination between those to whom we wish to be just and those to whom we do not wish to be just. It must be a justice that plays no favorites and knows no standard but the equal rights of the several peoples concerned;

2. No special or separate interest of any single nation or any group of nations can be made the basis of any part of the settlement which is not consistent with the common interest of all;

3. There can be no leagues or alliances or special covenants and understandings within the general and common family of the League of Nations.

4. And more specifically, there can be no special, selfish economic combinations within the League and no employment of any form of economic boycott or exclusion except as the power of economic penalty by exclusion from the markets of the world may be vested in the League of Nations itself as a means of discipline and control.

5. All international agreements and treaties of every kind must be made known in their entirety to the rest of the world.

Special alliances and economic rivalries and hostilities have been the prolific source in the modern world of the plans and passions that produce war. It would be an insincere as well as an insecure peace that did not exclude them in definite and binding terms.

Armistice and Peace Settlement.—On Oct. 4, 1918, Prince Maximilian of Baden, the German imperial chancellor, informed President Wilson:

The German government accepts the program set forth by the President of the United States in his message to Congress of Jan. 8, 1918, and in his later pronouncements, especially his speech of Sept. 27, as a basis for peace negotiations.

The Fourteen Points were thus designated by the German (and separately by the Austrian) government as an acceptable basis for peace. See VERSAILLES. TREATY OF.

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FOURTOU, MARIE FRANÇOIS OSCAR BARDY DE (1836–1897), French politician, born at Ribérac (Dordogne) on Jan. 3, 1836, represented Dordogne in the national assembly after the Franco-German War. He was minister of public works (1872). of religion (1873) and of education (1874). As minister of the interior in Broglie's cabinet in 1877, he resumed the administrative methods of the second empire. In the general elections of that year he used the whole weight of officialdom to secure a majority for the right-wing group, which supported a clerical and reactionary program. In spite of these efforts the cabinet fell, and a commission was appointed to inquire into their unconstitutional abuse of power. Fourtou was unseated in consequence of the revelations made. In the chamber of deputies Gambetta gave the lie direct to Fourtou. A duel was fought in consequence, but neither party was injured. Fourtou died in Paris on Dec. 5, 1897.

FOUSSA (*Cryptoprocta* ferox), the largest carnivorous mammal peculiar to Madagascar, which combines characteristics of the civets and the cat family. It is about twice the size of a cat (five feet from nose to end of tail), with short dense fur of pale brown. Most active at night, the foussa usually dwells in trees during the day. Although it has been known to prey upon poultry, sheep and cattle, it more commonly feeds on birds and lemurs. The specific name refers to its ferocity, which the foussa shows when wounded.

See CARNIVORA: Feloidea. (J. E. HL.; X.)

FOWEY, a seaport and municipal borough in the Bodmin parliamentary division of Cornwall, Eng., 12 mi. S. of Bodmin and 28 mi. W. of Plymouth by road and ferries. Pop. (1951) 2,347. Area 4.7 sq.mi. It lies on the west bank of the river Fowey where it widens into a deep-water estuary which vessels drawing 30 it. can enter. The river banks are high and wooded; the town, with its steep narrow streets. is a residential one. attracting many artists and writers. It is also a holiday and yachting centre, with the latter's headquarters at the Royal Fowey Yacht club. Deep-sea fishing is carried on, and china clay is exported. There is a car ferry to Bodinnick and a passenger ferry to Polruan opposite Fowey. The 14th-century church, dedicated to St. Fimbarrus or Fin Barr of Cork. stands on the hillside. Place house, adjacent, is a Tudor building. and there are 16th- and 17th-century houses in the town, which is portrayed in various writings of Sir Arthur Quiller-Couch. There is a ruined fort of the time of Henry VIII; the grammar school was established in 1692.

Fowey held a leading position among Cornish ports from the time of Edward I to the days of the Tudors. The numerous references to the privateering exploits of its ships in the Patent and Close rolls testify to its importance. Tin was exported in medieval times. Incorporated by James II, Fowey retained its charter until 1882. A new charter came into force in 1913. In 1316 the prior of Tywardreath, as lord of the manor, obtained the right to hold a Monday market and two fairs, which in 1690 were altered to a Saturday market and three fairs that continue to be held.

FOWL. Originally used to mean any bird, this term has now become (except in combination, as seafowl, wild fowl) almost restricted to the wild red jungle fowl, *Gallus gallus,* its domestic races and its wild allies. (For domestic fowls, see POULTRY AND POULTRY FARMING.) *Gallus gallus* inhabits northern India, Burma, southern Vietnam, the Malay archipelago and neighbouring islands. It resembles in plumage the domestic black-breasted game breed. It inhabits forests: thickets and bamboo jungles, dwelling in small parties. The crow of the cock is like that of a bantam. The cream-white eggs, 8 to 12 in number. are laid on the ground.

Three other species occupy much the same habitat. The gray jungle fowl, G. *sonnerati,* is found in western, central and southern India; the cock has the shaft of the neck hackles dilated) and his crow is more like a cackle. The Sinhalese species, G. lajayetti, is peculiar to Ceylon; the cock has a yellow comb with a red edge and is red beneath. G. *varius* inhabits the hlalay islands from Java to Flores; it does not possess hackles, and the cock has a large unserrated comb. All the species will interbreed with domestic poultry and with the wild G. *gallus,* but the hybrids are sterile.

See also GAME BIRDS.

FOWLER, CHARLES (1792–1867), English architect best known for his buildings in Covent Garden and Hungerford markets, was born at Cullompton, Devon, on May 17, 1792, and died at Great Marlow on Sept. 26, 1867. After an apprenticeship of five years at Exeter, he worked in the office of David Laing in London from 1814 until he began to practise alone. His first important work was the court of bankruptcy in Basinghall street (1821). In 1822 he gained first premium for a design for London bridge, which, however, mas not used. Among Fowler's designs for bridges was one erected across the Dart at Totnes. He also designed the markets of Gravesend and Exeter (lower market), several churches. the Devon lunatic asylum (1845), the London fever hospital (1849) and the hall of the Wax Chandlers' company, Gresham street (1853). He was honorary secretary and a vice-president of the Institute of British Architects.

FOWLER, SIR JOHN (1817–1898), English civil engineer, best known as the designer of the London hfetropolitan railway and as joint designer of the Forth bridge in Scotland, was born on July 1j, 1817, at Wadsley Hall, near Sheffield. He engaged in railway construction at an early age and set up his own business in 1844, laying out many small railway systems, which were later amalgamated into the Manchester, Sheffield and Lincolnshire railway. Fowler was engineer of the London Metropolitan railway, the forerunner of the underground railways, which was noteworthy in that it was mostly made not by tunneling but by excavating from the surface and then covering in the permanent way. He designed and constructed a special type of locomotive for this railway, afterward known as "Fowler's Ghost." He lived to be one of the engineers officially connected with the deep-tunneling "tube" system extensively adopted for electric railways in London. Fowler was also engineer for the construction of Victoria station. He was also engaged in the making of railways in Ireland, and in 1867 he served on a commission to consider a state purchase of the Irish railway system. He also carried out considerable works in relation to the Nene valley drainage and the reclamation of land in the Norfolk estuary.

In 186j Fowler was elected president of the Institution of Civil Engineers, the youngest president who had ever sat in the chair. He was strongly opposed to the project of a channel tunnel to France, and in 1872 he endeavoured, in vain, to obtain the consent of parliament to a channel ferry scheme. For eight years from 1871 he acted as general engineering adviser in Egypt to the khedive Ismail. The railway he planned to the Sudan mas not developed for financial reasons, but the maps and surveys were given to the war office and proved most useful to Lord Wolseley in his Nile expedition. For his service Fowler was knighted in 1885. He was created a baronet in 1890 on the completion of the great Forth bridge, of which he was joint engineer with his partner, Sir Benjamin Baker. He died at Bournemouth on Nov. 20, 1898.

See T. Mackay, *The Life* of *Sir John Fowler* (1900). (T. M. S.)

FOWLER, JOHN (1826–1864), English engineer, inventor of the steam-hauled plow, was born at Melksham, Wiltshire, on July 11, 1826. He was at first engaged in the corn trade but later trained as an engineer. In 1850 he joined Albert Fry in Bristol to found a works for the production of steam-hauled implements; and in the same year he laid porous pipe drains 2 ft. 6 in. deep by horsepowered windlass. He applied the steam engine to draining in 18j3 and to cultivation in 18j6. In 1857 he was awarded a £200 prize by the Highland Agricultural society for cultivation by a single stationary engine, using the first steel wire rope. The following year he won the Royal Agricultural society's £500 prize, using a single self-moving engine hauling the implement by a rope around a disk anchor on the headland opposite. He patented his famous clip drum and coiling gear in 1859. In 1861 he founded at Leeds the firm of John Fowler and Co. to make this machinery, and at one time other firms did so under licence. Fowler died at Ackworth, Yorkshire, on Dec. 4, 1864. (R. H. C.)

FOWLER, WILLIAM (*c.* 1560–1614), Scottish poet, attended St. Leonard's college. St. Andrews, between 1574 and 1578, and in 1581 was in Paris studying civil law. In that year he issued a pamphlet against John Hamilton and other Catholics, who had, he said, driven him from his country. He subsequently (about 1590) became private secretary and Master of Requests to Anne of Denmark, wife of James VI., and was renominated to these offices when the queen went to England. In *1609* his services were rewarded by a grant of *2,000* acres in Ulster. His sister Susannah was mother of the poet William Drummond of Hawthornden. A ms. collection of *72* sonnets, entitled *The Tarantula of Love*, and a translation *(1587)* from the Italian of the *Triumphs of Petrarke* are preserved in the library of the University of Edinburgh, in the collection bequeathed by his nephew, William Drummond. Two other volumes of his manuscripts are preserved among the Drummond mss., now in the library of the Society of Antiquaries of Scotland. Specimens of Fowler's verses were published in *1803* by John Leyden in his *Scottish Descriptive Poems*. Fowler contributed a prefatory sonnet to James VI.'s *Furies;* and James, in return, commended, in verse, Fowler's *Triumphs*.

FOX, *CHARLES JAMES (1749–1806)*, British statesman and orator, was born at 9 Conduit Street, Westminster, on Jan. 24, 1749, third son of Henry Fox, 1st Lord Holland, and his wife, Lady Caroline Lennox, eldest daughter of Charles Lennox, 2nd duke of Richmond. The father, who treated his children with extreme indulgence, allowed him to choose his school, and he elected to go to one kept at Wandsworth by a French refugee, named Pampelonne. Then the boy asked to be sent to Eton, where he was entered in the autumn of *1758*. During the six years he spent at Eton he acquired the love and knowledge of the classics in which he found refreshment and solace all through life. Lord Holland treated his children, and in particular Charles, as friends and companions in pleasure from the first. In *1763* he took Charles to Paris and to Spa, and encouraged him in dissipation and in gambling. In spite of this extraordinary interlude in his studies, Fox read hard from natural inclination. After he went up to Hertford College, Oxford, in *1764*, he made repeated visits to France and Italy during the vacations. He became a good French and Italian scholar, with a keen appreciation of Italian literature and art.

If Fox's youth was disorderly, it was never indolent. He was incapable of half doing anything which he did at all. He was as energetic in sport as in learning. At a later period when he had grown fat he accounted for his skill in taking "cut balls" at tennis by saying that he was a very "painstaking man." He was all his life a great and steady walker.

In *1768* Lord Holland bought the pocket borough of Midhurst for him. and he entered on his parliamentary career, and on London society, in 1769. Within the next few years Lord Holland reaped to the full the reward for all that was good, and whatever was evil, in the training he had given his son. The affection of Charles Fox for his father was unbounded, but the passion for gambling which had been instilled in him as a boy proved the ruin of the family fortune. He kept racehorses, and bet on them largely On the racecourse he was successful, and it is another proof of his native thoroughness that he gained a reputation as a handicapper. It is said that he won more than he lost on the course. At the gaming table he was unfortunate, and he was fleeced both in London and in Paris by unscrupulous players. Fox took his losses and their consequences with an attractive gaiety. He called the room in which he did business with the Jew money-lenders his "Jerusalem chamber." When his elder brother had a son, and his prospects were injured, he said that the boy was a second Messiah, who had appeared for the destruction of the Jews. "He had his jest, and they had his estate." In 1774 Lord Holland had to find £140,000 to pay the gambling debts of his sons For years Charles lived in pecuniary embarrassment, and during his later years, when he had given up gambling, he was supported by the contributions of wealthy friends, who in 1793 formed a fund of £70,000 for his benefit.

Early Years in Parliament.— In the House of Commons he began by supporting the court; and in *1770*, when only 21, he was appointed a junior lord of the admiralty with Lord North. During the violent conflict over the Middlesex election *(see* WILKES, JOHN) he took the unpopular side, and vehemeptly asserted the right of the House of Commons to exclude Wilkes. In *1772* during the proceedings against Crosby and Oliver—a part of the "Wilkes and liberty" agitation—he and Lord North were attacked by a mob and rolled in the mud. But Fox's character was incompatible with ministerial service under King George III. The king, himself a man of orderly life, detested him as a gambler and a rake. And Fox was too independent to please a master who expected obedience. In Feb. 1772 he threw up his place to be free to oppose the Royal Marriage Act, on which the king's heart was set. He returned tc office as junior lord of the treasury in December. But he was insubordinate; his sympathy with the American colonies, which were now beginning to resist the claims of the mother country to tax them, made him intolerable to the king and he was dismissed in Feb. 1774. The death of his father on July *1*, of that year removed an influence which tended to keep him subordinate to the court, and his friendship for Burke drew him into close alliance with the Rockingham Whigs. From the first his ability had won him admiration in the House of Commons. He had prepared himself as an orator by the elaborate cultivation of his voice, which was naturally harsh and shrill. His argumentative force was recognized at once, but the full scope of his powers was first shown on Feb. 2, 1775, when he made a remarkable speech (unfortunately lost) on the disputes with the colonies. "Taking the vast compass of the question before us," says Gibbon, "he discovered powers for regular debate which neither his friends hoped nor his enemies dreaded." When parliament met on Oct. *26*, Fox supported the amendment to the Address censuring ministers for increasing the discontent in America. "Ministers," he said, "have reason to triumph. Lord Chatham, the Ring of Prussia, nay, Alexander the Great, never gained more in one campaign than the noble lord [North] has lost—he has lost a whole continent." Next year, speaking again on the amendment to the Address (Oct. *31, 1776)* he maintained that if the choice lay between conquering and abandoning America he was for abandoning it; the advantages of the connection arose from trade and from relationship with a people of the same ideas and sentiments. These would be cut off by war, and the army there would oppress the people and be dangerous to liberty at home.

Fox's great political career is unique among the careers of British statesmen of the first rank, for it was passed almost wholly in opposition. Except for a few months in 1782 and 1783, and again for a few months before his death in *1806*, he was out of office. He declared, indeed, that he had "totally subdued" ambition, and was content with his life; yet it was certainly a cause of bitter disappointment to him that he had to stand by while the country was in his opinion not only misgoverned, but led to ruin. His reputation as an orator and a political critic, which was great from the first and grew as he lived, most assuredly did not console him for his impotence as a statesman.

During the eight years between his expulsion from office in 1774 and the fall of Lord North's ministry in March *1782* he planted the seed of the modern Liberal party as opposed to the pure Whigs. He became a member of the Rockingham party and worked in alliance with the marquis and with Burke. In opposing the attempt to coerce the American colonists, and in assailing the waste and corruption of Lord North's administration. as well as the undue influence of the crown, he was at one with the Rockingham Whigs. During the agitation against corruption, and in favour of honest management of the public money. which was very strong between 1779 and 1782, he and they worked heartily together. It had a considerable effect, and prepared the way for the reforms begun by Burke and continued by Pitt. But if Fox learnt much from Burke he learnt with originality. He declined to accept the revolution settlement as final. or to think with Burke that the constitution of the House of Commons could not be bettered. He believed that, if the House was to be made an efficient instrument for restraining the interference of the king and for securing good government, it must cease to be filled to a very large extent by the nominees of boroughmongers and the treasury. He became a strong advocate for parliamentary reform. He was the ardent advocate of what have in later times been known as "Liberal causes," the removal of all religious disabilities and tests, the suppression of private interests which hampered the public good, the abolition of the slave trade, and the emancipation of all classes and races of men from the strict control of authority.

A detailed account of his activity from 1774 to 1782 would entail the mention of every crisis of the American War of Independence and of every serious debate in parliament. Throughout the struggle Fox was uniformly opposed to the coercion of the colonies and was the untiring critic of Lord North. While the result must be held to prove that he was right, he prepared future difficulties for himself by the fury of his language. He was the last man in the world to act on the worldly-wise maxim that an enemy should always be treated as if he may one day be a friend, and a friend as if he might become an enemy. At the opening of the autumn session in 1779 Fox, who was convinced that the king was responsible for North's continuance of the American War, stated plainly that the doctrine that the king could be his own minister was entirely unconstitutional and drew attention to the fate of Charles I. and James II. He denounced William Adam, a supporter of Lord North's, and in a duel which followed (Nov. 29) Fox was wounded. He assailed Lord North with unmeasured invective, directed not only at his policy but at his personal character, though he knew that the prime minister remained in office against his own wish, in deference to the king who appealed to his loyalty.

When the disasters of the American war had at last made a change of ministry necessary, and the king applied to the Whigs, through the intermediary of Shelburne, Fox made a very serious mistake in persuading Rockingham not to insist on dealing directly aith the sovereign. The result was the formation of a cabinet (March 1782) belonging, in Fox's own words, partly to the king and partly to the country—that is to say, partly of Whigs who wished to restrain the king, and partly of the king's friends, represented by Shelburne, whose real function was to baffle the Whigs. Dissensions were acute between Shelburne and Fox, the two secretaries of state. The old division of duties by which the southern secretary had the correspondence with the colonies and the western powers of Europe, and the northern secretary with the others, had been abolished on the formation of the Rockingham cabinet. All foreign affairs were entrusted to Fox. Lord Shelburne, as secretary for the colonies, claimed a right to interfere in the negotiations for the peace at Paris, and fundamental differences arose. Fox thought the independence of America should be unconditionally acknowledged; Shelburne wished it to be the price of peace. The majority in the cabinet sided with Shelburne. Fox was about to resign, but resignation was deferred by the illness of Rockingham, who died on July 1, 1782. The king offered the premiership to Shelburne, Fox resigned, and was followed by a part of the Rockingham Whigs.

The 1783 *Coalition.*—Fox's next step was ruinous. On Feb. 14, 1783, he formed a coalition with Lord North, based as they declared on "mutual goodwill and confidence." Fox maintained that the original cause of quarrel, the American War, being over, there was no longer any serious ground of difference. But to the country at large this union, formed with a man whom he had denounced for years, had the appearance of an unscrupulous conspiracy. In the House of Commons the coalition was strong enough to drive Shelburne from office on Feb. 24. The king made a prolonged resistance to the pressure put on him to accept Fox and North as his ministers (see PITT, WILLIAM). On April 2, he was constrained to submit. In the new ministry the duke of Portland was prime minister and Fox and North were secretaries of state. The new administration was ill liked by some of the followers of both. Fox increased its unpopularity both in the House and in the country by consenting against the wish of most of his colleagues to ask for the grant of a sum of £100,000 a year to the prince of Wales. The introduction by Fox of the India bill in Nov. 1783 offended the king by the provision which gave the patronage of India to a commission to be named by the ministry and removable only by parliament. The coalition, and Fox in particular, were assailed in a torrent of most telling invective and caricature. George III. gave it to be understood that he would not look upon any member of the House of Lords who voted for the India bill as his friend. The bill was thrown out in the upper House on Dec. 17, and next day the king dismissed his ministers.

Fox now went into opposition again. The remainder of his life may be divided into four portions—his opposition to Pitt during the session of 1784; his parliamentary activity till his secession in 1797; his retirement till 1800; his return to activity and his short tenure of office before his death in 1806. During the first of these periods he deepened his unpopularity by assailing the undoubted prerogatives of the crown, by claiming for the House of Commons the right to override not only the king and the Lords but the opinion of the country, and by resisting a dissolution. This last pretension came very ill from a statesman who in 1780 had advocated yearly elections. He lost ground daily before the steady good judgment and unblemished character of Pitt. When parliament was dissolved at the end of the session of 1784, the country showed its sentiments by unseating 180 of the followers of Fox and Korth. The defeated candidates were known as "Fox's martyrs."

Fox himself was elected for Westminster with fewer votes than Admiral Lord Hood, but with a majority over the ministerial candidate, Sir Cecil Wray. The election was marked by an amazing outflow of caricatures and squibs, by weeks of rioting in which Lord Hood's sailors fought pitched battles in St. James's Street with Fox's hackney coachmen, and by the intrepid canvassing of Whig ladies. The beautiful duchess of Devonshire (Georgiana Spencer) is said to have won at least one vote for Fox by kissing a shoemaker who had a romantic idea of what constituted a desirable bribe. The high bailiff refused to make a return, and the confirmation of Fox's election was delayed by the somewhat mean action of the ministry. He had, however, been chosen for Kirkwall, and could fight his cause in the House. In the end he recovered damages from the high bailiff. In his place in parliament he sometimes supported Pitt and sometimes opposed him with effect. His criticism on the ministers' bill for the government of India was sound in principle, though the evils he foresaw did not arise. His support of Pitt's Reform Bill was qualified by a just dislike of the ministers' proposal to treat the possession of the franchise by a constituency as a property and not as a trust. His unsuccessful opposition to the commercial treaty with France in 1787 was unwise and most injurious to himself. He committed himself to the proposition that France was the natural enemy of Great Britain, a saying often quoted against him in coming years. It has been excused on the ground that when he said France he meant the aggressive house of Bourbon.

In 1788 Fox travelled in Italy, with his faithful companion, Mrs. Armistead (Elizabeth Cane), but returned in haste on hearing of the illness of the king. Fox supported the claim of the prince of Wales to the regency as a right. a doctrine which provoked Pitt into declaring that he would "unwhig the gentleman for the rest of his life." The friendship between him and the prince of Wales (see GEORGE IV.) was always injurious to Fox. In 1787 he was misled by the prince's ambiguous assurances into denying the marriage with Mrs. Fitzherbert. On discovering that he had been deceived he broke off all relations with the prince for a year, but their alliance was renewed. During these years he was always in favour of whatever measures could be described as favourable to emancipation and to humanity. He actively promoted the impeachment of Warren Hastings, which had the support of Pitt. He was always in favour of the abolition of the slave trade (which he actually effected during his short tenure of office in 1806), of the repeal of the Test Acts, and of concessions to the Roman Catholics, both in Great Britain and in Ireland.

The French Revolution affected Fox profoundly. Together with almost all his countrymen he welcomed the meeting of the states-general in 1789 as the downfall of a despotism hostile to Great Britain. On hearing of the fall of the Bastille he wrote to Fitzpatrick: "How much the greatest event it is that ever happened in the world! and how much the best!" He continued to adhere stoutly to his opinion that the Revolution was essentially just and ought not to be condemned for its errors or even for its crimes. As a natural consequence he was the steady opponent of Pitt's foreign policy, which he condemned as a species of crusade against freedom in the interest of despotism. Between 1790 and 1800 his unpopularity reached its height. He was left almost alone in parliament, and was denounced as the enemy of his country. On May 6, 1791, occurred the painful scene in the House of Commons, in which Burke renounced his friendship. In 1792 there was some vague talk of a coalition between him and Pitt, which came to nothing. The scene with Burke took place in the course of the debate on the Quebec Bill, in which Fox displayed real statesmanship by criticizing the division of Upper from Lower Canada, and other provisions of the bill, which in the end proved so injurious as to be unworkable. In this year he carried the Libel Bill. In 1792 his ally, the duke of Portland, and most of his party left him. In 1797 he withdrew from parliament, and only came forward in 1798 to reaffirm the doctrine of the sovereignty of the people at a great Whig dinner. On May 9 he was dismissed from the privy council.

The interval of secession (he and his friends ceased to attend parliament in 1797) was perhaps the happiest in his life. In company with Mrs. Armistead he established himself at St. Anne's Hill near Chertsey in Surrey. In 1795 he married her privately, but did not avow his marriage till 1802. Fox's time at St. Anne's was largely spent in gardening, in the enjoyment of the country, and in correspondence on literary subjects with his nephew, the 3rd Lord Holland, and with Gilbert Wakefield, the editor of Euripides. Greek and Italian were his first favourites, but he was well read in English literature and in French, and acquired some knowledge of Spanish. His favourite authors were Euripides, Virgil and Racine, whom he defends against the stock criticisms of the admirers of Corneille with equal zeal and insight.

Fox reappeared in parliament (Feb. 3, 1800) to take part in the vote of censure on ministers for declining Napoleon's overtures for a peace. The fall of Pitt's first ministry and the formation of the Addington cabinet, the peace of Amiens, and the establishment of Napoleon as first consul with all the powers of a military despot, seemed to offer Fox a chance of resuming power in public life. The struggle with Jacobinism was over, and he could have no hesitation in supporting resistance to a successful general aho ruled by the sword, and who pursued a policy of perpetual aggression. During 1802 he visited Paris.

The death of Pitt (1806) left Fox so manifestly the foremost man in public life that the king could no longer hope to exclude him from office. The formation of a ministry was entrusted by the king to Lord Grenville, but when he named Fox as his proposed secretary of state for foreign affairs George III. accepted him without demur. Indeed his hostility seems to a large extent to have died out. A long period of office might now have appeared to lie before Fox, but his health was undermined. Had he lived it may be considered as certain that the war with Napoleon would have been conducted with a vigour which was much wanting during the next few years. In domestic politics Fox had no time to do more than insist on the abolition of the slave trade. He, like Pitt, was compelled to bow to the king's invincible determination not to allow the emancipation of the Roman Catholics. When a French adventurer calling himself Guillet de la Gevrillière, whom Fox at first "did the honour to take for a spy," came to him with a scheme for the murder of Napoleon, he sent a warning on Feb. 20, to Talleyrand. The incident gave him an opportunity for reopening negotiations for peace. A correspondence ensued, and British envoys were sent to Paris. But Fox was soon convinced that the French ministers were playing a false game. He was resolved not to treat apart from Russia, then the ally of Great Britain, nor to consent to the surrender of Sicily, which Napoleon insisted upon, unless full compensation could be obtained for King Ferdinand. The later stages of the negotiation were not directed by Fox, but by colleagues who took over his work at the foreign office when his health began to fail in the summer of 1806. After carrying his motion for the abolition of the slave trade on June 10, he was fgrced to give up attendance in parliament, and he died (of dropsy) in the house of the duke of Devonshire, at Chiswick, on Sept. 13, 1806. His wife survived him till July 8, 1842. No children were born of the marriage. Fox is buried in Westminster Abbey by the side of Pitt.

The striking personal appearance of Fox has been rendered very familiar by portraits and by innumerable caricatures. The latter were no doubt deliberately exaggerated, and yet a comparison between the head of Fox in Sayer's plate "Carlo Khan's triumphal entry into Leadenhall," and in Abbot's portrait, shows that the caricaturist did not depart from the original. Fox was twice painted by Sir Joshua Reynolds, once when young in a group with Lady Sarah Bunbury and Lady Susan Strangeways, and once at full length. A half-length portrait by the German painter, Karl Anton Hickel, is in the National Portrait Gallery, where there is also a terra-cotta bust by Nollekens.

See Earl Russell, *Memorials and Correspondence of Charles James Fox* (1853–57), and *Life and Times of C. J. Fox* (1859–66); G. O. Trevelyan, *Early History of C. J. Fox* (1880), and *The American Revolution (4* vols. 1909); J. L. Hammond, *Charles James Fox, a Political Study* (1903); Lloyd Sanders, *The Holland House Circle* (1908); John Drinkwater, *Charles James Fox* (1928). *See* also the general literature of the period indicated *s.v.* GEORGE III.

(D. H.; X.)

FOX, EDWARD (c. 1496–1538), bishop of Hereford, was born at Dursley, Gloucestershire; he is said on very doubtful authority to have been related to Richard Fox (*q.v.*). From Eton he proceeded to King's College, Cambridge, and after graduating was made secretary to Wolsey. In 1528 he was sent with Gardiner to Rome to obtain from Clement VII. a decretal commission for the trial and decision of the case between Henry VIII. and Catherine of Aragon. On his return he was elected provost of King's College, and in Aug. 1529 conveyed to the king Cranmer's historic advice that he should apply to the universities of Europe rather than to the pope. After a brief mission to Paris in Oct. 1529, Fox in Jan. 1530 befriended Latimer at Cambridge, and took an active part in persuading that university and Oxford to decide in the king's favour. He was sent to employ similar methods of persuasion at the French universities in 1530–31, and was also engaged in negotiating a closer league between England and France. In April 1533 he was prolocutor of convocation when it decided against the validity of Henry's marriage with Catherine, and in 1534 published his treatise *De vera differentia regiae potestatis et ecclesiae* (2nd ed. 1538, Eng. tr. 1548). He received the archdeaconry of Leicester (1531) and the bishopric of Hereford (1535). In 1535–36 he was sent to Germany to discuss the basis of a political and theological understanding with the Lutheran princes and divines, and had several interviews with Luther, who could not be persuaded of the justice of Henry VIII.'s divorce. Bucer dedicated to him in 1536 his *Commentaries on the Gospels,* and Fox's Protestantism was also illustrated by his patronage of Alexander Aless, whom he defended before Convocation. Fox died on May 8, 1538. He was the most Lutheran of Henry VIII.'s bishops, and was largely responsible for the Ten Articles of 1536.

FOX, GEORGE (1624–91) was born in 1624 at Drayton in Leicestershire, the son of a weaver. As a child he was unusually serious and sensitive to right and wrong. His relatives thought of educating him as a clergyman, but he was eventually apprenticed to a shoemaker and grazier. After a time he felt that the command of God was for him to leave his family and friends and go forth alone and he went on a series of journeys visiting preachers in search of spiritual guidance.

The influence of his remarkable personality soon made itself felt. The mysticism of Fox was positive and practical; leading him at the outset of his ministry to denounce all kinds of social evils.

In 1647 he began a peripatetic ministry which continued till the closing years of his life, broken by intervals of imprisonment. He was first imprisoned in 1649 at Nottingham, for interrupting a sermon by an impetuous appeal from the Scriptures to the Holy Spirit as the authority and guide. In 1650 he was committed to Derby gaol as a blasphemer, and at Derby, the nickname of Quakers was given to Fox and his friends by Justice Gervase Bennett. But Fox won such esteem that while still in gaol he was offered a captaincy in the Parliamentary army which he declined.

He bore his frequent sufferings and hardships with great courage and found a wide response to his appeal, especially in the north-west of England, among companies of "Seekers." By 1651 other Quaker preachers joined him in his service. The centre of the movement was for some years at Swarthmore Hall, near Ulverstone, the home of Judge Fell, Cromwell's chancellor of the duchy of Lancaster, who was friendly to the Quakers, while his wife, Margaret, joined them.

He spent six years in various prisons, at Nottingham (1649), Derby (1650–51), Carlisle (1653), Launceston (1656), Lancaster and Scarborough (1664–66) and Worcester (1673–75), sometimes amid terrible conditions. Throughout his active ministry he found time to issue numerous books and pamphlets. His style was uncouth, his grammar and spelling often faulty, but amid occasional obscurities and repetitions pregnant phrases occur, while his *Journal* often shows striking power of narrative. Recent research has shown that he was more widely read than has been supposed. But it was his presence and spoken words which made the deep impression vividly portrayed in Penn's preface to his *Journal,* winning universal respect, affection and attention.

By 1666 his strong frame was shattered by severe imprisonment, and henceforth much of his time was given to building up the Quaker community in a church order, which offered freedom of service to men and women and at the same time gave expression to the group spirit. Fox also took care to institute careful provision for the poor and for the accurate registration of births, deaths and marriages.

In 1669 he married Margaret, the widow of Judge Fell, but continued his travelling mission, visiting the West Indies and America in 1671–72, Holland and north Germany in 1677, and Holland again in 1681. After his long imprisonment at Worcester, he stayed to recuperate at Swarthmore Hall (1675–77), and resided there once again in 1678–80, making use of this time to arrange his papers and prepare his *Great Journal.* But feeling still the call to a wider service, he went south again, his later years being passed chiefly in and around London, where his wife came at intervals to stay with him.

Notwithstanding failing health he still kept at work, visiting Quaker meetings and families, promoting the establishment of schools, corresponding with the Quaker communities abroad, advising his fellow Quakers in difficulties great and small and even interviewing members of parliament to help in the framing of the Toleration Act. He died on Jan. 13, 1691.

Fox's *Journal,* the work by which he is principally known, was printed in 1694, being edited from his papers by Ellwood The complete *Journal* was edited verbatim in 1911 by Norman Penney, and the *Short Journal* and itinerary journals in 1925. Folio volumes of Fox's epistles and doctrinal works were issued in 1698 and 1706. In 1852 an edition of his works in eight volumes was published in Philadelphia, but no complete collection has yet been printed.

For Fox's life *see* Thos. Hodgkin's *George Fox* (1896) and *A.* N. Brayshaw's *The Personality of George Fox* (1919). (T. E. H.)

FOX, RICHARD *(c.* 1448–1528), successively bishop of Exeter, Bath and Wells, Durham and Winchester, lord privy seal, and founder of Corpus Christi College, Oxford, was born about 1448 at Ropesley, near Grantham, Lincolnshire. His parents belonged to the yeoman class, and there is some obscurity about Fox's early career. He probably studied at Magdalen college, Oxford. whence he drew so many members of his subsequent foundation, Corpus Christi. He also appears to have studied at Cambridge. In 1484 he was in Paris, where he met the earl of Richmond (the future Henry VII.) and was taken into his service. In January 1485 Richard intervened to prevent Fox's appointment to the vicarage of Stepney on the ground that he was keeping company with the "great rebel, Henry ap Tuddor."

On Henry's accession Fox became the King's principal secretary. and soon afterwards lord privy seal and bishop of Exeter (1487). The ecclesiastical preferment was merely intended to provide a salary not at Henry's expense; for Fox never saw either Exeter or the diocese of Bath and Wells to which he was translated in 1492. His work was political and especially diplomatic. In 1487 he negotiated a treaty with James III. of Scotland, in 1492 he helped to conclude the treaty of Etaples, and in 1497 he was chief commissioner in the negotiations for the famous commercial agreement with the Netherlands, the *Magnus Intercursus.*

Meanwhile in 1494 Fox had been translated to the see of Durham, which was of political importance as a palatine earldom and because of its position with regard to the Borders and relations with Scotland. Fox therefore visited and resided in his new diocese; and he occupied Norham castle, which he fortified and defended against a Scottish raid in Perkin Warbeck's interests (1497). But his energies were principally devoted to pacific purposes. In that same year he negotiated Perkin's retirement from the court of James IV., and in 1498–1499 he completed the negotiations for that treaty of marriage between the Scottish king and Henry's daughter Margaret which led ultimately to the union of the two crowns in 1603 and of the two kingdoms in 1707. The marriage itself did not take place until 1503.

This consummated Fox's work in the north, and in 1501 he was translated to Winchester, then reputed the richest bishopric in England. In that year he concluded the negotiations for the betrothal of Prince Arthur to Catherine of Aragon. He also arranged the betrothal of the king's younger daughter Mary to the future emperor Charles V. In 1500 he was elected chancellor of Cambridge university, and in 1507 master of Pembroke hall in the same university. The Lady Margaret Beaufort made him one of her executors, and with Fisher, he was principally responsible for the foundation of St. John's college and the Lady Margaret professorships and readerships.

His financial work brought him a less enviable notoriety, though a curious freak of history has deprived him of the credit which is his due for "Morton's fork." The invention of that ingenious dilemma for extorting contributions from poor and rich alike is ascribed as a tradition to Morton by Bacon; but the story is told in greater detail of Fox by Erasmus, who says he had it from Sir Thomas More. a well-informed contemporary authority.

Under Henry VIII. the personnel of the ministry at first remained unaltered. The Venetian ambassador calls Fox *alter rex* and the Spanish ambassador Carroz says that Henry VIII. trusted him more than any other adviser, although he also reports Henry's warning that the bishop of Winchester was, as his name implied, "a fox indeed." Wolsey's rapid rise in 1511 put an end to Fox's influence. The pacific policy of the first two years of Henry VIII.'s reign was succeeded by an adventurous foreign policy directed mainly against France; and Fox, who desired peace, complained that no one durst do anything in opposition to Wolsey's wishes. Gradually Warham and Fox retired from the government; the occasion of Fox's resignation of the privy seal was Wolsey's ill-advised attempt to drive Francis I. out of Milan by financing an expedition led by the emperor Maximilian in 1j16. Tunstall protested, Wolsey took Warham's place as chancellor, and Fox was succeeded by Ruthal, who, said the Venetian ambassador, "sang treble to Wolsey's bass." He bore Wolsey no ill-will, and warmly congratulated him two years later when warlike adventures were abandoned at the peace of London. But in 1522 when war was again declared he refused to bear any part of the responsibility, and in 1523 he opposed in convocation the financial demands which met with a more strenuous resistance in the House of Commons.

He now devoted himself assiduously to his long-neglected episcopal duties. His sight failed during the last ten years of his life. The crown of Fox's career was his foundation (1515–16) of Corpus Christi college. Originally he intended it as an Oxford house for the monks of St. Swithin's, Winchester; but he is said to have been dissuaded by Bishop Oldham. who denounced the monks and foretold their fall. The scheme adopted breathed the spirit of the Renaissance; provision was made for the teaching of Greek. Erasmus lauded the institution and Pole was one of its earliest fellows. The humanist Vives was brought from Italy to teach Latin, and the reader in theology was instructed to follow the Greek and Latin Fathers rather than the scholastic commentaries. Fox also built and endowed schools at Taunton and Grantham, and was a benefactor to numerous other institutions. He died at Wolvesey on Oct. 5, 1528; Corpus possesses several portraits and other relics of its founder.

See *Letters and Papers of Henry VZZ. and Henry VZZZ.*, vols. i.–iv.; *Spanish and Venetian Calendars of State Papers;* J. Gairdner, *Lollardy and the Reformatton* (1908–13) and *The Eng. Church in the 16th Cent.* (1899); A. F. Pollard, *Henry VIII.* (1905); Longman, *Political History*, vol. v. (1905); other authorities cited in the article by T. Fowler (formerly president of Corpus) in the *Dict. Nat. Biog.*

FOX, ROBERT WERE *(1789–1877)*, English geologist, was born at Falmouth on April *26, 1789.* He made researches on the internal temperature of the earth, being the first to prove that the heat increased definitely with the depth; his observations being conducted in Cornish mines from 1815 for a period of forty years. In *1829* he commenced a series of experiments on the artificial production of miniature metalliferous veins by means of the long-continued influence of electric currents, and his main results were published in *Observations on Mineral Veins (Rep. Royal Cornwall Polytech. Soc., 1836).* He constructed in *1834* an improved form of deflector dipping needle. In *1848* he was elected F.R.S. He died on July *25, 1877.* (See *A Catalogue of the Works of Robert Were Fox, F.R.S., with a Sketch of his Life,* by J. H. Collins, *1878.)*

His daughter, CAROLINE FOX (1819–1871), born at Falmouth cn May *24, 1819,* wrote a diary recording memories of many distinguished people, including John Stuart Mill, John Sterling and Carlyle. Selections from her diary and correspondence (1835–71) were published under the title of *Memories of Old Friends* (ed. by H. N. Pym, *1881*; 2nd ed., *1882).* She died on Jan. *12, 1871.*

FOX, SIR STEPHEN *(1627*–1716), English statesman, born on March *27, 1627,* was the son of William Fox, of Farley in Wiltshire, a yeoman farmer. At *15* he entered the service of the earl of Northumberland; then he entered the service of Lord Percy, the earl's brother, and was present with the royalist army at the battle of Worcester (Sept. *3, 1651)* as Lord Percy's deputy at the ordnance board. Accompanying Charles II. in his flight to the continent, he was appointed manager of the royal household, on Clarendon's recommendation. He was employed on several important missions, and acted eventually as intermediary between the king and General Monk. After the Restoration he was appointed to the lucrative offices of first clerk of the board of green cloth and paymaster-general of the forces. He entered parliament in *1661,* was knighted (1665), and was a commissioner of the treasury from *1679* to 1702. In *1680* he resigned the paymastership and was made first commissioner of horse. In *1684* he became sole commissioner of horse. In *1685* he was again M.P. for Salisbury and opposed the bill for a standing army supported by the king. During the Revolution he maintained an attitude of decent reserve, but was confirmed in his offices by William III.

Fox died on Oct. *28, 1716.*

FOX, SIR WILLIAM (1812–93), New Zealand statesman, was born in England on June *9,* 1812, and educated at Wadham college, Oxford. He was called to the bar in *1842,* but immediately emigrated to New Zealand, where, in *1843,* he became the New Zealand company's agent for the South Island. In *1848* Fox became attorney-general, but gave up the post to join in the agitation for a free constitution. In 1850 he came to London as political agent to urge the demands of the Wellington settlers, but the Colonial Office refused to recognise him. When government by responsible ministers was initiated in *1856.* Fox ousted the first ministry and formed a cabinet, holding office for 13 days. In *1861* he became premier for nearly *13* months, and in *1863* again took office with Sir Frederick Whitaker as premier. Fox's third premiership was from *1869* to *1872,* and his fourth for five weeks in March–April *1873.* Soon afterwards he left politics, though he led the attack which overthrew Sir George Grey's ministry in *1879.* He lost his seat in the dissolution which followed in that year, and did not again enter parliament. He was an active champion of self-government for the New Zealand colonists, and laboured to secure their just rights for the Maori races, and to establish peace among the tribes. Sir William Fox was made K.C.M.G. in 1880. He died on June *23, 1893.*

FOX, WILLIAM (1879–1952), U.S. motion-picture producer and distributor, was born in Tulchva, Hung., on Jan. *1,* 1879. Brought to the U.S. as an infant, he was reared in New York city and worked there in the garment industry. He entered the motion-picture business in 1904 when he bought a nickelodeon in Brooklyn for *$1,600.* He soon formed an exhibition company, a chain of motion-picture theatres and later a production company in Staten Island, N.Y. In 1915 he founded the Fox Film Corp. to produce, distribute and exhibit films. His holdings were expanded until by 1929 his interests in the Fox corporation, Loew's, Inc., and Gaumont-British were valued at $300,000,000. After the 1929 stock market crash the Fox empire swiftly crumbled, and in *1936,* plagued by lawsuits, he went into bankruptcy.

Fox died in New York, May *8, 1952.* (M. S. BY.)

FOX (female, vixen), primarily the popular name for the European species of the dog family *(Canidae)* which by Linnaeus was named *Canis vulpes;* but by modern zoologists this species and others related to it are assigned to the genus *Vulpes,* because the nasal passages do not open into hollow spaces of the frontal bones as they do in *Canis* and its allies, and the postorbital processes are flat or hollowed instead of convex.

The typical fox *(Vulpes vulpes)* differs from other foxes in having a white "tag" to the tail combined with black on the backs of the ears—as thus defined the species has a wide geographical range, embracing practically the whole of Europe, Africa north of the Sahara, the whole of temperate Asia and North America as far south as Mexico. It has adapted itself to the most varied physical conditions and has become differentiated into a large number of local races or subspecies differing in size, colour, thickness of coat and other respects. There are too many to mention in detail; but the little fox (V. *v. leucopus)* of the plains of northwest India is of interest as illustrating the general principle that the southern races are smaller than the northern, the Himalayan fox (*V. v. montana)* and the Egyptian fox (*V. v. aegyptiaca)* being intermediate in size between it and the European race. In the matter of coat the finest foxes come from the far north. The typical colour of the species is reddish, grizzled with gray or buff, desert forms being paler than others; but the prevalent tint varies from fiery red to black, melanism being of frequent occurrence. In North America and parts of Asia there are three main varieties, the red, the cross and the silver; the cross fox being intermediate between the other two. The silver, a black fox sprinkled with white, provides valuable furs; but the price is likely to decline owing to the success that is being achieved by breeding these animals in fox farms. Most of the red fox skins on the market come from Australia where European foxes were introduced years ago to check the rabbit plague.

Habits of **the** Fox.—So far as is known the habits of the common fox vary in no important respect wherever it is found. It is a predacious, mostly nocturnal animal, feeding principally upon small birds and mammals but taking frogs, shell-fish, insects and even fruit at times. The sexes may live apart except at the mating season, which occurs early in the year. The male may assist in raising. After a gestation of about *63* days, the vixen brings forth her litter of four or a few more young in a burrow or natural crevice, in the spring. Only one litter is produced in the year and the young, which are blind for about ten days, are able to shift for themselves by the autumn and become adult when about a year old. Foxes do not hibernate and are as active in winter as in summer even in the coldest latitudes. Accounts of hybrids between dogs and foxes have often been published, but there is no authenticated case known and specimens never come to hand for expert examination when demanded.

Foxes are noted for the cunning they evince in the avoidance of traps and, in countries where they are hunted by hounds, for the methods they adopt in breaking the line of scent left by their footfall on the soil, even by leaping on to the backs of sheep. Since foxes have no natural enemies other than man to trap and pursue them in that way, it has been suggested that their devices are due to instinct engendered by man's persecution continued generation after generation. But all the indications of the cleverness of foxes cannot be explained in that way.

No other species of fox has a range nearly so extensive as the red fox. A few close relatives occur in the same latitudes. The small corsac (V. *corsac)* of the Siberian plains differs in having a black tail-tip. The hoary fox *(V. cana)* of Baluchistan and the northwestern frontier of India is about *16* in. long, the tail about 11 in.; the colour is gray, the tail-tip black. The Tibetan sand fox *(V. ferrilata)* has short ears and tail; the colour is yellowish, the tail-tip white; the skull with very narrow and elongate nostrum and wide zygomatic arches. Its eyes differ from those of other foxes in having round pupils. The kit fox *(V. velox)* lives on the northern great plains, from southern Canada to Wyoming. It is small (head and body about *18* to 21 in., tail about 11 in.), buffy gray in colour. The long-eared kit fox *(V. macrotis)* of the southwestern United States and Mexico is extremely slender, with large ears; its colour is grizzled gray with ochraceous buff on the sides. It is about the same size as the swift fox, but its legs and ears are longer. The tail is gray to the tip. Other species are more southern in their ranges. The small Indian fox *(V. bengalensis).* grayish in colour, with a black tail-tip, the ears coloured like the back of the neck, is found in most parts of India between the Punjab and Assam. The fennec *(I!'. zerda)* of the Sahara and north Africa is the smallest of the foxes (being only about $15\frac{1}{2}$ in., the tail $6\frac{3}{4}$ in.). while its ears are relatively larger than those of any other, and wide. In colour the fennec is a reddish buff. the tail-tip black, the underparts, the edges of the ears and around the eyes, white. Riippell's fox (I^{r}. *rüppellii)* is found in upper Egypt and the Nubian desert. It is about *19* in. long, the tail about 9 in., and the ears are nearly as large as in the fennec. The African sand fox *(V. pallida)* is pale yellowish, the tail mixed with blackish and with a poorly marked black tip. It is found from Senegal to the Nile region and in Cyrenaica. The South African "silver fox" *(V. chama)* is grayish mixed with some yellowish, the tail-tip black and the sides of the face marked with ochraceous. It is a little smaller than the red fox and has much longer ears. There are no foxes in the Malay region.

The American gray fox *(Urocyon cinereoargenteus)* is found from New England to South America. The grizzled upperparts and reddish sides of this fox, its short ears, erectile dorsal crest on the tail, as well as cranial characters, distinguish it from other foxes. It frequently climbs trees and may choose a hollow- in a tree trunk as a home den. The South American wild dogs are related to *Urocyon.*

Mainly north of the range of the red fox, but partly overlapping it, occurs the circumpolar Arctic fox *(Alopex lagopus).* This fox is somewhat intermediate between *Vulpes* and *Canis.* In summer this fox is grayish brown above but in winter it turns pure white. A colour variety, the blue fox, does not turn white in winter. The African long-eared fox *(Otocyon megalotis)* is gray, with blackish legs and tail-tip. It is about the size of a red fox but its ears are as extreme as those of the much smaller fennec. The sectorial carnassial teeth characteristic of the dog family are not differentiated in this species and there is an extra molar usually in both upper and lower jaws. *(See* CARNIVORA.)

(R. I. P.; J. E. HL.)

FOXE, JOHN (1517–1587), author of *The Book of Martyrs,* was born at Boston, Lincolnshire. in 1517. A devout and scholarly boy, he was sent to Brasenose college, Oxford, whence he migrated to Magdalen college, holding a fellowship for seven years. But in 1545 being suspect for Protestantism he resigned his fellowship, and took a tutorship with the Lucy family at Charlecote, Warwickshire, where he married Agnes Randall of Coventry. In 1547 he moved to London, and became tutor to the grandchildren of the duke of Norfolk. He was ordained deacon in *1550* by Nicholas Ridley, and worked for the Reformation, writing several tracts. He also began a Latin history of the persecution and martyrdoms in England from John Wycliffe onward, but had carried it no farther than the year 1500 when Mary's accession *(1j53)* forced him to flee with his wife overseas, hotly pursued by emissaries of Stephen Gardiner, bishop of Winchester and lord chancellor. Proceeding to Strasburg he printed his unfinished martyrology in octavo *(Commentarii rerum in ecclesia gestarum,* 1554), and then spent a year in Frankfurt, where in the violent controversies over the use of the *Book of Common Prayer* he gave a moderating support to the Calvinistic party of John Knox. When his party was defeated in *1jjj,* he settled at Basel, earning a meagre living by correcting proofs for the printer Oporinus, and writing a burning appeal to the English nobility to restrain the queen from persecuting *(Ad inclytos Angliae proceres,* 1557). But his chief labour was the extension of his martyrology. By aid of manuscripts from England he carried this to Thomas Cranmer's death in 1556, and printed it in folio *(Rerum in Ecclesia gestarum . . . Commentarii,* 1559). He then returned to London with his family, and devoted himself to the completion of his great work. Ransacking registers and using the memories of eyewitnesses, he enlarged and rounded off his story. The book was printed in March *1563* by John Daye under the title *Acts and Monuments of these latter and perilous Days.* It was a big folio, written in English, and adorned with woodcuts. It made a great sensation and immediately acquired the popular name, *The Book of Martyrs.* But Foxe was not satisfied. There were errors to amend. and much fresh material was flowing in. For seven years more he laboured, to the lasting detriment of his health, and in 1570 produced his second edition, not a little improved, in two gigantic volumes. This was the crown of his achievement: for he made few changes in his third *(1576)* and fourth (1583) editions.

Foxe was ordained priest in *1560* by Edmund Grindal, bishop of London, but having Puritan scruples refused all preferments save two prebends—at Salisbury (1563–87) and Durham *(1572–73).* But he often preached. and a sermon delivered at Paul's Cross (Of *Christ Crucified,* 1570) had a wide sale. In the plague of *1563* he ministered to the victims and wrote a beautiful tract of consolation. For Archbishop Parker he edited in *1j71 Reformatio Legum Ecclesiasticarum* (the proposed revision of canon law) and *The Gospels, Anglo-Saxon and English.* He was much in request as spiritual counselor, and never feared to speak his mind even to the greatest. When Anabaptists in 1575 and Jesuits in *1581* were condemned to death Foxe wrote vehement letters to queen and councilors begging a reprieve. His integrity, warm heart and social gifts won him friends of all classes: among them Lord Burleigh and Sir Francis Drake. He died on April *18, 1587,* and was buried in the chancel of St. Giles. Cripplegate, his parish church, amid a great concourse of mourners.

Foxe's monument is his book. It spoke straight to the heart of Elizabethan England. It was installed in churches, read aloud by Drake on the western seas to his shipmates, praised by Knox, archbishop Whitgift and William Camden. But it speaks also to our cooler age. It is indeed prolix, unsystematic, carelessly edited, one-sided, oversharp, sometimes credulous. But it is honest and it is strong in facts. It opens a window upon the English Reformation by preserving much firsthand material unobtainable elsewhere. Foxe's ready pen and deep compassion for suffering can make his death scenes very moving. The charges of deliberate falsification brought against him by Alan Cope (1566), Robert Parsons *(1603)* and some moderns have no substance. Despite faults the book lives and it deserves to live.

See J F Mozley, *John Foxe and his Book* (1940). This book reviews the whole case and clears the controversial air, vindicating Foxe from the gravest charges made by S. R. Maitland (1792–1866) and his followers. It also proves (against Maitland) that the long memoir of Foxe inserted into *Acts and Monuments* (1641), was written by his younger son, Simeon Foxe (1568–1642). (J. F. MY.).

FOXGLOVE, biennial and perennial herbs of the family Scrophulariaceae, comprising the genus *Digitalis.* It contains about 20 species found in Europe, western Asia and the Canary Islands. The common or purple foxglove, *D. purpurea,* is common in dry hilly pastures and rocky places and by roadsides in various parts of Europe; it ranges in Great Britain from Cornwall and Kent to Orkney. and is sparingly naturalized in North America. It flourishes best in siliceous soils, and is not found in the Jura and Swiss Alps. Its characters are: stem erect, roundish, downy, leafy below, and from *18* in. to 5 ft. or more in height; leaves alternate, ovate or elliptic-oblong, and dull green, with the undersurface downy and paler than the upper; root of numerous, slender, whitish fibres; flowers $1\frac{3}{4}$–$2\frac{1}{2}$ in. long, pendulous, on one side of the stem, purplish crimson, hairy and marked with eyelike spots within; corolla bell-shaped with a broadly two-lipped obtuse mouth, the upper lip entire or obscurely divided; stamens four, two longer than the other two (*didynamous*); capsule ovate and pointed; and seeds numerous, small. It normally flowers in June: and ripens its seed in August, but may occasionally be found in blossom as late as September. Many varieties have been raised by cultivation, with flowers varying in colour from white to deep rose and purple. Its commercial cultivation in Michigan and Oregon is extensive, as its leaves are the only source of digitalis, a valuable drug in certain types of heart disease (*see* DIGITALIS). Other. but nonofficial, species of *Digitalis* are also grown in Spain and France, especially *D. lutea.*

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COMMON OR PURPLE FOXGLOVE (DIGITALIS PURPUREA)

The foxglove, probably from folk's-glove (*i.e.,* fairies' glove), is known by a great variety of popular names in Britain. In the south of Scotland it is called bloody fingers; farther north, dead-men's-bells; and on the eastern borders, ladies' thimbles, wild mercury and Scotch mercury. In Ireland it is generally known as fairy thimble. Among its Welsh synonyms are *menygellyllon* (elves' gloves), *menyg y llwynog* (fox's gloves), *bysedd cochion* (redfingers) and *bysedd y cwn* (dog's fingers).

In France its designations are *gants de notre dame* and *doigts de la Vierge.* The German name *Fingerhut* (thimble) suggested to Fuchs, in 1542, the employment of the Latin adjective *digitalis* as a designation for the plant.

Other species of *Digitalis* are grown in England for ornament, notably *D. ambigua,* with yellow, brown-spotted flowers; *D. lanata* of eastern Europe, with white and purple flowers; and *D. lutea* of Europe with yellow or whitish flowers. Few are grown in the U.S., where summer heat discourages them, except in cooler regions.

(N. TR.)

FOX HUNTING: *see* HUNTING.

FOX INDIANS, the name, from one of their clans, of an Algonkin tribe. whose former range was central Wisconsin. They call themselves Muskwakiuk, "red earth people." Owing to heavy losses in their wars with the Ojibways and the French, they allied themselves with the Sauk tribe about 1780, the two tribes being now one.

FOXTAIL GRASS, the name given to perennial grasses of the genus *Alopecurus,* comprising about 30 species, natives of cool north temperate regions. Of these the meadow foxtail (*A. pratensis*) is extensively cultivated in Europe as a pasture grass, and is also naturalized in North America. Various species of *Setaria* are likewise called foxtail grass, of which the yellow foxtail (*S. lutescens*) and the green foxtail (*S. viridts*), widely naturalized from Europe in North America, are often troublesome weeds. (*See* GRASSES.)

FOX-TROT, a modern dance of smooth, easy movement resembling a walk taken with long, rather springy steps, with knees slightly bent. Many variations are introduced. The music is in $\frac{4}{4}$ time. (*See* also DANCE.)

FOY, MAXIMILIEN SÉBASTIEN (1775–1825), French general and statesman, was born at Ham, Picardy, on Feb. 3, 1775, and educated at the college of Soissons, passing to the artillery school of La Fère. After his first campaign in Flanders (1791–92) he attained captain's rank, and served under Dampierre, Jourdan. Pichegru and Houchard. In 1794 he was imprisoned by the Convention, but released on the fall of Robespierre. He distinguished himself in Moreau's campaigns of 1796–97, and in the Swiss campaign of 1798, winning the rank of *chef de brigade* under Masséna in 1799. In 1800 he served in the Marengo campaign. Foy's opposition, as a republican, to the rise of Napoleon, and his vote against the establishment of the empire led to his joining the army in Holland. In 1807 he took part in the defense of the Dardanelles against the English. and later served throughout the Peninsular War. He won the rank of general under Junot, and served under Soult and Masséna. Napoleon, to whom Masséna sent him on a mission, made him a general of division. He won new laurels at Salamanca (1812) and in the Pyrenees, and received a command at the first restoration of the Bourbons. He joined Napoleon when the king fled the country, and held a divisional command in the Waterloo campaign (*q.v.*). He retired from the army at the second restoration, and in 1819 was elected to the chamber of deputies, where he used his considerable influence on the side of the liberal principles of 1789. At this time he began his history of the Peninsular War. In 1823 he protested against French intervention in Spain. and after the dissolution of 1823 was re-elected for three constituencies. He died in Paris on Nov. 28, 1825, and the great esteem in which he was held for his maintenance of liberal principles was shown by the vast concourse at his funeral.

The *Histoire* de *la guerre de la Péninsule sous Napoléon* mas published from his notes in 1827, and a collection of his speeches (with memoir by Tissot) appeared in 1826. *See* Cuisin, *Vie nzilitaire, politique, etc., du général Foy;* Vidal, *Vie militaire et politique du général Foy.*

FRACASTORO [FRACASTORIUS], **GIROLAMO** [HIERONYMUS] (1478–1553), Italian physician and poet, was born at Verona. He studied at Padua and became professor of philosophy there in 1502, afterward practising as a physician in Verona. It was by his advice that Pope Paul III, on account of the prevalence of a contagious distemper, removed the Council of Trent to Bologna. Fracastoro's theory of infection was that "infection" was due to the passage of minute bodies, capable of self-multiplication, from the infector to the infected, a theory which bears a superficial resemblance to modern doctrine. The term "syphilis" apparently originated with him. In 1517, when the builders of the citadel of San Felice (Verona) found fossil mussels in the rocks, Fracastoro took the view—following Leonardo da Vinci—that they were the remains of animals once capable of living in the locality. He died at Casi, near Verona, on Aug. 8, 1553; and in 1559 the town of Verona erected a statue in his honour.

The principal work of Fracastoro is a kind of medical poem entitled *Syphilis sive Morbi Gallicus,* (Verona, 1530), which has been often reprinted and also translated into French and Italian. His complete works were published at Venice in 1555, and his poems were collected and printed at Padua in 1728.

FRACTION, a part of any unit, as a fraction of a pound, of an acre, of an inch, of an hour, or of a group.

FIRST IDEAS

Elementary Idea of Fraction.— If we take any two positive integers, say 2 and 3, the quotient $\frac{2}{3}$ is a fraction. More generally speaking, if we take any two positive finite integers, a and *b*, such that *b* is not zero, the quotient $\frac{a}{b}$ is integral, if and only if, *a* is exactly divisible by *b*. If *a* is not so divisible and is less than b, speaking in the primitive sense $\frac{a}{b}$ is called a *fraction* or, according to relatively late usage, a *proper fraction.* In this expression *a* and *b* are called the *terms* of the fraction, *a* being the *numerator* (numberer) and b the *denominator* (namer). We may also consider this fraction as representing *a* of the *b* equal parts of some unit. *a* being then the "numberer" of the parts and *b* the "namer" of the parts, as in three-fourths ($\frac{3}{4}$) of a pound. We may also look upon the fraction as representing one bth of *a* units; for example, $\frac{2}{3}$ may be thought of as representing one-third of two units. These various ideas of a fraction are consistent with one another! as also with the idea that, say, $\frac{3}{4}$ means the ratio of 3 to 4, or the number which, multiplied by 4, becomes 3.

Extension of the Idea **of** Fraction.— These elementary ideas of fraction have been extended from time to time so as to permit of terms that are fractional, irrational, or imaginary, or that represent still other types of number, the denominator b never being zero.

The tendency to generalize has led to allowing the numerator to be any multiple of the denominator, the fraction then becoming 1 or some other integer; or to be any number whatsoever, not only less than but equal to or greater than the denominator. Since these two latter generalized cases do not properly represent fractions in the primitive sense ("proper" fractions), they are called *improper fractions.*

The fraction $\frac{a}{b}$ may be expressed as a/b, this being a more convenient form for printing or typewriting. Since the slanting bar resembles ihe old symbol for *solidus* (later used in the British 2/6 for 2s. 6d.), the form a/b is sometimes called the *solidus form*. If a and b are both rational, a/b is called a rational fraction; if both are integers, it is called a *simple fraction;* if either a or b is fractional, a/b is called a *complex fraction.* Questions relating to the least (in algebra, *lowest)* common denominator are sufficiently discussed in any elementary text book, where it is also shown that any rational complex fraction can be reduced to a simple fraction.

For the study of such continued fractions as

$$a+\frac{b}{c+}\,\frac{d}{e+}\ldots \text{ or } 2+\frac{1}{3+}\,\frac{1}{4}$$

see CONTINUED FRACTIONS.

Laws of Operations.— In any of these cases the laws governing the fundamental operations with fractions are as follows:

$$\frac{a}{b}+\frac{c}{d}=\frac{ad+bc}{bd}; \text{ for example, } \frac{3}{4}+\frac{2}{3}=\frac{9+8}{12}=\frac{17}{12}=1\tfrac{5}{12};$$

$$\frac{a}{b}-\frac{c}{d}=\frac{ad-bc}{bd}, \text{ for example, } \frac{3}{4}-\frac{2}{3}=\frac{9-8}{12}=\frac{1}{12}.$$

$$\frac{a}{b}\times\frac{c}{d}=\frac{ac}{bd} \text{ for example, } \frac{2}{3}\times\frac{3}{4}=\frac{2\times 3}{3\times 4}=\frac{1}{2};$$

$$\frac{a}{b}\div\frac{c}{d}=\frac{ad}{bc}; \text{ for example, } \frac{2}{3}\div\frac{3}{4}=\frac{2\times 4}{3\times 3}=\frac{8}{9};$$

$$\left(\frac{a}{b}\right)^2=\frac{a^2}{b^2}; \text{ for example, } \left(\frac{2}{3}\right)^2=\frac{4}{9};$$

$$\sqrt{\frac{a}{b}}=\frac{\sqrt{a}}{\sqrt{b}}; \text{ for example, } \sqrt{\frac{8}{9}}=\frac{\sqrt{8}}{\sqrt{9}}=\frac{1\sqrt{8}}{3} \text{ or } \frac{2\sqrt{2}}{3}.$$

Reduction.— With respect to the reduction of fractions to higher or lower terms, the following laws are valid for any value of m except zero and infinity:

$$\frac{a}{b}=\frac{ma}{mb} \qquad \frac{a}{b}=\frac{a\div m}{b\div m}$$

When all common factors have been removed from both terms of a fraction. the fraction is said to be *reduced to lowest terms,* or to be *irreducible.*

It is often possible to reduce a proper fraction a/b to the sum of two or more simpler fractions. For example, to perform the following reduction to *partial fractions:*

$$\frac{a^3-6a^2+a+2}{a^2-4a-12}=\frac{a^2}{a+2}+\frac{1}{a-6}.$$

The methods of procedure are given in most intermediate or higher algebras, but the importance of the subject is not seen until the student reaches the calculus.

Difficulties Created by Colloquial Expressions.— The colloquial use of a fraction like $\frac{1}{2}$ is so extended as to cause considerable difficulty on the part of a learner. He hears of half of an object, and can easily visualize it; half of a group is a little more difficult; half as large is still more so; and the idea becomes still less distinct when he hears such expressions as "half as long a time," "half as dark," and "half as beautiful." The simplest fraction thus comes, through such colloquial expressions, to be unusually difficult. Certain other fractions—notably $\frac{1}{4}$, $\frac{1}{10}$, and $\frac{1}{100}$—are used in the same loose way.

Vicissitudes of the Name.—Since "fraction" (from Lat. *frangere,* to break) means "broken," it was natural for the English writers of the 16th century to speak of "fractions or broken numbers" and of a "broken of broken" (Baker, 1568), meaning a fraction of a fraction. The word "frsgment" was also occasionally used for "fraction." In the middle ages the word *minuciae* was used as the equivalent of *fractiones,* and not solely with the meaning of "minutes" as in sexagesimal fractions. The fact that a fraction is a broken number led to such exprrssions in the early printed books as *Ein gebrochene zal* (Riese, German, 1522), and *Die ghebroken ghetalen* (Raets, Dutch, 1580). Since the Latin *ruptus* also means "broken," such names as *rotto* (Italian), *rocto* (Spanish), and *roupt* and *nombre rompu* (French) appear in the early printed books.

Fundamentally One **Type.**—We speak of proper fractions, mixed numbers, irrational fractions, and the like; but in view of the gradual extension of meaning, it is legitimate to say that any expression a/b is a fraction. It would even be allowable to admit the case of $b=0$, giving an interpretation accordingly, if this were necessary or advisable. Moreover, while we speak of common or vulgar fractions, of decimals, and of sexagesimals, these are chiefly differences in symbolism and have little bearing upon the nature of such a fraction as $\frac{1}{2}$, 0 5 (or 0 j), 30° (1° being the unit), or 2^{-1}, all of which have the same value.

VULGAR OR COMMON FRACTIONS

Relation to Compound Numbers.— The ancients had such difficulty in representing fractions that they generally resorted to compound numbers in order to avoid their use. Thus the Roman fractions of weight and of value were referred to the *as.* A twelfth part of the *as* was an *uncia,* as was also the twelfth part of a foot, whence our words "ounce" and "inch." Since 16 *asses* (in early times, 10 *asses)* made a *denarius,* the Romans were able to avoid speaking of $\frac{1}{2}$ of a *denarius* by referring to 8 *asses,* just as we may refer to 8 ounces instead of to $\frac{1}{2}$ of a pound, avoirdupois. To represent $\frac{1}{8}$ of a *denarius* the Roman would say *denarii uncia semuncia;* that is, $\frac{1}{12}$ and $\frac{1}{2}$ of $\frac{1}{12}$ of a *denarius.* This use of unit fractions goes back to some of the earliest fraction forms known, appearing in the Rhind (Ahmes) Papyrus of *c.* 1650 B.C., where the ratio of 2 to 43 is expressed (to use modern symbols) as $\frac{1}{42}+\frac{1}{86}-\frac{1}{129}+\frac{1}{301}$. The same plan was used by Heron (Hero) of Alexandria (possibly *c.* 200), in the Akhmim Papyrus (*c.* 8th century), by Rabbi Sa'adia ben Joseph el-Fayyumi (*c.* 930), and even, for certain purposes, up to modern times. Such compound numbers as 3yd. 1ft. 6in., instead of $3\frac{1}{2}$yd., and as £2 10s. instead of £$2\frac{1}{2}$, are late evidences of the desire to avoid fractions whenever possible.

Ancient Symbols.— In the Egyptian hieroglyphics the unit fraction was represented by a symbol resembling the outline of an eye, the denominator being represented underneath. In hieratic a dot replaced this symbol, $\frac{1}{3}$ appearing in somewhat such form as ııı. The Greeks had various forms, one being two short lines above a numeral, as in Γ″ for $\frac{1}{3}$, and Δ for $\frac{1}{4}$. The most common of all their fractions, the half, had a special symbol resembling our initial parenthesis (. Aristarchus *(c.* 260 B.C.) wrote the word or its initial for the numerator and the numeral for the denominator, as we might write "ten 71st,"—in Greek, ΔΟΑ̈. The Greeks also used the plan of writing the numeral for each term, but doubling it for the denominator, as if we should write 2′3″3″ for $\frac{2}{3}$.

On their coins the Romans commonly represented the half by the symbol S (for *semis),* or the Greek Σ or (; $\frac{1}{3}$ (the triens) was . . . . (that is, $\frac{4}{12}$), and $\frac{1}{6}$ (the sextans) was . . They also used bars instead of dots, as in =– (that is, $\frac{3}{12}$) for $\frac{1}{4}$ (the quadrans).

Modern Symbols.— Our present fractions seem to have had their genesis in India. Brahmagupta *(c.* 628) and Bhāskara *(c.* 1150) wrote $\begin{smallmatrix}2\\3\end{smallmatrix}$ for $\frac{2}{3}$. The Arabs introduced the bar, but they did not make use of it in all cases. When Abraham ben Ezra (Rabbi ben Ezra, *c.* 1140) adopted the Moorish forms he generally omitted it; but it is commonly found in manuscripts after his time.

The Name.—The fractions that were commonly used by merchants in the iate middle ages were called *fractiones vulgares,* whence the French use of *fractions vulgaires* (Trenchant, 1566) and the English "vulgare or common Fractions" (Digges, 1572).

The English writers finally adopted the adjective "vulgar," and the early American writers did the same; but about the beginning of the 19th century the latter changed to "common fractions." In English the word numerator (numberer) has given place to such terms as *numerus*, "topterme," "top," *superior*, and *denominato*, the *denominator* having such equivalents as *"base," inferior*, and *denominate*.

SEXAGESIMAL FRACTIONS

Nature and Origin.—Fractions written on the scale of 60 (Latin, *sexaginta*) are called *sexagesirnal fractiorts* (from the Latin *sexagesimus*, 60th). Since the Babylonians wrote their numbers on a combined scale of 10 and 60, in which the character for 1 represented any power of 60, they naturally used 60 as a radix in certain systems of measure, as in the case of 60 *maneh* making a talent. The statement that 60 seconds make a minute was probably looked upon quite as our statement that 12 inches make a foot, the idea of sexagesimal fractions, as we have it, not being present. The Greek astronomers no doubt received the scale of 60 from the Babylonians or their successors, and it seems to have been they who developed sexagesimal fractions on a large scale. When they decided to take 120 units as the length of the diameter of their standard circle (probably because its numerous factors, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 40 and 60 made the representation of fractions easy), the circle (using the old value 3 for π) became 360 units. To each of these units they gave the name μοῖρα (*moi'ra*), which became (either through the Latin *de+gradus*, step, or the Arabic *daraja*, step, scale, ladder) our "degree." They then called $\frac{1}{60}$ of a degree a first part (πρῶτα ἑξηκοστά, *pro'ta hexekostá;* Latin, *pars minuta prima*, first small part), whence our "minute"; and $\frac{1}{3600}$ a second part (δεύτερα ἑξηκοστά, *deu'tera hexekostá;* Latin, *pars minuta secunda*), whence our "second," and so on. Since these fractions were used in astronomy, they were called "astronomical fractions" in the middle ages. They were also known as "physical fractions," and so we find Gemma Frisius (*c.* 1540) writing *De Fractionibus Astronomicis, siue de minutiis Physicis*, to distinguish them from the *fractiones vulgares*. He wrote:

	$\tilde{\text{s}}$.	$\tilde{\text{g}}$.	$\tilde{\text{m}}$.	$\tilde{2}$.	$\tilde{3}$.	$\tilde{4}$.
	1.	10.	25.	17.	21.	27.
for	1 sign (30°),	10°,	25′,	17″,	21‴,	27$^{\text{iv}}$.

To the mediaeval astronomers and their successors in the Renaissance such fractions were probably as significant as our decimal fractions are to us, but the operations beyond subtraction were difficult.

DECIMAL FRACTIONS

Forerunners.—The mediaeval computer who wished to find the square root of 7, having no decimal fractions with which to work, first multiplied the number by, say, 10,000, then found the square root of 70,000 to three figures, and then divided the result (246) by 100, obtaining $2\frac{46}{100}$, or $2\frac{23}{50}$. The process was known to the Hindus and the Arabs and is found in Europe as early as the 12th century. Even after the decimal fraction was known, such devices remained; this is seen, for example, in the custom of comparatively recent writers in taking the radius of a circle as 10,000,000 so as to avoid the use of decimals in the trigonometric functions. Early in the 15th century al-Kashî, assistant of the prince astronomer, Ulugh Beg of Samarkand, is said to have given the value of π as $\frac{\text{sah-hah}}{3}$ 1415926535898732, where *sah-hah* (modern Turkish *sahih*) means complete or integral. If the manuscript of his work now in Constantinople goes back to his time, this is the earliest evidence we have of any precise knowledge of the decimal fraction. Pellos (1492) made use of the decimal point in cases like 9537919÷70. He first placed a decimal point, 953791·9, then divided by 7, obtaining 136255 with a remainder, and finally wrote the result as $136255\frac{69}{70}$. In Rudolff's *Exempel-Büchlin* of 1530 an example in compound interest is solved by the aid of decimal fractions written in the form 393175, 413|4375, and so on to 20|6164099697265625oooo, the operations being carried on as they are to-day. The first book devoted solely to these fractions was *De Thiende* (Flemish; there was a French translation, *la Disme*, The Tenth, in the same year), written by Simon Stevin (Stevinus) and published in 1585. In this the decimal 27.847 (English) or 27.847 (American) appears as 27⓪8①4②7③. The first writer to use a decimal point with full understanding of its significance seems to have been Clavius. In the columns of differences of his table of sines printed in his work on the astrolabe in 1585, differences like 46·5 are given, this particular one being explained in the chapter "De parte proportionali sinuum, & arcuum" (p. 229) as equivalent to $46\frac{5}{10}$. The question as to what kind of decimal point to use has never been settled. The use of a separatrix of some kind was generally agreed upon early in the 17th century, but the precise form or position is still uncertain. The decimal (or centesimal) symbol % appears in the 15th century under the form "per c°," the "per" being finally dropped and the c° becoming $\frac{o}{o}$ in the 17th century. It is of Italian origin.

Operations.—The operations with decimal fractions are the same as with integers except for the proper placing of the decimal point, a matter of no difficulty as the subject is now taught. The rules are easily deduced by first writing each fraction as a common fraction. For example, $\frac{3}{10}\times\frac{7}{100}=\frac{21}{1000}$, and hence $0{\cdot}3\times0{\cdot}07=0{\cdot}021$ (British), or $0.3\times0.07=0.021$ (American).

Recurring Decimals.—If we reduce $\frac{1}{6}$ to a decimal fraction, we have (using the British decimal point in this discussion) 0·1666, the 6 continually recurring. Such a fraction is called a *recurring decimal, circulating decimal*, or *repeating decimal*. This fraction may be written $0{\cdot}1\dot{6}$, the superposed dot indicating that the 6 is repeated indefinitely. We see, by division, that

$$\tfrac{16}{111}=0{\cdot}144144\cdots=0{\cdot}\dot{1}4\dot{4},$$

and $\tfrac{178}{55}=3{\cdot}2363636\cdots=3{\cdot}2\dot{3}\dot{6}$,

the dots being placed above the first and last figures of the *repetend*.

Considering the last of these cases, $3{\cdot}2\dot{3}\dot{6}$, the decimal $0{\cdot}0\dot{3}\dot{6}$ forms an infinitely decreasing geometric series, $0{\cdot}036+0{\cdot}00036+\cdots$, in which the first term is 0·036, the ratio is $\frac{1}{100}$ and the number of terms is infinite. The formula for S, the limit of the sum of this series, is $a/(1-r)$. Substituting

$$S=0{\cdot}036/(1-0{\cdot}01)=0{\cdot}036\div0{\cdot}99=\tfrac{2}{55},$$

and so $3{\cdot}2\dot{3}\dot{6}=3{\cdot}2+\frac{2}{55}=\frac{178}{55}$.

The following rule for the reduction to a common fraction is easily deduced: From the given number (3·236), considered as a whole number (3236), subtract the non-recurring part (32) and divide the result (3204) by a number composed of as many 9's as there are figures in the repetend with as many zeros annexed as there are figures between the repetend and the decimal point (that is, by 990). The result is the equivalent common fraction ($3204\div990=\frac{178}{55}$).

There is a considerable amount of theory connected with the recurring decimal, and the subject formerly found place in most of the elementary arithmetics.

THE INDEX NOTATION

Origin.—The need which modern science has created for decimal fractions to a large number of decimal places has led to the introduction of a new symbolism based upon the fact that $\frac{1}{10^n}=10^{-n}$, and hence that $\frac{1}{1000000}=10^{-6}$,—a shorter way of expressing the common fraction. For example, instead of saying that a millimicron is 0·000000001 of a meter, we may say that it is 10^{-9}m.; and instead of saying that a square millimeter is 0·00155 of 1 sq. in., we may say that it is $1{\cdot}55\times10^{-3}$ sq. in. or 155×10^{-5} sq. in. The index notation is also used in connection with very large numbers, as when we express 750,000,000,000,000 ultra violet waves per second as $7{\cdot}5\times10^{14}$ per second.

Advantages of the Index Notation.—The demands of astronomy and physics render it necessary to use numbers to represent such great and such small distances and lengths that the eye has difficulty in detecting their meaning when they are written. The index notation not only condenses the statement but it is particularly valuable when logarithms are to be used.

For example, in the case of $1{\cdot}55 \times 10^{-3}$ we see that the characteristic of the logarithm is -3, and in the case of $7{\cdot}5 \times 10^{14}$ it is 14. Since a fraction expressed in any one notation can be expressed in any other, it is immaterial what notation is used so far as the general principles of fractions are concerned.

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FRACTIONAL DISTILLATION: *see* DISTILLATION.

FRACTIONATION, in chemistry, consists in separating into fractions materials which differ in rates of crystallization, boiling points or other characteristics, rendering possible a sharp separation. Gases may be separated by fractional combustion, as in burning oxygen out of the air to secure the nitrogen *(see* NITROGEN, FIXATION *OF).* Fractional crystallization requires conditions favourable for the crystallization of one component in a reasonably pure state. Further purification is obtained by redissolving and recrystallization. Various conditions, temperature and a choice of solvents are important, as well as a knowledge of the characteristics of the solids to be separated. Fractional distillation is dependent upon differences in boiling points, the best example being the concentration of alcohol *(see* ALCOHOL). Here the lower boiling point of the alcohol allows its removal in a high state of purity from the water with which it is admixed. Fractionating columns are of various designs, the object in all cases being to concentrate to a high purity with low heat consumption. Complex mixtures of liquids are often separated by several distillations, in the course of which one after another is removed, according to predetermined conditions. *(See* DISTILLATION.) Fractionation may also be applied to precipitation, where one material after another may be thrown out of a mixed solution, depending upon the reagents used.

FRACTURES AND DISLOCATIONS. The most common injuries involving the bones are fractures and dislocations. A fracture is a break in the normal continuity of a bone. A fracture is called simple when the overlying skin is not broken and the bone is not exposed to the air; it is called compound when the bone is exposed, either as a result of the injury destroying the skin over the bone or of the broken end of the bone piercing the skin. The terms transverse, oblique, spiral and T-shaped refer to the direction of the fracture line. A transverse fracture line goes directly across the bone, an oblique fracture line crosses it at an angle and a spiral fracture line winds around the bone. A T-shaped fracture line goes transversely across the bone near a joint and the smaller piece of bone near the joint is split longitudinally.

Incomplete, greenstick, complete, impacted and comminuted are terms that refer to the position the broken ends of the bone assume following the injury. An incomplete or greenstick fracture occurs when the bone appears to bend but does not completely break into two separate pieces, the latter condition being termed a complete fracture. An impacted fracture occurs when the broken ends of the bone appear to be jammed together by the force of the injury. A comminuted fracture is one in which the ends are shattered into many pieces. A pathological fracture results when a bone weakened by disease breaks from a minor injury.

A dislocation is a disruption of a joint leaving the ends of the bones that meet to form the joint out of contact with each other. In simple dislocation, the joint surfaces are not exposed to the air. When the joint surfaces are exposed by destruction of overlying skin or by the end of the bone being driven through the skin the dislocation is called compound. A congenital dislocation is present at birth and is the result of defective formation of the joint. An acquired dislocation results irom an injury. A recurrent or habitual dislocation is a repeated dislocation of the same joint. A pathological dislocation occurs as the result of a disease which weakens the capsule and ligaments about the joint.

Injuries which cause dislocations may cause a iracture of one or more of the joint surfaces at the same time. This condition is called a fracture-dislocation.

Causes. — Fractures are produced by an injury which is forceful enough to overcome the resistance, whether normal or weakened, of the involved bone. In direct external injuries the force is applied directly at the point of fracture, as in the case of fracture of the iorearm as the result of a blow with a weapon. In indirect external injuries the force is transmitted from a distance to the point of iracture, ior example, as in a iracture of the upper arm as the result of a fall on the outstretched hand. In internal injuries the force is provided by the pull of the muscles which attach to the fractured bone. An example of this injury is a fracture of the upper arm as the result of throwing a ball.

Conditions which weaken the bones and predispose to fractures may be classified as normal or pathological. The normal predisposition exists in infants and young children whose bones have not fully matured and in elderly people, especially women, who normally undergo a weakening of the bone with age. Many pathological conditions which involve the skeleton, most commonly the spread of cancer to the bones, result in weakening of the bones. In persons with such pathological conditions fractures may occur as a result of very minor injuries.

Dislocation of a joint is caused by an injury which is forceful enough to overcome the resistance of the ligaments, muscles and capsule which hold the joint in place. Dislocation of a normal joint most commonly follows an injury in which the iorce is transmitted along the length of the bone and thrusts the end of the bone through the tissues which surround the joint but it may also follow direct injuries in the region of the joint.

Habitual, or recurrent, dislocations are those that reappear following an original injury, as the result of improper healing of the tissues or of the joint being made defective by the original injury. Subsequent repeated dislocations may then occur with minor injuries or even with ordinary movements of the joint.

Pathological dislocations result irom diseases that weaken the capsule of the joint or make the joint defective; such dislocations frequently follow minor injuries.

Diagnosis. — The recognition of iractures and dislocations is based upon the history of the injury, the symptoms the injured person experiences, the visible signs of the injury and X-ray examination. The history of the manner in which the injury occurred is helpful in localizing the area oi the iracture or dislocation, particularly in the case of young children who may be unable to indicate the region in which the pain is felt. A history oi a minor injury causing a iracture or dislocation leads to a search ior an underlying cause. The most common symptoms of a fracture or dislocation are pain and tenderness to the touch at the site, a sensation of grating or grinding on attempting to use the injured limb and an inability to use the injured limb. The most irequently seen physical signs of a iracture are deformity of the injured part, swelling in the region of the iracture, discoloration of the overlying skin, abnormal mobility of the bone and a grating or crepitant sensation felt at the point of the fracture when the strength of the injured bone is tested. The physical signs present in most instances of a dislocated joint are deformed appearance of the injured joint, swelling of the tissue about the joint, discoloration of the overlying skin and the inability to use the injured limb or to move the dislocated joint. X-ray examination of the injured bone or joint is of great value in the diagnosis of iractures and dislocations and is also helpful in indicating the type of treatment to be given since it reveals the type and extent of the injury more accurately than does the physical examination.

Healing. — All fractures, regardless of cause, attempt to heal in the same iashion. The injured bone very quickly produces new tissue that extends across the iracture line and joins the broken pieces together. In the early stages of healing this new tissue is soft, puttylike in consistency and easily injured. As time passes the body deposits bone minerals in this new tissue and it gradually hardens and cements the broken pieces firmly together. At this stage the new tissue is called the fracture callus and by virtue of the minerals deposited in it is faintly visible on an X-ray film. In the latter stages of healing this hardening callus becomes transformed into mature bone. As the callus is gradually changing into bone the union between the broken pieces becomes firmer until the area of fracture has become transformed into one solid piece of bone.

Several factors may govern the healing of a iracture, including the type and severity of the injury. In severely injured bone or in certain types oi iractures the blood supply to the broken bone may be destroyed. This bone is then unable to produce new reparative tissue to heal the iracture. Proper realignment of the broken hone promotes prompt healing since it makes it possible ior the new reparative tissue to bridge the gap between the broken ends of the bone. If other tissues such as muscle or tendon have been driven in between the broken ends of the bone they must be removed so the ends of the bone may be brought together. Adequate immobilization of the broken bone is necessary to achieve union. When the hone has been realigned it must be maintained in one position and must not be allowed to move or else the new delicate iracture callus will be injured and will not cement the ends oi the bone together. If the immobilizing apparatus is removed before healing has united the broken ends, motion may weaken the callus and allow the ends of the bone to spring apart.

Despite proper realignment and adequate immobilization, infection about the broken bone may retard or prevent healing by killing the new reparative fracture callus tissue. Other factors such as diet, age, general health, vitamins, syphilis and race which are popularly thought to play important roles in fracture healing have been shown to be of only minor importance. A child's bone heals more rapidly than does an adult's but advancing age does not retard healing or make it more difficult.

Dislocations involve injuries to the muscles, ligaments, tendons and capsule of the joint which hold the ends of the bone in contact. The dislocations heal by forming a scar between the cut or torn edges of these soft tissues. This healing process will take place whether the bones have been replaced in their proper position or not. The injured joint tissues heal more quickly than do broken bones.

Fracture-dislocation injuries heal by a combination of the two processes just described.

Treatment.— The proper treatment of a fracture or dislocation is dictated by many interrelated factors. The patient's age, general health, associated injuries, occupation and the type and location oi the iracture must all be taken into consideration in the treatment of an individual patient although many of these features have no direct bearing on the healing of the fracture itself. The emergency care of injuries suspected of having caused fractures or dislocations consists of controlling heavy bleeding with bandages or tourniquets, bandaging with clean bandages areas where skin has been torn or badly cut, splinting the injured limb without trying to straighten the deformity and gently transporting the patient to a place where medical care may be given.

The treatment of simple fractures consists of realigning the broken ends of the bone if they have been displaced and then preventing motion between them until sufficient time has elapsed ior the fracture to heal. Minor fractures with no displacement of the broken ends of the bone require no realignment. Incomplete fractures, the majority of fractures in children, and fractures involving bones that do not have powerful muscles attached to them may frequently be realigned by manipulation. The broken bone is grasped with one hand on either side of the fracture and manipulated with the hands until the desired position is attained.

Fractures involving bones that have powerful muscles attached to them or iractures in which the bone is shattered into many pieces often require more extensive care to realign them. The pull of the muscles may cause the broken ends of the bone to be pulled apart. In these cases a steady, continuous pull is put on the injured limb to counteract the pull oi the muscles after the bone ends have been realigned by manipulation. The pull is applied by attaching weights to the injured limb and suspending them in such a iashion that gravity iurnishes the pull—the traction method of treatment. The traction is maintained until healing has progressed to the point where release of the pull will not allow the ends of the bone to be pulled apart. Certain iractures cannot be realigned either by manipulation or by traction. This condition usually is the result oi a shattering injury or iracture in which muscle and other tissue is driven between the broken ends of the bone and cannot be dislodged. In these instances a surgical operation is necessary to realign the bone after which it is immobilized in one of several ways.

Minor iractures may he held with simple bandages or slings. Fractures that require manipulation for realignment are immobilized by splints or casts made of rolls of plaster of paris. The limb is held in the proper position and the cast applied. Following hardening oi the plaster of paris, slings, canes or crutches are used by the patient to further protect the injured limb. When traction is utilized to hold the bone ends together sandbags, slings or casts may be used in addition. Fractures that are treated by surgical operation are many times fixed internally by means oi metal pins, wires, screws, rods. nails or plates. Frequently in these cases casts or splints are not necessary to maintain stability of the broken bone.

The immobilization is continued until the iracture callus is strong enough to maintain union of the broken bone without external support, as determined by gently testing the strength of the bone and by X-ray examination. Following removal of the splints or casts complete use of the injured limb may not be permitted until further healing has taken place.

As soon as healing permits, gentle exercises to strengthen the injured limb are begun. Hinged casts, removable splints, crutches, canes, walkers, hot water pools, slings and braces are all devices that are used to protect the partially healed broken bone at this stage. Violent exercises which cause pain are avoided. Complete use of the limb is allowed when the fracture callus has been transformed into bone and the bone is solidly united. If advisable, metal devices which have been used to fix a fracture may be removed by a second operation aiter healing is complete.

Compound fractures present a more serious problem than do simple fractures. The wound (*q.v.*) produced by the loss of skin over the bone or by the bone piercing the skin irequently becomes infected by germs introduced at the time of injury. If the iniection extends about the broken ends it will inhibit the ability of the bone to form the fracture callus and will prevent healing. Ordinarily healing will not take place until the infection has been cured.

When a patient is seen within the first few hours after a compound fracture an operation is indicated. The broken bone is realigned and all tissues about the wound that have been exposed to germs are cut away in an attempt to remove all contaminated tissue beiore an infection can become established. The wound is then sewed together or skin is grafted over it and the iracture is kept immobilized by closed methods (application of splints or casts). The patient is immunized against tetanus and treated with drugs in a iurther effort to prevent infection. If by these procedures iniection is avoided and the wound heals the fracture is then treated as a simple fracture.

In cases where these measures fail or where infection has developed before treatment can be started all treatment is directed against the infection. Healing infections about iractures is frequently a prolonged, serious and difficult procedure. The fracture is placed in the best possible alignment and maintained by closed methods. After the infection is cured the fracture may be treated as a simple iracture.

Another serious problem is a iracture which extends into a joint and destroys the normal smooth surface of the joint. If the surface is made rough and uneven by the injury and heals in this irregular alignment the joint will irequently be permanently stiff and painful. Unless the surface of the joint can be accurately realigned by manipulation or traction surgical operation is necessary.

Simple dislocations are treated by repositioning the dislocated ends of the bones in their proper position, usually by manipulation. Occasionally it may he necessary to employ traction. Following reduction of the dislocation the involved joint is immobilized by bandages, slings, splints or casts until healing of the torn tissues about the joint has occurred. Gentle motion of the joint is then begun. Forcing painful motion is avoided. Complete function of the injured limb is not permitted until partial painless motion has been restored.

Compound dislocations are treated in the same fashion as compound iractures. Recurrent dislocations and congenital dislocations are special problems which require in most instances surgical reconstruction of the defective joint. (See ORTHOPAEDIC SCRGERY.)

Fracture-dislocations are the result of severe injuries. Frequently a loose piece oi bone remains jammed between the ends of the dislocated bones and may have to be removed surgically before the dislocation can be reduced. Even if the fracture can be realigned and the dislocation reduced by manipulation or traction, motion of the involved joint must be restricted longer than in a simple dislocation to allow healing of the fracture.

Complications.— The major complications of a broken bone are failure to heal, healing oi the bone in a position that interferes with the limb's iunction and loss of the injured limb's function despite healing of the fracture in good position.

The iailure of broken bones to heal may be due to inadequate immobilization, infection, massive destruction of bone or injury resulting in loss of blood supply to major portions of the bone; in certain instances the fracture may fail to unite ior no knou-n reason.

Healing in an improper position, or malunion, with resulting deformit'y, is usually caused by iailure to realign the bone properly. Malunion results when injuries have destroyed large portions oi the bone so that in order to salvage a limb, deiormity must be accepted. Injuries to the growth centres of bones in children cause malunion and subsequent growth in a deiormed manner.

The loss of function in a limb despite healing of a iracture is usually caused by prolonged immobilization necessary to achieve healing of severe fractures, by heavy scarring following infection from compound fractures or by heavy scarring irom associated wounds while the limb is immobilized. Stiffness in joints may follow even minor injuries to a limb. The cause of this phenomenon is unknown.

The major complications of dislocations are stiffness and pain in the joint and development of a recurrent dislocating joint. The usual causes of the pain and stiffness are failure to reduce the dislocation, irreparable damage to the joint by injury, heavy scarring in the surrounding tissues during healing and prolonged immobilization. Recurrent dislocating joints are produced by improper healing of the surrounding tissues or damage to the joint surfaces which result in a defective joint.

Bone Grafting.— Bone grafting is a surgical procedure in which one or more pieces of bone are placed across or packed around the broken ends of bone which have failed to heal. *(See* ORTHOPAEDIC SURGERY.) This operation stimulates the ends of the broken bone to produce fracture callus, provides a framework for the callus to grow across the break, and the grafted bone is thought by some to produce callus of its own which aids healing. It has been shown that bone obtained from the patient himself makes a graft superior to bone obtained from another person, an animal or a "bone bank." Bone grafts are useful in bridging large deiects in severely damaged bone, correcting deformities and bringing about healing in fractures which have failed to unite by other methods. (W. F. E.)

FRAGONARD, JEAN HONORÉ (1732–1806), one of the best-known and most typical French painters of the 18th century, was born in Grasse on April 5, 1732, the son of a glovemaker. His father articled him to a notary, but he showed such talent for painting that his employer suggested a change of profession. He entered the studio of F. Boucher. was sent on to J. B. Chardin, and six months later, having learned little, returned to Boucher (1750) who this time gave him serious attention. In 1752 Fragonard won the Prix de Rome with a picture of "Jeroboam Sacrificing to the Idols" (École des Beaux-Arts, Paris), but before leaving for Rome he spent three years at the École des Elèves Proteges, where he studied under F. Lépicié, M. Dandré-Bardon and C. Vanloo. Finally. in 1756, he arrived in Rome.

Despite this wealth of tuition, Fragonard learned all he knew from Boucher and from his own studies from nature in the Roman Campagna. On the eve of his departure. Boucher warned him to avoid the old masters and to concentrate on artists with whom he had a temperamental affinity, such as F. Albani and G. B. Tiepolo. In Rome he became friendly with the landscape painter Hubert Robert, with whom he spent many long days sketching; in 1759 the rich Abbé de Saint-Non arrived from Paris and the three men passed the summer at the Villa d'Este. Saint-Non engraved Fragonard's red chalk drawings of the gardens (many of which are now in the museum at Besançon), and they won the approbation of his superiors at the French Academy in Rome. He returned to Paris via Venice in 1761 with his style completely formed.

In 1764 he was admitted to the French Academy on the strength of his "Corrésus et Callirhoé" (Louvre, Paris). The king bought the picture but did not pay for it until some time later. After 1767 Fragonard ceased to exhibit in the Salon and was no longer considered a "serious" artist by his contemporaries. He accepted commissions from rich financiers (who paid promptly) and from actresses and demimondaines, and worked mainly on decorative projects for, among others. Mme. de Pompadour. Mlle. Guimard, and Mme. du Barry, who commissioned from him in 1771 a series of panels for Louveciennes on the theme "Le Progrès de l'Amour dans le Coeur des Jeunes Filles" ("The Progress of Love in the Hearts of Young Girls," now in the Frick collection, New York city). The subject matter of his small paintings became slighter and more allusive. as "Le Baiser à la dérobée" ("The Furtive Kiss." Hermitage, Leningrad), "La Chemise enlevée" ("The Stolen Chemise." Louvre) and "La Balançoire" ("The Swing." Wallace collection. London) will testify.

In 1773 he was taken to Italy by one of his patrons, Bergeret de Grandcour. who has left a charming account of the journey. They visited all the main towns and returned to Paris via Vienna, Mannheim and Dresden. Fragonard was rich, happy and famous, but he was also closely identified with the way of life of the *ancien régime,* and his fortunes fell with the Revolution. Thanks to his former friendship for the young Jacques Louis David, whom he had chosen to complete his decorations for Mlle. Guimard. Fragonard was protected from reprisals and even appointed to the committee of the new Museum des Arts. He died in Paris on Aug. 22, 1806.

Fragonard is represented in the major French. British and American collections and notably in the Louvre. the Wallace collection. and at Chantilly, Besanqon, Amiens, Nantes, Grenoble, Avignon and Marseilles. His finest landscape, "La Fête a Saint-Cloud." is at the Banque de France in Paris. Of his few engravings, the most important is "L'Armoire" ("The Wardrobe," 1778).

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FRAMINGHAM, a town in Middlesex county, Mass., 21 mi. S.W. of Boston. Settled in 1650, it was named after the English home (Framlingham) of Gov. Thomas Danforth who owned the land. It was incorporated in 1700. Power and rail developments assisted in limited industrial development in the 19th century. It is the site of the first normal school in the country, founded in 1839 in Lexington and moved to Framingham in 1853; in 1932 it was renamed State Teachers college. The State reformatory for women is located in the town. After World War II, increasing use of the automobile and the development of superhighways, particularly the Massachusetts turnpike, made the community a retail-industrial centre and residential area for the Greater Boston industrial complex. Among the firms introduced at this time mere scientific concerns and regional distributors to the industrial leaders: paper and allied goods, auto assembly, textiles and chemicals. Framingham was chosen for the site of the first suburban shopping centre in the nation, Shoppers World (but it was the second to be completed, in Oct. 1951). It retains unlimited town-meeting government. For comparative population figures *see* table in MASSACHUSETTS: *Population.* (R. C. Mo.)

FRAMLINGHAM, a market town in the Eye parliamentary division of East Suffolk, 88 mi. N.E. of London by road. Pop. of civil parish (19ʒ1) 1,943. The church of St. Michael is a Perpendicular and Decorated building of black flint surmounted by a tower 96 ft. high. Monuments include those of Thomas Howard, 3rd duke of Norfolk (d. 1554); Henry Howard. the famous earl of Surrey, who was beheaded by Henry VIII; and Sir Robert Hitcham. Dominating the little town are the remains of the castle: a splendid curtain wall 44 ft. high and 8 ft. thick with 13 towers more than 50 ft. high. The chimneys are mostly dummies added in the 17th century. The castle, originally founded in the 6th century, was captured by the Danes and retaken by the Saxons. In 1100 Henry I gave it to Roger Bigod whose son Hugh, the 2nd earl of Norfolk. built a masonry structure. About the end of the 12th century this was enclosed by the still-existing curtain wall with its towers, and a new hall on the west side replaced one built (c. 1150) on the east. In 1306, in default of heirs. the castle passed from the Bigods to the crown and was granted by Edward II to his half brother Thomas of Brotherton, created earl of Norfolk in 1312. From him it descended to the Mowbrays and then to the Howards. Town and castle followed the vicissitudes of the dukedom of Norfolk and after being alternately forfeited to the crown and restored it was sold in 1635 to Sir Robert Hitcham. In 1636 he left it to Pembroke college, Cambridge, on condition that "all the castle. saving the stone building, be pulled down" and that a poorhouse be provided. The curtain wall with its towers now encloses a grassy space measuring about zoo ft. by 300 ft. with a building which has in turn served as poorhouse, courthouse and drill hall. Scheduled as an ancient monument, the fabric is cared for by the ministry of works. Half a mile from the station is Framlingham college. founded by public subscription in 1864 as the memorial of Suffolk county to the prince consort.

FRAMPTON, SIR GEORGE JAMES (1860–1928), English sculptor and craftsman, the author of some noted public monuments, was born in London on June 16. 1860. He studied under W. S. Frith and at the Royal Academy schools, where he won a traveling studentship. During 1888–90 he studied in Paris under A. Mercié. by whom he was much influenced. At the beginning of the 1890s he was attracted by the arts and crafts movement (*q.v.*) and experimented with decorative sculpture, using various materials such as bronze, ivory, marble and jewels combined in one work. His principal statues include those of Mrs. Alice Owen at Owen's school, Islington. London; Queen Victoria at Calcutta, at Leeds, at Southport and at Winnipeg; and (all in London) Quintin Hogg in Langham place, Peter Pan in Kensington gardens and Edith Cavell (a conspicuous failure) in St. Martin's lane. Frampton became a royal academician in 1902 and was knighted in 1908. He died in London on May 21, 1928. (R. Gs.)

FRANC, originally a French coin but now also the title of a number of national currencies of different values, notably those of France, Belgium. Luxembourg. Switzerland and most French and Belgian overseas territories. The name was first applied to a gold coin, minted by King John II of France in 1360, because on one face was the legend *Johannes Dei gracia Francorum rex* ("John, by the grace of God, king of the Franks"). As this coin also carried an effigy of the king on horseback it was known as the *franc* a *cheval* to distinguish it from another coin of the same value subsequently issued by Charles V of France and labelled the *franc à pied* because the monarch was shown on foot. During the 16th century the minting of franc gold coins ceased, but the name was freely applied by the French public to the new unit of exchange then introduced—the livre tournois, a gold coin subdivided into 20 sols. In 1795, to symbolize the political changes that followed the revolution of 1789. the government of the republic introduced a new franc currency. The first coin was a 5-franc silver piece. but subsequently gold coins worth 20 francs (napoleonsj were produced in quantity. The livre tournois, which was exchangeable into the new currency at a rate of 81 livres to 80 francs, continued to circulate in France until 1834.

The franc was formally established as the monetary unit of France in 1799 and made divisible into 10 decimos and 100 centimes. Reaflirmed in this position by the more elaborate law of 1803 (which also introduced a fixed relationship of $15\frac{1}{2}$ to 1 between gold and silver in monetary uses), the franc has continued to form the basis of the French monetary system although subjected to stresses that have greatly reduced its international standing as well as its purchasing power. The decline of its status largely occurred after the opening of the 20th century. During the 19th century its stability, coupled with the tendency for France to dominate the continent of Europe politically and economically, led to its being widely used as the basis for the currencies of other countries. The currency system introduced in Belgium after that country gained its independence from the Netherlands in 1831 provided that the Belgian franc should be maintained at parity with the French franc and permitted French gold and silver coins to circulate freely. In 1850, following the reform of the constitution, the Swiss government decreed that the French franc should supersede all existing currency, while the new lira currency introduced in Italy in 1862, shortly after the unification, was directly linked to the French franc on a parity basis. Finally, in 1865, when France, Italy, Belgium and Switzerland joined together in a plan for strengthening European economic ties through the formation of the Latin Monetary union, the French franc was made the medium of exchange for external transactions. (*See* MONETARY AGREEMENT.) The union, which was later joined by Greece and, on a limited basis, by Spain, Venezuela and other countries, did not formally end until 1926, but for practical purposes it broke up during World War I. With its disintegration, the French franc lost its dominating position in the European currency field and thereafter there were no special links between the minor franc currencies.

French Franc. — The decline in the price of silver having forced France and other Latin Monetary union countries in 1873 to abandon the practice followed since 1803 of giving both a gold and a silver standard for currency purposes, France entered World War I with a gold standard currency only. The gold link was then severed, however. During the war period, the franc was pegged at the prewar levels of 25.22 to the pound sterling and 5.18 to the U.S. dollar. But after the exchange was freed in 1918 the franc fell until a level of 244 to the pound was reached in July 1926. At that point, with the country on the verge of financial collapse, the Poincaré ministry undertook reform with the result that it became possible to stabilize the franc on a gold basis in 1928 at rates of 124.2 to the pound and 25.51 to the dollar. Following the departure of Great Britain and other countries from the gold standard in the early 1930s, the French balance of payments deteriorated. This and internal financial crises led to the abandonment of the gold standard and three successive devaluations of the franc between Oct. 1936 and May 1938. From a level of 74.60 to the pound and 15.13 to the dollar at the end of 1935, the franc had fallen to 176.63 to the pound and 43.83 to the dollar four years later. During the German occupation a rate of 20 fr. to the reichsmark was maintained, which corresponded to a sterling rate of about 200 and a dollar rate of about 50. But the real value of the franc fell rapidly as a result of inflationary forces. Nevertheless, although black market quotations indicated that by the autumn of 1944 the franc had fallen to about 800 to the pound and 200 to the dollar, the new rates fixed after France was liberated were 200 to the pound and 49.63 to the dollar. This overvaluation of the franc, however, impeded postwar economic recovery and the exchange was therefore adjusted to the more realistic level of 480 to the pound and 119 to the dollar at the end of 1945. But the economic situation continued to deteriorate mainly because of inflationary stresses stemming from the budget deficit and rising wage rates. In consequence the franc had to be devalued twice in 1948 and again in April 1949 to 1,097 to the pound and 270 to the dollar.

When sterling was devalued in Sept. 1949, the franc was reduced again against the dollar to 350 but raised against the pound to 980. In Aug. 1957 tax changes for certain trade purposes and a new exchange rate for foreign tourists reduced the franc to 420 against the dollar although the official rate remained at 350.

Though most of the franc currencies circulating in French overseas territories depreciated substantially after World War I, they were not all devalued to the same extent as the metropolitan franc.

Belgian Franc. — In 1925 a first, abortive attempt was made to stabilize Belgian currency, which had depreciated severely after World War I. But a new attempt made in 1926 backed by an international loan of $100,000,000 proved successful on the basis of an exchange rate of 175 fr. to the pound and 36 to the dollar. To facilitate trade a new unit known as the belga, with a value of 5 fr., was then introduced to govern external business, but the franc was retained for internal purposes. The new gold standard currency came under pressure in the 1930s as a result of the devaluation of other currencies and had to be reduced in value in terms of gold. During the German occupation an exchange rate of 12½ fr. to the mark was enforced. After liberation in 1944 the currency system was wholly reformed. The belga was abolished and a new franc currency introduced with an exchange value of 176.6 to the pound and 44 to the dollar. The new rates structure overvalued the country's currency a little and advantage was taken of the world currency realignment of 1949 to reduce its gold value by 14%, establishing it at 50 to the dollar and 140 to the pound. Between 1950 and 1956 the Belgian external payments position was sound and the new structure was maintained without difficulty.

The Congolese franc used in the Belgian Congo is directly linked with the Belgian franc on a parity basis.

Luxembourg Franc.—Before World War I Luxembourg had a franc currency linked to the German mark at a value of 80 pfennigs. Since economic union with Belgium came into practical being in 1922, however, the duchy's currency has been directly linked to the Belgian franc on a parity basis and Belgian notes and coin have circulated freely.

Swiss Franc. — With the collapse of the Latin Monetary union, Switzerland began to mint Swiss francs on a large scale to end the former dependence on foreign currencies. Since then its currency has depreciated to a materially smaller extent than other leading world currencies, partly because of Switzerland's remaining neutral in both World Wars I and II and partly because of the sound monetary policies pursued by successive governments. It is also one of the few world currencies that, by the mid-1950s, had not had its freedom of movement restricted by exchange controls. During World War I it was maintained at 25.22 fr. to the pound and 5.18 to the dollar and these were the rates chosen when stabilization took place upon return to the gold standard in 1929. The gold value of the franc had to be reduced in 1936 because of the pressures imposed on Switzerland's balance of payments by the devaluation of many other currencies between 1931 and that year. In 1940 a slight increase was made in the gold value and the new level was maintained during and after World War II despite the fact that many other European currencies were considerably reduced in value. During 1950–56 it was quoted at a level of about 12.25 to the pound sterling and 4.35 to the U.S. dollar. (C. G. T.)

FRANÇAIS, FRANÇOIS LOUIS (1814–1897), French painter. was born at Plombières (Vosges). After a few years of hard struggle, during which he made a precarious living by drawing on stone and designing woodcut vignettes for book illustration, he studied painting under Gigoux, and subsequently under Corot, whose influence remained decisive upon Français's style of landscape painting. He exhibited first at the Salon in 1837 and was elected to the Académie des Beaux-Arts in 1890. Comparatively few of his pictures are to be found in public galleries, but his painting of "An Italian Sunset" is at the Luxembourg museum in Paris.

FRANCAVILLA FONTANA, a town and episcopal see of Apulia, Italy, province of Brindisi, 22 mi. E. by N. of Taranto by rail. 460 ft. above sea level. Pop. (1951) 24,743. It is in a fine situation. and has a massive square castle of the Imperiali family. to whom, with Oria, it was sold by Carlo Borromeo in the 16th century for 40.000 oz. of gold, which he distributed in one day to the poor.

FRANCE, ANATOLE (1844–1924), whose real name was Jacques Anatole Thibault, French man of letters, was born in Paris on April 16, 1844. For 30 years French literature was dominated in the eyes of all the world by the fame of Anatole France. It is true that his influence declined in the last period of his life and that his ideas were questioned: but not his style nor the services rendered by him to the language. In his old age he was revered as a genius and a patriarch. No reputation since Voltaire's has been found comparable with his.

The son of a bookseller called Thibault. this youth who was to make illustrious the pseudonym of Anatole France started his career quite humbly. He was fond of literature, he was studious and erudite, but negligently preferred reading to writing. He composed publishers' puffs and contributed a weekly article signed "Gérôme" to the *Univers Illustré*. For his own amusement he wrote verse, *Les poèmes dorés* (1875) and *Les noces corinthiennes* (1876), which showed learning, charm and taste. In 1879 he published his first volume of stories. *Jocaste et le chat maigre,* and in 1881 his first novel, *Le crime de Sylvestre Bonnard,* which was acclaimed by the discriminating as delightful.

In 1883 he first met Mme. Arman de Caillavet. with results that profoundly influenced his career. Mme. de Caillavet became his lifelong friend. She was clever and active; she had a host of acquaintances and her receptions were attended by the leading figures of literature and politics. She laboured for the fame of Anatole France and she forced him out of his inertia into composition. The extracts from her correspondence with him prove the important share she took in his writings, and in the dedication of *Crainquebille* (1904) Anatole France could say: "To Madame de Caillavet, this book which I should not have written without her help, for without her help I should write no books."

For 40 years Anatole France poured out a series of lively, solid, graceful and profound works. There are the pungent and mischievous short stories: *Balthazar* (1889), *L'étui de nacre* (1892), *Le puits de Sainte-Claire* (1895); the meditative and critical books, *Les opinions de Jérôme Coigaard* (1893), *La vie littéraire* (4 vol., 1883–92); a philosophical novel: *La rôtisserie de la Reine Pédauque* (1893); an historico-philosophic novel, *Thaïs* (1890), describing Alexandria at the beginning of the Christian era and contrasting the ideals of dying paganism with those of nascent Christianity; an admirable novel on the French Revolution and the Terror, *Les dieux ont soif* (1912); a society novel, *Le lys rouge* (1894), a powerful study of jealousy set amid the artistic treasures and lovely vistas of Florence; then the series of political satires. the four volumes of *L'histoire contemporaine—L'orme du mail* (1897), *Le mannequin d'osier* (1897), *L'anneau d'amkthyste* (1899), *M. Bergeret à Paris* (1901), where Anatole France creates the legendary figure of M. Bergeret and portrays society before and during the Dreyfus affair; novels of a revolutionary tendency, *Sur la pierre blanche* (1903), *L'île des Pingouins* (1908), *La révolte des anges* (1914), a biography of Joan of Arc (1909–10); lastly the reminiscences, *Le petit Pierre* (1918), *La vie en fleur* (1922). Such is the sum of this work admirable in its wealth and variety.

The philosophy of Anatole France developed during the course of his career. Until 1900 he was primarily a sceptic. As Voltaire's spiritual son he delighted in the play of ideas and observed without pity the stupidity and the silliness of men. He probed the past and the present and spared no example of human inconsistency, error or weakness. *Les opinions de Jérôme Coignard* gives the reader much pleasure, so witty and mischievous is the author, and gives him, too, a complete lesson in scepticism. The same remark may be passed on *Les dieux ont soif,* where Anatole France considers almost exclusively the failures of the French Revolution. At this time the author seems to have kept respect for beauty alone, the beauty of natural or artistic forms or of such superior intelligence as was shown in the great Greek and Latin writers. Meanwhile he beamed indulgently upon an imperfect universe. As he believed in nothing, he did not believe in a better or a worse. In the writings prior to 1900 may even be found conservative and aristocratic maxims. A supreme indifference inclined him to accept what is rather than risk what might be.

On the outbreak of the political crisis of 1900 his temper changed. He was then seen to show a preference for the progressive parties, and little by little went on to the revolutionary parties. which became honoured by his support. He was no orator; words came slowly, and neither his mind nor his phrases were of the kind likely to be popular. The part taken by him at public meetings was undistinguished, being limited to signing manifestos and applauding resolutions. especially those with an international objective. He was more powerful with his pen. An opponent of church and state, he seemed to put his faith in the people and to expect the world to be renewed by some kind of revolution. On this point his ideas remained rather vague. In one of his books. *Sur la pierre blanche,* he ends the description of future society with a dreadful cataclysm that destroys everything, and here he is nearer to nihilism than to socialism. World War I changed the trend of his thoughts. As he was too old to serve in the field he wanted at least to show his good will and asked to be employed in a Tours office. This great upheaval left him uncertain concerning the destinies of humanity. Perhaps extreme scepticism is not for long tolerable, and Anatole France felt the need of escape into a revolutionary faith which he refused to define, leaving it a mere aspiration.

What is indisputable is the quality of Anatole France's art. The younger generations, tried by war and witnessing the consequent political difficulties, ill comprehend the detachment of dilettante M. Bergeret. They need more moral discipline, they believe more in virtue and action. But they do not deny the master who charmed their elders with his graceful wit and magic phrases. As a storyteller, in lucidity of thought and form, Anatole France is incomparable. In his style, too, there is a sweetness, an almost voluptuous grace, which distinguishes his phrases from those of any other writer. He owed much to Voltaire, much to Renan, much to the old French romances, to memoirs and to chronicles. He had read and remembered much; but what he borrowed he made his own; all mas changed, and for the better, by his style and interpretation. He translated into a pungent idiom all that could delight or stimulate the intelligence of his cultured contemporaries. He was a deep admirer of classicism, and to the end of his life when he mentioned Molière, Racine or Stendhal his conversation or his writing attained their richest substance and most pleasant harmonies.

He makes another strong claim on the attention of posterity. He was the finest flower of the Latin genius. His knowledge of antiquity was great, and his work contained the essentials of Greek and Latin wisdom. He portrayed in *Thai's* characters who distil the philosophy of the ancients. He put into the mouth of Jérôme Coignard maxims which likewise represent the sum of the meditations and arguments common to antiquity.

Lastly, in all periods of his career, whatever his theories, he was a deep student of human nature. He expressed in magic words most of the wisdom that may be acquired from the observation of life and the reading of history. He created characters who persist in the memory—Jérôme Coignard, Jacques Tournebroche, M. Bergeret, Mme. Martin Bellème, Catherine. the laceworker, Paphnuce, Nicias, Evariste Gamelin. He described what was comic and evil in mortals. He described, too, what was august in man, sacred in man's labours and sufferings. Though he lacked enthusiasm and ardour, his critical intelligence did not prevent him from brooding over human misery, and in the story of Crainquebille he showed his heart. While humbling himself before the invincible forces of fate and lust, he dedicated his work now to irony—which brought brightness into his life—and now to pity—which at other times reminded him that life deserves a serious, a solemn attention. And so he became twice fortunate, for he was at once a subtle artist acclaimed by the critics and a universally respected publicist who influenced the simple-minded. He died at Tours, Oct. 13, 1924.

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FRANCE, a country occupying part of the extreme west of the European continent, lies between 51° 9′ and 42° 23′ N. lat. and between 4° 38′ W. and 8° 10′ E. long. It comprises an area of 212.821 sq.mi. (including Corsica, *q.v.,* 3,367 sq.mi.) and, excluding the components of the Soviet Union, is the largest country in Europe. It is roughly pentagonal in shape. Its maximum length is about 621 mi. from Dunkirk on the north coast to the Pyrenees; its greatest breadth. from the western tip of Brittany to the Rhine, is roughly the same distance. The country is bounded everywhere by natural frontiers in the form of sea, mountains or rivers except on the northeast, where it marches with Belgium.

The country's northern frontier from the Belgian border to the western tip of Brittany is formed by the Straits of Dover and by the English channel. The coast is at first straight, flat and bordered by dunes, then rocky around the Pas-de-Calais, low and sandy along the province of Picardy, and rectilinear and flanked by high chalk cliffs to eastern Normandy. The coast of Normandy is occasionally indented and lined by a few low cliffs; farther west it juts out in the steep and rocky Cotentin peninsula. The northern Breton coast is rugged, hilly, serrated by numerous bays and bordered by reefs and islands.

The long western Atlantic border can be divided into three parts: the western Breton coast, broken by large bays and deep inlets, fringed by islets; the coast of Vendée, Aunis and Saintonge between the estuary of the Loire and the Gironde, flat with occasional low headlands, straight and bordered by dunes; and finally the flat rectilinear edge of Aquitaine, behind whose dunes lie numerous extensive lakes and marshes.

The southern frontier is constituted by the Pyrenees, which stretch in a continuous barrier from the Atlantic to the Mediterranean, by the Languedoc coast of this latter sea (mostly flat and studded with ponds enclosed within dunes) and by the high rocky fringe of Provence, up to the Italian border. The island of Corsica is the subject of a separate article.

On the east France is bounded, from the Mediterranean to Lake Geneva, by the Alps, which separate the country from Italy; then by the Jura mountains, which form its boundary with northwestern Switzerland; farther north by the Rhine, which divides France from Germany until the northeastern frontier leaves the Rhine plain near Rarlsruhe and, marching with the Saar. Luxembourg and Belgium. strikes the North sea east of Dunkirk (Dunkerque). On leaving the Rhine it runs through the foothills of the Vosges and Hunsriick ranges to Luxembourg; then through those of the Ardennes and finally through the featureless lowlands of Flanders.

Presenting broad faces to the North sea, to the Atlantic and to the Mediterranean, France is. therefore, a maritime state with access to important sea routes. By virtue of its long eastern border it is also linked closely with southeastern and with western central Europe.

PHYSIOGRAPHY

Geology. — The geological history of France can be briefly summarized as follows.

Two principal periods of mountain building have occurred in France since Archaean times. During the first. which took place toward the close of the Palaeozoic era, a mountain chain (part of a more extensive European one known as the Hercynian system) was raised, running from east to nest through the northern area of the country. A second system running from southwest to northeast was also created in the south and centre. A long period of erosion mostly reduced these two ranges of mountains to peneplains. The more uplifted remnants (now represented by the Vosges, the Ardennes, the Brittany uplands and the Massif Central) were subsequently covered by a thin layer of sedimentary rocks. Other areas of the country aere overlaid in greater thickness by deposits of limestones, sandstones, marls and clays left during the ages by the retreats of successive invading oceans. These are now the lowlands of the Paris and Aquitaine basins. the Flanders plain, the Rhône-Saône corridor and the Languedoc plain.

In mid-Tertiary times there took place a second period of folding, nhich created the Alps and the Pyrenees. During this folding the existing blocks of older rocks were further raised. The area of the Massif Central itself became a region of intense volcanic activity which created a new relief in the shape of plateaus or rugged crests. The more outlying areas of the north and west mere only gently folded by this new disturbance. Erosion, which followed in later Tertiary times, stripped much of the sedimentary cover from the older rocks and created valleys within their systems. This erosion reduced the northern area to a surface of low relief, diversified, honever, by bands of more resistant rocks. Into the low Aquitaine basin and the Rhône-Saône corridor Tertiary sediments were deposited by the mountain rivers. France escaped the ice sheets of Quaternary ages, but local icecaps in the country's mountains contributed to the creation of valleys and the deposit of additional debris into them and existing plains.

Thus, the principal and more surface geological divisions are briefly as follows: the Massif Central, of older crystalline rocks or more fertile volcanic and limestone; the Vosges and Ardennes, where granite is occasionally covered with sandstone; the peneplain of Brittany nhere granite is sometimes covered with slates or sandstones; and the folded Tertiary mountains of the Alps and pre-Alpine zones, created later and comprising high massifs of granite and crystalline rocks and lower ranges or plateaus of limestone and sandstone.

The chief lowland areas comprise: the Paris basin, varied and bordered by scarplands of limestone and sandstone, but mostly composed of sedimentary deposits laid down from Jurassic to Miocene times, in which alluviums, gravels and loam (loess, *limon*) predominate; the Flanders area, a district of clay, sand-capped ridges and chalk hills, under which lie the richest carboniferous strata of the country; and the Aquitaine basin of a later Tertiary formation than the Paris, where limestone is less frequent and sand or clay predominates and where gentle undulations replace scarplands. Other areas are the Languedoc plain of limestone and gravel in the south and the Rhône-Saône corridor, a structural depression between the Alps and the Massif Central, which has been filled in by Miocene and Pliocene sediments or glacial and fluvial deposits.

Natural Regions. — The surface of France is divided almost evenly between lowlands and hills or mountains. The principal lowland areas comprise a succession of valleys and plains interspersed with hills and plateaus which wheel in a deep rough arc from the Belgian border to the Pyrenees. Their base is the axis of mountains and outlying uplands from the Ardennes to the gate of Carcassonne which divides the southern tip of the Massif Central from the eastern Pyrenees. In the north and west the valleys run roughly from northwest to southeast and thus form natural arteries into the centre of the country. Access from the Mediterranean area is provided either to the east and to the centre by the Rhône and Saône corridor, which breaches the two great mountainous regions of the Alps and the Massif Central; or to the southwestern central areas by the gate of Carcassonne and the Garonne plain.

The most extensive and highest mountainous area is that of the Alps nhich occupies the southeast. There the highest massifs and peaks rise to more than 10.000 ft. (with Mont Blanc reaching 15,781). The Alps are, however, pierced by a number of great valleys leading to passes, which make them relatively easy to cross in all directions. The core of the Massif Central is composed rather of plateaus, with cones reaching heights of around 6,000 ft. Within its mountains spring the headwaters of some of France's largest rivers. The Pyrenees, dividing France from Spain, form on the French side a steep rampart dominating the plains of Aquitaine. Their highest peaks rise to more than 10.000 ft., and passes through the chain are relatively rare. The tno remaining mountainous areas in the east, the Jura (really part of the Alpine system) and the Vosges are lower (around 4,000 ft.), less extensive and of a more rounded and smoother relief than the other systems. When treating the geography of France in some detail, it is convenient to divide the country into various regions.

The Northeastern Region. — This region comprises the Flanders plain, part of the Ardennes and Lorraine. The Flanders plain stretches from the North sea southeastward for about 100 mi. The maritime area (Cap Blanc-Nez to the Belgian frontier) includes a low sandy coast bordered by dunes behind which lie reclaimed marshes and a flat clay plain. The hinterland is a rich agricultural region, linked to the ports of Calais, Dunkirk and Gravelines by canals. With its humid atmosphere and good soil it supports dairy cattle and horses. The maritime belt is succeeded by a low central plain, mostly of clay and relieved by occasional ridges. It is watered by various rivers and bounded on the southwest by the Artois uplands. There wheat, barley and hops are grown. To the southeast, the plain runs into the foothills of the Ardennes. Stretching through the centre is the most important coal field of France, to which metallurgical, engineering and textile industries are attached.

The foothills of the Ardennes limit the southeast of the plain (of the Ardennes, only the small southwestern area is in France). They rise into a plateau covered with forest and moors of peat and clay. The area is deeply cut by the gorges of the Meuse and its tributaries. A harsher climate and poorer wooded soil are general except in the deep river valleys nhere a varied agriculture is practised.

The southernmost part of the region comprises the limestone Lorraine plateau and plain, bounded on the nest by the scarplands of Champagne and on the east by the Vosges. The plateau, extensively wooded, is intersected by rivers (chief of which are the Saar, Moselle and Meuse) rising in the Vosges and in the lower border of southerly hills. Cultivation is practised, chiefly wheat, potatoes and beets and fruits together with stock raising. In the plateau area are found the rock salts and iron ore which support the Lorraine industry; in the Moselle valley coal deposits are being increasingly exploited.

The Paris Basin.—The Paris basin in the north and centre of the country roughly covers a geographic area of 110,000 sq.km. (42,471 sq.mi.) or about one-fifth of France. It is bounded on the northeast by the Artois hills, on the east by the Lorraine plateau and on the southeast by the Monts du Morvan and the plateau of Langres, which divide it from the corridor of the Sabne. To the south, the valleys of the central Loire, of the Cher and of the Indre may be included within the region; to the west, it merges into the eastern hills of Normandy; on the north it is bounded by the English channel. The principal artery is the Seine which, in its course, is fed by numerous rivers, especially from the east and southeast. Limestone is the predominant element and superficial deposits include clays, river alluvium and *limon,* the latter especially productive for cereal and root crops.

The basin itself can be divided into several areas, most of them covered nith a deep layer of linzon. The core (with Paris and its outskirts forming an urbanized and industrial centre) consists of various districts, each possessing many of the same economic characteristics. Brie, lying between the Marne and the Seine to the east of Paris, is a country of clay to the north and limestone to the south; it supports a varied agriculture, dairy cattle and sheep. Beauce, between the Seine and the Loire to the south, is a level expanse of limestone covered with limon and without important rivers; it is one of the granaries of France because of its fertile soil; and again cultivation is varied by the raising of cattle and sheep. The district watered by the Risle, Eure and Iton to the west of Paris is of similar soil but broken by deep river valleys and more nooded. That of Valois and the Soissonnais. lying to the north and to the northeast between the Oise and the Marne, is also a limestone area covered with limon, intersected by valleys and composed of rich farmlands.

The outer core of the Paris basin is composed of various districts. which stretch into the neighbouring provinces of Maine, Normandy, Picardy, Artois, Champagne and Berry. To the west lies the clayey bocage plateau of Perche, partly in Normandy and partly in Maine. This region is particularly celebrated for the breeding of horses. It merges to the north with the more open country of Neubourg and St. André, an agricultural area with an emphasis on the raising of young stock for export. To the north of the Seine lies the dissected chalk plateau of the Vexin, where agricultural pursuits are supplemented in the river valleys by a small-scale cotton and woollen industry; and the woodland and pastures of the clay soils of Bray, where flourishes particularly stock raising and dairy farming. Bordering the coasts lies the Ievel, open district of Caux, where a thick covering of limon supports arable farming and stock raising and where small textile towns are found in the valleys. Picardy, lying farther northeast, is a chalk upland, partly forested and divided by the valleys of the Somme, Authie and Canche. Where it is covered with limon intensive cultivation is found. Small towns specialize in sugar refining and distilling or in various branches of textiles. Farther north lie the bare chalk hills of Artois, bordered by the undulating meadow and woodland coastal area of the Boulonnais, again extensively cultivated or given over to stock raising.

The outer eastern area of the basin comprises the extensive Champagne plain. Its western fringe is composed of the Cbtes de Champagne, whose slopes, particularly south of Reims and around Epernay, form the vine-growing area of the province. In the extreme north bordering the Ardennes is a fertile area of cultivated and pasture lands. A large area of the north and northwest is, however, covered with forest, ponds and marshes.

Much of central Champagne (Champagne Pouilleuse) is a dry plateau of chalk without any covering of *limon* and with fertile areas only in the river valleys. Farther east is a wetter and richer district, supporting a mixed type of farming. In the southeast lies the more hilly, wooded and dry country of Bassigny. Weaving industries are found around Reims and Troyes, metallurgy in the St. Dizier-Joinville area.

The southeast of the Paris basin is enclosed by the Langres plateau and the Monts du Morvan. To the south bordering the northern limits of the Massif Central, lies a region of low hills and plains, which varies in character. Sologne, a little northwestward, is a sparsely populated district of sandy pine-covered soil or of marshland, capable in some places of supporting sheep; some attempt has been made to reclaim land there for agriculture. Farther south stretches the province of Berry. The Sancerrois in its northeast is a district of well-watered chalky hills which give a good pastureland. The centre of Berry comprises the wide loamy plain of the Champagne Berrichonne between the Loire and Chbteauroux. This offers a mixture of good arable land, sheep pasturages or wooded areas.

Farther southward and westward toward the northwest of the Massif Central lie the districts of Brenne, an area of sand and ponds, Boischaud, of fertile valleys, and the hilly Val Berrichon. In Berry extensive forests, abundant water power and the presence of iron ore formerly gave rise to a widespread metallurgical industry. This chiefly survives in Vierzon and its district.

Normandy.—Kormandy is divided into Haute Normandie and Basse Normandie. The former lies chiefly to the north of the Seine, and comprises the districts of the Vexin Normand, Caux and part of Bray, which have been considered as belonging to the Paris basin (see above). Along the coasts of Haute Normandie are the flourishing ports and fishing towns of Dieppe, St. Valéry, Fécamp and Le Havre.

Basse Kormandie is a much larger area, lying to the west and southwest and south of the province. Its more easterly plains, which may be said to fall geologically within the Paris basin, from the Campagne de Caen and Évrecy across the Lieuvin (around Lisieux) to Neubourg and St. André are widely covered nith *limon* and thus provide rich soils for the cultivation of grain crops and of fodders (for stock raising and fattening), fruit growing (*e.g.,* apples for cider or spirits) or for dairy production (*e.g.,* of cheeses, Camembert, Pont-l'Évêque, etc.). Farther west lie the areas of the Cotentin and the Bocage Normand. which belong geologically to the Armorican massif. The Cotentin peninsula is composed of central lowland and an extreme northern upland: the former comprises chiefly the Carentan plain and the Valognes basin, of alluvial soils, where drainage has considerably improved agricultural productivity; the upland resembles rather a bocage type of countryside. with coasts terminating in rocky headlands.

The whole area supports a scattered but relatively dense population, specializing particularly in stock raising and dairy farming. Western Normandy is chiefly composed of two parallel flat granite ridges, running from northwest to southeast, the Collines de Normandie (reaching about 1,200 ft.), each cut by the valleys of rivers or tributaries. Soils are chiefly clays or, in the higher parts, sands. The whole area is well wooded and chiefly devoted to rearing cattle and horses or to fruit growing.

Some industrial life is found within Basse Normandie. Mining and metallurgy are carried on around Caen and Cherbourg, weaving at Flers and Alençon and tanning and lacemaking on a small scale in various towns and villages.

Brittany.—Brittany, forming a peninsula to the west of Normandy, constitutes a peneplain out of which rivers have fashioned deep valleys; two parallel ranges of hills run from west to east within the interior. Locally, the province is divided into the "country of the sea" (Armor) and of "the woods" (Argoat). The former comprises an extremely indented rocky coast line. along which there is an intense maritime life, chiefly in numerous small ports situated on the estuaries. The sedentary element of the coastal population is occupied chiefly in the cultivation of vegetables. The interior of the province comprises the Rennes basin, an extensive area of lowland with fertile soil devoted chiefly to cereals, market gardening and stock raising; the Rohan plateau of moorland and woods in the centre; and. in the west, the Châteaulin basin, which is mainly a dairying region. Throughout the whole of the interior, vegetables, apples and the hardier grains are grown. Stock raising is intensively practised; in the east, horned cattle and in the west horses predominate.

The Provinces of the Lower Loire.—South of Normandy and Brittany lie the areas watered by the lower Loire and its tributaries the Mayenne, the Sarthe, the Vienne, etc. Maine, in the north. is divided into Haut and Bas Maine. The former and eastern part is a wooded region, interspersed with fertile soils which give rise to various agricultural pursuits. Bas Maine is country of a more bocage type. Throughout the whole province is a scattered population, practising stock raising and poultry rearing. Small deposits of iron ore, coal and slate are found, and, in addition, there exists some cultivation of linen and hemp. South of Maine lie the provinces of Anjou and Touraine, watered by the Loire and its tributaries. There a mild, sunny climate and fertile soil favour the cultivation of vines, fruits and various types of cereal. South of the Loire is the province of Poitou. Its western area, La Vendée, is, in the north, chiefly a dissected plateau of sandy and infertile soils whose vegetation is moor and gorse. or of a bocage type; but nearer the coast and to the south is a richer area supporting all types of cereal, stock and poultry.

The southwestern part of Poitou marches with the old maritime province of Aunis. The rest of the province comprises Bas Poitou, an area of plain and marshland where market gardening predominates; and the "gate" of Poitou. a low plateau between the northwestern outskirts of the Massif Central and the southeastern end of the Armorican massif, composed of chalk soils supporting livestock and crops and offering a ready means of access between the Paris and Aquitaine basins.

The Southwestern Plains.—A longitudinal expanse covering approximately one-seventh of France's surface begins south of Poitou. Its western border is the Bay of Biscay and its eastern the edge of the Massif Central. To the south it broadens eastward to include the wide valleys of the Dordogne, the Lot and the Garonne, so that its base stretches along the whole of the Pyrenees. In general, the area is one of varied agricultural occupations. Industries are chiefly found in the few large-sized towns.

The various geographical divisions of this extensive region are as follows: In the northwest, Angoumois on the east and Saintonge on the west form an area of limestone and marl, sloping gradually to the coast. Watered by the Charente and its tributaries, this area is one of open country, becoming somewhat swampy near the sea and the broad estuary of the Gironde, which forms its southwestern boundary. Much of the land is given over to arable farming, and there is extensive dairy farming. Along the eastern valleys between Saintes and Angoulême stretch the vineyards of the Cognac district.

To the southeast of Angoumois lie the plateaus of Périgord and Quercy. Périgord (with a general height of about 700 ft.) is of limestone and provides a poor cornland and pastures. The river valleys of the Dronne, Isle, Vézère and Dordogne, which cross it from east to west, offer, however, a much better soil on which a variety of cereals and fruits together with vines are grown. The still more southeasterly plateaus of Quercy are higher (reaching nearly 2,000 ft.), but their limestone has usually a poor productive soil, though the river valleys are wide and fertile.

From the western bank of the Gironde toward the Basses-Pyrénées and the Spanish border stretches the westernmost part of the ancient province of Guienne-et-Gascogne, a remnant of the former duchy of Aquitaine. This extensive area, now comprising the western and southern parts of the Gironde de'partement and the de'partement of the Landes, can be divided into several regions.

The whole of the long coastal belt is low, rectilinear and flanked by dunes. At its northern extremity, between the Bay of Biscay and the Gironde, lie the districts of Médoc and the Bordelais: there the coastal districts are marshy areas of sand or sandstone studded with ponds or covered with pines; inland the vines, fruits and vegetables are grown on low slopes. To the south of the Bordelais the coastal belt stretches monotonously in a flat broad plain behind the barrier of dunes. Formerly a waste of sand, swamps and dunes underlaid with an impervious deposit of "iron pan," large areas have been reclaimed by drainage and afforestation. Farther inland stretch the immense forests, chiefly pine, of the Grandes Landes. Large areas of these forests are composed of plantations, which have to a great extent curtailed the marshy pastures where herdsmen on stilts graze their flocks. The southern inland area of the Landes, the Chalosse, is a higher and more populated area, where is found the cultivation of wheat, maize and tobacco and certain mineral deposits.

East of the Landes stretches the broad Garonne valley, which forms the heart of Aquitaine. There is found the richest soil and the greatest density of population. In particular the Agenais, between the Lot and the Garonne, with its limestone soil yields good crops of wheat, vine and fruits.

South of the Agenais, across the Garonne, lies the district of Lomagne with its heavy and fertile soil favouring the cultivation of cereals and stock raising. Still farther south is Armagnac, an area of irrigated meadows of maize and wheat and vine-covered slopes. Again to the south, under the Pyrenees, stand the stony plateaus of Lannemezan and, westward, of Bigorre, arable or wooded in their lower areas but drier and affording a poor pasture higher up.

The Massif Central.—The Massif Central may be represented as an immense core around which the northern and western valleys and plains wheel. It covers roughly about one-sixth of France, and is the most important source of the country's rivers. The Massif Central itself can be divided into several well-defined areas.

The central area comprises the volcanic country of Auvergne, where cones or *puys* (*e.g.*, the Plomb du Cantal and Mont-Dore) rise up to around 6,000 ft. and massive plateaus are dissected by deep and often broad fertile valleys. The volcanic soils favour both cultivation and stock raising. The upper slopes of the mountains, snow covered in winter, offer a summer pasture which supports a migrant population. Cutting westward out of the volcanic mass run the headwaters of the great rivers which cross the Aquitaine plain, the Lot, the Dordogne and the Charente. To the east the Massif Central consists of a succession of south-north chains, divided principally by the river valleys of the Allier and the Loire, which broaden to the north and finally enter the southern borders of the Paris basin. The eastern boundary of the region is the Rhône valley.

In the southeast the Cévennes mountains form a dissected frame to the wide plain west of the Rhône delta. Along the valleys of the Cévennes grow wheat, olives and mulberries. Higher up are forests of beech and chestnut interspersed by summer pastures. South of the mountains of Auvergne lie the lava plateau of Aubrac and lower limestone plateaus (les Causses), cut by the headstreams of the Lot and of the Tarn. There sheep can be pastured and hardier cereals grown. The western and northwestern parts of the Massif constitute an extensive plateau deeply indented by the upper courses of numerous rivers. In the higher regions, the country consists of moors or poor grassland; in the lower, the soil supports intensive cattle raising and some production of cereals.

The Pyrenees.—The Pyrenees extend for about 300 mi. from the Bay of Biscay to the Mediterranean and form a natural frontier between France and Spain (roughly 60 mi. in depth at the centre, 20 in the west and 6 in the extreme east). Many of their peaks (particularly in the centre) rise to more than 10,000 ft., and passes through the barrier are relatively rare.

The chain can be divided into a western, a central and an eastern region. In the west, few dominating peaks are found; the mountains consist mostly of a high limestone plateau below 6,000 ft. Along the valleys grow vines and maize; on the lower slopes are woods of chestnut and ash; and good grazing land is common even in the higher levels. The central Pyrenees contain high massifs and peaks cut by transversal valleys and gorges through which the headwaters of the Garonne and its tributaries flow; the lower heights are covered by forests of ash and beech. In the eastern Pyrenees longitudinal valleys merge into basins or plains, and the influence of a warm climate is felt: vegetation on the mountain slopes is chiefly the cork oak and Mediterranean chestnut, broom and plants subsisting on a drier soil.

The *Mediterranean* Littoral.—From the eastern Pyrenees to the Italian border stretches the Mediterranean littoral. It can be divided into two areas: the low coastal Languedoc plain running eastward in a rough semicircle south of the Massif Central from the Roussillon valley to Marseilles; and the narrower band of Provence, where the southern Alps sometimes run down to the sea. Roussillon, an irrigated gravel vale, is an intensively cultivated area of vine and early vegetables, with marshes or ponds along the coast, from which in some cases land has been reclaimed. Along the coastal strip of the plain of Languedoc lie long belts of dunes enclosing lagoons; but farther inland are arid gravel lands, supporting extensive vineyards and backed by undulating limestone uplands nhich merge with the foothills of the Cévennes.

The lower Rhône valley and delta to the east of the plain comprise marshy lands such as the Camargue; drainage has turned much of the delta into rich farmland, pastures and market gardens, but the lower lands bordering the branches of the Rhône and its tributaries still remain swamp.

East of Marseilles begins the mountainous country of Provence. In the southernmost part of this province there is first a series of east-west limestone ranges and then the granitic Maures and Esterel mountains, between which lie broad plains. Agricultural production specializes in vines, wheat, fruits and flowers. To the northeast rise the Maritime Alps which at the eastern end of the littoral approach close to the coast. This is a higher dry area, sparsely populated except along the narrow coastal plain.

The Alps.—The French Alps stretch from Lake Geneva to the Mediterranean (about 248 mi.) and from the Rhône valley to the Italian border. They contain some of the greatest massifs and peaks of the Alpine system (Mont Blanc, 15,781 ft.) but are breached by wide valleys and passes.

The Alpine area can be divided into the lower limestone ranges stretching from Geneva to the Drôme valley, roughly the western section (Alpes de Savoie and du Dauphine). The eastern section comprises loftier granite and crystalline massifs of the western Alpes Pennines and Alpes Graies. where are to be found the highest peaks. Farther south lie the Alpes Cottiennes, crystalline massifs interspersed with limestone ranges; these higher ranges broken by deep narrow valleys offer little opportunity for' cultivation or even stock raising. At the southern end of the Alpine area are the Alpes Maritimes, chiefly of Jurassic and limestone rocks and, in general, of a poor soil supporting a scattered population.

Elevation governs to a large extent the economic value of this area. In the lower valleys (more common in the west) the soil produces cereals, fruits and vines. Above 2,500 ft. cultivation becomes rare, and vegetation chiefly comprises coniferous forests or extensive pasturages which form the greatest wealth of the Alps. These pasturages; many of which are summer ones, extend to the lower limits of perpetual snow (around 10,000 ft.); the lower slopes support cattle and the higher ones sheep or goats. Throughout the area is a scattered mineral wealth, \\-hich is only slightly exploited, but in the 20th century the numerous swift rivers were increasingly harnessed for the production of electric power.

The Rhône-Saône Valley.—The Rhône valley, dividing the Massif Central from the French Alps, extends from the Mediterranean to a point above Lyons. Thereafter the valley is continued northward by the broader plain of the Saône up to the Vosges mountains and the plateaus of eastern France. Thus, a continuous corridor about 340 mi. long leads to the eastern heart of the country. Easy access can also be obtained to the northwest through gaps between the north of the Massif Central and its northeasterly extensions. to the northeast through the Belfort gap and the north through the hlarne, Meuse and Moselle valleys.

From Avignon (the northern end of the Rhône plain), the corridor is relatively narrow. It is bordered by the poorly forested hills of Bas Dauphiné. Above Lyons the Saône cuts a wide band about 1 jo mi. in length and forms a fertile region of plains or low hills, watered by its various tributaries.

The Jura.—The Jura mountains form the eastern flank of the Saône plain and curve in an arc about 35 to 45 mi. broad for about 18; mi. to form the frontier between France and Switzerland. They are predominantly limestone ranges, rising to heights of 5,000 ft., and fall into two longitudinal sections known as the Folded Jbra and the Plateau Jura, the latter lying to the west and descending in stages to the SaBne plain. The whole area is relatively sparsely populated, with a poor soil.

The Rhine Valley.—The northern half of France's eastern border is formed by another broad river valley, the Rhine, stretching from the Swiss border to the German Palatinate and framed to the west by the Vosges. The alluvial plain in the extreme south is fertile, producing cereals, market-garden produce, hops and vines. Farther north around Mulhouse the soil becomes, however, gravelly, and toward the Rhine itself, forested. To the west, in the outlying valleys of the Vosges, is a considerable textile industry. The northern part of the plain is composed of very fertile soil, interspersed with small gravelly areas covered by forests. There are grown corn, sugar beets, tobacco, hops and fruits. Petroleum and mineral deposits give rise to various industries.

The *Vosges.*—The Vosges stretch northward in long rounded folds to the west of the plain of the Rhine, dividing it from Lorraine. They are divided into the Hautes Vosges in the south. a granite massif whose rounded tops rise to about 4,500 ft., and the Basses Vosges in the north, sandstone rocks of a lesser altitude. The former are breached by various low passes. They are well forested, and in their valleys stock raising is found side by side with textile and wood industries.

The Basses Vosges form a steep escarpment over the Rhine plain, but descend more gently eastward toward Lorraine. They also are well forested and supply wood for various minor industries. A more extensive occupation is that of glassmaking for numerous uses. Cultivation is mostly confined to potato growing for distillery and starch industries.

Vegetation. — The flora of France may be considered geographically as comprising four elements: the central European or continental, the oceanic or Lusitanian, the Mediterranean and the alpine.

In the northern and central regions of France, which include most of the country, the central European or continental type of vegetation is found. This consists, where the natural succession of plants has reached its climax, of deciduous summer forest, chiefly oak and beech. The valley of the lower Loire is marshy, but the highest hills south of the river are covered with moorland consisting largely of gorse and heather.

Part of the marshy plain between the Massif Central and the Loire has been planted with pines, birch and oak, but large tracts of gorse and bracken and areas of peaty moorland remain. Big stretches of oak and beech forest cover the upper slopes of the valleys of the Oise and lower Seine; the chalk land of Picardy, where tall poplars and willows line the banks of the Somme and where there is a marshy valley containing islands of market gardens which have to be reached by boat; the crest of a long ridge in the Pays d'Othe; the plateau of the Argonne, where the valleys are marshes with dense undergrowth; the southern part of Alsace, where there is also a great deal of marsh with willows and poplars; and the iimestone of Périgord, where truffles are found in the oakwoods. On the Jurassic limestone round Boulogne there is short-turfed downland, and on the rocks of the adjacent Marquise district gorse and heather predominate.

Along the Atlantic coast is the belt of oceanic or Lusitanian type of flora. There, in the wetter places, will be found moorland with willows, bog myrtle (*Myrica* gale). Sphagnum, *Pinguicula* lusitanica, two heaths, Erica *vagans* and E. ciliaris, etc. Where it is drier, scrub occurs with alder, stunted oaks (in the more sheltered parts), petty whin (genista anglica) and so on. On the uplands of Brittany and on the highlands south of the Loire are large tracts of moor and scrub. Behind the sand dunes of the Landes, farther south, the swamps have been drained and reafforested with pines.

The Mediterranean element occurs in the south, where olives, vines, mulberries and figs are common, with the strawberry tree (Arbutus *unedo*), laurels and the Mediterranean heath (Erica *mediterranea*). There the typical Mediterranean scrub communities, called maquis and garigue, are found. The former is low scrub, often dominated by the maritime pine (*Pinus pinaster*), with myrtle (*Myrtus communis*) and wild olive as its chief associates. The latter consists of discontinuous low scrub with large patches of bare soil: the kermes oak (Quercus coccifera) is often the dominant tree with broom and gorse, or there may be aromatic communities containing lavender, thyme, rosemary and other herbs. In Provence oranges are grown, and imported *Eucalyptus* and dwarf palms flourish in the hot sheltered places. Mediterranean conditions prevail in the Cévennes, where olives, mulberries and vines are grown in the valleys, while above them chestnuts have been planted for food, replacing the beeches; higher up still are grasslands. The forests of the south are largely of Aleppo pines (*Pinus halepensis*) and maritime pines with local woods of evergreen oaks, Spanish chestnut, etc. The eastern half of the Pyrenees bears forests of cork oak (*Quercus* suber) and kermes oak, Spanish chestnut and other Mediterranean types, while the western half supports a continental flora with forests of ash and beech on the lower slopes (see PYRENEES).

The alpine flora is found immediately below the snow line on the mountains. (See ALPS.) There grow the cushion plants such as *Silene acaulis,* Androsace, *Primula* and Saxifrage with mosses and lichens. Below the alpine zone comes the subalpine, where dwarf pines and juniper, bilberry and dwarf rhododendrons are among the flowering plants. Next below this, in the Alps, is a continuous belt of conifers, while on the lower slopes grow beeches, oaks and other deciduous trees. Large areas of forest have been turned into pastureland in the Alps. In the Vosges and the Jura there are extensive tracts of coniferous forest on the lower slopes with grassland, moorland and swamps higher up. Some of the higher parts of the Massif Central are covered with marsh and moorland, with woods of chestnut (grown for food) and beech.

Fauna. — Central European in character, the fauna of France includes about 90 species of mammals. The many fossil remains of prehistoric animals found show that the mammoth was once plentiful in the valleys of the Rhbne and the Sabne and in the Paris basin. The largest beast now living is the brown bear, still plentiful in the Pyrenees but in the Alps found only in the remoter forests. The wolf, very common up to 1880, became about 1900 in danger of disappearing from its haunts in the big stretches of forest scattered over the country, while the lynx completely disappeared. Other inhabitants of the forests include polecat and marten; the rarer wildcat, found in most of the big stretches of forest but not in Brittany or Normandy; the stoat, found in all but the southern forests; the rare sable of the east; the dormouse of the east and southeast; and the wild boar, especially common in the Haute-Marne and the Ardennes.

Roe deer live in nearly all the forests, in some of which they are protected, but red deer are much more restricted in their distribution. There are different species of chamois in the Alps and the Pyrenees, while the ibex, once very common in the Alps, was hunted out of the country. Among other beasts of the mountains are the alpine hare (*Lepus timidus*), which occurs above 5,000 ft.; the marmot, found up to 10,000 ft.; mountain varieties of bat, vole and shrew and, in the Pyrenees, a special kind of muskrat (*Galemys pyrenaicus*). The commonest mammals in the country are small insectivores, carnivores and rodents, including hedgehogs: shrews, moles, bats, foxes, weasels, squirrels, voles, mice and rabbits. Badgers are locally common, while hares are found chiefly in the northeast and hamsters are becoming increasingly rare. Most of the rivers contain otters, but beavers: once common in nearly all the rivers, are now found only in the Rhbne and the Camargue where they are protected. The brown rat (*Rattus norvegicus*) was introduced in 1750 and largely displaced the black rat (Rattus *rattus*), which probably came in at the time of the crusades. The mouth of the Somme is the home of a colony of seals, and there are porpoises and whales in the coastal waters.

A high proportion of the bird population of France consists of summer visitors which winter farther south. There are also many winter visitors and migrants. There are very few endemic species. In the Mediterranean region blackcaps, buntings, bee eaters and many others are common; terns nest in colonies along the south coast; in the Camargue stilts, flamingos, egrets and night herons breed; storks are seen especially in Alsace; eagles, falcons and vultures haunt the mountains, but the lammergeyer is only found in the Pyrenees. Wood pigeons visit the country in summer; pheasants became common after their introduction from Asia; red-legged partridges are found in the south and hazel hens in the eastern forests, but the capercaillie had almost disappeared by mid-20th century. The lapwing nests regularly, and curlews and kites are common when on migration. Woodcock and larks are frequently seen, and common everywhere are dunnocks, warblers, thrushes, tits, magpies, rooks and other passerines, owls, buzzards and harriers and waterfowl of various kinds. Round the coasts are numbers of oyster catchers. gulls and other sea birds.

Various species of frogs and toads, lizards, slowworms and snakes are found all over the country, but only in the south is the serpent lizard (*Chalcides* striatus) to be seen. Of river fish the most abundant are eels, chub. perch, pike. carp and roach. Salmon spawn in the Loire, Allier and Rhine and in the streams of the northnest. and trout live in the rivers of the north and in the lakes and streams of the Alps. Sturgeon, found in all river mouths in the middle ages, are now confined to the Rhbne and the Garonne; flounders, lampreys and mullet are caught round the coasts. Lobsters, crayfish, scorpions (in the Midi), insects and many other invertebrates are abundant.

Climate. — Two factors chiefly govern climatic conditions in France: the country's partly oceanic and partly continental position. and its variety of relief. Four broad types of climate can be distinguished: a western oceanic with moderate rainfall. less frequent in summer, and a relatively equable diurnal and annual temperature; a modified continental with more extremes of temperature and summer rain; a Mediterranean with hot dry summers and mild wetter winters; and a mountain one of cool summers and cold sunny winters.

Prevailing winds in winter are westerly and southwesterly in northern and western France. with periods of easterly over the northern area; and northwesterly in southern France. In summer they are westerly or northwesterly over most of the area. Two local winds which are experienced in the Mediterranean area are the mistral, a cold northerly one, sometimes of gale force and particularly common in the Rhône valley and in Languedoc; and the *marin,* a strong southeasterly which is also felt in the Garonne plain.

Temperature is governed by latitude, altitude and proximity to the sea. but no part of France is free from frost or snow except the most sheltered areas of the Mediterranean. In addition to this part of France, the coast of Brittany enjoys a temperate winter. In the higher areas of the centre and the east the mean winter temperature is below freezing and snow lies unmelted for considerable periods.

Rainfall is particularly heavy in the mountainous areas (more than 55 in. yearly) and in their adjacent hills and plateaus (31–55 in.) and also in Brittany, the Landes, the Cotentin and the hillier parts of Normandy and coastal areas of the northeast. Along the Mediterranean, the Garonne plain and large expanses of the centre it is between 23 and 31 in. with figures below 31 in. in certain districts.

TABLE I.—*Climate* Averages

		Brest	Paris	Strasbourg	Bordeaux	Marseilles
January	Temperature	44.8° F.	36.0° F.	31.5° F.	40.7° F.	43.4° F.
	Rainfall	3.2 in.	1.4 in.	1.3 in.	2.4 in.	1.9 in.
August	Temperature	62.6° F.	63.7° F.	63.9° F.	68.4° F.	71.1° F.
	Rainfall	2.0 in.	1.9 in.	2.7 in.	1.9 in.	0.9 in.

Table I gives some figures of temperature and rainfall representative of towns in different latitudes.

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HISTORY

Geographically, France occupies a happy position between continent and ocean. Situated at one extremity of that indented peninsula known as Europe, France is closely united to the body of the continent—at once and equally a maritime and a land power.

If its position between north and south made it from earliest times the meeting place of peoples, it has also had the task of defending on the north and east an extended land frontier and long seacoast. Hence French governments have been ever torn between two essential but not always reconcilable policies.

The foundation of Marseilles about 600 B.C. by Greeks from Phocaea in western Asia Minor affords the first approximately accurate date in French history. At that time the Mediterranean coast and much of the hinterland of what is now France was inhabited by the Ligurians. A second and even more important invasion was that of the Celts or Gauls, a tall. blond race who came from beyond the Rhine and spread themselves throughout Gaul in successive waves of immigration during the course of two or three centuries until it became a Celto-Ligurian country. Settled in distinct tribes, the Gauls never achieved a centralized government. The victory of Caesar over the Gauls (57–52 B.C.) was, above all, the result of the fact that he never had to face a united Gaul until. after six years of spasmodic effort, it united for a day round Vercingetorix only to die heroically at Alesia.

The Roman conquest brought civilization in its train. The assimilation of a conquered people is an essential of successful conquest, and in this art Rome was a past master. Roman rule was a harsh but beneficial discipline, and Gaul speedily forgot its independence, although an attempt was made (A.D. 259–273) to establish a separate Gallic empire. The Pax Romana was seen to be preferable to the former anarchy: as a result of the existence for three centuries of a common policy, language, religion and administration, Gaul prospered under the Romans. *(See* also GAUL.)

Despite the benefits of the Pax Romana, the strongest bond uniting Gaul and Roman was their common fear of the barbarians who thrust themselves unceasingly against the eastern frontier. Many times already the storm had burst over Gaul. It had required a Marius to stem the torrent of the Cimbri and Teutoni (102 B.c.), a Caesar to hurl back the Germans under Ariovistus into their mountain fastnesses (58 B.C.). Then the western horizon brightened until the disaster to Varus wounded cruelly the pride of an Augustus. Abandoning the conquest of Germany, the Romans for two centuries entrenched themselves behind the fortified frontier line that ran from Cologne to Regensburg, affording a protection to which the Gauls gratefully acquiesced. But under the pressure of migrating tribes upon those already settled, the German invasion gradually penetrated across the frontier, now in the guise of colonization, now in that of war. Suddenly, at the beginning of the jth century, under a violent forward thrust of the German tribes, themselves subjected to the pressure of the Huns, the Rhine frontier, denuded of guards by civil wars. was swept away. For 70 years (405–475) the tempest raged over Gaul.

The barbarians were groups of tribes and not a single nation. For them there mas so little question of substituting a barbarian empire for that of Rome (for which they entertained a superstitious reverence) that their conquests seemed to them illegitimate without imperial ratification. When the first storm had passed, the Visigoths had established a powerful kingdom from the Loire to Andalusia. The Burgundians set up another in the valleys of the Rhône and Saône. Finally, the Franks, divided into two groups, settled in northern Gaul: the Ripuarians round Cologne and the upper Moselle; the Salians round Cambrai and the Somme. For a last time all the barbarians, auxiliaries of Rome, ranged themselves under Aetius in 451 to overthrow near Chblons the hordes of Attila. Then the empire of the west retreated over the Alps to die.

The Roman Church, which survived the empire, inherited to some extent the imperial attitude toward barbarian Europe. Gradually the "City of God" came to take the place of the Roman state as the guardian of civilization. That they might re-establish order and maintain it, the bishops sought from the barbarian kings the support that they had hitherto received from the empire in their contest with the Arian heresy and with the survivals of paganism. But the Visigothic and Burgundian kings were infected with Arianism, and to them the bishops were inevitably opposed. The Franks, who were to give to the land its permanent designation and who were to play so great a role in its history, seemed as yet far from such pre-eminence: they were less civilized than the Visigoths and Burgundians, and they were pagans: and by a double paradox, it was this that helped them. Their strength as fighters enabled them to extend their power and keep out fresh invaders; and, further. the church has always preferred pagans to heretics. The conversion of Clovis to the Catholic faith was a master stroke: at one and the same time it made his fortune and that of the Franks. A common faith was to become the token of a unified state and the foundation stone of Christian France.

THE MEROVINGIANS

Clovis.—Clovis was the king of only one of the tribes of Salian Franks who, under his iather Childeric, had come in search of new lands to cultivate in the rich valleys of the Somme and the Oise. When the victory of Soissons (486) over Syagrius, last representative of the fallen Roman power in France, had brought the power of Clovis to the Seine and then to the Loire, Remigius, archbishop of Reims, made a swift decision. To Syagrius. now a fugitive among the Visigoths. he preferred Clovis, who as an ally could be as useful as he would certainly be dangerous as an enemy. For his part Clovis well understood that he would never bring Gaul beneath his sceptre without the support of the church and of the Catholic Gallo-Romans who were tired of anarchy. Clovis laid the foundations of the French state by his conversion to Christianity, due to his wife, Clotilda, and to Remigius, rather than by his victory over the Alamanni at Tolbiac (496).

From that time forth his conquests took on the character of holy wars: after the victory of Dijon in 500, he became nominal overlord of the king of Burgundy; in 507, by his victory at Vouillé, he set free the whole of Aquitaine from the Arian Visigoths and drove them into Septimania (the march of Gothia) and Spain. In order to prevent a possible coalition of the Frankish tribes that had remained heathen, Clovis deposed and assassinated their kings. In these murders the church saw only the divine reward to a faithful soldier and convert from paganism and gave its consecration to his triumph by appointing him to preside over the council of Orléans (511). Clovis, like the Christian emperors before him, became for the church a new David. Finally, the eastern emperor Anastasius, by sending him the consular emblems, gave a legal sanction to his rule, even as the church had sanctified his military conquests. Thus the Merovingian dynasty was enabled to hold sway for two centuries and a half.

The Successors of Clovis **(511–751).**—After the death of Clovis, his house produced no monarchs worthy to rank with him. Neither the Roman law nor the influence of Christianity was strong enough to preserve the unity of the state. The Frankish custom of partitioning the royal domains at the death of each king to the exclusion of the female line, as though the kingdom were a private estate, coupled with the avariciousness of the princes, occasioned constant civil wars. Thus at the death of Clovis (511) his domains were divided into four kingdoms (Reims, Paris, Orléans and Soissons). For 50 years, indeed, his heirs sought to continue his work and to add to his dominions. From 523 to j32 they subdued Burgundy and Provence, and love of booty brought their armies into Italy and Spain. They even attempted the conquest of Germany. Because of the accident of Clotaire I's surviving his three brothers the dominions of Clovis were reunited from 558 to 561. But on the death of Clotaire, his kingdom was once more divided among his four sons, and during the years 567–613 domestic tragedies checked the progress of the Merovingian power and took the place of wars of aggrandizement and pillage. No trace is to be found of any political ideal in the wars between Chilperic and Sigebert. Chilperic's murder of his Visigothic wife Galswintha may have caused her sister Brunhilda, wife of Sigebert, to urge her husband to make war, though ambition was urge enough. After Sigebert's death Brunhilda carried on the strife. Her bitter rivalry with Fredegond, Chilperic's widow, is the thread on which the history of continuous war is hung. The central authority grew steadily weaker. It was further threatened by the growing power of the bishops and great nobles against whose aggressions Brunhilda strove all her life. Two landmarks in this struggle are the treaty of Andelot in 587 and the edict of Clotaire II in 614 by which benefices granted to the aristocracy of high officials mere made tenable only for life. But these exhibitions of strength were but momentary and could do little to arrest the steady development toward the feudal days (see FEUDALISM). The ordinary freeman, unprotected because of the weakness of royal power, was driven to commend himself to the local bishop or great noble.

The Mayors of the Palace.—From the 7th century onward, the mayor of the palace (see MAYOR; MAYOR OF THE PALACE) seriously weakened the already failing authority of the kings. The palace in those days as in the time of the empire and in mediaeval times, was the court of the king and the seat of his government. The mayors controlled this ambulatory court and in effect controlled the state; they sought not only to be independent but also to establish over the rest of the Frankish kingdom the supremacy of that division over which they ruled. Some tried to re-establish a unified Frankish monarchy and the rule of the state over the church; others, who were distrustful of the idea of a single kingdom, sought above all to assure their own independence. For a century (613–714) these two opposing tendencies can be traced. After a brief revival of the royal power under Dagobert (628–638) there ensued its long decadence with meaningless partitions, perpetual minorities, the ever-increasing power of the mayors over the rois *fainéants* and, finally, the duel between the Neustrians of the west and the Austrasians of the east (see AUSTRASIA; NEUSTRIA) and the great conflict between Ebroin, mayor of Neustria, and Archbishop Léger, who was all-powerful in Burgundy. The battle of Tertry (687) finally decided the struggle in favour of the Austrasians under Pippin of Héristal; but the death agony of the degenerate Merovingian dynasty was prolonged until 751.

THE CAROLINGIANS

Merovingian savagery and chaos ended in a general paralysis of the state. A new Clovis was needed and found in Pippin II of Héristal. In his person he united the two great houses, of Pippin and of Arnulf, archbishop of Metz. The Pippins, from father to son, had succeeded to the mayoralty of the palace in Austrasia from 61j to 655. They had at their back a great company of vassals and vast landed estates; above all they had patience—without which nothing lasting can be built. It took them nearly 100 years to supplant the Merovingian by the Carolingian dynasty.

Pippin of Héristal governed under four kings. A pioneer, he began all those tasks which his descendants were to carry to completion; he himself was precipitate in nothing. As warrior, he defended the frontiers that were threatened by the Frisians, the Alamanni and Bavarians; as a son of the church, the descendant of Arnulf, he brought in the train of his armies missionaries through whom the Carolingians were to consolidate their conquests. He died in 714 without having deemed it opportune, or without having found the occasion to sweep away the phantom kings whose sole utility was to date charters and diplomas.

Charles **Martel (714–741).**—With Pippin's son Charles began the greatness of Austrasia. He accomplished successfully a fourfold task. Although a bastard, he asserted his power in Austrasia where he deposed his half brothers from the mayoralty. He achieved the supremacy of Austrasia over Neustria and Burgundy by the victory of Vincy (717). Frankish unity was re-established. He then defended Gaul against the Frisians, the Alamanni and the Bohemians. Without being any more conscious of his mission than Clovis had been, Charles proved himself another soldier of the cross by repelling 'the Moorish invasion at Poitiers (732), which won for him his appellation of Martel—"the Hammer."

An alliance with Charles Martel, the pacifier of Gaul, the protector of St. Boniface and the vanquisher of the "infidels," became ever more necessary to Pope Gregory III, menaced as he was by the Lombards, and promised to be even more fruitful than was that of Clovis with Remigius. Unable to forget that the Lombards had aided him in expelling the Saracens from Provence, Charles contented himself with professions of zeal.

Pippin the Short **(741–768).**—Pippin the Short at once took over and continued his father's work. In 747 he became sole master of the kingdom, for his elder brother, Carloman, became a monk and Pippin compelled Childeric III, the last of the rois *fainéants*, to shave his royal locks. Grifon, Pippin's half brother, was also set aside. It only remained for Pippin to assume the royal title. Consulting Pope Zacharias on this matter and receiving the answer that "he who exercises the king's power should enjoy the king's title," Pippin had himself crowned at Soissons in Nov. 751, an act which was further consecrated in 754 by the grander coronation in St. Denis, whereby the church pronounced the new dynasty to be holy and its title indisputable.

The title of patrician, also conferred by the pope, still further attached the dynasty to Rome. But these rewards mere not unearned. During 754–756 it was Pippin who founded, at the expense of the Lombards, that temporal power of the papacy which was to endure till 1870, the bulwark of their spiritual authority. The price for his consecration paid, Pippin, between 758 and 768, assured the safety of his kingdom on the farther bank of the Rhine against the Germans and Slavs, and against the Arabs to the south of the Pyrenees. Moreover, by the alliance of the greatest material force of the age with the greatest moral authority, the way was opened up for a restoration of the western empire.

Charlemagne **(768–814).**—On the death of Pippin in 768 the kingdom was divided between his two sons. Charles and Carloman; but in 771 Carloman died, and the whole of this great inheritance was united under Charlemagne. Charles devoted his half-barbarian genius to the service of the church and of the traditions of Rome, and in realizing this ideal of his age, earned his appellation of "the Great." He attempted to found an empire after the Roman model. Prevented by the Moors from founding its capital on a Mediterranean site, he placed it in his own native land. Austrasia, with the intention of doing for Germany what Caesar had accomplished for Gaul. Christianity, which had been the weakness of the old empire, was to be the strength of the new. The victory of the soldiers was to be completed by the victory of the missionaries. And thus would a common, religion unite peoples otherwise separated by blood, language and customs.

The conquest of Gaul, from Brittany to Gascony (769–811) assured for his armies a reserve of soldiers that cost him nothing, since military service was obligatory upon all free men. The poor and the serfs cultivated the land. Between 774 and 777 he consolidated the patrimony of St. Peter by the destruction of the Lombard kingdom, whose iron crown he placed on his own brow. On the eastern frontier he turned his forces against the Saxons, but it took him 32 years (772–804) and 18 campaigns before he was at last victorious. But. unlike the Gauls, despite compulsory baptism, destruction of their idols and deportation or massacre. these heathens submitted themselves unwillingly to "the easy yoke of Christ." Charlemagne fortified his frontiers by marches, or military districts, but in multiplying these advance posts the Frankish empire came into contact with new peoples—each one a prospective enemy. In Spain Charlemagne suffered disaster at Roncesvalles (A.D. 778; see CHARLEMAGNE) and afterward he created the Spanish march as a defense for his southern borders. From their camp on the Hungarian plain, the tireless cavalry of the Avars had overrun Bavaria in the very year of its subjugation by Charlernagne (788), and it was not before the Danubian lands had been devastated that this new menace mas destroyed. Meanwhile, behind the Elbe and the Saale, the Slavs of Bohemia were engaged in an unceasing warfare with the Saxons. and in the north the Danish pirates raided the coasts of the North sea and the channel. After 47 years of warfare, the Carolingian empire stretched from the Elbe to the Ebro, and from the Eider to the Tiber—growing greater day by day, but also exposed increasingly to attack. Charlemagne's power extended farther than his frontiers. Christian princes from beyond the channel and the Pyrenees, Moorish amirs from Fez and Baghdad visited his palaces or offered him presents, as to the great Christian emperors. Through men like Alcuin and Peter of Pisa the church taught this German—still primitive in many ways—the traditions of Rome and Byzantium. Why should not he be the heir to the Caesars? Why should he not restore, in his own favour, the empire of the west? Nothing was wanting save the imperial crown.

In 797 the empress of Constantinople had deposed and blinded her son Constantine VI, and the imperial throne might be considered vacant. In 799 the pope had been driven from Rome by a revolt and only restored by a Frankish army. The time was ripe, and at Christmas 800 Charles was crowned emperor by Pope Leo III.

Of the reconstituted empire, Charlemagne wished to be himself the lawgiver. He was himself the ruler of his empire. He made his power felt to the farthest extremities of the empire by his missi *dominici,* or representatives, by his courts, military, judicial or political. Highhanded with his people in this violent world, the emperor believed that he was no less responsible for their eternal salvation in the next. The *missi* enforced his spiritual as well as his temporal authority. By this administrative hierarchy and centralization on the Roman model Charlemagne reconstituted the superstructure of the imperial monarchy; but in legalizing by his caoitularies the fief and the *beneficium* he undermined the foundations of the edifice which he believed himself to be strengthening; by requiring from the greatest in the land the oath of fealty, he admitted that the sovereign of all needed in addition to be definitely acknowledged as the direct overlord of his most powerful subjects; by the extension of *beneficia* the small freeholder gradually disappeared to make room for the feudal tenant (see FEUDALISM). The poor freemen gave up their freedom to win protection from the neighbouring lord or prelate. Unable to prevent this development Charlemagne systematized it. thinking himself strong enough to turn it to his own account. As long as he lived he was successful; but, even during his lifetime. the treason of Ganelon proved that he was not always served by a Turpin or a Roland. His authority, powerful and respected, decayed because it depended on him and him alone.

When, in 814, Charlemagne was laid in his tomb at Aix-la-Chapelle, his work was buried with him. There remained only a twofold legend—the religious one that made of him a saint; the other that made of him the hero of French epic. Twenty-nine years after the death of Charlemagne his empire was divided into three separate kingdoms by the treaty of Verdun; and division succeeded division as the 9th century drew to its close. France became no more than a scrap heap of almost independent states, out of which feudalism was springing. The seignorial system, which had at first aggrandized the Carolingians, had also prepared their ruin.

Louis the Pious **(814–840).**—The empire devolved upon Louis the Pious or Affable (le *Débonnaire*)—titles indicative of his characteristics. so valuable in peace, so calamitous in times of stress. From the beginning of his reign the clumsy machine of government was out of his control. As his predecessors had done, he kept the entire sovereignty in his own hands, but divided his benefices and offices between his three sons, Lothair, the eldest, whom he associated with himself in the empire, Pippin and Louis. A fourth. Charles, was born to him in 823 of a second marriage, and to him he gave a share also. War between the brothers resulted: the imperial dignity became a laughingstock and Louis himself was twice deposed and imprisoned in a monastery. Scarcely was he buried at Metz (840) before his sons rushed to arms. Lothair desired to preserve the unity of the empire and the patronage of all the fiefs in one hand. Louis the German and Charles the Bald leagued themselves against him by the oath of Strasbourg. the first treaty in the history of France and Germany to be written in the vulgar tongue. An amicable partition of the paternal property was, however, clearly desirable and this was presently effected by a treaty made at Verdun in 843.

The Treaty of Verdun **(843).**—The treaty of Verdun marks an important turning point in history. Louis received for his share the land which was to become Germany; Lothair the title of emperor, with Italy and the valleys of the Rhône, the Saône and the Meuse, in addition to the two capitals, Rome and Aix-la-Chapelle; Charles, called the Bald, found himself the possessor of the rest of Gaul. The unity of the Carolingian empire was definitely broken. The boundaries between the kingdoms were ill-defined. That of Lothair, without a national basis, soon split up into transient principalities, so that the vast and indeterminate territories of Burgundy, Lorraine and Provence (*qq.v.*) were to be the battleground of modern France and Germany.

Charles the Bald **(840–877).**—Charles the Bald was the first king of western France. Anxious as he was to maintain the traditions of Charlemagne, he was not strong enough. Rather a man of culture than a warrior, he was obliged to spend his life sword in hand, fighting against the Bretons, against the people of Aquitaine who had appealed to Louis the German, against the Norman raiders who were becoming more and more insolent; fighting always, but always without success. He even found himself obliged to entrust the defense of his patrimony to Robert the Strong, duke of the country between the Loire and the Seine and ancestor of the Capetian dynasty. Unable to defend his own kingdom of western France, Charles the Bald yet coveted other crowns and looked obstinately eastward. He succeeded in becoming. in turn. king of Lorraine. emperor of Germany and king of Italy: an accumulation indeed of titles, but not of strength.

Growth of the Feudal System.—The great vassals of the crown had remained faithful to Charlemagne because they had had need of his protection. Under Charles the Bald, and still more under his successors, it was the prince aho had need of the nobles. Thus was the feudal system turned against the throne, for the great vassals took advantage of it to perpetuate themselves in their offices and in their fiefs and to gain possession of lands and authority. Little by little the monarchy lost influence. since it no longer performed any services; hence, from the end of the reign of Charles the Bald, there was left only the appearance of royalty—administrative officialdom. No longer deeply rooted in the soil, a shadow without effective force, it hovered above the local powers which encroached upon it, seized its land and divorced it from its subjects. The king, the lord of lords, was poorer than his lords; while they were establishing themselves in strong principalities. he alone was creating no strong territorial basis for his power. The great vassals were confirmed in their new rights by the capitularies of Mersen (847), of Pitres (862) and of Quierzy-sur-Oise (877).

Vassalage could only be a disintegrating, not a unifying factor. That this disintegrating process did not go on indefinitely was because of the existence of 12 or 1; great military commands—Flanders, Burgundy, Aquitaine, etc. (*qq.v.*). The duchy of France, which Robert the Strong had received as a reward for his services, grew into a powerful fief, but it was not strong enough to withstand outside attack. In 911 King Charles the Simple gave to Rollo, a Danish chief, the lordship of the district surrounding the lower reaches of the Seine, land nominally under the rule of the dukes of the French. Rollo began to build up the Norman duchy (see NORMANDY). The ecclesiastical fiefs emancipated themselves in the same manner as the lay fiefs, and ceased to sustain the royal authority unless it was given into their control. Day by day the disparity became clearer between the vastness of the Carolingian empire and the feeble administrative control of its weak rulers over a society once again become barbarian and menaced by other barbarians. None obeyed an emperor whom all hoped perhaps to supplant. Each country developed its individual life and language. The races no longer understood one another, nor possessed common ideals.

The Last Carolingians.—The death struggle of the Carolingians lasted for a century. Royal power, hitherto hereditary, tended to become elective. It was given to Charles the Bald's son, Louis the Stammerer, only after election by the great magnates and bishops under the leadership of the successor of Robert the Strong. Since the kings were no longer rendering service, they could no longer claim service from others, as in the case of Charles the Fat who narrowly escaped deposition for his incapacity and cowardice in the face of the Normans. After many intrigues, Odo (Eudes), son of Robert the Strong, was chosen as king in 838 on account of his brilliant defense of Paris. Henceforth there ensued a long duel between the Robertians and the Carolingians in which three times the Robertians were chosen and might have taken the crown but three times deemed it more expedient to favour the restoration of the Carolingians, or more advantageous to have the power without the title. Thus heredity was asserted in favour of Charles the Simple in 893, of Louis IV in 936, of Lothair in 954 and of Louis V in 986. The difficulty indeed was not the taking of the crown but the keeping of it when once taken. The dukes of France had rivals (notably Herbert of Vermandois) capable of crushing them by forming coalitions; and if the Robertians had the support of Normandy, the Carolingians had that of Germany. Moreover the support of the archbishop of Reims, faithfully rendered to the Carolingians, gave to them more distinction than that of the bishop of Sens gave to the Robertians. Consequently, Hugh the Great (d. 956; son of Robert, count of Paris, and grandson of Robert the Strong) was content to remain the kingmaker of the Carolingians, even as Pippin's descendants had been of the Merovingian *rois fainéants*. But by waiting for the fruit to ripen, he almost lost the chance of gathering it. The Carolingians whom he had had elected—Louis IV and Lothair—displayed a fresh energy and capacity. Was it the last flicker of a dying light or the long-delayed return of their fortune? For 30 years none knew on which side the balance would dip; but on the death of Louis V after a reign of only one year, the assembly of Senlis eliminated from the succession the rightful heir, Charles of Lorraine, and elected Hugh Capet, son of Hugh the Great. The final struggle followed. The conflict raged between Laon, the royal capital. and Reims, the ecclesiastical capital. The one ensured the kingdom of France; the other the crown. Hugh Capet won the first in 985 and the second in 987; but the prestige of the Carolingians was still such that their fall seemed to presage the end of the world.

THE CAPETIANS OF THE DIRECT LINE

The same difficulties that confronted the last Carolingians confronted the first Capetians. They inherited all the strength and weakness of the feudal system. Their strength was their central situation in the kingdom—the Ile-de-France. Their weakness was the possession of a very small domain surrounded on all sides: on the west by the county of Blois and the powerful duchy of Normandy; on the north and east by the counties of Flanders and Champagne and by the duchy of Burgundy. Beyond this little belt stretched provinces almost impenetrable to the royal authority—Brittany, Aquitaine, Gascony, Toulouse and the Spanish march. Thus the kings lay stifling in the midst of a feudal jungle which thrust itself upon their horizon and forced them to establish their power in the only two towns of any importance in their kingdom—Paris. the capital of the future. and Orléans, the city of learning. Their first responsibility was, therefore, to gain breathing space, to give their energies to practical politics and, above all, to avert their eyes from that chimera of a restored empire which had ruined their predecessors. If from 987 to 1060 they had not carefully avoided unequal combats they might have forfeited the hope of acquiring for the royal house those titles, greater than any resulting from feudal rights, which their descendants were to establish. Thus the beginnings of the Capetians gave less an impression of regeneration than of a prolongation of the decadence of the Carolingians.

Hugh Capet (987–996), due to his diplomacy rather than to his military strength, contrived to maintain his independence despite the opposition of Charles of Lorraine (the last descendant of the Carolingians), the insubordination of the great lords and the hostility of a pope who favoured the empire. Above all, by associating his son, Robert the Pious (996–1031), with him in the royal power while he himself still lived, Hugh Capet secured the future of his dynasty by suspending the feudal right of election, an act of political sagacity that his grandson, Henry I (1031–60), copied in 1059 in favour of his own son, Philip I. But their system was still too like that of the Carolingians, and it became necessary to change it. Apart from their prudent opportunism, the greatest merit of the early Capetians was that they had sons, so that their dynasty endured without unduly long minorities and quarrels over partitions of territory.

Philip I (1060–1108).—Philip I accomplished little during his long reign of. 48 years beyond the essential son and heir, Louis the Fat, and a slight expansion of the royal domain. Absorbed in carnal and material pleasures and in love of money, he remained a total stranger to the great events of his time. The conquest of England in 1066 by William of Normandy was begun while he was a minor and could do nothing to prevent it, but for the moment it diminished the pressure of Normandy upon his kingdom. The first crusade was preached in 1096 by a French pope, Urban II. Philip, excommunicated the year before, played no part in it; but indirectly the monarchy benefited, for while it increased the prestige of France in the east, it also weakened the power of the feudal lords who either perished in or were ruined by it.

Louis VI the Fat (1108–37).—After a century of lethargy, the Capetian power awoke again under Louis the Fat, who concentrated his energy on extending his territory and rendering it obedient. The summit of his ambition was to effectively establish the king's highway from Paris to Orléans, and during 34 years of war he purged his domain of feudal brigandage. To become master in his own house he allied himself to a communal movement in Amiens against his rival Enguerrand de Coucy, but—sublimely an opportunist—he suppressed a similar movement in Laon because of the connection with it of his enemy Thomas de Marle. If he refused to admit feudal principles in his own affairs, or to his own disadvantage, he invoked them quickly enough against the great feudal lords who were more powerful than he. Little more than a mere police officer, he had the church on his side, but he did not allow it to dominate his actions.

His principal minister, Suger, began as a simple monk and became abbot of St. Denis. His other officials were all unimportant people, trustworthy and dependent on him. Thus, the Holy Roman emperor Henry V, who sought to invade the kingdom in 1125, soon fell back before the united strength of the vassals and townsfolk rallied under the oriflamme of St. Denis. The moral unity of the land had become a political factor.

Louis VII (1137–SO).—His successor, Louis VII, almost destroyed his work at the very moment when circumstances were conspiring in his favour. The two powers of greatest danger to his kingdom—England and Germany—were rent by civil distractions and disputed successions. His marriage, on the other hand, with Eleanor, heiress of the duchy of Aquitaine, had increased the area of his kingdom fivefold. Suger, his father's minister, continued to give him the support of his wise and moderate counsel. But unhappily the second crusade, undertaken despite Suger's warnings and the doubts of the pope, inaugurated a series of magnificent but fruitless exploits. Quarrels with his wife were even more disastrous, and the death of Suger in 1151 deprived Louis of his wisest counsellor at the moment when the annulment of his marriage (March 1152) was compromising the fortunes of the Capetians. Two months after that annulment Eleanor found a youthful candidate for her dowry in Henry Plantagenet who thus added to his county of Anjou and his duchy of Normandy the whole southwest of France. Two years later he obtained the crown of England (1154) as Henry II. Henry and Louis at once began the struggle between England and France which lasted till the middle ages were almost ended. Wedged between the Angevin power and the German kingdom of Frederick Barbarossa, it was little less than a miracle that the French dynasty escaped extinction. Twice the church saved its devoted son by the moral prestige given him by the presence in France of a refugee pope and by the interdict which was placed on Henry II after the assassination of Thomas Becket. Happily, after 28 years in which three successive wives had given him daughters only, Louis was presented in 1165 with a son, Philip, whose birth averted the prospect of a war of succession.

Philip Augustus (1180–1223).—The new king began to give proofs of his energy and calculating ambition before his 20th birthday: in five years (1180–86) he freed himself from the Flemish tutelage of Philip of Alsace and from that of the counts of Champagne. But his major problem was to destroy the Angevin empire. The battle was a long one. Abandoned by his sons, Henry II in the moment of death was brought to submission. but Philip Augustus found himself confronted by a new English king, his former ally Richard Coeur de Lion. If he accompanied him to the crusade, he did so less from a desire to go than from a wish to return. His one interest was Richard's kingdom, and the absence of his rival seemed to him to afford an opportunity to despoil it. When Richard was captured in Germany on returning from his crusade Philip allied himself with Richard's brother, John, and they tried to bribe the emperor, Henry VI, to keep Richard a captive; but Richard bought his liberty, and the "devil at large" cost Philip all the fruits of his intrigues and shut him off from Normandy by the strong fortress of Château Gaillard. But the arrow that carried off Richard at the siege of Châlus and the misfortunes of his brother and successor, John, restored the fortunes of the Capetians. Philip seized Normandy; then Anjou, Touraine, Maine and most of Poitou fell into his hands. He failed, however, to conquer Guienne and Gascony. Fortunately for the future of his dynasty, Philip, instead of seeking to conquer England, marched against the allies of John in the northeast, the counts of Boulogne and of Flanders (1211–12). The power of the Capetians was now clearly very dangerous, and a European coalition was formed to combat it. The king of England, the emperor Otto and all the great lords of Flanders, Belgium and Lorraine allied themselves together. But the whole country responded to the call of Philip Augustus to repulse a feudal reaction allied with foreign intervention. The national victory at Bouvines (1214) placed the Capetians in an unrivalled position.

Anxious not to risk his gains, but desirous' rather of consolidating them by organization, Philip left to others the toil and trouble of conquests, the advantages of which were not for them. In 1216, when his son Louis wished to wrest the crown of England from John, then fighting with his barons, Philip intervened without appearing to do so, supporting and disavowing his son by turns. Likewise, when the church and the needy and fanatical nobility of northern and central France began to destroy the feudal power of the counts of Toulouse and the rich civilization of Languedoc in the Albigensian crusade (1209–29), Philip took no part in order to avoid the odium that attached itself to this act of bloody oppression: but it was for the royal house that Simon de Montfort, although he knew it not, conquered Languedoc. Henceforth, except for the English power in Guienne and Gascony, there was but one royal France embracing the whole kingdom.

As in war, so in peace, Philip Augustus was an efficient sovereign. If he did not love feudalism he liked theocracy no better—as is evidenced by his quarrels with Innocent III. He allied himself to the church on the condition that it should comply with his designs. He took advantage of its weakness in the midst of a violent age and gave to it the protection of the royal power, even in lands beyond his authority. In setting the feudal lords against each other, the king and the church found a common advantage. In furthering his antifeudal policy Philip similarly exploited the wish for security and the instinct of independence among the townspeople who were demanding henceforth an assured position in the feudal hierarchy. By means of the communes (*q.v.*) he was able to make a breach in feudalism and to exercise his royal authority far beyond his own domain. He did more. He gave to the monarchy instruments of government of which it was still in need: in Paris, a council of men of humble birth, but wise and loyal; in his domains, *baillis* or seneschals, all-powerful against the great nobles but submissive to himself; a treasury filled by the harsh exploitation of private wealth; an army that was no longer a temporary feudal levy but a permanent royal force; and, finally, a fixed capital where the university sprang up about the towers of Notre Dame. So strong had the monarchy become that the son of Philip Augustus was the first of the Capetians who did not need to be consecrated in his father's lifetime.

Louis VIII (1223–26).—Louis VIII continued his father's work, acquiring southern Poitou and large parts of Guienne-Gascony from Henry III of England and Languedoc from the Albigenses. In distributing great appanages among his sons he avoided family quarrels such as had brought Henry II of England to submission, and he facilitated unity by encouraging French customs in the more distant parts of the kingdom. But he lacked the time to reveal his capacity, for he died suddenly in 1226, leaving a foreign wife and infant son, the future Louis IX, behind him.

Louis IX (1226–70).—The queen mother, Blanche of Castile, assumed the regency and undertook the guardianship of her son. For nine years she ruled with a strength of character and a farsightedness that frustrated the enemies of the kingdom, who had hoped to take their revenge for Bouvines. In 1230 she even got help from the malcontent barons of the east against Peter of Dreux, who had transferred his homage for Brittany to Henry III of England. Raymund VII of Toulouse made his submission in 1229. The marriage of Louis to Margaret of Provence in 1234, to be followed by that of his brother Charles to her sister Beatrix in 1246, frustrated imperial designs on the "kingdom of Arles" (*q.v.*).

But Blanche's greatest work was the education of her son. She imbued him with that high morality that inspired not only his private life but the whole conception of kingship to which he remained faithful. In Louis IX morality entered the domain of politics; his sole aim was the good of the whole world and the reconciliation of all Christians in the name of a general crusade. Not that Louis was a monk: well-balanced, he inherited and exhibited the qualities of his house—courage, skill and common sense. But he added to these a new element—religious fervour, the spirit of Christ. Sometimes, indeed, he was forced to fight, as when the small nobility of the south of France rebelled under the leadership of Raymund Trancavel, viscount of Carcassonne, in 1240 or when Henry III sought to restore the English hold on Poitou. After the double victory of Taillebourg and Saintes (1242) Louis imposed terms on Henry III. Then he left for his first crusade in Egypt, which was to end disastrously. Louis indeed preferred negotiations to battles. On his return from Egypt, in the treaty of Corbeil (1258), he concluded with James I of Aragon an agreement whereby France renounced Catalonia and Roussillon in return for Aragon's renunciation of Toulouse and Languedoc (except Montpellier). By the treaty of Paris (1259) with Henry III, in exchange for the recognition of the conquests of Philip Augustus, Louis agreed to recognize Henry as his vassal not only for the remnant of Aquitaine that the English were still holding but also for large parts of the dioceses of Limoges. Périgueux and Cahors, with further conditional claims in the Agenais and Saintonge.

He won for himself and his kingdom a moral authority that made of him a universal arbiter: the oak of Vincennes under which, as it is said, he delighted to administer justice, cast its shade over all his policy. The peace was established among the princes and justice decided no longer by battle but by law. He intervened in the interests of serfs; he granted privileges to townspeople; and the book of the Establissemens des *mestiers* offered protection to the workers against exploitation by the masters. Having accomplished all this and notwithstanding his former failure, against the advice of his mother and his counsellors and even of the pope himself, Louis IX embarked on the crusade to Tunis in which he met his death on Aug. 25, 1270.

Philip the Bold (1270–85).—His son and successor, Philip III, departed from the wise traditions of Capetian policy. The death of Alphonse of Poitiers on the way back from Tunis meant that, as well as the crown of France, Philip inherited Poitou, Auvergne, Toulouse and the marquisate of Provence. The death of Henry I of Navarre, who was also count of Champagne (*q.v.*) and Brie in 1274 left his heiress, a three-year-old girl, in Philip's hands. Champagne and Brie were annexed to the crown and a marriage between the heiress and the king's second son (Philip, later Philip IV) arranged. These successes and the temporary success of Charles of Anjou (see CHARLES I, of Naples) in southern Italy encouraged Philip to look outside the boundaries of France for conquests. But the Sicilian Vespers (see VESPERS, SICILIAN) ended the hopes of Charles in Italy in 1282 and Philip's attempt to win the crown of Aragon for his son Charles of Valois failed in 1285. Philip III died on his way back from Spain.

Philip the Fair (1285–13141.—The new king, by methods completely opposite to those of St. Louis, won for his kingdom a pre-eminent position in Europe. His policy was simple. He sought to bring feudalism and the papacy into subjection to the monarchy by means of a more and more centralized administration. In his realism and his prudent ambition, and still more in his method of government, Philip was a man of the modem world.

With him the French monarchy formulated its ambitions and changed by degrees its feudal and ecclesiastical character for a legal constitution. His progressive and aggressive policy and his ruthless financial legislation were carried out by those lawyers of Normandy or the south who had been brought up in the school of Roman law, in the universities of Bologna and of Montpellier, raising themselves little by little to the political stage, and who were now leading the king and filling his *parlement.* It was no longer on religion or on morals but on imperial and Roman law that the *chevaliers ès lois* based the omnipotence of the ruler. Nothing indicates more clearly the new tradition which was growing up than this fact: all the great events in the reign of Philip the Fair were given at any rate the appearance of legal process. The first of these was with the papacy. The famous quarrel between papacy and empire had ended in the victory of the former. A new quarrel was opened by Boniface VIII with the kings of France and England. As vicar of Christ, the pope insisted that the temporal princes should render him the same obedience as they owed to God—an obedience not only spiritual but temporal. And thus, in effect, he laid claim to the benefices of all Christendom and refused to admit that any king could demand tithes from the clergy without the consent of the pope. The quarrel began in 1296: the bull *Clericis laicos* definitely forbade the clergy to pay taxes to the lay power. The king, whose expenses had increased with his wars *(see* below) and who had no revenues beyond those derived from his domains, was always short of money. The feudal lords, ruined by the crusades, and the lower classes, fleeced by everyone, could give but little. As in all times of crisis, Philip forbade the export of gold or silver from the kingdom. Thus deprived of his revenues from the French clergy, Boniface protested in vain. Philip's expenses were constantly increasing and he took violent measures to improve his financial position. Everyone who had dealings with him resented the constant attempts to raise money by tampering with the coinage. He both issued bad money and ordered by proclamation the value that should be put on it. Papal pretensions to interference in any matters that touched Philip's financial or political position could not be borne by the king and he used the meeting of national representatives, the states-general, to support the national cause against the pope. In a meeting in 1302 protests against papal oppression were made. Boniface determined to win the support of a council against Philip, whose ministers replied with a display of freedom of thought that was centuries in advance of the age. Guillaume de Nogaret (*q.v.*) travelled to Anagni, where he seized the person of Boniface with the object of bringing him, in his turn, before a council (Sept. 1303). A month later the pope became insane and died: the Capetians had conquered where the Hohenstaufen had failed. The Roman theocracy, which had thought to see its dream realized in the jubilee of 1300, found itself confronted by the captivity of the papacy at Avignon.

The affair of the Templars, also a matter of money, was another legal process carried out by Nogaret. As a military and religious order, the Templars had no longer any *raison d'être;* further, the order had the misfortune to be international and to have sided with Boniface; but its greatest crime was its wealth—for great financial powers become speedily unpopular: the Jews and the Lombards had already aroused popular dislike and envy. Philip made use of this hatred among the people, and also of the weakness of his creature, Pope Clement V. The trial of the order, though disguised under the imposing names of religion and morality, was in truth a political affair (1307–13); and this astonishing conclusion to the crusades resulted in a vast scheme of secularization that was the precursor of those in the 16th and 18th centuries.

Philip's foreign policy had the same litigious character. He instituted suits against his natural enemies—the duke of Guienne (king of England) and the count of Flanders, the former as powerful as his suzerain, and the latter at once the vassal of two rival sovereigns, the king of France and the Holy Roman emperor. Philip began his reign by settling the Sicilian and Aragonese adventures that he had inherited from his father.

Philip then seized upon a quarrel between English and French sailors to institute his customary legal procedure: a citation of the king of England before the *parlement* of Paris and, in case of default, a forfeiture to be followed by execution, that is to say, by the seizure of Guienne (1294–95). A truce brought about through the mediation of Boniface VIII restored Guienne to Edward I, gave him Philip's sister as wife and promised him the hand of Philip's daughter for his son (1298).

By a still more prolonged and unhappy lawsuit Philip sought to incorporate Flanders within his kingdom (1297–1312). Guy of Dampierre, who was lord of the country, had desired to marry his daughter to the eldest son of Edward I without the permission of his suzerain. Arrested and imprisoned in the Louvre, he was forced to deliver up Flanders (1297); but when James of Châtillon attempted in the king's name to take possession he found himself confronted by a rising of powerful counts and of turbulent and haughty republics of merchants and weavers, who had need of English wool for weaving the cloth that was the staple product of the land. The Flemish infantry overthrew the chivalry of France at Courtrai (*q.v.*) in 1302. By the treaty of Athis-sur-Orge (1305), which was a veritable masterpiece of chicanery, this luckless venture for France was momentarily settled. Philip secured the French-speaking towns of Lille, Douai and Valenciennes, but Flanders remained independent.

The efforts of Philip the Fair to expand his territory eastward met with greater success. His marriage had brought him one of the five great French fiefs—Champagne with Brie. Hard cash enabled him to extend his influence over the county of Chartres, Bar, the Lorraine bishoprics and Franche-Comté and to acquire Lyons and the Vivarais. Thus he removed the threat of encirclement which had been the preoccupation of the early Capetians. Disdaining the dream of imperial honours that haunted the mind of his brother and the lawyers, he turned all his energies toward the, eastern frontier, the line of least resistance, which might have yielded to him but for his death at the age of 46 (1314).

The Sons of Philip the Fair, 1314–28.—Philip's three sons continued his work. Louis X mastered the feudal reaction provoked in 1314 by the terrorist methods of his father's jurists. But in order to save the administrative and political gains of his predecessors he was compelled to sacrifice Enguerrand de Marigny, his minister of finance, to the mob fury roused by taxation as severe as it was necessary. In 1316 Louis died, leaving a daughter, Joan; his posthumous son, John I, lived only five days. Philip V the Tall therefore succeeded to the throne, and Charles IV the Fair followed Philip V in 1322 because it was impossible to permit France to be brought as a dowry to a strange prince. This precedent came to be known as the Salic law, yet it amounted to nothing more than the feudal rule that the whole domain returned to the crown in default of a male heir.

Under these eventless reigns, and also because of troubles in Germany and England, the development of the kingdom went on apace. In particular, under that born organizer Philip V, the administration was improved by the development of the judicial and financial departments out of the *conseil du roi.*

But with these kings the first direct male line of Hugh Capet failed. For three centuries and a half they had laboured greatly in founding a kingdom, a kingship and administrative institutions. Under Hugh Capet in 987 the territory of France was scarcely as great as two French *de'partements* of the present day; by 1328 it was equal in extent to 59 *de'partements.* The political unity of the kingdom was no longer impeded by about 15 great seignorial districts, but by 4 isolated fiefs: Flanders in the north, Brittany in the west, Burgundy in the east and Guienne in the south. For a long time unsettled, the capital was now established in the Louvre, which had been fortified by Philip Augustus. Like the fiefs, feudalism had been broken into pieces. The Capetians, though not of royal origin, had known how to create around them an administrative system in order to achieve order and centralization—the royal treasury of the Louvre; the *chambre des comptes;* the *parlement* dealing out a justice common to the whole realm; a royal currency; local representatives, provosts, *baillis* or seneschals. Two adversaries alone might have been dangerous; but one, the church, was now a captive in Avignon, and the second, the people, although they protested strongly against the taxes, had greatly prospered (if one may judge from the great booty captured by the English) and were consenting to efface themselves in the states-general behind the royal will. This well-established authority was also aided by the memory of St. Louis, and it was through the strength of this ideal that the royal prerogative survived the Hundred Years' War, in the course of which a unified monarchy arose and feudalism met its death.

THE VALOIS DYNASTY

With the extinction of the direct line of the house of Capet, the crown passed to a cadet branch, the Valois. On the death of Charles the Fair his cousin Philip of Valois became king as Philip VI.

Philip VI (1328–50).—On the new king's accession no one seriously thought of pressing the claim of the English king Edward III, grandson of Philip the Fair, least of all Edward himself. The Hundred Years' War (*q.v.*), the first period of which was to constitute the major preoccupation of the new reign, was aggravated rather than caused by the existence of this English claim. It began as a feudal dispute between a suzerain and his vassal.

Beginnings of the Hundred Years' War.—Gradual French encroachment on the English king's Aquitanian fief, under cover of legal process, had been begun under Charles the Fair and was at first quietly continued by Philip VI. But a distinct quarrel between the French and English kings had meanwhile been emerging from the Flemish question. The Flemish communes depended for their industry on imports of wool from England and barely tolerated the rule of the count of Flanders or that of his suzerain, the king of France. But after the French victory at Cassel (1328) Philip VI's authority had been established over them. Then Robert of Artois, who had married Philip's sister but was bitterly aggrieved at being dispossessed of the county of Artois, fled to England (1334) and was very well received. Prompted by him, Edward at last countered Philip's successes by prohibiting the export of wool from England to Flanders. As this reduced the Flemish industrial towns to idleness, Jacob van Artevelde (*q.v.*) incited them to break with France. Philip now retaliated by declaring Edward to have forfeited Guienne, and war broke out (1337).

The first important engagement was a disaster. The French fleet, which had been neglected for years, was destroyed at the battle of Sluys (1340). The sea was thus closed to France, but the war continued spasmodically on land. Flanders was overrun after the murder of Artevelde (1345). A war of succession had meanwhile broken out in Brittany between John of Montfort and Charles of Blois, the nephew of Philip VI. Edward naturally supported Montfort, and war went on in Brittany. The capture of Montfort did not end the struggle. Edward, setting out with a large army, exceptionally well provided with archers and including a small train of artillery, turned aside at the suggestion of a Norman exile, Godfrey of Harcourt, to land in the Cotentin and ravage defenseless Normandy. He raided almost up to Paris itself and turned northward to join his ships and so avoid a pitched battle while securing his booty. Followed and overtaken at Crécy, Edward achieved a complete victory over the French (Aug. 26, 1346). The subsequent capture of Calais (1347) afforded him a permanent gateway into France. These military disasters were followed by the Black Death, and Edward forebore to press his advantage, partly from prudence and partly because of the heavy cost. Before he died in 1350 Philip VI at least had the good fortune to add Montpellier and Dauphiné to his domain—the latter the future appanage of the eldest son of the French kings.

John the Good (1350–64).—Philip's son, John the Good, has commonly been reproached for his extravagance, romantic restlessness. brutality and recklessness. In truth. however, on ascending the throne, he found treason surrounding him on all sides—first Harcourt, next the constable d'Eu and then, in his own immediate family, Charles the Bad of Navarre. He crushed the traitors. but was driven, in default of any sufficient revenue, like Philip IV, to abuse his right of coinage. He spent money recklessly to win over Charles the Bad, who had betrayed him. As soon as Charles was imprisoned in Chbteau Gaillard, his followers deserted openly to England and the war began again. Edward III needed money as badly as John the Good. Wealthy by reason of its commerce and industry, England could borrow from the Florentine bankers under the security of a monopoly upon wool. But in France, which was solely an agricultural country, recourse could only be made to the inadequate and dangerous expedients of confiscation, debasement of the currency and arbitrary taxation. Regularly levied taxes could alone fill the treasury. In Nov. 1355 John summoned the states-general, which voted him aids on condition that they should be levied upon all classes and that their collection and application should be regulated by definite guarantees. The principle was a good one and resulted in the setting-up in France of representative institutions analogous to those which were already established in England; the estates, however, were no more fortunate than had been the monarchy in inducing the taxpayers to pay their impositions.

Thus it was that John came to fight and be captured at Poitiers (1356) with a well-nigh empty treasury and with troops no better equipped or disciplined than those which had been defeated at Crecy. Revolution followed. Confronted by a dauphin who was not yet of age, and amid the ruins of a discredited council, the states-general reassembled and, at the instance of Robert Lecoq, bishop of Laon, and of Étienne Marcel, provost of the merchants of Paris, the leaders of the Parisian representatives refused to co-operate with the dauphin's counsellors and determined to take him under their own tutelage. But politics at once took the place of considerations for the public weal, and they demanded the release of Charles the Bad. The dauphin hesitated; but, threatened with a rising, was forced to give way. In Feb. 1357 the states-general reassembled and transformed themselves, by means of the Grand Ordinance, into a deliberative, independent and permanent assembly. The government, at first seized by the middle classes, was soon under the revolutionaries led by Étienne Marcel; but the support of a name and a cause was imperative. This Marcel obtained through the coup de main which liberated Charles the Bad. But the murder of the marshals of Champagne and Normandy under the eyes of the dauphin (Feb. 22, 1358) and the consequent flight of the latter provoked in the noblesse and the states-general at Compiègne a strong loyalist reaction. At the same time the burghers in the barricaded capital, shocked at these crimes, deserted the reformers with their foreign allies. Neither the peasant rising of the Jacquerie, which was crushed at Meaux, nor a last, but unheeded, appeal to the towns, nor the uncertain alliance of Charles the Bad, whom he offered to make king of France, availed to save Marcel from death at the hands of the royalist party in Paris (July 31, 1358). As a consequence of the reaction that followed his death, the crown inherited the financial administration which the states-general had erected as a protection against its extravagance. Instead of being the representatives of the estates the *élus* and superintendents became officials like the *baillis* and provosts. Taxes, such as the hearth tax and the tax on salt, voted provisionally to meet the expense of war, were to be levied throughout the entire reign of Charles V and to be added to his personal revenues. The opportunity to found political liberty on the right to grant and control taxation was lost.

Treaty of *Brétigny*.—Besides the re-establishment of order in Paris, it was important to put an end to the wars with England and Navarre. This was done in the treaty of Brétigny (*q.v.*) by which (1360) John ceded a third of his kingdom to Edward III; but in the final draft, signed at Calais, John retained sovereignty over the ceded lands. John further obtained his liberty at the price of the enormous sum of 3,000,000 gold crowns, which he was never able to pay in full, and he returned to his pleasant captivity in England, where he died in 1364. But in its suffering and sorrow France was gradually realizing itself. Vanquished, it felt far more strongly than its king the shame of defeat. Local patriotism, like municipal patriotism, grew up in the peasants as in the burghers, and in a common hatred of the English was gradually founded a national feeling.

Charles V (1364–go).—The treaty of Brétigny, however, did not bring peace to the kingdom. For ten years the stragglers of the English, Navarrese and Breton armies, banded together in what mere known as the great companies, ravaged France till Charles V, *durement subtil et* sage, succeeded in sweeping them away. He persuaded their chiefs to lead them off wherever there was any fighting to be done—to Alsace, Brittany, Spain. With the help of Bertrand du Guesclin, a Breton adventurer of military genius, who became constable of France, some were trained to form an army to fight the English when war should be renewed. At the same time Charles fortified the towns and cities. A great diplomat, he made it his object to nullify the treaty of Brétigny by alliances with Flanders, the heiress of which he married to his brother Philip, duke of Burgundy; with Ferdinand of Portugal and with the emperor Charles IV. His alliance with Henry of Trastamara, the usurping king of Castile, was an inducement to the Black Prince to support the exiled Peter the Cruel. Debts incurred in Spain forced the Black Prince to try to raise money from his lands in France; the Gascon lords appealed to Charles V. Summoned to appear before the courts in Paris, the Black Prince failed to obey, and war was renewed in Gascony, Poitou and Normandy.

But this time *(1369)* different tactics were used. As the English still held to the employment of great masses of cavalry, Charles gave orders that the towns were to be defended and that the enemy was to be harried without risking a general engagement. Because of the prudent constable Du Guesclin, and the admiral Jean de Vienne, Charles was able, sitting quietly at home, to win back, bit by bit, all that his predecessors had rashly lost on the field of battle. When he died in *1380* the English possessions in France were reduced to Bayonne, Bordeaux, Brest, Cherbourg and Calais.

Charles VI (1380–1422).—The death of Charles V and the dynastic quarrels in England brought the war with that country to a close, but inaugurated a civil strife that lasted 35 years. Charles V's brothers at once fell to fighting for the regency of Charles VI, a child of *12,* and in the place of a strong central power there arose a republic of princes divided among themselves and wholly concerned for their personal interests. The faithful and wise counsellors of Charles V, whom the princes derisively called the *marmousets,* were removed, and the bad government of the king's uncles aroused widespread and increasing discontent. When they claimed to levy the aides which Charles V had renounced on his deathbed, the populace of Paris, armed with mallets, sought to murder the tax collectors. The great towns followed the example set by Paris and the Jacquerie was renewed in Auvergne and the Vivarais; but the battle of Roosebeke (1382), won by a French army over Flemish burgesses, reacted on the situation in France, and the forces of feudalism and of monarchy triumphed.

When he came of age, Charles VI recalled his father's counsellors to power, and in two months they restored order. But they could not control the king's pleasures, nor his extravagance, and when he became insane their rule came to an abrupt end (Aug. 5, 1392). Once more the king's uncles assumed the government, but instead of lessening the evil consequences of the king's insanity, they aggravated them.

War Between Burgundians and *Armagnacs.*—This time the combat was fought between two branches of the royal house—Orléans and Burgundy. Philip the Bold, duke of Burgundy, uncle of the king, had over his rival, Louis of Orléans, the king's brother, the advantages of superior age, of alliances with England and Germany, of wealth and great territorial possessions. The two opponents did not represent two different political programs: what each sought was to be the master of the intermittently insane Charles VI in order to exclude his rival from the pillage of the royal treasury. The contest became still more bitter when John the Fearless succeeded to the dukedom of Burgundy in 1404. Up to this time the queen, Isabella of Bavaria, had been held in a sort of dependence by Philip of Burgundy, who had brought about her marriage to Charles VI. Less desirous of power than of money, she suddenly became favourable to the side of the duke of Orléans. Whether it was passion or policy, it cost the duke his life, for John the Fearless had him assassinated, (1407) and thus set loose against each other the parties known as the Burgundians and Armagnacs, the latter so-called because the son of the murdered duke, Charles of Orléans, was the son-in-law of the count of Armagnac (*q.v.*). Despite all efforts to effect a reconciliation, the whole country divided itself into two camps, the south and west supporting the Armagnacs and the north and east the Burgundians. Paris, with its tradesmen—above all the butchers—and its university, played a prominent part in the quarrel, for to be master of Paris was to be master of the king.

In *1413,* as a result of the rising of the Cabochiens (the butchers led by Simon Caboche), the duke of Burgundy gained the upper hand. Out of this daring combination of brute force and idealism sprang the famous Ordonnance *cabochienne,* a practical program of financial reform. Unhappily the time was lacking in which to give it effect,nor were the actions of its authors in accord with the spirit of the ordinance. The government was at the mercy of the mob which was itself terrorized by turbulent and incapable leaders. The conflict ended in a war of factions between the carpenters under Cirasse and the butchers under Caboche. John the Fearless fled from Paris, and the Armagnacs entered the city in his rear; from Dec. 12, 1413, until July *28,* 1414, the white terror took the place of the red. These disorders allowed Henry V of England to resume the offensive.

War With England: *Agincourt.*—A national disaster was the reward of these internecine feuds. At Agincourt (1415), as at Crécy and Poitiers, the chivalry of France was shown to be incapable of playing the soldier in real warfare. Charles of Orléans was taken prisoner and John the Fearless, who had held aloof from war. set out to return to Paris. The Armagnacs were discredited by defeat, but the duke of Burgundy did not take advantage of the situation.

An unnatural alliance between Burgundy and the queen led to a renewal of civil war, and Henry V, seizing his chance, occupied Normandy and in two years destroyed the work of Philip Augustus. No serious resistance was anywhere offered, and the common need urged the duke of Burgundy to seek alliance with the Armagnacs, in whose hands was the heir to the throne, the dauphin Charles. But the assassination of John the Fearless at the conference at Montereau in 1419 by members of the dauphin's household was a fatal mistake: the whole Burgundian party, with them the queen, made a close alliance with the English. This treacherous assassination gave renewed life to the feuds which were showing signs of dying a natural death in the face of foreign invasion. By the treaty of Troyes (1420) Henry V, who was to marry Catherine, daughter of Charles VI, was recognized as heir to the French throne instead of the dauphin Charles. When Henry V and Charles VI died in 1422, Henry VI, with the aid of the new duke of Burgundy, Philip the Good, was proclaimed in Paris as king of France and England. In 1423 the English held not only Guienne but also the whole of northern and eastern France; and the two chief institutions in the land—the university and the *parlement* of Paris—acknowledged the English king.

Charles VII (1422–61).—But the greatest weakness of the French was again the king himself, Charles VII, the "king of Bourges" as he was commonly called. This youth of *19,* born of a madman and a loose-living Bavarian princess, timorous and suspicious, was the symbol of France itself. After his victories of Cravant and Verneuil (1424), the duke of Bedford, regent for the young Henry VI, gave Charles a respite of four years. But Charles's favourites, Pierre de Giac and Georges de la Trémoille, solely occupied in lining their own pockets, surrounded the king with intrigues. The banishment of the constable Richemont, the one forceful man about Charles, was secured and the unhappy king faced the tragic hour when Orléans, the last bulwark of the south, besieged by the earl of Salisbury, was about to fall *(1428).* He had neither the desire nor the means of Philip VI or John the Good to undertake reckless military expeditions to defend his country. A policy of withholding his hand from a vain display of military strength which might easily be broken had served Charles V well, but Charles VII had not his grandfather's skill, nor was he acting on any well-thought-out plan.

Joan of Arc.—Help came to him from an unexpected quarter. The cruel, prolonged war had year by year stimulated the growth of a national feeling against the English. La *grande pitié* qui *était* au royaurne de France was suddenly incarnated one day in the person of a young girl from Domremy in the Barrois, inspired with a stubborn faith and an exalted spirituality. The timid counsels of the army commanders, the not disinterested doubts of the courtiers, the criticism of experts and the questions of the doctors, she countered and overcame by her "voices." They told her, she said, to raise the siege of Orléans and to lead the gentle dauphin to Reims for his coronation.

Her sublime folly was to prove itself wiser than all their wisdom. In two months (May–July 1429) she raised the siege of Orléans, destroyed the prestige of the English army at Patay and brought the hesitating and spiritless king, in spite of himself, to his coronation at Reims—an event that was to have an extraordinary political effect throughout France. Through her, Charles VII was accepted without question as "the man to whom the kingdom of France ought to belong." After Reims the Maid's first thought was of Paris and of completing the destruction of the English. A check outside Paris enabled the jealousy of La Trémoille to use the Maid for eight months in secondary operations until the day when, under the walls of Compikgne, she was captured by the Burgundians and sold by them to the English. She was placed on trial, condemned to death and was burned alive at Rouen on May 30, 1431. (See JOAN OF ARC.)

The End of the Hundred Years' War.—Her martyrdom paved the way for the realization of one of the Maid's dearest wishes: the reconciliation of the warring parties in France. The English regent, Bedford, had with difficulty kept the Burgundian alliance. It was strained by the duke of Gloucester's marriage with Jacoba of Hainault and the consequent quarrel between Burgundy and Gloucester. It was broken when on the death of his wife, Anne of Burgundy, Philip's sister, Bedford married a vassal of Burgundy, Jacquetta of Luxembourg. The overthrow of the favourite La Trémoille through the agency of the constable Richemont removed the last barrier to agreement. Hard though its terms were, the treaty of Arras enabled a united France to expel the English from the east and opened the way for the king's return to Paris (1436). During the next three years famine, plague, the atrocities of the *écorcheurs* or flayers and finally the aristocratic rising of the Praguerie completed the misery of the country. But during the truce with England Charles VII succeeded, with the aid of the brothers Bureau, in establishing the first permanent royal army (1445) and, with that of Jacques Coeur (*q.v.*), in paying for it by means of a permanent tax (1449). But he repaid his servants with the ingratitude that he had shown toward Joan of Arc, whose fame he rehabilitated only in 1450. Meanwhile the English, weakened by the death of Bedford, continued to wage war unsuccessfully and to lose their possessions. Normandy dropped from their hands at Formigny (1450); Guienne, which had been English since the 12th century, was lost at Castillon (1453). Calais alone remained to them, and now it was they who were ruled over by a madman, Henry VI. France emerged from the Hundred Years' War victorious, but ruined and depopulated. Her patriotism, in the broadest sense, had been stimulated by the menace of dismemberment. But the victory was, above all, a victory for absolutism. The distracted nation, preferring established order to insecure liberty, was content to abandon all attempt to control the government and to give itself up to the enjoyment of living in peace. The king and the nation, now more at one and trusting each other better. pursued a utilitarian and steady policy along lines set for them by the natural resources and extent of the kingdom. Thus, when England was engulfed in the Wars of the Roses and the menace of the Habsburg empire rose up behind the indeterminate frontiers on the east, Charles VII turned toward Lorraine and Alsace. Toul and Verdun claimed his protection; but the opportunity had passed for annexing them without grave difficulty. On the other hand the appanages that under the Capets had guarded the unity of the kingdom had given rise under the Valois to a new and powerful feudal baronage. (X.)

Louis XI (1461–83).—The second half of the 15th century, from the end of the wars with England, was a decisive period for France. Political problems that had existed for several centuries were solved; the social system of the middle ages was undergoing a rapid change; and a modern state was taking the place of the feudal monarchy. Under Louis XI these developments were accelerated, to some extent as a result of Louis's own designs.

Louis had simple tastes and a bourgeois outlook. Mistrustful of the nobles, he liked the common people. Opposed to luxury, he wore old-fashioned clothes decked with relics and holy medals. But his modest exterior went with a very clear idea of his own authority, which he imposed invariably without regard to methods. Modelling himself on the contemporary Italian despots, he was determined to proceed toward absolute government and applied all his resources to this end. Quick-witted and scheming, he preferred intrigue and secret diplomacy to war; but he was sometimes too imaginative to appreciate a situation correctly: His mistakes of judgment were enormous and laid him open to surprises which make one question his statesmanship; he lacked foresight and, indeed, political sense. Thus he owed his successes largely to his skill in extricating himself from a false position and, above all, to the surprising accidents which removed his opponents. His character, good and bad, is precisely summed up in the phrase *universelle* aragne (universal spider).

On his accession France was barely out of the Hundred Years' War, and there was no proof that it would have anything more than a truce to enjoy. The threat of invasion remained. At home the great feudal states, used to independence, were a menace to the kingdom—especially the duchy of Burgundy which, by a series of fortunate acquisitions, had become a formidable power in the no man's land of Lotharingia (still hanging between France and the empire). The dukes did not owe allegiance to the king of France even for their fiefs within his frontiers and usually joined his enemies or organized coalitions of princes against him. Philip the Good, who had solidified the power of Burgundy, was to be succeeded by Charles of Charolais (Charles the Bold), who was determined to withstand the king in France and to create a kingdom for himself. Louis XI would have to defend himself against more than one feudal coalition.

The first was provoked, from 1465, by certain measures of a clumsily severe or arbitrary character. This was the League of the Public Weal (Ligue du Bien Public), in which Charles of Charolais had the support of Francis II of Brittany, of John II of Bourbon and of Louis's own brother Charles of France. Louis had assisted at the birth of this league without suspecting anything. His army met the rebels at Montlhéry near Paris without any decisive result, and the matter was closed by the treaties of Conflans and St. Maur, whereby Louis granted favours and lands to the conspirators, in particular the Somme towns to the duke of Burgundy and the duchy of Normandy, in exchange for Berry, to his brother Charles.

In 1467 there was a new coalition in preparation. To resist it, Louis saw fit to arrange for a revolt to take place at Likge against the Burgundian domination at the very moment when he was to be negotiating in person with Charles the Bold on his own territory at Péronne. News of the revolt arrived when he was in the duke's hands; and he was kept a prisoner (1468) and had to give in, promising to fulfil all previous treaties and making further concessions; he even went with Charles to help in suppressing the revolt at Likge.

Yet another coalition was formed in 1472, this time with the backing of the English, who were preparing a new invasion of France. But Charles the Bold failed at the siege of Beauvais; and when Edward IV landed with a solid force of 20,000 men he found himself unable to join his ally, who was involved in an ill-advised enterprise on the Rhine. Louis managed to come to terms with Edward and induced him to sign the treaty of Picquigny, whereby Ed ard was satisfied with an indemnity (1475). The English peril seemed henceforth to be receding.

At the same time Charles the Bold was undertaking adventures that turned his attention away from France. He dreamed of conquests on the Rhine, in Lorraine and in Alsace—to unite his possessions in Burgundy with those in the Low Countries. The duke of Lorraine, the Swiss cantons and the Austrian Habsburgs were alike threatened by these ambitions, and Louis's diplomacy gathered all these powers into the Union of Constance, which was to deal definitively with his adversary. Charles seemed likely to be crushed by a general coalition; then Louis, by an unaccountable change of face, withdrew from the struggle and signed the truce of Souleuvres with him. Charles went to war against the Swiss, who defeated him at Grandson and Morat (1467), then against the duke of Lorraine. He was killed under the walls of Nancy (1477), and this chance occurrence gave Louis XI his victory.

Louis showed himself no better advised in settling the Burgundian succession, which devolved on Charles's only daughter Mary. He had the right to take all the provinces comprised within the kingdom by marrying the heiress to a prince of his own choosing, who could well have been the dauphin; and he was strong enough to be able to impose this solution. But he was pleased to make certain unco-ordinated acquisitions while Mary of Burgundy discovered a protector in the Austrian archduke Maximilian, the future emperor. The treaty of Arras (1482) conceded the duchy of Burgundy, Franche-Comté, Artois and Picardy to France. It was a gain, but a limited one; and it gave rise to the conflict that was to set Austria and France rgainst one another for 300 years.

Throughout his reign Louis had continually intrigued in Spain, with a view to the acquisition of Roussillon and Catalonia. There too he wasted his energies without understanding that his object could never be wholly realized. He got Roussillon, but by doing so precipitated the union of Aragon and Castile and the unification of Spain which, when it was joined with the power of Austria under Charles V, was to constitute a grave danger to the future of France. Within the kingdom Louis had to discipline his nobles and to extend the royal domain at the expense of the princes' territories. He sought to restore everywhere the order that had been compromised for a century by the decline of the king's authority. To this end he meant to break all resistance, laying the foundations of an absolute monarchy. The nobles were treated harshly, the king's enemies imprisoned or put to death; the Armagnac dynasty was annihilated; and on the death of King René the duchy of Anjou and the county of Provence were incorporated in the royal domain. The church was likewise under control: in reaction against the methods of Charles VII, who had issued the Pragmatic Sanction of 1438 (to exempt the clergy from all obligation toward the pope and to give it the right of free election of bishops and abbots), Louis signed a concordat which gave the pope the right to intervene in the bestowal of benefices. As for the states-general, they were convened not to formulate the demands of the nation but to approve the king's decisions.

Louis desired above all to have plentiful resources and a strong army. Pressure was put on the towns and on the provincial estates. The taille. a tax imposed by the king for the upkeep of the army, was quadrupled in the course of Louis's reign; and the personnel of the army was expanded through the *compagnies d'ordonnance* and the francs-archers. A quantity of artillery was provided. An army of this sort made sure of the submission of the nobility throughout the kingdom.

Louis also concerned himself with reviving economic activity after the devastations of the Hundred Years' War; towns had been depopulated, trade interrupted, the countryside left untilled. The restoration of the productivity of the land was an immense task and would call for the labour of more than one generation. Louis recognized these problems and took some effective measures: he tried to introduce a silk industry and inaugurated the Lyons fairs. But the peace within the kingdom which made it possible to resume work in safety throughout the rural areas was still more effective than these governmental undertakings. When Louis died in 1483 the kingdom was richer and the king's authority greater than when he came to the throne.

Charles VIII (1483–%).—The 13-year-old dauphin Charles was incapable of governing; nor was he ever to show any aptitude for it. He was physically degenerate and of poor intelligence. The reading of novels of chivalry confused his outlook and inspired the Italian expedition, an adventure gratuitously initiated and madly pursued.

In the first years of the reign government was in the hands of Charles's sister, Anne of Beaujeu (Anne of France) who had married Duke Peter II of Bourbon. Anne had the mind and the vitality required for her task in difficult circumstances, where moreover she had to resist the aristocratic reaction inevitable at the end of Louis XI's authoritarian reign. She and her husband, guardians of Charles VIII, begdn by making concessions. Certain agents of Louis's were sacrificed to the anger of the *parlement*, and lands were restored to hostile nobles, of whom the chief was Louis, duke of Orléans (afterward Louis XII of France), a son-in-law of Louis XI. They even authorized the states-general to meet at Tours (1484); and for the first time the country districts as well as the towns were represented there. The royal party, however, succeeded in making the states-general reject the duke of Orléans' demand that he should be regent and in packing the *conseil du roi* with their supporters. Once supplies had been voted, they could ignore such demands as the control of taxation and the summons of a meeting of the states-general every two years. The malcontent party next attempted to obtain by revolt what the estates had failed to secure. Thus began the "Mad War" in which the king had to fight the dukes of Orléans and Brittany supported by Henry VII of England and the archduke Maximilian. The war ended with the royal victory of St. Aubin-du-Cormier (1488).

This victory was decisive in solving the question of the Breton succession. Duke Francis II had only a daughter, Anne, whose marriage would determine the future of the duchy. It was Charles VIII who got her; and the marriage treaty, if it did not prescribe the annexation of Brittany, at least effected the personal union of the heads of the two states, from which the union of the states themselves was to result (1491).

After this success the kingdom was secure, and there was no cause for Charles to be drawn into new enterprises. But absurd ambitions now attracted him to Italy, where he wanted to give effectto the rights that he had inherited from the dukes of Anjou. For more than 50 years the French kings were to have to engage their armies and spend their money on adventures that made them the dupes of the Italian princes and gave them only a little vainglory to balance against some serious reverses.

In preparation for his campaign, Charles wanted to conciliate his adversaries by meeting their demands; he restored Roussillon to Ferdinand II of Aragon and Artois and Franche-Comté to Maximilian and paid a heavy indemnity to Henry VII. He raised an army at great expense, borrowing money right and left, and crossed Italy unopposed (1494), without suspecting that he was leaving enemies in his rear. He entered Naples in triumph but had to leave shortly afterward when a coalition threatened to cut his communications. He escaped with difficulty from the battle of Fornovo and had lost his conquests when he returned to France (1495). He was preparing another expedition at the time of his death (1498).

Louis **XII (1498–1515)**.—The crown passed to the duke of Orléans, who had taken part in every aristocratic rising of the previous reigns but had now had time to grow wiser; indeed his premature old age won him that reputation of "father of the people" which hired writers handed down to posterity — though in fact his rule was authoritarian and as costly and oppressive as that of his predecessors. He entertained Charles VIII's designs on Italy augmented by claims to the Milanese, representing himself as having inherited it through his grandmother Valentina Visconti.

Louis XII began by marrying Charles VIII's widow Anne of Brittany, as was necessary in order to keep Brittany united to France. To this end he had to divorce his first wife, Joan of France, which gave rise to great scandal. Simultaneously he concerned himself with Italian politics, aided by Georges Cardinal d'Amboise, his prime minister, who was ready however to use French policy to further his own ambition to become pope. Two successive campaigns (1499–1500) led to the conquest of the duchy of Milan. Then Louis allied himself with Ferdinand of Aragon for the partition of the kingdom of Naples. But Ferdinand deceived him, and in 1504 he finally had to abandon Naples, which was henceforth to be the object of repeated and always disastrous expeditions for his successors.

Louis next let Pope Julius II involve him in a league against the Venetian republic. This was the League of Cambrai, which pledged France to another costly and fruitless undertaking. After the victory of Agnadello (1509) Louis had to face the Holy league organized by Julius II to drive the French "barbarians" out of

Italy. Though Gaston of Foix was victorious at Ravenna, the French had to evacuate Italy (1512), while the Swiss threatened Dijon and the English landed on the continent.

Louis sought vengeance on the pope by raising the Gallican church against him. He revived the Pragmatic Sanction and summoned a council to depose him. But this dispute ended in a setback, and a pontifical council threatened to interdict France. Barren enterprises that promised the country no advantage had ruined its fortunes and endangered its renascent prosperity.

Francis I (1515–47).—The new king, Francis, was the son of Louis XII's first cousin Charles of Angoulême. Twenty years old, he charmed the court with his youth and his handsome bearing, which formed a contrast with his predecessor's appearance. He liked strenuous exercise, hunting and warfare; he had a ready tongue and enjoyed the company of men of letters, who made out that he had a great mind. In fact his intelligence was ordinary and his culture mediocre and he knew nothing of politics and religious matters, of which he let his advisers take care. Antoine Cardinal Duprat and the constable Anne de Montmorency were the two statesmen of the reign, if we omit the queen mother, Louise of Savoy, whose influence was considerable. From his accession Francis thought only of resuming his predecessor's Italian ventures. These took up his whole reign and eventually involved him in a struggle against the Austro-Spanish power that was to absorb all France's efforts for several centuries.

In 1515, with a magnificent army, Francis won the battle of Marignan (Melegnano) and reconquered Milan. The peace of Fribourg with the defeated Swiss (1516) and the concordat of Bologna with Leo X inaugurated a twofold alliance that was to last as long as the monarchy itself. But Italy, where hitherto the French had had no rivals but the Spaniards, was now to attract other powers; a sequence of lucky inheritances had raised the sovereign of the Burgundian Netherlands, the archduke Charles, to the throne of Spain at the death of Ferdinand of Aragon (1j16) and to the succession of the Austrian territories at the death of Maximilian (1519). Elected emperor despite Francis' competition, Charles V now controlled most of western Europe as well as the Mediterranean and the Spanish colonial empire. France could see itself threatened on every frontier, but on the plea of self-defense undertook an interminable struggle that finally developed into a fight for supremacy between two rival dynasties. In this contest Francis' principal object was the duchy of Milan, which he wanted either to attach to the kingdom or to bestow on one of his sons. Charles V had his eye mainly on Burgundy, for ancestral reasons. But the rivals pursued other interests as well: the French kings intervened in imperial affairs, profiting from the disputes that arose out of the Reformation.

The rivals looked for allies. Two presented themselves: the king of England, who, not having abandoned the conquest of the Plantagenets, could at any moment checkmate Francis I should the latter descend upon Italy; and the pope, who, seated between Milan and Naples, was invaluable to both but always feared the union of north and south. After the meeting on the Field of the Cloth of Gold (1520), where Francis had in vain sought an alliance with him, Henry VIII of England turned to Charles V. As for the pope, there remained the alliance made with France after Marignan; but the pope was potverless and would never give Francis any real support.

War began in 1521, in Navarre, on the northern frontier and in Milan. But Francis' endeavours were countered by the flight of Duke Charles of Bourbon, the constable of France, who passed to the emperor's service after the illegal sequestration of his lands. A further expedition ended disastrously at Pavia (1525), where Francis was made prisoner. Taken to Madrid, he signed a treaty relinquishing all territories that Charles V claimed-(1~26) but on recovering his freedom he refused to put it into effect. Charles had failed to profit from his victory and had been restrained by the astute diplomacy of Louise of Savoy, the regent of France. He could only take vengeance on Francis' allies and on the pope, who was besieged in Rome and made prisoner. Rome itself was sacked by Protestant troops under the constable Bourbon, who was killed (1527). To put a stop to this profitless warfare, the treaty of Cambrai was signed. This modified the conditions of the treaty of Madrid: Francis renounced Italy but kept Burgundy (1529).

The following years were spent in preparing for a new war, which in this case was to be extended beyond the contentious sphere of Italian politics. Francis was in secret communication with the Turks of Constantinople, who threatened simultaneously the southeastern frontiers of the empire and the Mediterranean coasts. He was in alliance with the Lutheran princes of Germany, who were forming the League of Schmalkalden (1531) to defend their religious freedom. Christendom was scandalized to see the "most Christian king" allied with infidels and heretics.

A new war was fought from 1536 to 1538 and eventually won by Francis, as a result of the defensive strategy of the constable Montmorency. The war that broke out in 1542 ended merely in a truce, the peace of Crépy-en-Laonnois (1544), since the two parties were alike incapable of winning a decisive victory and coming to a general agreement on matters in dispute between them. Francis was piling up money for another war when he died (1547).

Trend Toward *Absolutism*.—Francis I was of a commanding disposition, and the opposition was less formidable than in the previous reigns. To so brave and fiery a temperament, love and war were schools hardly likely to teach moderation in government. Italy not only inspired him with the love of literature and the arts but also furnished him an arsenal of despotic maxims; and his principles of government, based on his inclination to dominate, were applied by his great officersof state, men thoroughly learned in the law, such as the chancellors Antoine Cardinal Duprat and Guillaume Poyet, and by the jurists of the southern universities, who drew their inspiration from Roman legal maxims.

All worked successfully to distinguish the "greatness and super-excellence of the king" from the rest of the nation; to isolate the nobility amid the seductions of a court life full of pleasures and possibilities of favour and high places; and to win over the bourgeoisie, at first by bribery and afterward by the hereditary transmission of offices.

The states-general were never convened; the king put a stop to the system of moderated monarchy that hitherto had allowed the nation's representatives, convened in times of stress, a voice in affairs. Francis had his ordinances registered by the *parlements* regardless of the remonstrances addressed to him. Attempts at resistance met with harsh treatment: the Gallican church's opposition to the application of the concordat was brutally repressed.

Intervention by judicial commissions served to remove any officers who proved refractory to Francis or lost his favour for a time: for instance the constable Bourbon, the chancellor Poyet, the admiral Philippe Chabot and the surintendant des finances Jacques de Beaune. baron de Semblançay, as well as other heads of the finance department.

The concordat of 1516 strengthened the king's authority by its settlement of the system of benefices, which lasted until the end of the ancien *régime*. The king nominated the holders of consistorial benefices (bishops and abbots) and so could avail himself of the revenues of the church for his favourites and for public servants. This was very much to his advantage, as it assured him a faithful episcopate; but though some of these bishops were conscientious, the church not infrequently found itself governed by unworthy men who cared nothing for their apostolic duties.

Francis I's prime concern was to have enough to maintain his court and his army without recourse to his subjects or diminution of his authority. He achieved this by increasing the returns of the taille, by raising regular tithes from the clergy and, especially, by organizing a system of state credit consisting of loans from the towns and from the Italian and German bankers, who proved more obliging than the French financiers that he had shaken off. This system was at once useful and dangerous to the state, as the abuse of credit was later to cause formidable crises.

The Reformation.—From the end of the 15th century circumstances in France had favoured a reform of religion. The clergy was in general decadent, both morally and intellectually, and concerned primarily with worldly affairs; and the faithful satisfied themselves with a formal practice that left no place for religious sentiment. The theologians themselves, given over to the barren discussion of formal logic, were not interested in going back to the true sources of Christian thought.

At the same time the Gallican quarrels, which pitted the king against the papacy, exposed the Roman hierarchy to mistrust and criticism in men's minds. The circulation of ideas and the spread of printing, together with the closer study of the classics and the Scriptures, opened new vistas to the reformers, who at the beginning of the 16th century were dreaming of a regenerated church with dogma and hierarchy intact.

The first attempts were by mystics who wanted to revive religious life: for example Jean Standonck and, after him, Jacques Lefèvre d'Étaples (Faber Stapulensis) and his whole group of Christian savants at the Collège du Cardinal Lemoine. Erasmus contributed his ideal of humanism. At the beginning of Francis I's reign Guillaume Briçonnet, bishop of Meaux, tried to put this ideal into practice by preaching the Scriptures in a way that made them accessible to the faithful (this constituted the group of Évangéliques de Meaux). But this reformation, hitherto simply moral, ended with an attack on dogma: the study of the Bible and of the Pauline texts and contact with the Lutheran reformers of Germany led to the doctrine of justification by faith and to the limitation of ritual practices. At the same time social changes favoured a contumacious attitude toward the clergy and a revolt against the abuses of the church. The Rebeine rioting at Lyons (1529) was a movement aimed at the church. The reformist clergy had the support of the common townspeople.

Francis I at first favoured the ne ideas and the reformers. who had the protection of his sister Margaret of Angoulême, queen of Navarre. But he became hostile when he saw society threatened by the reformers; and the affair of the placards, when broadsides against the Mass were posted in the towns (1534), and the publication of Calvin's Christianae Religionis Institutio (1536) made him decide for repression. Henceforth edict followed edict proscribing the heretics, and the tribunals were ready with convictions.

Henry II (1547–59).—The new king's character was less pronounced than his father's. Of slight intelligence and rather narrow, given over to the strictest religious orthodoxy, Henry II exposed himself to the influence of the dominant factions of his entourage. These comprised his mistress Diane de Poitiers; the constable Montmorency, whom he regarded with an almost filial affection; and the princes of the house of Lorraine, Francis duke of Guise, the greatest soldier of his time, and his brother Charles, the cardinal of Lorraine.

The Italian campaigns that occhpied the previous governments were continued in the new reign, instigated chiefly by the Italian princes at court; and they conflicted more than ever with the interests of the kingdom. But new enterprises were developed, and the king's political and military fields of action were widened. To maintain the struggle against Charles V, Henry continued his father's practice of German Protestant alliances, which was all the more necessary since the victory at Mühlberg had assured Charles's supremacy throughout the empire and presented an indirect threat to France. With the consent of the German princes Henry in 1552 occupied the Three Bishoprics (Metz, Toul and Verdun) in Lorraine, which were part of the empire. Francis of Guise successfully withstood the siege of Metz by Charles V (1553), and Henry kept his acquisitions. The Three Bishoprics remained in French hands, and the treaties of Westphalia (1648) were finally to acknowledge their cession to the king of France. This was the first step forward in the policy of expansion toward the Rhine.

Warfare was continued after Charles V's abdication, either in Italy or in the Low Countries. Through Montmorency's lack of experience, French arms suffered a disastrous defeat at St. Quentin which might have left the road to Paris open if the victors had had the means to pursue the operation (1557). But Henry had his revenge on the English: Francis of Guise took Calais and all the continental territory that they had been occupying for 200 years (1558).

Meanwhile, however, the Protestant party in France was approaching the zenith of its power. Some reckon its membership at one-third of the population of the kingdom. Numerous churches had been organized after 1555, and there were now more than 2,000. Under ministers schooled for the most part at Geneva, they were grouped in synods and assemblies; a national synod took place in Paris in May 1559. The party moreover had changed as it grew. Whole peoples in certain provinces, particularly in the Midi, had become Protestant, including the rural population; and nobles had taken the leadership over from the theologians. Henceforth the leaders were the prince of Condé (Louis de Bourbon), the admiral Gaspard de Coligny and Antoine de Bourbon. king of Navarre, who was succeeded in 1562 by his son Henry III (afterward king of France as Henry IV). The party had its own policy, made alliances outside the kingdom (with the queen of England and the German princes) and hired foreign armies.

Repressive measures against Protestantism were even more severe under Henry II than under his father: in the first year of his reign he set up the chambre ardente in the *parlement* to judge the malsentans de la foi. But Henry's military enterprises abroad exhausted France and set it in opposition to Spain, the great Catholic power, and so prevented his devoting himself wholly to the struggle against the Reformation. He therefore decided that, in order to crush heresy, peace had to be restored and the Italian ventures, the sterility of which had become apparent, renounced. This change of policy culminated in the peace of Cateau-Cambrésis (April 1559). Henry totally and unconditionally gave up his claims on the Italian territories. He even relinquished his positions in Tuscany and also Savoy, which had been French for 20 years and seemed to have been definitively incorporated in the kingdom. The restored Franco-Spanish friendship was cemented by Philip II's marriage to one of Henry's daughters, Elizabeth. This way of ending the Italian wars was no more reasonable than the policy that had poured France's wealth and strength into them over the past 50 years. However, it enabled Henry to issue the Edict of Écouen (June 2), which seemed to envisage a real civil war against the Protestants and perhaps a campaign in alliance with Spain against Geneva. During the festivities in celebration of his daughter's marriage (June 30, 1559) Henry took part in a tournament and received a wound that proved fatal.

Francis II (1559–60).—The new king, Henry II's son. was a major but too young to govern, and the direction of policy was entrusted to the Guises, uncles of the young queen Mary Stuart, who was also queen of Scotland. Francis of Guise was commander in chief of the army and his brother the cardinal of Lorraine held the administration. Both were fervent Catholics, in opposition to the Protestant leaders Condé and Antoine de Bourbon. To overthrow the Guises Condé organized the conspiracy of Amboise (le *tumulte d'Amboise,* 1560), which miscarried and was rigorously put down. This was the first resort to violence. To make peace and to rehabilitate the country's finances, it was decided to summon the states-general at Orléans; but the sitting had only begun when Francis II died (Dec. 1560).

Charles IX (1560–74).—Francis' brother was a minor at his accession and his guardian was the queen mother, Catherine de Medici, an intelligent, cultured but primarily crafty Italian who was to take part in the government for nearly 30 years. Her main object was to preserve undiminished the authority of her sons Charles IX and, after him, Henry III. She cared nothing about the truth of any religion and had no solid political principles, striving rather to keep the factions in awe even if this called sometimes for treachery. Her methods, which she pursued ruthlessly, finally destroyed the authority that she meant to reinforce.

At first she thought toleration practicable, in which opinion she had the support of the chancellor Michel de l'Hôpital. She summoned the colloquy of Poissy (Sept. 1561), where the best theologians of either side gathered to propound their doctrine. It became obvious that conciliation was impossible for two religions with firm dogmatic systems and differences on essential points; and their encounter at Poissy made reciprocal opposition more pronounced, between Catholics under the triumvirat (Francis of Guise, Anne de Montmorency and the maréchal de Saint-André, Jacques d'Albon) and the Huguenots under Condé and Coligny.

Catherine de Medici tried, failing an agreement, to keep the peace by edicts that gave the Protestants a certain freedom in the exercise of their religion: that of Jan. 1562 allowed them the right of assembly outside the towns. This generous toleration could have saved the religious peace, but the Catholics thought it excessive and meant to oppose the application of the edict.

The peace had already been troubled in the provinces of the Midi. On March 1, 1562, an incident at Vassy between the duke of Guise's troops and the congregation of a Reformed church ended in a massacre. This was the beginning of the Wars of Religion, to which the government was, for nearly 40 years, powerless to put a stop.

These wars involved no great operations, and there were no decisive battles. Armed bands attacked towns or châteaux and indulged in looting and massacre—exploits which made famous the Protestant baron des Adrets and the Catholic Blaise de Montluc. The hostilities particularly affected the Loire provinces, round Orléans and Sancerre, where the Huguenots were numerous, Dauphiné and Vivarais in the southeast and Gascony and Périgord in the southwest, where the nobles were turbulent and impoverished.

The first war lasted a year. Threatened by an English invasion, which Coligny and Condé had purchased by ceding Le Havre, Guise captured Rouen by assault, but in the attack Antoine de Bourbon lost his life. At Dreux, fought to close the road to German reinforcements hastening to join the English, Saint-André was killed; but Montmorency (the victor) and Condé were taken prisoner. Guise was assassinated by Jean Poltrot de Méré as he was attacking Orléans (Feb. 1563). Freed from his uncomfortable tutelage and now head of a Catholic party of tried strength, Catherine was able to destroy the unity of the Huguenots with the peace of Amboise (March 1563), by which Condé demanded freedom of worship for the Protestant aristocracy only. Catholics and Protestants then united to drive the English out of Le Havre.

Within the next four years Charles IX attained his majority; but he left the direction of affairs in the hands of his mother Catherine de Medici. Catherine wanted to use the peace to bring her conciliatory policy to fruition and restore the country's finances and the king's authority. She travelled over the kingdom presenting Charles to his subjects to enhance his prestige and had a meeting uith Philip II of Spain at Bayonne, where plans were laid for joint opposition to the heretics. Her efforts were unsuccessful; the second civil war broke out, and in the course of it Montmorency was killed in the battle of St. Denis (1567).

The peace of Longjumeau (1568) was short-lived. The third war saw real military operations developed in the western provinces and in the Midi, between the royal army under the king's brother, the duke of Anjou, and the Protestant armies of Condé and Coligny. CondC was killed at the battle of Jarnac and Coligny defeated at Moncontour (1569). The ensuing peace (1570) was another compromise between the parties, but contained a clause of which later events were to reveal the importance: the king assigned to the Protestants four places de *sûreté*, which were to have a Protestant governor and a Protestant garrison and to constitute places of refuge for members of the Reformed religion who could not safely live elsewhere. This seriously affected the sovereignty of the king, and the Protestant party seemed to be threatening the unity of the state.

St. Bartholomew's Day.—To seal the peacemaking it was proposed that Henry of Navarre should marry Charles IX's sister Margaret of Valois; and a further development on the same lines took place when the king, weary of his mother's power over him, drew closer to Coligny in order to prepare for mar against Spain in the Netherlands. In 1572 a fleet was prepared and an army raised, while an alliance was made with England.

Catherine de Medici reacted to this threat with characteristic treachery. Taking advantage of the princess Margaret's wedding, for which numerous Protestants, including Coligny, had come to Paris, she arranged an attempt on Coligny's life (Aug. 22, 1572). Coligny, however, was only wounded; and Catherine, fearing a Protestant rising and an investigation that might have revealed the truth, prevailed on the king to order a general massacre. This massacre, begun in the early hours of Aug. 24, lasted several days in Paris and claimed hundreds of victims. Those who were spared, for instance Henry of Navarre, had to abandon their religion. Similar proceedings took place in the other principal towns of the kingdom, but they were not thorough enough to annihilate the Protestant party, which made use of these very happenings to feed the increased virulence of the propaganda conducted by such pamphleteers as François Hotman and Philippe de Mornay (Du-Plessis-Mornay). Henceforth this propaganda was aimed at the king himself, indicated as the murderer of his own subjects.

The massacre of St. Bartholomew's day aggravated the conflict between the two religions and provoked a new Protestant rising: several towns in the Midi and Sancerre and La Rochelle in the midland region took up arms, and the siege of La Rochelle was the principal feature of the fourth war of religion. Despite another treaty of peace, the disorders became increasingly serious; the Protestants, during the war, had organized themselves politically and militarily in the southern provinces, which mere now in fact detached from the scope of the king's authority and had their own assemblies (provincial and general), their own army and their own tribunals.

The *Politiques*.—Moreover, a section of the Catholics. anxious for peace's sake to allow the dissidents liberty of worship, joined the opposition: these constituted the party of the Politiques or Malcontents, who, as they drew closer to the Protestants, were also called *Catholiques* unis. At their head was the king's brother, the duke of Anjou, who shortly afterward left France to become king of Poland (May 1573), whereupon his brother Francis, duke of Alençon, took his place at the head of the Politiques. This attitude on the part of the princes made anarchy worse.

Henry III (1574–89).—Henry of Anjou returned from Poland to succeed his brother Charles but was no more capable of restoring the royal authority than he had been. Intelligent and cultured but, because of his sexual immorality, little respected, he was to try to govern amid the factions without having the strength of character for which the situation called—at times dominated by his adversaries, at others seeking to regain the ascendant by treachery or assassination. Moreover the situation was more critical than before: Henry III was childless, and the heirs presumptive were his brother Francis of Alençon, who was himself childless, and Henry of Navarre, chief of the Protestant party. The question of the succession was the greatest problem of the moment.

Henry III was hardly back in France when the fifth civil war broke out. Despite Guise's victory at Dormans. Henry conceded all that the Protestant-Catholic coalition demanded in the peace of Monsieur (May 6, 1576). Alençon received the appanage of Anjou, Touraine and Berry; Henry of Navarre, Guienne; and Condé, Picardy. The Protestants likewise obtained the restoration of their places de *sûreté* and liberty of worship throughout the kingdom except in the neighbourhood of Paris. Chambres *mi*-parties, composed of Protestants and Catholics, were created in all the *parlements*, to judge Protestants brought to trial. This was another step in the decline of public authority.

The Catholic reaction to this favouring of the Protestants, which they determined to prevent, was the formation of the Holy League, under the inspiration of Guise. Grouping several local associations of the same kind, it was composed of common townspeople and directed by parish priests with a few bourgeois, lawyers and officials. It demanded the restoration of Catholicism, the revival of the provincial liberties and control of the government by the states-general. It was a democratic and antidynastic movement. Henry thought that the cleverest defense was to declare himself head of the league and to run it in his own interest. Henry therefore convened the states-general at Blois, as he had promised (1576). As the Protestants refused to participate, the Catholic majority did as the king wished and agreed to demand the re-establishment of religious unity, thereby nullifying the last peace treaty. However. the moderates under Jean Bodin recovered the advantage by refusing the subsidies needed for a new war. War broke out nevertheless; and a brief campaign led to the peace of Bergerac (1577), which established, in a somewhat curtailed version, the terms of the previous peace. This was later renewed at

Fleix (1580) after the so-called "Lovers' War," which arose out of the intrigues of the wanton Margaret, wife of Henry of Navarre.

Meanwhile Henry had abolished all leagues, and his position seemed to be becoming less precarious. Then came the death of his brother Francis, which revived in more acute form the question of the succession: Henry III had no heir but Henry of Navarre, which meant that the crown would go to a Protestant prince. The two parties were more than ever at variance. The Huguenots found themselves again the supporters of the hereditary principle and the divine right of kings. The Catholics and the Guises, the latter with a selfish mental reservation, became the upholders of elective monarchy and the sovereignty of the people. Was it not unthinkable that the crown of the "eldest daughter of the church" should be allowed to pass to a relapsed heretic? In order to realize their possible succession to the throne the Guises, who had already fabricated a genealogy that led them back to Charlemagne, entered into an understanding at Joinville (Dec. 1584) with Philip II and the pope to set aside Henry of Navarre and to substitute for him Charles, the old cardinal of Bourbon, who on his death would leave the crown to Henry of Guise.

The Guises relied on the reconstituted League, which made rapid progress (1585). Its avowed intention was to resist by force those who sought "to ruin the Catholic religion and the state." Centred in Paris, it had a council and an organization that made it in fact a revolutionary government.

War therefore broke out again: Henry of Navarre, Henry of Guise and Henry III faced each other and sought help from abroad, from Elizabeth of England, from Philip and the pope and from the German princes and the Swiss, who supplied mercenary troops and *reîtres*. Henry of Navarre was victorious at Coutras, Guise at Vimory and at Auneau (Oct.–Nov. 1587); but these engagements were indecisive and left the king as helpless as ever between the Protestants and the League.

Events at Paris were decisive. The ever-increasing tension made the Leaguers afraid of a Protestant resort to force, and they called Henry of Guise to their aid. He entered Paris in defiance of the king's prohibition, and the Parisians put up barricades. Henry III took fright and fled, leaving Paris in the hands of a revolutionary council; and the Edict of Union (July 1588), whereby he adhered to the League, consummated his defeat. The states-general, on the League's demand, were summoned to Blois. But Henry III, to recover the ascendancy from a majority that outvoted him in the League's favour, decided on a resort to force: he had the duke of Guise and his brother Louis, cardinal of Guise, assassinated and the cardinal of Bourbon, pretender to the crown, thrown into prison (Dec. 23, 1588).

Far from restoring the power of the king, this coup finally destroyed it. Henry III had no choice but to ally himself with Henry of Navarre, and the two kings were preparing to take Paris when Henry III was assassinated by Jacques Clément (Aug. 1, 1589).

Economic and Social Developments, 1460–1589.—The Hundred Years' War had ravaged the country, disrupted commerce and spread pestilences in France. In the middle of the 15th century the land was untilled, some villages had disappeared and many houses in the towns themselves were dilapidated. The population was falling; in the regions that had suffered most the peasants had left their fields to take refuge in the towns, where the multitude of beggars contributed to the disorder. Workers were scarce and labour expensive. Monetary difficulties made things worse, as precious metals were vanishing while salaries generally rose. The return of peace was not in itself enough to revive the country's economy: the resumption of work and the restoration of lost wealth called for an immense effort.

The most urgent task was to revive agriculture. Of the great landowners who had survived many were bankrupt, and they set about restoring their domains with the help of new farmers, to whom they made very generous conditions; the serfs were emancipated, and land was granted for small dues, the rate being fixed once and for all. After half a century of effort the results made themselves felt: fallow land was recovered, and the forest receded. Villages were re-established, and the beginning of the 16th century was a period of real agricultural prosperity. But if the peasants profited from it, their overlords were no longer as well placed as before: tenants paid only low dues, the real value of which decreased as money became cheaper. It was the beginning of a serious crisis, which was to undermine the conditions that had made possible the existence of the rural nobility.

Simultaneously with agriculture, industry and commerce revived, largely because of foreign businessmen, especially Italians, who engaged both in trade and in banking, imported luxury articles and set the flow of international business in motion again.

By the last years of Charles VII's reign the progress brought about by Jacques Coeur, who sent his ships to trade in the Levant and exploited the mines in the midland of France, was already discernible. But this activity developed under Louis XI, who, without having any precise ideas, took an interest in commerce and obtained results: he re-established the Lyons fairs, tried to introduce the silk industry and to develop the wool industry and took measures, with success, to attract stable currency and to impose a sort of protectionism which seems to foreshadow Colbert. Were, too, progress was discernible at the end of the 15th century, and under the following kings prosperity continued. Louis XII took advantage of these favourable conditions, which in fact gave rise to the legend so long connected with his name.

The 16th century gave a new turn to this prosperity. Voyages of discovery increased the sphere of commercial enterprise: there was the traffic in exotic merchandise, whether brought home directly from the new world or purchased in the great international markets of Spain and Antwerp. The ports of the Mediterranean were not neglected, but those of the channel and the Atlantic saw a new activity. There was a considerable development of the great international fairs, for instance those at St. Denis and, particularly, at Lyons, which became the centre of commercial life in France. But the most important feature was the discovery of the gold and silver mines of America, which produced, mainly from 1550 onward, a quantity of precious metal that continued to accrue till the beginning of the 17th century. Imported gold and silver flowed from Spain into all the neighbouring countries, and the 15th-century shortage of currency was followed by a surfeit, with various results: trade was stimulated, prices rose and the buying power of money diminished.

Besides real estate, which hitherto had been the basis of wealth, reserves of specie began to be accumulated for use in the purchase of goods, in industrial enterprise and in credit operations. The banks made use of letters of credit, the deposit system and clearances to maintain the international movement of capital, the principal centres being the exchanges of Antwerp and Lyons. Loans at interest were profitable to those who made them, so profitable in fact that the institution of capitalism can be dated from this time.

The men who handled this money gave their help to the governments; the French kings, who were involved in the costly enterprises of the Italian wars, could not go on without more than the usual resources of the treasury. They had to borrow; and from the time of Francis I a system of public credit was built up whereby the needs of the state were met with the help of bankers (mainly Italians or Germans) and of the towns, which themselves borrowed from private persons.

The debt, on which the interest was heavy, grew continuously and, in spite of insolvencies that reduced the total, imposed a burden that obstructed all attempts to restore the state's finances. The efforts of Michel de l'Hôpital, under Charles IX, were wrecked by disorder in the administration and by ever-increasing requirements. Henceforth the government was to live only on loans from the partisans (members of syndicates of investors) who received allotments of the royal domain as concessions or the right to reimburse themselves by collecting public revenues.

This led to far-reaching changes in the various social classes. Those who lived on fixed incomes were affected by the depreciation of the coinage and by the rise in prices: the rural nobility, who had feudal rights that brought returns not liable to change, was declining fast; likewise the *rentiers*, whose rents came from houses or land. The workers were even more affected, since the rise in wages was always slower than the rise in prices. On the other hand, merchants and peasants were becoming richer by buy-

ing the lands that the rural nobility were obliged to sell. Fortunes were made by businessmen who bought seignorial domains with title of nobility and thus composed an aristocracy that was to bring new blood into the noble classes of the 17th century. The houses of Gondi (from Italy) and of Villeroi were parvenus of this kind.

Another consequence of the government's financial policy was the sale of offices. In previous centuries people had tolerated the king's functionaries' selling their charges or passing them on to their children. The kings themselves had sometimes sold public charges, but this was exceptional until Francis I made the system general and created public functions in order to make money out of them. These were the offices, which found buyers because merchants and capitalists were making fortunes that could be employed in raising their dignity and in getting them a share of authority in the state. Thus most of the judiciary or financial charges were turned into offices, which were the property of their holders, incorporated into their patrimony and handed down to their children. The king was thus losing his authority and could neither recruit capable functionaries nor impose the necessary discipline.

These difficulties were discernible by the middle of the 16th century and contributed much to the outbreaks of civil war; the ruined gentry, who could find no place in the army since peace had been signed, were no less susceptible to any political ferment than the destitute workers. But the radical causes of the disorders were to become more general as time went on; the vicious system of finance and the anarchy pervading the administration through the sale of offices became progressively worse even in periods of stability. These evils were, in 200 years' time, to encompass the ruin of the monarchy.

THE BOURBONS, TO 1789

Henry IV (1589–1610).—The new king was a remote cousin of Henry III. As king of Navarre he had only a small domain; and his life had hitherto been that of a Gascon gentleman soldiering at the head of the Protestant armies. However, his mind was of exceptional quality: he had an admirable understanding of politics and could see the significance of events and win the sympathy of all by an opportune admixture of cordiality and authority. A warrior born for action, with a distaste for sedentary work, he knew how to find capable collaborators to manage his finances and his diplomacy. If he contrived to bring back stability and to redirect the government toward absolutism, he wanted above all to return to the past, without putting into practice the far-reaching reforms that experience might have indicated to him. He it was in fact who created the monarchy of the *ancien régime* with the vices that led to its end in 1789.

His first task was to recover the kingdom. At his accession he controlled only a few strongholds and a small army, as numbers of the Catholic gentry refused to serve a heretic king. He had against him the League, which was all-powerful in the towns and controlled by Charles, duke of Mayenne, since the murder of his brother Henry of Guise. The people as a whole would not accept a Protestant king whom the clergy refused to anoint. This opposition rallied round Charles, the aged cardinal of Bourbon, who was incapable of governing and was, moreover, Henry IV's prisoner.

Henry tried to get possession of Paris through the west. He won victories at Arques (1589) and at Ivry (1590) over the League's armies, but failed before Paris. Neither side could prevail through the use of force. Mayenne thought that the time mas ripe for a meeting of the states-general to proclaim him king; and so the estates of the League were assembled in Paris (Jan. 1593). But agreement could not be reached, since the Spanish ambassador was present and proposed Philip II's daughter (who was French on the maternal side) as a candidate for the throne instead of Mayenne. The moderates of the League rejected these Spanish claims and were upheld by the *parlement* of Paris. The pamphlet of the *Satire Ménippée* finally destroyed all respect for the clearly powerless estates. Henry IV, on his part, made this reverse more serious by embracing Catholicism (July 25, 1593); and this conversion, the effect of which was immeasurable, assured his success. He was crowned at Chartres in Feb. 1594 and entered Paris on March 22. The pope gave him absolution in Sept. 1595; and several days later Mayenne himself made his submission. Gradually the heads of the League's government, the seigneur de Villeroi (Nicolas de Neufville) and Pierre Jeannin, went over to the king, and all the provinces recognized him one after the other. Only a few obstinate people kept themselves detached; it was these who inspired Jean Châtel's attempt on Henry's life.

Spain still had to be dealt with and Henry declared war in 1595. The victory of Fontaine-Française did not settle anything, and a Spanish offensive led to the capture of Amiens, which was liberated only after a long siege. But since the defeat of the Armada Spain had been weaker. and Philip II resigned himself to the treaty of Vervins (1598) which confirmed that of Cateau-Cambrésis and set its seal on the decadence of Spain. The duke of Savoy, Charles Emmanuel I, in his turn was forced to capitulate: the treaty of Lyons (1601) at last brought the frontiers of France to the southern Jura.

The Edict of Nantes.—At the same time the Edict of Nantes (April 13, 1598) put an end to religious conflicts. as a result of long negotiations with the assemblies of the Protestant churches. Protestants were given the right to live in the kingdom and equality of citizenship; their worship could be celebrated in the houses of *seigneurs haut-justiciers* (the greater nobles), in places where it was celebrated in 1597 or where its celebration had been permitted by the Edict of Poitiers (1577) and in two towns in every *bailliage* or *sénéchaussée*. Whereas all these terms constituted a state of toleration rather than freedom of conscience, there were additional privileges as well: *chambres mi-parties* in the *parlements,* the granting of 150 *places de sûreté* and the right to hold assemblies of the religion. The statute was put forward as provisional and so kept the Protestants in suspense but at the same time granted them privileges that amounted to governmental authority and were to prove useful to them as a basis for further insurrections. The Edict of Nantes was neither so reassuring nor so definitive as its appearance suggested; in fact it was registered only with difficulty, as public opinion rightly saw in it a source of future conflicts.

The Government Reorganized.—From 1598 onward, being at peace with the church and having guaranteed the Protestants their freedom, Henry could set about reorganizing the system of government. He wanted only to restore the state of affairs that had existed before the civil wars. Apparently of an easy disposition, he was nevertheless resolved to tolerate no opposition. Government became more absolute than under Francis I. The country moreover lent itself to this development, being tired of disorder and anxious only to work for recovery. Henry addressed the *parlements* and municipalities as their master and considered their leaders factious and prevaricating. He no longer convened the states-general, which had done nothing but stir up trouble since 1560, but summoned only an "assembly of notables" at Rouen, having chosen the members of it himself; even then he presented himself to them "with his sword in his hand."

For his government he relied on councils, which he convened regularly and in which the work of administration was done by a staff of jurists, *conseillers d'e'tat* and *maîtres des requites:* these comprised the *conseil des affaires,* the *conseil d'e'tat* and the *conseil des finances.* At the head of the principal departments were the *secrétaires d'e'tat,* the *chancelier* and the *surintendant des finances.* Finally, to safeguard his authority in the provinces, he appointed intendants, who hitherto had been employed only intermittently. These intendants were the king's representatives whose duty it was to keep the local administrators aware of his authority. Thus emerged the organs of administrative monarchy, which the succeeding reigns did but perfect.

In this way Henry eliminated all the disorders that were troubling the kingdom: he suppressed the brigandage that ravaged the countryside and also the conspiracies of the nobles (for example that of the duc de Biron, who had been in secret communication pith Spain and mas executed in 1602).

Henry's greatest obstacle was presented by the Protestants.

They held assemblies with which he had to treat, for fear of provoking a new rebellion. This made difficulties between him and the Catholics, who were always anxious about favours granted to their adversaries. The king's great problem was to maintain equality and peace between the hostile factions.

Economic Rehabilitation; Sully.—The first necessity was to recover the prosperity of former days. The king's concern with this matter was prompted at once by pity for his subjects and by a desire to increase the revenue. His attitude is summed up in the famous dictum attributed to him: "Every family should have a fowl in the pot on Sunday." Since he was ill-informed on the subject of finance, Henry relied on his councillors, the most renowned of whom was Maximilien de Béthune, duc de Sully.

Sully was a Protestant gentleman who had served in the royal armies before being admitted to the *conseil* des finances. He was ambitious, and he contrived to get rid of his colleagues and to remain himself alone at the head of the financial administration with the title of surintendant. An unsparing worker, capable and honest, he exploited these advantages to win the king's confidence by every means and to make a considerable fortune for himself. He sought to enrich the kingdom by giving support to agriculture; he allowed the peasants a remittance of their arrears of taxes, prohibited the seizure of agricultural instruments and had marshlands drained and roads and canals built.

This renewal of prosperity made it easier for the peasants to pay the taille. The finances were also restored, by arbitrary measures liquidating the debts of the state and comparable in fact to a bankruptcy. One reform was above all disastrous because of its remote consequences: the Edict of La Paulette (1604) made it possible to hold as hereditary, in return for an annual payment of one-sixtieth of its estimated value, any of the offices that had hitherto been tenable for life only. This system was profitable for the treasury, but it finally established the heredity of offices which was to be disastrous for society and for the government. Its immediate result was however a success, since Sully could at last accumulate reserves of gold in the vaults of the Bastille after the poverty of the early years.

Besides the agricultural effort, to which Olivier de Serres contributed, there was the industrial policy inspired by Barthélemy Laffemas, who wanted "to set up manufactures in this kingdom" and to produce luxury articles for sale abroad, so as to prevent the export of currency. He proposed a customs policy that would exempt raw materials from tariff payment and prohibit the import of manufactured products. Thus began the mercantilism that Colbert was to develop. At the end of Henry IV's reign the kingdom was enjoying real prosperity again, largely a result of the government's efforts and above all to the peace kept since 1598.

Foreign Policy.—The treaty of Vervins did not bring lasting peace. Henry was still mistrustful of the power of Spain, with its Austrian alliance. Taking no account of the repeated setbacks that exposed the final exhaustion of Spain, he maintained a traditional hostility that was potentially dangerous for France. Officially neutral, he nevertheless continued, in association with England, to support the rebellious United Provinces against Spain and the German princes against the emperor.

In 1610 he was preparing for war against the Habsburgs on the Rhine to settle the Julich-Cleves succession—a serious venture that might have brought to nothing all the progress of the years of peace—when he was assassinated by François Ravaillac (May 14, 1610). The assassination may be regarded as symptomatic of a Catholic reaction in favour of Spain.

Louis XIII (1610–43).—With the accession of Louis XIII the unstable character of the monarchy was again made manifest. The organization of a regency in the name of a king who was a minor always proved a hazardous undertaking with the issue depending on the rivalry between factions. The queen mother, Marie de' Medici, who could not govern, was faced by the late king's servants, by rebellious nobles eager to recover their liberties, by an anxious Protestant party and by Catholics who wanted a rapprochement with Spain.

Proclaimed regent by the *parlement*, the queen mother yielded to the pressure of the Spanish party and renounced the now impracticable war. French policy was committed to the rapprochement with Spain, which culminated in two marriages, that of Louis XIII with the infanta Anne of Austria and that of his sister Elizabeth of France with Philip III's son, the future Philip IV.

For home affairs, Marie could think of nothing better than to distribute offices and money among the chiefs of both parties. Once the treasury was despoiled and Sully disgraced, she lost all her influence and became the tool of the ambition of a lowborn Florentine, Concino Concini (afterward maréchal d'Ancre). Thenceforward policy became a matter of petty artifice; after having made a show of drawing the sword against Condé, the leader of the great nobles, the queen regent opened her purse instead. The costly peace of Ste. Menehould (May 1614) marks the first abdication of power on the part of the monarchy.

To get support against the restless and hostile nobility, the regent convened the states-general, which met in Paris in Oct. 1614. The three orders, however, were represented by privileged persons concerned only with protecting their own interests. They quarrelled among themselves and could not reach any agreement on the proposals submitted to them; and when they refused to grant the desired subsidies the assembly was dissolved. The states-general had once more shown themselves to be powerless; and they were not to be summoned again before 1789.

For the next ten years the affairs of the kingdom were in the hands of intriguing favourites, as unworthy as they were incompetent; and policy swayed between the two forces that were emerging in Europe. On the one side was the party of the Counter Reformation, which sought to restore the Catholic Church's position against the Protestant churches by the union of the papacy with the Austrian and Spanish Habsburgs, abetted by the Jesuits; this in France was the policy of the *parti dévot*, which predominated in the circles surrounding the regent. On the other side the Protestant powers, that is to say the United Provinces and the German Protestant princes grouped in the Evangelical union, stood together against Spain and relied, in France, on the Protestant party headed by Henry IV's old followers, Henri. duc de Rohan, his brother Benjamin, seigneur de Soubise, and Philippe de Mornay, who feared that the religious liberties obtained with such difficulty might be lost. This party organized itself for resistance even by civil war: the country was divided into *cercles* and an army was raised on funds provided by the churches. It was, as Richelieu later called it, "a state within the state," keeping up its own relations with foreign powers.

This opposition—Protestants anxious about the *rapprochement* with Spain and nobles who wanted to supplant the favourites in high places—rose on several occasions. One rebellion ended in the peace of Loudun (May 1616), which granted governments and pensions to the nobles involved. Concini and his followers saw their power augmented, while Louis XIII grew up in the shadow, humiliated by their tutelage. Nevertheless, Louis was able to get rid of them by supporting a plot against Concini, who was murdered on April 24, 1617; and the regent and Richelieu, whom Concini had brought into the government, were thrust from power. New favourites were installed as ministers including Charles d'Albert de Luynes, a young nobleman who became a duke and then constable. Soon afterward new risings took place, with the complicity of the duc d'Épernon; these ended in the treaties of Angoulême (1619) and Angers (1620).

On the other hand, at the instigation of the militant Catholics, Luynes conceived the unfortunate idea of re-establishing the Catholic faith in Béarn, which had been Calvinist since 1563. But he was repulsed before Montauban, and his death in 1621 spared him the disgrace of his predecessor. His authority and intrigues were inherited, for the next three years, by Marie de' Medici. In those three years there were three different ministers, all mediocre men. In the background stood the subtle personality of the cardinal de Richelieu.

Richelieu.—Born into a family of the petty nobility, Armand du Plessis de Richelieu had at first been bishop of Luçon and had sat in this capacity in the states-general of 1614. Eaten up by ambition, he had pushed himself into Concini's circle; and when Concini fell he was removed from power. But he eventually insinuated himself again into the government and attained the prime ministership. which he held till his death 18 years after.

The situation called for a strong-willed man of foresight and energy who could restore order at home and intervene in the events that were troubling central Europe, In his *Testament* Richelieu revealed that the course of action followed by him with an indomitable determination had been planned at the time of his entry into the royal council. "I promise," he told the king, "to devote all my energy and all the authority that it may please you to place in my hands to destroying the Huguenots, to abasing the pride of the great nobles, to restoring all your subjects to their duty and to raising the name of your majesty among foreign nations to its rightful place."

The first objective was to command "the four square feet of the king's cabinet," which involved a permanent struggle. Richelieu had to remain in power—a difficult task with such a master as Louis XIII, who "liked to be governed yet bore being governed with impatience." Louis gradually came to trust his minister but never learned to like him. He was accustomed to listen to his mother, who accused the cardinal of ingratitude, and to his wife (too good a Spaniard), who reproached him with wanting to dismember her country. The heir presumptive to the throne, Louis' brother Gaston of Orléans (originally duke of Anjou), who posed as the beloved prince in all conspiracies directed against Richelieu and who each time played Judas in the end, had often to be reckoned with. These divisions within the royal family were naturally exploited by the nobles. Suspicious and irritable, Richelieu frequently believed himself to be threatened when he was not and, in identifying himself with the king, sincerely believed that he was defending the king's authority and not the cardinal's. As long as his position was uncertain he was forced to suppress court conspiracies, time and again displaying merciless severity: on Henri de Talleyrand. comte de Chalais, who sought to prevent the marriage of Gaston of Anjou with Marie de Montpensier (1626); on the brothers Michel and Louis de Marillac; and even on the two queens after the "day of dupes" when they believed that they had succeeded in securing his dismissal (1630). There were also armed re\ olts against Richelieu, for sharing in which Henri II de Montmorency, the governor of Languedoc, forfeited his head in 1632. Other rebels against the cardinal's authority summoned foreigners to their aid—notably François Auguste de Thou and the marquis de Cinq-Mars, who allied themselves with Spain but were overthrown and executed (1642).

The Protestant rebellion was shorter but more menacing. Richelieu, though a theologian and a churchman, was unwilling to use constraint to reduce the Protestants to orthodoxy; but he demanded their total submission from the political point of view. Although his first acts had shown a tendency to commit himself against Spain (on the question of the Valtellina), the Protestants, supported by England, rose against him. Richelieu, to settle the matter, took possession of La Rochelle after a year's siege (1627–28) and continued the war in Languedoc. When Rohan was defeated in the Cévennes, notwithstanding the help of Philip IV of Spain, Richelieu was able to impose the Edict of Alès (1629) on the Protestants, withdrawing their political privileges, their *places de sûreté* and the possibility of raising armies and leaving them only their religious liberty. This ensured total peace for the Reformed churches for more than half a century.

Richelieu's principal object was to rid himself of domestic problems so as to be able to intervene advantageously in European affairs, to halt the progress of Spain and to "make the king the most powerful monarch in the world." Now since 1618 the Thirty Years' War had been harassing Germany; the emperor Ferdinand II had subjugated the Bohemian Protestants and was trying to re-establish the imperial power as it had been in the previous century. Philip IV, on his part, was trying to maintain his position in Italy and in the Netherlands and to safeguard his communications between these remote possessions. The first campaigns had been favourable to the Habsburgs, who had defeated the Protestant leagues and their allies. Though this did not constitute any direct threat to France, the nation felt itself menaced and so obliged to take measures against encirclement. With this in mind Richelieu had from the start made his choice between the various available policies, that is, between *rapprochement* with Spain and the system of Protestant alliance; but for a long time the internal situation in France made intervention impossible and the Spanish party endangered his authority. He was restricted to indirect action in Italy: he restored French influence in the Valtellina, which connected the Milanese with Austria; by swift action at Susa he forced the duke of Savoy to make peace; and finally he obtained the succession to the duchy of Mantua for a French prince (1629).

Events in Germany called for more resolute action. After defeating the Bohemian Protestants, Ferdinand II had beaten Christian IV of Denmark at Lutter-am-Barenberge (1626); and the Edict of Restitution (1629) marked the Catholic victory, obliging the Protestant princes to surrender ecclesiastical property that had been secularized since 1552. Wallenstein, at the head of his army, enforced the edict and made ready to subject Germany to the emperor's authority. Richelieu put a stop to this advance at the diet of Regensburg (1630), where his closest adviser, Father Joseph, obtained the dismissal of Wallenstein and prevented the election of Ferdinand's son as king of the Romans. At the same time Richelieu was appealing to the king of Sweden, Gustavus II Adolphus, to intervene in Germany, in the hope that he would attack the emperor only, without threatening the Catholic princes. The Swedish army landed in Pomerania in 1630 and won resounding successes. Gustavus Adolphus, soon finding himself master of Germany, sought, in the face of Richelieu's opposition, to establish a great Protestant empire on the ruins of Catholicism. This ambition, even after the death of Gustavus at Lützen (1632), provoked a Catholic reaction just when the Protestant alliance was dissolving as a result of the defeat at Nördlingen (1634) and at the moment of the murder of Wallenstein, whom Richelieu had sought to set up as a rival to Ferdinand in Bohemia. In 1635 the emperor again dominated Germany.

France was obliged to intervene. It had already taken advantage of the Swedish victories by occupying Lorraine and by establishing itself at Trier, in Alsace and on the Rhine, so as to have bases for further operations. Simultaneously Richelieu mas negotiating with Sweden and with the United Provinces to get their collaboration and to ensure the liberties of the German princes. Finally, on May 19, 1635, France declared war on Spain and on the emperor. At the outset the war went badly for France. The capture of Corbie, near Amiens, by the Spaniards served to reveal the vulnerability of Paris, so dangerously near the frontier. But Spain was incapable of exploiting its success, and the situation was soon reversed; thanks to Bernhard of Saxe-Weimar and to the comte de Guébriant, Alsace was conquered. Faced with revolts in Portugal and Catalonia, Spain lost Artois in 1640 and Roussillon in 1642. These were Richelieu's last successes and he was considering negotiation to give France recognized possession of its conquests when he died, on Dec. 4, 1642. Five months later (May 14, 1643), Louis XIII died also.

Richelieu's ambitious policy necessitated 2 firmly grounded authority at home. The disorders of the previous years had shown the need for a resumption of absolutist methods. There was no meeting of the states-general, but only an assembly of notables (1626). The provincial estates were rarely convened and always kept off politics. An edict forbade the *parlement* to take cognizance of public matters. The press, only just created by Théophraste Renaudot, was forced into the service of the government as was the Académie Française. Provincial and municipal privileges met with the same treatment. Richelieu denied to the people the right of criticizing the acts of the government and killed the spirit of public opinion that had been revealed in the *Republic* of Jean Bodin, in J. A. de Thou's History, in Étienne de la Boétie's *Contr'un* and in the *Satire Ménippée*. He was not an enemy of the nobles, to whom indeed he assigned a predominant position in the state, but intended to impose a strict discipline on them, rigorously enforcing the edicts against duelling and demolishing the châteaux of the marauding gentry.

To ensure the submission of the nobles, Richelieu made general the system of intendants, the king's representatives in the prov-

inces, above the oficiers (whose independence was thus limited). In reaction against the decentralization that had gone together with the League, Richelieu fell into the opposite error of too great a concentration of power. By means of the intendants he began that transformation of the monarchy whereby civilians and bureaucrats were given influence, to the exclusion of soldiers and aristocrats.

Richelieu's policy imposed heavy burdens on the people, so that economic progress had to be a major concern of his. He had clear ideas on industrial and commercial development, and mercantilist principles underlay his projects. These projects however were for the future, and he saw no need to reform the administration of finances. He let the disorder subsist and mas satisfied with the worst sort of expediency in providing the treasury with the requisite funds. The resumption of war and the excessive taxation had disastrous results: after 1630, among the rural population, insurrections arising from sheer misery were frequent; the Croquants rose in the south, the Va-nu-pieds in Normandy. Even the rentiers of the Hôtel de Ville in Paris, ordinarily a peaceable people, were excited by the curtailment of their incomes and, in 1639 and 1642, were roused to fury. Despite the great work that was accomplished the treasury remained empty and the reforms a dead letter.

Altogether, Richelieu was a statesman rather than an administrator. He looked upon material concerns as of secondary importance; he could organize neither an army nor a navy, neither justice nor finance nor colonies, but at most a police system. His true greatness lay in the art of diplomacy. His work was wholly accomplished in the field of foreign policy, where he displayed most consistency and foresight.

Mazarin's Ministry for Louis XIV (1643–61).—*A pupil of Richelieu's, Jules Cardinal Mazarin continued and completed his work. But the task was not done without many setbacks. The crown fell to an infant, Louis XIV, only five years of age in 1643. The regent, Anne of Austria, was a Spaniard and the prime minister was again a foreigner, as Concini had been. Mazarin (Guilio Mazarini) did not have Richelieu's elevation of outlook but was highly intelligent and clever at dominating his adversaries. Unscrupulous in his methods, sometimes a trickster and avid for wealth, he justified the attacks made upon him by his enemies. But his talents, furthered by a favourable situation, allowed him resounding successes which made France the premier European power.*

Anne of Austria began by getting the parlement to annul Louis XIII's will and to commit into her hands "the entire administration of the kingdom," which she forthwith entrusted to Mazarin. Through his adroit diplomacy and the military genius of two young generals, the prince of Condé (Louis II de Bourbon) and the vicomte de Turenne, the great tree of the house of Austria was shaken to its very roots. At Rocroi (May 1643) Condé destroyed the famous Spanish infantry, afterward joining forces with Turenne in Alsace. The Rhineland was freed by the victory of Freiburg-im-Breisgau (1644), and the generals were again victorious at Nordlingen in Bavaria (1645). Meanwhile Mazarin laboured unceasingly to preserve the Swedish alliance. The Swedes were finally victorious at Zusmarshausen (May 17, 1648), three months before Condé, at Lens (Aug. j), for a second time defeated the Spaniards. At last the emperor Ferdinand III brought himself to sign the peace that had been under negotiation for seven years.

The Treaties of Westphalia (1648).—*The treaties signed at Munster and at Osnabrück settled questions that had been vexing for 100 years, fixed the political structure of the Holy Roman empire and put an end to several territorial disputes. The emperor recognized the liberties of Germany, which became a "republic of princes," guaranteed by France and Sweden. The states were to enjoy freedom of religion and a political freedom that would allow them to make alliances with foreign sovereigns.*

Numerous ecclesiastical territories were secularized and assigned to lay princes. Sweden received Pomerania. As for France, apart from the confirmation of its receiving the Three Bishoprics conquered in 1552, the acquisition of Alsace safeguarded the Rhine frontier and prevented the Spaniards from uniting Luxembourg to Franche-Comté. These treaties were regarded for 200 years as the charter of Europe and dispelled the Habsburg dream of an unitary Catholic and German empire.

The Fronde (1648–53).—*These military and diplomatic successes were achieved in the face of terrible difficulties within the kingdom. With the king a minor, Mazarin found himself confronted with the problems that Richelieu had been unable to solve, now become even more complicated. With his position hampered by his foreign birth and by the king's minority, the adversaries of Mazarin had had plenty of time to coalesce against him, while everyone was sick of government by ministers.*

Revolt was provoked by the constantly aggravated financial difficulties. Careless of the details of financial administration, Mazarin had left it in the charge of an Italian businessman, Michel Particelli d'Émery, who, as surintendant des finances, had recourse to the costly and occasionally dishonest expedients that had been employed in the past: to the creation of offices, to the curtailment of incomes, to taxes on houses built in the approaches to Paris, to forced loans. These levies roused public opinion against Mazarin, whom the oficiers moreover reproached with a further extension of the system of intendants. In addition the sovereign courts (e.g., the parlement and the chambre des comptes) made political claims, calling for "second powers" to moderate the sovereign power of the king.

The nobility added its turbulent disposition to resentment of these grievances. The prince of Condé, the duchess of Longueville (Anne Geneviève de Bourbon) and the archbishop of Paris' coadjutor Paul de Gondi (who became cardinal de Retz in 1651) led this aristocratic party, which joined with the bourgeoisie and the common people of Paris. All were influenced by the same fever that was raging in Catalonia, Portugal, Naples and England.

The malcontents however were incapable of co-ordinating their efforts. Events therefore proceeded in such chaotic fashion that their real significance is often hard to discern. The Fronde was in fact the beginning of a revolution that might have checked the advance of absolute monarchy.

It was the sovereign courts that took the initiative of the Fronde. The parlement of Paris made common cause with the chambre des comptes and the grand conseil and. in the declaration of July 27, 1648, sought to substitute constitutional for absolute monarchy. Since all her forces were at the war, Anne of Austria yielded; but when the victory of Lens set Condé's army free, she arrested some of the more violent members of the parlement. Insurrection followed, and barricades were put up in Paris. Anne capitulated once again and, fearing for her safety, fled nith the young king to St. Germain. Civil war broke out, involving in the general upheaval great lords, members of the parlements, generals, princes of the church, the common people and mercenaries from the Thirty Years' War.

This Fronde of the parlements had been a loyalist rebellion. Its armed protest was directed not against the king but against Mazarin; but it was soon disgusted with its allies — the princes and nobles and the Parisian mob that had been aroused by Paul de Gondi. When, therefore, a proposal was made in the parlement to receive a Spanish envoy, that assembly hastened to make terms with the court by the peace of Rueil (March 11, 1649). In the short respite (April 1649–Jan. 1650) that followed the treaty there ensued a scramble for power among the nobles, Condé, Gaston of Orléans, the prince de Conti (Armand de Bourbon) and the intriguing Longueville. The victor of Lens, thinking the world at his feet, assumed so dictatorial a manner that Anne of Austria and Mazarin, assured by Gondi of the support of the parlement and the mob, had him arrested. In defense of Condé a great conspiracy of court ladies sought vainly to arouse Normandy, Burgundy and Bordeaux. Turenne involved himself in dealings with the Spaniards and was defeated at Rethel. Unhappily Mazarin, as soon as he was victorious, forgot his promises, especially that of a cardinal's hat for Gondi. The nobles and the parlement made common cause and Mazarin fled to Bruhl in the electorate of Cologne, whence he continued to dominate the queen and the kingdom (Feb. 1651). But the leaders of the two parties, Condé and

Gondi, were soon engaged in a mortal rivalry. The exile of Mazarin and the attainment by the king of his majority (Sept. 1651) brought a temporary lull in the storm which broke out again on the return of Mazarin (Jan. 1652). Condé renewed the civil war with the help of Spain. Successful against the royal army at Bléneau, but nearly destroyed by Turenne at the Porte Ste. Antoine and saved only through the exertions of La Grande Mademoiselle (Anne Marie de Montpensier, daughter of Gaston of Orléans), Condé lost the support of Paris by permitting the massacre of citizens who were demonstrating in front of the Hôtel de Ville in favour of peace.

A general weariness of civil war gave a good opportunity to Mazarin's agents. In order that the way might be smoothed to a reconciliation, the cardinal pretended to exile himself to Bouillon (August). A collapse of the revolt ensued. Condé had taken refuge in Spain. Gaston of Orléans was in exile, the cardinal de Retz in prison and the *parlement* confined to its judicial functions. The field was thus left open for Mazarin who in Feb. 1653, four months after the king, returned in triumph to the Paris that had lately driven him forth with jeers and mockery.

The government had to make good the material and political losses of this war. Poverty was worse now than in the last years of the League and called forth a vast work of charity, animated by St. Vincent de Paul. The financial disorder, moreover, was irremediable as long as the war ment on. The *surintendant* Nicolas Fouquet did what he could to meet requirements, including the lavish upkeep of Mazarin's household.

As for the political rectification, attempts at revolution were over and done with. The rebels, Retz and Franqois de la Rochefoucauld, could henceforth give vent to their dissatisfaction only in their *Mémoires* or their *Maximes;* and the king kept the upheaval in mind with a view to preventing its recurrence. Louis XIV forbade the *parlement* to concern itself with state business, and Mazarin recruited the ministers of the new reign from the *bourgeoisie:* for example Michel Le Tellier, Hugues de Lionne and Colbert. Public opinion, weary of agitation, accepted without regret the return of absolutism.

The Treaty of the Pyrenees (1659).—Spain was still at war. It had even derived certain advantages from what happened during the Fronde, thanks particularly to the military talents of Condé, who had passed to its service. Mazarin applied himself to restoring the position with Turenne's help. For external support he turned to England, despite the royal government's distaste for Cromwell's regime. In Germany he was able to form the League of the Rhine, to keep the empire neutral and to prevent the emperor's helping Spain (1658). This was a step forward in the policy of intervening in the Rhine countries, which developed under the pretext of protecting the liberties of Germany. The recapture of Dunkirk after Turenne's victory at the dunes, which resulted in the conquest of Flanders, dealt the final blow to the Spaniards, who were compelled to make peace.

By the treaty of the Pyrenees (1659), France gained Roussillon and Cerdagne, Artois with certain posts in Flanders, Hainaut and Luxembourg. Louis XIV married the eldest of the Spanish infantas, Marie Thérèse, who renounced her claims to the Spanish throne in return for a dowry of 500,000 crowns. Mazarin had thus realized the policy of Henry IV and Richelieu—the destruction of the Catholic empire of Philip II and the stabilization of the monarchy. It remained to be seen whether France would be satisfied with this achievement or risk new ventures to complete the destruction or the absorption of a power henceforth negligible.

***Personal Government* of *Louis* XIV (1661–1715).**—The personal reign of Louis XIV began with Mazarin's death in March 1661. Louis's character was already formed. He was of average intelligence but had a certain practical sense, which however was sometimes misled by an ambition and a love of glory that obscured the true facts for him. His closely reasoned theory of government is expounded in his *Mémoires*. He found the elements of it in Richelieu's political writings, in Mazarin's teaching and also in his own experience. The Fronde had inspired him with a horror of revolutons, .parliamentary remonstrances and disorder in general. His projects were also informed with a love of order that reflects the classical spirit of the times. His theory was that of absolutism pushed to the extreme: the king is God's lieutenant, responsible to God alone, and can dispose of the property and even of the conscience of his subjects. The superior rights of the people and, with them, the states-general and the independent courts of justice, all these must be swept away; there could be no individual rights among his subjects; the sole remedy offered for their miseries was prayer and resignation. Thus did the nation identify itself with the person of the king.

Likewise, the king was not to share his authority with anyone. The function of a prime minister disappeared with hfazarin, and the king had the illusion of governing by himself, with ministers who were merely secretaries. These he chose from among the middle classes, leaving to nobles and to churchmen posts that were honorific but powerless. It was a bourgeois reign—to the indignation of the duc de Saint-Simon. The king moreover. applied himself unremittingly to his task, receiving ambassadors, presiding at the councils to the day of his death and enjoying the exercise of this *métier de roi.*

No one dared question this system of government. Never was there such a chorus of flattery round a sovereign. Jacques Bossuet justified the king's philosophy by citations from Scripture, and a troop of writers celebrated his virtues with an enthusiasm that was to capture later generations. The few dissidents incurred the royal displeasure: Franqois Fénelon, Sébastien de Vauban and the Jansenists, who were critical, brought disgrace without redress upon themselves.

The cult of the king had its temple at Versailles, which Louis caused to be so appointed as to enhance the brilliant majesty of his person by a sumptuous and artistic environment; he could live there surrounded by his court, far from the Paris that was made hateful to him by the presence of the people. The highest nobility competed for posts in the royal household. Attendance at court was the first and only duty in the eyes of a proud prince who noted everything, particularly absentees. Versailles became the centre of the national life and a model for foreign courts. If he thus played a part in the history of civilization, Louis also affected the social and political life of France. Through the insistence upon etiquette and the place hunting that were the guiding principles in the lives of the courtiers, Versailles sterilized the leisured upper classes, and the working classes were exhausted by the extravagant cost of its upkeep; moreover it separated the king more and more from his kingdom.

The reign witnessed no assembly either of the states-general or of the notables. Most of the provincial estates were not convened, and the provincial or municipal autonomies ceased to be respected. The municipalities were subjugated under the pretext of restoring their finances; and the function of mayor was turned into a hereditary office. The governors of provinces were reduced to representatives, and authority belonged to the intendants, the general system of the latter being henceforth the basis of the monarchical administration. The *parlements* themselves were confined to their judiciary functions. Only the assemblies of the clergy met regularly, because the king got subsidies and support against the total power of the popes from them. In administrative matters Louis introduced no innovation. Refusing to sanction any radical reform, he devoted himself to organizing in all its details the mechanical system inherited from his ancestors, both in the central and in the provincial administration.

This system moreover underwent changes. Louis's designs adapted themselves to circumstances. Thus two periods can be discerned, separated by Colbert's death (1683), the revocation of the Edict of Nantes (1685) and the English revolution (1688).

Colbert.—Louis's policy required a strong army and prosperous finances. It was Jean Baptiste Colbert who, for 22 years, gave himself up to this work of economic reorganization. He was of modest origin, from a family of Reims drapers. Beginning as secretary to Mazarin, he became *intendant des finances;* then he attained the foremost rank with the title of *contrôleur général des finances*, displacing Fouquet by extremely questionable manoeuvres, after which he was made minister of state, *surintendant des bâtiments* and secretary of state for the navy, having thus the entire internal administration of the kingdom assigned to him. If his ambition was unbounded, his capacity for work and his application were not less: in addition to his economic measures, ordinances on civil and on criminal procedure (1667–70) inaugurated the legal system of the Code Louis, which was to be superseded only by the Code Napoléon.

He sought to establish the greatness of the king on the increased wealth of the kingdom and to set up a stable finance that would provide resources for which there mould be no call. Colbert was against war and extravagance, that is, against the policy of magnificence to which he had to resign himself and which eventually caused the collapse of his work.

His first concern was to set France to work, to get that abundance of money which constitutes "the power and the strength of the state": a mercantilist system already practised and appreciated by his predecessors, but now so amply developed as to be described as *colbertisme*. He wanted every subject of the king to be obliged to work and to produce. He hated idleness and denounced as idle the rentiers, the *officiers*, the nobles and the churchmen. He deplored men's inclination to a life of ease and wanted to frustrate it by constraint. Likewise he sought to prevent any slackening by disciplining the workers. The corporate system was substituted for independent work, and detailed instructions were issued to ensure uniformity and high quality in products. As nevertheless the small artisans still produced little and proved recalcitrant to his discipline, Colbert endeavoured to substitute privileged and better-equipped manufactories. He thus created the royal manufactories of furniture and tapestries (Gobelin), of carpets, of mirrors and of cloth. The main difficulty was to set up companies and to find capital. Colbert was exacting and raged against opposition.

To complete this work he had to promote commerce and, above all, navigation. Envious of the Dutch, who enriched themselves by carrying the merchandise of other countries, he wanted to compete with them. He therefore had ships built and companies created and initiated a far-reaching colonial policy that was inspired by Richelieu's earlier efforts. He sought new markets and endeavoured to revive French interest in those enterprises in which it had been outstripped by the English and the Dutch trade. He extended New France from Canada to the Mississippi by supporting La Salle in Louisiana; he added to this the French tropical possessions in Guiana; he established the king's authority on the African coast from the Bay of Arguin to the shores of Sierra Leone; and he gained a footing in Madagascar and established the first French trading posts in India. A commercial monopoly of these territories was given to the great royal companies. To defend the colonies Colbert created a navy and for its accommodation Vauban constructed great arsenals at Brest, Le Havre, Dunkirk, Rochefort and Toulon. For the Atlantic fleet he introduced the system of maritime conscription that remained almost unmodified thereafter. As a result of his efforts the French navy, at least until 1692, was in perfect condition.

To support this activity Colbert set up a system of protectionist customs whereby manufactured goods imported into France were taxed while raw materials could be brought in free. The first, relatively liberal, tariff of 1664 was superseded by the tariff of 1667, which was frankly prohibitive and constituted one of the causes of the Dutch war. By this means a favourable balance of trade was to be established; *i.e.*, the kingdom would sell manufactured goods abroad without buying anything for its own consumption and receive in exchange the gold that all this economic activity was devoted to acquiring.

This new wealth gave the state the resources it required and paved the way for that restoration of finances which the destitution of the past 50 years necessitated. The first task was to get rid of a debt that was swallowing up all the state's revenue in interest. Colbert succeeded by the classic manoeuvres, practical but dishonest; he set up a *chambre* de justice, which terrorized businessmen into cancelling their credits and began by making an example of the surintendant Fouquet, in contradiction of all justice. This bankruptcy of the state led to the restoration of financial equilibrium. Subsequently, Colbert safeguarded this equilibrium by accumulating revenues; as he could not increase the income from the taille without overwhelming the poor and affecting the privileged classes, he preferred to develop the system of indirect taxation, the aides, which touched all consumers. He worked at the same time to reduce expenditure, adjuring the king to give up his extravagances. He could thus balance the budget as long as the king showed moderation. But at his death the equilibrium was already compromised, and the final reverse came with the advent to power of less clear-sighted ministers and with the mounting expenditure on the armed forces. Colbert had given the royal finances a moment of respite amid the series of disorders that were to lead to the fall of the regime.

The Army.—At the same time an effort was made to reorganize the army. This work had been begun by François Sublet des Noyers (under Louis XIII) and by Michel le Tellier and was taken over by Le Tellier's son François Michel, marquis de Louvois. The old army, commanded by undisciplined nobles, was replaced by an orderly organization. Its hierarchy of officers was fixed, and its strength was to be kept at its full complement, with volunteer recruits and, later? *miliciens* pressed into service. The commissariat was organized and armaments perfected, with plentiful artillery. Particular attention was paid to the capture and defense of fortresses, the concern of the engineers. This last corps was the creation of Vauban, who remained through the reign the great practitioner of siege warfare and encircled the kingdom with a belt of strongholds specially fortified against artillery fire.

Religious and Ecclesiastical Affairs.—Louis XIV, the "most Christian king and eldest son of the church," considered himself the ruler of the souls of his subjects. Thus he felt himself called upon to establish the unity of the faith and to repel with the hand of orthodoxy all dissenters, Huguenots, Jansenists or Quietists, whose independence was insupportable to him. Religious division, however, was impairing the structure of the state, which was ceasing to provide for the salvation of the people just as it was no longer the guardian of their material interests. It was now nothing but a kind of lay society, with part of its activity withdrawn from its rightful leaders. For these reasons, gently at first, then more violently as he became still more of a bigot, Louis's absolutism in religious matters asserted itself with the willing consent of a nation in love with the ideal of unity.

Since the peace of Alès, the Huguenots had enjoyed freedom of worship and had prospered in the fields of industry, agriculture and commerce. The clergy, under the influence of the Compagnie du Saint-Sacrement, sought from 1651 onward to unify matters at first by persuasion, later by a legal and narrow interpretation of the Edict of Nantes. His passion for absolutism, his religious zeal (the more active since he wished to make amends for his injuries to public and to private morals), the financial necessity of increasing the voluntary offerings of the clergy and of gaining their support in his quarrels with the papacy—all these led Louis to identify himself with this religious policy. Between 1661 and 1685 the Huguenots were successively excluded from the diplomatic service and from the municipalities and deprived of their hospitals, colleges, academies and schools. Fines proving inadequate, soldiers were quartered upon the recalcitrant under the system of dragonnades, which brought about mass conversions. Louis, thinking that an act of authority would settle the matter, revoked the Edict of Nantes (1685). There followed a mass emigration and later the terrible revolt of the Camisards, who held the royal armies in check in the Cévennes from 1703 to 1711, at a time when the kingdom was threatened with invasion. Nevertheless, Protestantism was not entirely destroyed.

The persecution of the Jansenists arose from the same principles. The theories of the founder, Cornelius Jansen, bishop of Ypres, revived those of St. Augustine on grace and predestination. Introduced into France and developed by the abbe de St. Cyran and by Antoine Arnauld, they inculcated a strict morality in reaction against contemporary licentiousness and against the servile spirit pervading society. The sect was recruited from the disillusioned followers of the Fronde and, because of the brilliance of its writers and thinkers (*e.g.*, Pascal and Racine), made a formidable body of opinion.. Its centre was Port Royal, near Paris, where the Solitaires had settled. Eventually, when the dispute over the *régale* reawakened the persecution, Port Royal was destroyed and the nuns dispersed, while the ashes of the dead were scattered to the four winds (1709–11). The bull *Unigenitus* (1713), which once again condemned their doctrine, reopened a dispute that survived the death of Louis and filled the 18th century with its reverberations. (*See* JANSENISM.)

The much less grave affair of the Quietists likewise arose from the desire for uniformity. That it was even for a moment serious was due to the fact that Madame de blaintenon and the ladies of St. Cyr were waging war upon the mysticism of Madame Guyon, who had abandoned dogmas and prayers and given herself up to the pure adoration of God. Fénelon, who had adopted her doctrines, was condemned in 1699; and the affair was important only because of his duel with the representative of the principle of authority, Rossuet.

The Libertins, philosophers such as Pierre Bayle, savants such as Bernard de Fontenelle and commentators apart from the main tradition such as Richard Simon, were exiled or kept under surveillance and their writings banned; but their doctrines were to appear again in the 18th century.

Despite his Christian attitude, Louis was constantly in conflict with the papacy through his wish to assert the independence of the temporal power from pontifical authority. This conflict had its origins in the distant past and had flared up in the time of the League; and under Louis XIII the Gallican principles expounded by Edmond Richer in his book De la puissance *ecclésiastique* et *politique* (1611) had caused long controversy.

Under Louis XIV the conflict was aggravated by political incidents which impaired relations between the two sovereigns: for example the affair of the Corsican guards (1662) and a dispute about 'the diplomatic immunity of the French ambassador's palace in Rome (1679–87). Rut the principal issue between them was in the matter of their rival jurisdictions, raised now by the question of the *régale*. Louis asserted, even more forcefully than his predecessors, his title to the usufruct of the temporal goods and spiritual rights of bishoprics that fell vacant—and that throughout the whole extent of the kingdom. Nicolas Pavillon and François Étienne de Caulet, bishops of Alet and Pamiers respectively, both of whom moreover were Jansenists, contested this claim and appealed to the pope.

The assembly of the clergy, to whom the question was referred, wanted to make a general pronouncement on "the usage of the power of the popes." Thence emerged the declaration of the Four Articles of 1682, which propounded the principles of Gallicanism, asserting that the pope has power over spiritual things alone, that general councils overrule him, that the rules of the Church of France are inviolable and that papal decisions on matters of faith are revocable only by consent of the church. This declaration widened a break that threatened to become a schism. The pope refused to consecrate the bishops nominated by the king. Louis, worried by the resistance that he was encountering all over Europe: had finally to yield (1693), without, however, withdrawing the Four Articles.

Foreign Policy.—Louis came into power at a time when all danger of a Spanish or imperial hegemony had been dispelled. "Peace was established for as long as I myself should wish it," he said. The traditions of Richelieu and Mazarin and the treaties of Westphalia and of the Pyrenees might have formed the basis of a policy of moderation. But Louis dreamed only of glory and "wanted business abroad," so as to make conquests. The treaties for him were the starting points of new projects, the seizure of the Spanish possessions and then of Spain itself and the domination of western Germany where he would take the place of the Habsburgs. The reinforcement of the army, the creation of the navy and the financial reforms were motivated only by the need to provide means of action.

As early as 1661 Hugues de Lionne encouraged Louis to use the treaty of 1659 to provoke a quarrel with Spain, and the king was exploiting the slightest incidents to threaten his neighbours. He claimed precedence for his ambassadors at foreign courts over those of other kings and refused to have his ships salute English ships in British waters. The dispute between his ambassador's escort and the pontifical guard in Rome led to a battle in the streets. Most serious was his claim to Spanish territories in the name of his aife Marie Thérèse, on the ground that her renunciation of her paternal heritage was not valid. This claim compromised the destiny of the Low Countries and disturbed the United Provinces. with whom an alliance had just been made. The purchase of Dunkirk, to which Charles II of England had agreed, likewise disturbed English public opinion; and while he wanted to keep alive the existing hostility between England and the United Provinces, Louis's policy had rather the effect of promoting their rapprochement in the face of French encroachment. At the same time political interventions in Lorraine and in Alsace roused the empire and the German princes against France.

The War of Devolutzon *(1667–68)*.—From 1659 Louis was thinking of spoil from the Spanish monarchy, which he accused of not complying loyally with the peace treaty. When Philip IV died (1665) Louis demanded the heritage of Marie Thérèse, invoking the right of devolution although it did not apply to public law. After military and diplomatic preparation, Turenne's army conquered part of the Low Countries (1667). In Feb. 1668 Condé occupied Franche-Comté in 14 days. These successes forced Spain to make peace but caused anxiety among the neighbouring powers, particularly among the Dutch. John de Witt organized the triple alliance between the Dutch, the English and the Swedes, which prevented any further French advance. The peace of Aix-la-Chapelle (1668) left France nith some strongholds in Flanders, which Vauban fortified. The war ended favourably to Louis, but the result warned him that his very allies were ready to coalesce against him.

The Dutch *War*.—Because it constituted an obstacle to his progress and was responsible for his recent humiliation, Louis wanted to destroy the Calvinist bourgeois power of the United Provinces, against which moreover Colbert had grievances on the commercial side. For several years Hugues de Lionne endeavoured to break up the triple alliance; and he contrived an alliance with England and Sweden again and even made sure of the emperor Leopold I's neutrality. Thus isolated, the United Provinces succumbed without much resistance (1672). In two months the French were at the gates of Amsterdam; but Holland was saved by inundation when the dikes were broken, and a revolution got rid of the republican party of the brothers De Witt, which was too much inclined to peace. Power was entrusted to the stadholder William of Orange, who broke off the peace negotiations. Louis's excessive demands alienated all the powers, and a coalition was formed between Charles II of Spain, the emperor Leopold, most of the German princes and even Charles II of England, who had to bow to the will of parliament. Louis had to withdraw his armies, and the war continued on the Rhine, in the Mediterranean and in Franche-Comté, which was again taken from the Spaniards. The victories of Condé and Turenne restored the situation. In 1678 the peace of Nijmegen secured the independence of the United Provinces—at the expense however of Spain, who had to surrender Franche-Comté and position in the Low Countries. Louis emerged with profits from a war that should have made him cautious.

French policy, on the contrary, became increasingly provocative. Claiming all the dependencies of his earlier conquests, Louis annexed a number of territories in consequence of decisions made by the chambres de *réunion* set up for the purpose in the Low Countries, in Lorraine and in Alsace, where Strasbourg was occupied (1681). Luxembourg surrendered after a siege (1684). All Europe felt the threat of these peacetime annexations. The king of Spain was rash enough to declare war, but had neither the allies nor the means to keep it up. In agreement with the emperor, he had to recognize Louis's acquisitions by the truce of Regensburg (1684). France seemed at the zenith of its prosperity, but hatred and hostility mere growing on all sides.

The War of *the* Grand Alliance (League of *Augsburg)*.—Circumstances increased the political tension. The revocation of the Edict of Nantes disturbed Europe, leading to a rupture with Brandenburg and making any understanding with the United Provinces impossible. When Louis intervened to get his protege the cardinal William of Furstenberg elected archbishop of Cologne, further aggression was to be expected. The powers concerned formed the League of Augsburg, comprising the emperor Leopold and all other sovereigns interested in the defense of Germany (1686). Its strength was increased when William of Orange, son-in-law of James II of England, on the appeal of the Protestant party took the English crown as William III (1688) and became the head of the coalition, from which was developed the Grand Alliance of Vienna (1689).

War had already begun; Louis had taken the opportunity of a dispute about the succession of the elector Charles of the Palatinate to invade the Rhenish provinces. The war spread over all the frontiers of France and developed particularly at sea, as the maritime powers, England and the United Provinces, were anxious to ruin French commerce. The conduct of the war was dominated by the economic interests of the belligerents, which gave it a character different from that of earlier conflicts.

Again the French armies found valuable leaders, in the duke of Luxembourg and Nicholas Catinat; and the fleet was under the comte de Tourville. The unity of the command gave Louis certain victories over the continually disunited allies: at Fleurus (1690), at Steenkirk (1692) and at Neerwinden (1693) in the Low Countries and at Staffarda (1690) and at Marsaglia (1693) in Italy. But Tourville, after the annihilation of his fleet at La Hogue (1692), lost the command of the sea, and this changed the position of the belligerents definitively.

Unable to destroy the coalition, Louis had to negotiate and to reduce his demands continually. The peace of Ryswick (1697) formulated these concessions. Louis kept Strasbourg, but gave back Lorraine and some of the territories incorporated in the kingdom, recognized William of Orange as king of England and renounced certain economic measures of reprisal. The moral setback was greater than the political.

The *War* of *the* Spanish Succession.—Louis's readiness to make peace resulted mainly from his interest in the question of the Spanish succession, which seemed likely to arise shortly. He had always asserted his rights to the Spanish heritage, bargaining meanwhile with the emperor, who made rival claims. He was aware that the European powers would not agree to Spain's being attached either to France or to Austria. To secure the support of the maritime powers he negotiated the treaties of The Hague (1698) and of London (1699) with William III, whereby certain territories were to go to the dauphin and the rest to a Bavarian prince or even to an Austrian archduke; the emperor, if he rejected this arrangement, would be forced to accept it by the contracting parties.

Charles II of Spain died on Nov. 1, 1700, having named as his sole heir Louis's grandson, Philip, duke of Anjou; and Louis, regardless of his undertakings, accepted the testament, risking a coalition of all the duped and disappointed powers. His decision would have been tolerated had he not added further provocations: he asserted the right of the new Spanish king Philip V to the crown of France (Dec. 1700) and expelled the Dutch forces from the towns that they were occupying in the Low Countries (Feb. 1701). This was a challenge to all the powers who reconstituted the Grand Alliance in the fall of 1701. At the same time Louis recognized the Stuart pretender James (III) as king of England.

France lacked the necessary financial resources: the budget had shown a deficit since 1672, and if the nation's armed forces were comparable to those of the coalition it yet had no commanders capable of standing up to Prince Eugene of Savoy or to the duke of Marlborough. Though from 1701 to 1703 fortune was equally balanced in Italy, Germany and the Netherlands, the successors of the duc de Villars (who had been sent against the Camisards) lost Germany at Blenheim (1704) after the treachery of the duke of Savoy. In 1706 the defeats of Ramillies and Turin led to the evacuation of the Netherlands and of Italy. In 1708 the disaster of Oudenarde left the northern frontier exposed. Nature allied herself with the enemy during the terrible winter of 1709. Louis was forced to ask for peace from the Dutch but, disgusted by their unwillingness to compromise, began a new campaign and was defeated at Malplaquet. Invasion followed, and Louis was saved from disaster only by his dauntless courage, by the strong will of his secretary of state the marquis de Torcy (Jean Baptiste Colbert. son of the great Colbert) and by the victory of the duke of Vendôme at Villaviciosa. The failure of the conferences at Gertruydenberg, which obliged the Whigs and Marlborough to resign their power into the hands of the Tories, now weary of the war and chiefly preoccupied in securing the mastery of the sea; the death (1711) of the emperor Joseph I, who had attempted to reconstruct the empire of Charles V for his brother, Charles VI; and the victory of Villars at Denain (1712)—all combined to make possible the treaty of Utrecht, which gave Italy and the Netherlands to the Habsburgs, Spain and its colonies to Philip V and royal crowns to the duke of Savoy and to the elector of Brandenburg. Gibraltar, Minorca, the gates of Canada and the commerce of the colonies fell to England, which, in affecting to defend the liberty of Europe, had always had the acquirement of these in view. For France the treaty put an end to the policy of glory and general conquest which Louis had substituted for the preservation of the advantages won by the treaties of 1648 and 1659. France, now weakened and destitute, faced the maritime powers who controlled the seas. It had roused the hostility of a Germany becoming conscious of unity and of a Prussia that was to find its fulfilment in the policy of realizing this unity against France.

End *of* the Reign.—Internal difficulties were as bad for France as were the military disasters. The royal family had suffered such losses that the succession seemed precarious: the dauphin Louis (le grand dauphin) and Louis, duke of Burgundy, and the duchess his wife Marie Adélaide of Savoy were all dead, so that the heir to the throne, in 1715, was Louis XIV's great-grandson, a five-year-old child. The great ministers of the early years, Hugues de Lionne, Le Tellier and Colbert had gone; Louvois had died in 1691; and their successors were the marquis de Seignelay and the marquis de Torcy (both Colbert's sons) and the far inferior comte de Pontchartrain (Louis Phelypeaux) and Michel Chamillart. The king had to undertake whatever was to be done—in consultation with Madame de Maintenon, whose influence was predominant from 1685.

The policy of grandeur had as its counterpart the ruin of the kingdom. The excessive governmental direction, the raising of the customs tariffs and the wars made industry and commerce waste away. Agriculture was affected, and years of bad harvests led to nation-wide famines, as in 1709.

Moreover, the general economy of the country was affected by the general fall in prices, which ruined producers and owners and paralyzed business. The population itself was declining, with the emigration of the Protestants depriving the kingdom of an especially industrious element. All this brought chaos into the royal finances: taxation could not meet the constantly increasing expenditure but crushed the poorer classes; new taxes were evolved, and the government resorted to such expedients as devaluation, borrowing and the sale of offices. It was the reign of contractors or partisans and bankers (*e.g.*, Samuel Bernard), who became the suppliers of the treasury.

Even the literary brilliance of the first years grew dimmer: the generation of Racine and Molière had passed. Writers now spent their time bitterly criticizing the government, and the bolder ones left France and published defamatory pamphlets abroad; the political literature of the 18th century was already making its appearance. Nothing remained of the splendours of the reign but its indestructible monuments, the Louvre, the Invalides and the château and park of Versailles.

Louis XIV died having ruined a kingdom that he had found at its apogee. He left it enlarged but exposed to the enemies called forth by his ambition. The enthusiasm that had greeted his earlier victories had died away, and his funeral was marked by the rejoicings of the people. (R. Dt.)

The **Regency of Orléans (1715–23)**.—By his will, Louis XIV entrusted the regency to his nephew, Philip, duke of Orléans, since his great-grandson, Louis XV, was a minor; but, as he disliked Orléans, he placed all the power in the hands of a council in which his illegitimate children, with Madame de Maintenon and the Jesuits. held the predominant position. In thus seeking to render the regent powerless, Louis only succeeded in making him powerful. For the regent, with a view to becoming king in the event of the premature decease of Louis XV, sought allies in the parlement of Paris. In return for its declaration that Louis's will was null and void, the regent restored to it the right of remonstrance which had been suspended since 1673. On the advice of Saint-Simon he replaced the secrétaires *d'état* by six councils, largely composed of the great nobles; he also abandoned Louis XIV's policy of sponsoring the bull *Unigenitus* against the Jansenists. Highly endowed but lacking the ability to use his talents, Orléans was presently forced to recognize the inconvenience of a hydra-headed government, the mistake of having restored to the parlement its political power and the vanity of his hope of achieving a religious peace. A reaction was accomplished, but not before Louis XIV's governmental machine had suffered gravely.

This reaction did not make an end of the financial crisis; only a strong government could have dealt with one of such magnitude. Adrien Maurice, duc de Noailles, who had contented himself with outworn expedients as *président* du *conseil* des finances, could accomplish nothing. Then recourse was taken to the "system" of the clever Scottish adventurer John Law (*q.v.*; and see below, Society and Progress), the sudden collapse of which in 1720 brought many fortunes to ruin and left much of the public debt unextinguished.

In the earliest phase of the Anglo-French "second Hundred Years' War" for maritime, colonial and commercial supremacy which may be considered to have begun in 1688 and was to last till 1815, England had won a great advantage by the treaty of Utrecht. From that time, France should have maintained peace on the continent and brought to bear against England its forces at sea and in the colonies. The necessity for this, however, did not at once present itself. Orléans was content to help England to preserve the treaty, partly because of his personal ambition, partly because of the Spanish menace.

Philip V of Spain and the emperor Charles VI, while they each accepted the portion of the Spanish inheritance assigned to them by the treaty of Utrecht, laid claim to the whole of what they had wanted. Moreover Elizabeth Farnese, second wife of Philip V, sought Italian thrones for her children and was abetted by the efforts of Giulio Cardinal Alberoni to revive Spain. To counter this, Guillaume Dubois (the regent's trusted minister, later a cardinal) signed the triple alliance with England and the United Provinces at The Hague in 1717 and, aided by Lord Stanhope, induced the emperor to participate in it (1718). The intrigue between the Spanish ambassador, Antonio Giudice, prince of Cellamare, and Louis XIV's bastard, Louis Auguste, duke of Maine. to exclude the house of Orléans from the French throne was discovered and repressed; a Spanish fleet was destroyed by Adm. John Byng and the dockyards at Pasajes burned by the duke of Berwick. The dreams of Alberoni were finally dissipated by the terms of the treaty of London (1720).

Ministerial Government for Louis XV **(1723–43)** Louis XV came of age and the regency ended in Feb. 1723. Power. however, was left in the hands of Orléans and Dubois. But Dubois died in August, Orléans in December, and their place was taken by Louis Henry, duke of Bourbon, who pursued his predecessors' foreign policy but let himself be led by the worthless marquise de Prie, thus inaugurating the long reign in diplomacy of publicly recognized mistresses. The couple tried to rid themselves of André Hercule de Fleury, the king's tutor, who had been the author of their fortunes. Bourbon hoped to maintain himself in power by marrying Louis XV to Marie Leszczynska. But the consequent dismissal of the Spanish infanta, who had been betrothed to Louis, strained relations with Spain, and discontent was aroused by the new tax of one-fiftieth imposed upon all classes of income and by the revival of persecution of the Jansenists and Huguenots. All this was cleverly exploited by Fleury. Acting on his advice the king dismissed Bourbon in 1726.

Fleury.—A soft-spoken, crafty septuagenarian, the new minister and cardinal was a pacifist by nature and conviction. His surly right-hand man Philibert Orry, whom he made *contrôleur général* des finances, reduced expenditure and restored order to the finances. Religious peace proved more difficult of attainment. Fleury took strong measures against the Jansenist agitation. By means of *lits* de justice and lettres de cachet he routed out the Flagellants and made an end of alleged miracles. In a few years his administration had re-established prosperity. In accord with Robert Walpole over foreign policy, he devoted himself to promoting general peace. First he reconciled the French and Spanish descendants of Louis XIV, divided among themselves since the Polish marriage, by the treaty of Seville (1729), to which England too was a party. Next the emperor Charles VI, in order to secure the imperial succession to his daughter Maria Theresa, was obliged now that Walpole and Fleury had detached his Spanish ally from the friendship set forth in the first treaty of Vienna (1725), to sign the second treaty of Vienna (1731), sacrificing the Ostend company (whose competition was arousing the anger of English and Dutch) and procuring the duchy of Parma for Philip V's son Charles.

But Fleury's peaceful policy was compromised in 1733, when Augustus II of Poland died and his son Augustus III and Stanislaus Leszczynski, father-in-law of Louis XV, were rival candidates for the throne. The Poles elected Stanislaus but could not support him against the empire and Russia. Fearing English action in support of the emperor, Fleury rendered no substantial assistance. Germain Louis de Chauvelin, the secretary of state for foreign affairs, who was supported by a public opinion enraged by Fleury's pusillanimity, made a diversion in Italy with the help of Spain and Sardinia. Yet Fleury's diplomacy restored the peace; by the third treaty of Vienna (1735–38) Louis XV gained the duchy of Lorraine for his father-in-law with reversion to himself and professed to recognize the rights of Maria Theresa. Chauvelin was sacrificed to the cabinets of Vienna and London.

Another French success was the mediation of the peace of Belgrade (1739) between Austria and Turkey. Russia thus lost Austria's support and had to renounce most of the advantages gained since its attack on Turkey in 1736. In 1740 the grateful Turks renewed the capitulations (religious and commercial concessions) granted to France.

In Oct. 1739 England attacked Spain. Knowing that France would be dragged into the war, Fleury sent, in the first place, two squadrons. But on Oct. 20, 1740, the emperor Charles VI died, and the question of the Austrian succession was opened. France no less than the rest of Europe had accepted the Pragmatic Sanction in favour of Maria Theresa, and Fleury was naturally inclined to abide by it; but the traditionalist party headed by the comte de Belle-Isle kept up the old outworn dispute between the French and Austrian houses. England thus acquired Austria and, from 1742, Saxony as continental allies; France, allied to the unreliable Prussia, was fully involved on the continent (see AUSTRIAN SUCCESSION, WAR OF THE). Fleury died in Jan. 1743, his views apparently confirmed by the French reverses in the first years of the war.

Personal Government of Louis XV **(1743–74)**.—Louis now declared that he wished to rule in person. but this he was incapable of doing. Handsome, intelligent, well-informed and generous-hearted. Louis was pathologically lacking in self-confidence and let himself be pushed and pulled in all directions by his family, by his mistresses (Pauline Félicité de Nesle, marquise de Vintimille, till 1741; then her sister, the duchesse de Châteauroux, till 1744; then the marquise de Pompadour, till 1764; and finally the comtesse du Barry, from 1769) and by his ministers and their followers. Mme. de Pompadour established her own political system, upset the time-honoured alliances of France, made and unmade ministers and chose the commanders for the army and navy. She was queen of fashion in a society where corruption bloomed luxuriantly and exquisitely; and in a century of wit, hers was second to none. In a reign of all-pervading satiety she alone managed to remain bewitching to the day of her death.

Foreign Policy.—The defeat at Dettingen (1743) was followed by a reassessment of France's interests in the War of the Austrian Succession and by a consequent improvement of her military fortunes. French armies conquered the Austrian Netherlands (Fontenoy, 1745), Savoy and the county of Nice. Nevertheless, by the treaty of Aix-la-Chapelle (1748) Louis surrendered everything; and in the colonies the status quo was restored. The indignation of France was roused.

The peace was no more than a truce. The rivalry between

French and English planters in the Ohio valley, fur traders round Hudson Bay and merchants in India led to fighting in 1755 and to the outbreak of the Seven Years' War (*q.v.*) in 1756. Once more the court allowed itself to be drawn into continental commitments. The "diplomatic revolution," inaugurated by the convention of Westminster (Jan. 16, 1756), whereby England and Prussia allied themselves, was consummated by the two treaties of Versailles (1756 and 1757, both May 1), whereby France committed itself to Austria. Hostilities in Europe dragged on; the French army lost prestige, notably in the Prussian victory at Rossbach (1757). The court ceased to care about the fleet and the colonies. Canada, ably defended by Montcalm and Lévis, was lost when Quebec (1759) and Montreal (1760) fell. Lally-Tollendal lost Pondicherry (1761) and India. Étienne François de Choiseul, secretary of state for foreign affairs from 1758, negotiated the "family compact" (Aug. 15, 1761) to bind together the external policies of the French and Spanish Bourbons, but this only involved Spain in the disaster. Under the treaty of Paris (Feb. 10, 1763) Louis surrendered Canada, the Ohio valley, the left bank of the Mississippi and several of the islands of the Antilles to England and Louisiana to Spain; renounced all political claims on India (where, however, he retained the settlements of Pondicherry, Chandernagore, Mahé, Yanaon and Karikal); and gave up the settlements in Senegal, with the exception of Gorée. He retained, however, the Newfoundland fisheries where his seamen learned their trade, as well as the principal islands of the Antilles. The great English victory, therefore, was not decisive.

At last the urgency of the situation was realized. Choiseul prepared for revenge, applied himself to developing the navy and bought Corsica from Genoa (1768). But neither he nor the duc d'Aiguillon, who succeeded him in 1770, could prevent the partition in 1772 of France's old ally Poland between Russia and the two newly reconciled powers whose long antagonism had cost France so much—Prussia and Austria.

This reverse was partly the result of the coexistence of official policy and the "king's secret." Whereas Choiseul trusted Austria, Louis realistically mistrusted it. The intrigues of Louis's agents counteracted Choiseul's diplomatic efforts toward getting Austrian support for the patriotic Confederation of Bar in Poland. The Turks, in their turn, were disastrously involved at the same time (1768). But French support for Gustavus III of Sweden led to the renewal of the Franco-Swedish alliance in 1773, after his coup d'état (1772).

Internal Affairs.—The absolute monarchy might have been saved from the catastrophe that was to come in the next reign if it had undertaken the requisite reforms. The aristocracy and first of all the aristocracy of the princes and the dukes should for instance have been broken. But, though the network of councils dominated by great nobles (la polysynodie) that the regent Orléans had substituted for the bourgeois ministers of Louis XIV had proved so manifestly inefficient that by 1718 it had become necessary to restore ministers, the great nobility nevertheless remained dangerous because of its intrigues at court, its numbers of dependents and its understanding with the parlernents.

The parlements, indeed, frustrated all attempts at reform. The right of making remonstrances, restored to them by Orléans in 1715 and occasionally restricted or suspended afterward, generally enabled them to delay the registration of royal edicts and to oppose financial reforms. Time and again, as the only solution to the financial problem aggravated by court expenditure, by wars and by peacetime rearmament, the king attempted to get all his subjects to make some contribution to the revenue, each according to his means. But to this the parlements, supported by the princes, the bishops, the provincial nobility and all privileged persons refused their assent. They frustrated the tax of one-fiftieth of eachincome (1725–27) and that of one-tenth (1733–36 and 1740–49; in force during the wars but so deformed as to weigh most heavily on the poor) and only registered under protest that of one-twentieth introduced by Jean Baptiste de Machault d'Arnouville (1749–54); they likewise defeated Étienne de Silhouette's *subvention générale* (1759). They gave countenance to all the enemies of the discredited king, for instance to the Jansenists against the Jesuits, whom Choiseul suppressed (1764) in the hope of conciliating them. The unprivileged classes, whom they often incited to rioting did not discern the selfishness of their motives. From time to time the king exiled and then recalled the *parlement* of Paris. Finally, by the coup of Jan. 19, 1771, the chancellor René Maupeou put an end to the sale of offices of justice and replaced the parlementaires by salaried judges—a reform further justified in view of the scandalous injustice that had been administered in such trials as those of Jean Calas and the comte de Lally (*qq.v.*).

The third member, with Maupeou and the duc d'Aiguillon, of the so-called *triumvirat* that governed France from 1771 to 1774 was the abbé Joseph Marie Terray, who began to reform the abuses of revenues and pensions but remained as unpopular as every other minister of finance. Louis XV died on May 10, 1774, and was succeeded by his grandson.

Louis XVI, to 1789.—Louis XVI, well-meaning, a skilled locksmith and a good family man who loved the people and seemed like a bourgeois on the throne, was notable primarily for the weakness of his character. His wife, the Austrian archduchess Marie Antoinette, was one of the most beautiful women at Versailles, passionately devoted to pleasure and delighting to free herself from the formalities of court life. When, however. she sought to play the part of a queen regnant, she very quickly earned herself considerable unpopularity.

Vergennes.—The new foreign minister, Charles Gravier, comte de Vergennes, had as his first object the reassertion of French prestige against England. His opportunity came when. in 1776, the English colonies in America revolted. Vergennes desired French intervention, but Louis XVI hesitated. yielding to the financial objections of Turgot and merely countenancing the assistance given to the Americans by volunteers under La Fayette until after the capitulation of Saratoga (1778). Then the French fleets established supremacy at sea and attacked at every point, in the Antilles. in India and at Gibraltar, and, together with Rochambeau's expeditionary force, contributed to the surrender of Yorktown (1781). Sir George Rodney's victory in the battle of the Saints (1782) made no difference to the outcome. England had to acknowledge the independence of the United States and to restore to France the settlements in Senegal, Tobago and St. Lucia (treaty of Versailles, 1783). For these enterprises overseas, France had needed stability on the continent. Vergennes had therefore refused to accept Austria's seductive offers in the Low Countries and in Egypt, made use of Frederick II and prevented Joseph II from conquering Bavaria (treaty of Teschen, 1779); and had quickly put a stop to an Austro-Russian attempt at the dismemberment of the Ottoman empire (1781–83). Joseph's second attempt on Bavaria (1784) was also prevented. Vergennes sought to crown his work by effecting a reconciliation between France and England in the commercial treaty of 1786, and when he died in 1787 his plans had been realized. To the people of France. however, these successes seemed inadequate compensation for the treaty of Paris; American democratic ideas excited them, and the financial crisis caused by the war paralyzed the monarchy.

Internal Affairs.—Of the reformers whom Louis summoned to his council at the very moment when, in a spirit of appeasement, he restored the reactionary parlements (1774) the most remarkable was Turgot. Physiocrat and contributor to the *Encyclopédie,* he wished to extend to the whole of France that experiment in liberty nhich had already succeeded in his own government of Limousin. He ordained the free circulation of grain throughout the kingdom, despite the "Flour War" (la guerre des farines) aroused by those who saw in this measure a threat of starvation. For the *corvée,* which had taken away the peasants from their aork in order to build roads, he substituted a territorial levy payable by all landowners. He established freedom of commerce and industry by abolishing the privileged trade corporations (1776). He offered himself as a minister of economics; there were to be no new loans and no new taxes. But public opinion that clamoured for reforms did not want to pay the cost, and the king nas too weak to put donn abuses or to refuse privileges. When, in order to decentralize administration, Turgot proposed to set up consultative bodies of landowners in each parish, town and province, Louis XVI sacrificed him to the intrigues of the prime minister Maurepas and to the American ambitions of Vergennes (1776).

Jacques Necker, the Genevan Protestant banker who succeeded him, abolished Turgot's edicts and proposed, as Law had done, a marvellous remedy: an unlimited loan. He succeeded in financing the American war, but at a grave charge upon the future. He transformed the municipal bodies set up by Turgot into provincial assemblies, heirs of the *parlements* and the intendants; and these immediately revealed themselves to be inspired with a reforming spirit. Opposition on the part of the privileged classes broke out again. Necker replied with his famous *compte-rendu*, purporting to show that there was an annual surplus of 10,000,000 livres. when in fact the deficit was close to 50,000,000 livres; but in 1781 he was overthrown by the reaction that he had helped to promote in attacking Turgot.

To the reforming ministers succeeded ministers who were courtiers only. But this reaction could not fill the empty coffers of the state, and in two years two ministers, Joly de Fleury and d'Ormesson, were discarded. Charles Alexandre Calonne (*q.v.*) feigned an optimism which nourished the confidence necessary to ensure the success of his loans; but like his predecessors, he experienced the enmity of the *parlements*. Seeing that Louis would never consent to a repetition of Maupeou's coup of 1771, Calonne sought the support of a quasi-representative body; and it was on his advice that the king summoned an assembly of notables, thus exposing the monarchy at a time when it was already compromised by the affair of the diamond necklace (*q.v.*).

Étienne Charles de Loménie de Brienne, archbishop of Toulouse, who followed Calonne in 1787, was no more successful. The notables referred him to the representatives of the people, to the states-general. But Loménie preferred to present to the *parlements* Calonne's projects for an extension of the stamp duty and a general land tax. He met with the same refusal and was referred again to the states-general. Louis XVI, at the royal session on Nov. 19, 1787, found himself in open warfare with the *parlement* of Paris. He suspended it in May 1788 and transferred the registration of edicts to a plenary court composed of reliable servants of the crown.

The *parlement* of Paris insisted on maintaining the so-called fundamental laws of the monarchy, on its right to a share in legislative power, on the king's obligation to respect covenants with the provinces drawn up in the late middle ages and on the necessity for taxes to be voted by the states-general. Its members, in league with the *noblesse d'kpke,* now supported the popular demands of the provincial *parlements.* The provincial estates of Dauphiné refused to pay taxes. On Aug. 8, 1788, the king was forced to convene the states-general for May 1, 1789. The Revolution was thus opened by a revolt of the privileged orders. (X.)

SOCIETY AND PROGRESS, 1715-89

France in the 18th century was still an agricultural country. The great bulk of its resources was then derived from the land; and the ownership of land, which was mainly in the hands of the nobility, formed the criterion of a man's place in society.

Noblesse d'Épée.—The landed aristocracy comprised the princes of the blood; the higher nobility, *ducs* and *marquis,* who resided for the most part at court and in Paris and seldom on their country properties (to which they retired when exiled); the archbishops, the bishops and the principal abbots; and the intermediate and petty nobility of the provinces. The landed nobility went by the name of *noblesse d'épée,* as having won its title originally by military prowess. The princes and the higher nobles were in a perpetual state of discontent. They resented the absolute monarchy's denying them all political action and likewise resented the king's policy of centralization which, through the intendants (*q.v.*) had deprived them of all provincial and local administrative powers (except in such provinces as Brittany and Languedoc, where assemblies or provincial estates were still maintained), leaving them with poaers only over their own manorial property. They demanded liberty, that is to say. government of France by the aristocracy. The petty nobility shared their views in regard to the administration of the provinces and joined with them also in protesting against the king's attempts to subject this privileged nobility to burdensome taxation; but they objected to the manner in which the higher nobility, in close touch with the king, monopolized all the honorific functions and pensions.

Almost all the nobles were in conflict with the other classes. As the *bourgeoisie* became increasingly important, the nobles asserted their privileges of birth more forcefully against it. The bishoprics were rigidly reserved for the younger sons of noble families. From 1757 efforts were made to reserve the commissioned ranks in the armed forces for the nobility, and in 1781 officer cadets were required to show four quarterings. The nobility was also in conflict with the peasants. The petty nobles, moreover, were poor and often brought ruin on themselves by service in the army, in which they fought heroically; they kept themselves respected for their military calling to the end. The general rise in prices and the fact that, for a long time past, the feudal dues had been fixed in money, forced the nobles to seek sources of revenue. They risked the forfeiture of their nobility by trading, by manufacture and even by cultivating their land in excess of the prescribed value workable by four plows. They sought too, especially during the last 30 years of the century, to exploit their feudal rights: experts searched the books of charters for forgotten legislation. The feudal regime became more oppressive. Both the higher and the intermediate nobility, moreover, tried to impinge on the common rights in the forests (which were decreasing in extent and increasing in value) and on the waste, with a view to converting them to arable land and pasturage. From 1760 the physiocratic school (*q.v.*) urged them on in the pursuit of this course. Certain nobles concluded contracts with village communities, either for *cantonnement,* which permitted them to enclose two-thirds of the commons, or for *triage,* which permitted one-third of the woodland to be enclosed. This movement toward enclosure, however, was restricted; France remained a country of small peasant holdings. Thus, in the latter years of the century, the nobles incurred the growing hatred of the peasantry.

In their opposition to the king, the nobles were provided by the philosophers with the doctrines of the social contract and of the rights ,of man and with the physiocratic theory. These gave them a clear conscience and the encouraging conviction of being in the right.

Noblesse de Robe.—The *noblesse d'kpke* was supported in its opposition by the *noblesse de robe; i.e.,* by the holders of the chief public appointments or offices (which the king continued to sell) and above all by the officials of the higher courts of justice, the *parlements.* The appointments held by the *noblesse de robe* were either inherited or put up for sale within the circle of a few families. The members of the *parlements* formed something like a caste; they despised the *noblesse d'épée* and were despised in their turn by it. But the *parlementaires* were just as much obsessed with their privileges and just as much landed gentry as was the *noblesse d'kpke* with which they allied themselves by marriage; and many of their sons also entered the military profession. They had, therefore, many interests in common with it. They claimed that they played a directing part in the affairs of state, as guardians of the "fundamental laws of the realm," which they interpreted according to their prejudices. In this capacity they exercised the right of making remonstrances, warning the king of any contradictions between proposed edicts and previous legislation or the fundamental principles of the constitution. They thus claimed that, by virtue of their judicial duties and political rights, they had the privilege of controlling the actions of the king; and they pursued a course of implacable opposition to every attempt at reform of the monarchy.

It was from these two classes that there issued the most violent pamphlets and the most scurrilous calumnies against the king, inspired by princes of the blood—the duke of Orléans, the prince of Conti or the duke of Enghien—and naively credited by romantic historians.

Bourgeoisie.—In spite of the nobility, the commercial and industrial *bourgeoisie* increased. Methods of payment and credit were developed. Kotwithstanding the prohibitions of the canon and civil laws, the practice of issuing loans at interest had perforce made its way. Even before Law, joint-stock companies. bearer bonds and forward dealing were known. John Law sought to quicken the circulation of money by the use of paper and thus to increase purchases and sales and to intensify production. His offer to the regent to take the place of the state in dealing with its creditors and gradually to settle Louis XIV's debt was accepted. He was thus able to found a private bank of issue in 1716 and the Compagnie d'Occident in 1717 and to group together in his system his own bank (raised to the status of royal bank in 1718), the Compagnie d'Occident (renamed Compagnie des Indes in 1719 and designed to exploit the Mississippi, Canada, the Antilles, Guinea, the Indian ocean and far east), the farmed-out tobacco revenues, the minting of currency and the collection of taxes—the whole constituting a vast state trust. Speculation in his shares caused a boom, followed by a crash. In Dec. 1720 Law was forced to flee. He had imbued the French with a dislike of banks and paper money but he had whipped up enthusiasm for commercial and industrial enterprise. After him trade brought about a gradual accumulation of the nation's reserves in specie. The Paris Bourse was opened in 1724; forward deals were authorized in 1780. Currency was stabilized in 1727 and remained stable until 1790. In 1776 a Swiss and a Scot founded the Caisse d'Escompte, which discounted commercial bills, accepted deposit accounts and issued notes. which hardly circulated outside Paris. In 1777 the Mont de Piété, to grant loans to clients on receipt of goods, was founded. From 1750 onward, especially after 1780, joint-stock companies became widespread, embracing coal mines (Société d'Anzin, 1757; Société d'Aniche, 1773), metallurgical works, spinning mills, banks and marine insurance. Hence followed a rise in prices, gradual from 1753 to 1760 and rapid, with periods of lower prices, between 1760 and 1770; this resulted eventually in increased profits and stimulated production.

Trade and industry were in a position to expand. Foreign trade grew from 215,000,000 livres tournois in 1716 (172,000,000 for Europe, 43,000,000 for the rest of the world) to 430,000.000 in 1740 (306,000,000 and 124,000,000) and to 616,000,000 in 1756 (412,000,000 and 204,000,000). After the Seven Years' War commercial activity revived. In 1777 the value of exports amounted to 259 000,000 livres, that of imports to 207,000,000; in 1789 the figures nere 354,000,000 and 301,000,000 respectively. Maritime trade mas the most profitable and employed more than 3,500 ships. All the ports—St. Malo, Lorient, Rouen, Le Havre, Nantes, La Rochelle, Bordeaux and Marseilles—were busy and prosperous, chiefly because of trade with the French colonies of the Antilles (particularly with Haiti in sugar and rum) and to the slave trade. Accumulated capital made possible a concentration of trade and industry in the vicinity of the ports; cotton goods at Rouen, linen at the Breton ports, cloth at Marseilles and at Sète. At Bordeaux and Nantes shipowners and merchants set up distilleries, refineries and shipyards; and throughout the kingdom there arose steelworks, paper mills and coal mines. It was their efforts that, toward the end of the century, gave rise to the first experiments in mechanization and in the concentration of industry. But the nobles followed the example of these bourgeois, investing capital in their enterprises, taking shares in their iron and coal mines and iron foundries and even competing with them: the marquis de Solage was part owner of the Carmaux coal mines.

Although home industries had shown a greater degree of expansion, there was a growing concentration of commercial enterprises. In the hosiery trade at Lyons 48 merchants employed 819 skilled workers in their small workshops. Concentration into factories came about. before any mechanization, where expensive and complicated outlay was required, and the same object was attained in a variety of ways; *e.g.,* the woollen textiles of Reims and Louviers and the printed calicoes of the Société Oberkampf (1789) and other houses. As for mining, the state after 1744 reserved to itself the subsoil, conceding its exploitation to large, well-equipped companies. In 1789 the Société d'Anzin was employing 4.000 workers, had sunk pits to a depth of 300 m. (instead of the original depth of 50 m.) and was producing 375,000 tons of coal. Gradually, mechanization was introduced from England. From 1732 Thomas Newcomen's engine was in use in some mines. For silk manufacture, Jacques de Vaucanson's machine made it possible to have 120 reeling basins in a single building at Aubenas. For cotton manufacture workmen and machinery were brought from England; in 1789 there were factories at Brives, Amiens, Orléans, Montargis and Louviers. The smelting of iron with coke was introduced (Le Creusot). The first Watt steam engine to be seen in France was the Chaillot "fire pump" intended to bring water to Paris (1779). In 1789 "fire pumps" were scarce in France; it was considered marvellous when the Société d'Anzin installed 12.

The *bourgeoisie* had, in fact, become the most important class. Society was turning bourgeois. The bourgeois spirit pervaded literature, art and a section of the nobility. After 1750 black suits were commonly worn, and the distinction between gentleman and bourgeois became less and less apparent. Under Louis XVI it came to be considered good taste for nobles to carry a simple bourgeois cane instead of a sword. Some gentlemen no longer wore perukes. Some affected an air of simplicity or *moeurs sensible* (the sentimental manner). A prince insisted on presenting his princess to his regiment with the words, "My lads, this is my wife."

The bourgeois sought freedom in the conduct of their affairs, suppression of the privileges of birth, a share in the formation of laws and control of the budget and of royal policy; they wished, however, to preserve many of the feudal rights and the enclosures, as many of them had purchased fiefs. The royal government did much for the *bourgeoisie.* The *bureau du commerce,* created in 1722, and the *conseil du commerce* provided them with information, assistance and guidance. By fits and starts the king directed the traditional mercantilist policy into liberal channels. Methods of communication were improved; the *corps des ponts et chaussées* was created under the regency; the *corvée royale,* or forced labour on the highways, was regularized in 1738; many new roads were constructed and the number of tollgates was reduced. Freedom to trade in grain, leading to increased production because of the certainty of sale at remunerative prices, was repeatedly proclaimed (1763, 1770, 1774 and 1787); this measure also benefited the peasant proprietors. After 1750, under the influence of the physiocrats, the king reduced the number of regulations relating to manufacture. Some of these regulations aere rescinded, others mere very sparingly applied. In 1776 Turgot, as *contrôleur général des finances,* for a short time caused the abolition of the trade guilds or *corporations de métiers* and of the *jurandes,* the guilds' special tribunals which obstructed the setting-up of new enterprises and the use of new processes. From 1779 efforts were made to give influential persons a share in administration by means of provincial assemblies.

But the guilds were soon reinstated. In: 1786 a ruinous trade treaty with England was signed; by lowering customs duties on English manufactured goods to 12%, it brought a flood of cheaper English goods into the country, causing a serious crisis. The bourgeois were allowed but little participation in local, provincial or national affairs; and they remained discontented.

Intellectual and Material Attainments.—General prosperity, the widening influence of the *bourgeoisie* and the rivalry between the classes gave a great impetus to intellectual life, in which bourgeois talent, rationalistic, positive and utilitarian, was the dominating factor. The intellectuals came, for the most part, from the middle classes; but the renaissance of a nobility battling for its pre-eminence and its very existence was evident in the number of gentlemen who took part in scientific and technical activity.

There was enthusiasm, amounting to infatuation, for the natural sciences, for "physics." Kings, dukes, magistrates, abbés, doctors, bankers, ladies, all had their *cabinets de physique,* attended public lectures and read pioneer books or simplified accounts and specialist periodicals. There was a "rage to learn," an "intellectual fever." Scientists were the object of ardent veneration. Buffon saw his estate raised by the king to the rank of a countship; he had ten poets singing his greatness; a statue of him was erected in his lifetime; and his house at Montbard became a place of pilgrimage. Louis XV instructed the Académie des Sciences to undertake the measurement of the meridian and the production of a general map of France. He sent scientific missions to Peru, Lapland, the Cape and elsewhere.

The mathematicians Alexis Clairault (1713–65), Jean d'Alembert (1717–83), Joseph Lagrange (1736–1813) and the marquis de Laplace (1749–1827) completed, proved and elucidated the propositions of Newton and Leibnitz regarding the infinitesimal calculus. They proved, developed and disseminated Newton's cosmology, applied the new calculus to mechanics and astronomy and constructed a system of celestial mechanics. The measurements of the meridian undertaken in 1735–36 by Charles de la Condamine and Pierre Bouguer in Peru and by Pierre de Maupertuis and Clairault in Lapland revealed the flattening of the earth at the pole. Gaspard Monge invented descriptive geometry. France enjoyed a royal supremacy in the field of mathematics.

In physics, René de Réaumur made one of the first thermometers in 1730. C. F. du Fay proved that all bodies may be electrified (1739), showed the analogy between electricity and lightning, demonstrated electrification by contact and distinguished the two kinds of electricity. Charles Coulomb showed that Newton's law is applicable to electric and magnetic attraction and repulsion (1785–89).

Antoine Lavoisier (1743–94) inaugurated modern chemistry with his method of weighing (1772) and his new nomenclature (1787). His *Traité élémentaire* de chimie appeared in 1789.

In the natural sciences, Buffon (1707–88), who belonged to the noblesse de robe, directed the compilation of a vast natural history, himself wrote the *Époques* de la nature, which laid the foundation of modern geology, and in his *Histoire* naturelle de *l'homme* established the bases of anthropology and of human geography. Michel Adanson (Familles naturelles des *plantes,* 1763) found the method of natural classification and demonstrated the variability of species. Lavoisier moreover explained the functions of respiration, perspiration and digestion. In comparative anatomy, Louis Daubenton and Félix Vicq d'Azyr demonstrated the unity of the plan of composition and the conformity of the structures and the genera of living creatures. Henri Duhamel du Monceau was the first to do animal grafting (1746). Maupertuis, Adanson and Buffon expounded the hypothesis of transformism.

In the scientific study of mankind, historical method was perfected (Louis de Beaufort, 1738). The east was unveiled: Abraham Anquetil-Duperron translated the Zend-Avesta (1771); the works of the French Jesuits of Peking, Prémare and Antoine Gaubil, were used by Jean Baptiste du Halde in his discovery of China. Voltaire began writing on the history of civilization (Sikcle de Louis *XIV,* 1751; *Essai sur* les moeurs, 1756). Sociological investigators included Montesquieu, a noble de robe who studied the necessary relationship of positive laws to every element of an environment (*L'Esprit* des *lois,* 1748); the physiocrats, Franqois Quesnay (Tableau e'conomique, 1758), Pierre du Pont de Nemours and Turgot, who believed that they had discovered the natural order of human society; and the abbé Jean Baptiste Dubos, who moreover was the originator of aesthetics (*Réflexions* critiques *sur* la *poésie* et *sur* la peinture, 1719).

The first results of this scientific research were embodied in a prematurely constructed synthesis, the "philosophy of the Enlightenment," which had as its *summa* d'Alembert's and Denis Diderot's Encyclope'die (1715–64) and as its breviary Voltaire's Dictionnaire *philosophique* (1764), in which the bourgeois ideal is formulated.

The whole of this middle-class society was bent on the practical application of its theories. The maréchals de Saxe and de Broglie and the comte de Guibert (Essai *général* de tactique, 1772) were building the army that Napoleon was to use, introducing individual fire, fighting in extended order, the column of assault and divisional organization. Guibert was the first to try the timing of fire. Jean de Gribeauval between 1764 and 1776 created the light standardized artillery. At sea, Pierre de Suffren Saint Tropez revolutionized tactics by instituting the natural order of battle and the fight to a finish (Indian campaign, 1782–83).

Claude Franqois, marquis de Jouffroy d'Abbans, launched the first paddle steamer (1783); Nicolas Joseph Cugnot drove the first steam automobile (1770); the monk Dom Gauthey made a successful experiment with an acoustic telephone in 1782; the abbé Claude Chappe began experiments in telegraphy; the brothers Montgolfier sent up the first balloons in 1783. Jean Franqois Pilâtre de Rozier and François Laurent, marquis d'Arlandes, were the first men to fly.

Frenchmen were pre-eminent in obstetrics. Antoine Petit removed gallstones. Jacques Daviel operated successfully for cataract and was summoned to all the courts of Europe. The French were perhaps the first to give technical education in such institutions as the École Royale Gratuite de Dessin (1767), the Bcole Royale des Ponts et Chaussées (1747), the École Royale Militaire (in Paris, 1777; attended by Napoleon), the École Royale d'Artillerie (at La Fère) and the École du Corps Royal du Génie Français (at Mézières; supplying Europe with artillerymen, engineers and skilled technicians).

Cultural Prestige.—French was the common European language. It had been the diplomatic language since the treaty of Rastatt (1714). Princes, courtiers, men of letters, all spoke and wrote in French. A number of Europeans wrote French extremely well and some of these, no less than the British Anthony Hamilton and even the German Leibnitz of the preceding generation, merit a place in French literature, for instance the Belgian prince de Ligne, the Italian abbé Galiani, the German publicist F. M. von Grimm, the Prussian king Frederick II, the tsarina Catherine II and J. J. Rousseau of Geneva. The literature of every country was made accessible to the rest of Europe by means of French translations and adaptations. The clarity and precision of the language, its strict logic and matchless order and the value of the observations and ideas expressed in French works were widely recognized.

European art was also French. In France art was still under the influence of the court and Versailles, but no longer exclusively so; the financial crisis of the monarchy had led to its becoming also Parisian and bourgeois. There is no doubt it had most influence as court art, but every branch of it pervaded Europe. Princes eagerly sought French cooks and tapestry weavers, Parisian furniture makers' and goldsmiths' work and the china and porcelain of Sbvres. Women adopted French coiffures and dress and anxiously awaited the doll from the Rue St. Honoré that would show them the latest Paris fashion every month. Music by French composers was played at all the German courts; Scarlatti, Handel and J. S. Bach were pupils of Franqois Couperin; Gluck applied Jean Rameau's principles to his compositions, and Mozart and Haydn were influenced by them.

Everywhere Frenchmen were to be found with appointments as chief painters, sculptors and architects for princes and kings; as directors of academies of the fine arts; as suppliers of plans and drawings; and as the publishers of those collections of engravings which made the work of Charles Augustin Daviler. Jacques Franqois Blondel, Jean Baptiste Alexandre Leblond and Jean de Jullienne an inspiration to Europe.

Everywhere imitations were made of the royal town and palace of Versailles and of the Place Louis XV (now Place de la Concorde) in Paris. Innumerable examples could be given: for instance the Arsenal in Berlin and the palaces of Potsdam and Sans Souci, with their sculptures. terraces and gardens and the equestrian statue of the great elector were all the work of Frenchmen or of men who had identified themselves with France. In Austria, the University of Vienna, the statue of Charles VI, the sculptures in the Schönbrunn gardens and the Belvedere palace were all modelled on Versailles; the Josef II Platz is a second Place Louis XV. In Russia the influence of Versailles is evident in Petersburg, in the imperial residences of Tsarskoye Selo, Pavlovsk and Peterhof, in Catherine II's Hermitage. The equestrian statue of Peter the Great was made by Étienne Falconet after a design for a statue of Louis XIV. Everywhere the characteristic plan of the Parisian hotel might be seen, as in the aristocratic mansions of the Wilhelmstrasse in Berlin, where the ornamentation recalls the theme of Antoine Watteau's *fêtes* galantes. The finest collections of French paintings of *fêtes galantes* are to be found in London, Berlin, Stockholm and Leningrad. The several series of portraits executed by French painters and sculptors constitute a splendidiconographic documentation on every royal court of Europe.

This success was due, above all, to an intrinsic superiority, though up to 1757 it also owed something to French military prestige. The French court was the model for all courts. Great noblemen, artists and writers were attracted to the Parisian salons held under the regency by the duchesse du Maine, by the marquise de Lambert and by the duc de Sully and afterward by the marquise du Deffand, by Mme. de Tencin and by Mme. Geoffrin. After 1750 there were the philosophical salons held by the baron d'Holbach, by Mlle. Quinault and by Mlle. de Lespinasse and the musical salon of A. J. le Riche de la Poplinière. The French, in their turn, swarmed over Europe. France, with a population higher even than Russia's (16,000,000 inhabitants in 1715; 26,000,000 in 1789), overflowed into a Europe converted to the cosmopolitan outlook of the philosophers, in which moreover nearly all the royal or princely families were allied to the Bourbons, whether by heredity, by marriage, by friendship or by obligation.

After 1760 a national and romantic reaction against French influence set in, especially in England and Germany. In France, the classical spirit declined into a collection of rules; and the cosmopolitan outlook had weakened French patriotism. The French fell, in their turn, under foreign and particularly under English influences. Tea, whist, horse racing, jockeys and the redingote invaded France about 1770. Salons gave way gradually to clubs. The language was loaded with English terms: budget, *convention,* humour, jury, *pamphlet, romantisme,* spleen. Romantic gardens in English style were laid out: that at Ermenonville (1763), the Bagatelle (1777–81), the Parc Monceau and the Petit Trianon (both 1778). By 1789 the decline had set in.

Colonization and Exploration. — Colonization in a France turned bourgeois was on commercial lines. The tropical colonies were intended to complement the temperate home country. Crown colonies had military governors of noble birth, civil intendants of bourgeois origin and a supreme council similar to the French parlements. The king also made use of trading companies that enjoyed monopolies and royal prerogatives and were controlled by the royal administration. The possessions regarded as indispensable were the Antilles (Haiti, Martinique, Guadeloupe, Marie Galante, Saintes, Désirade and, until 1763, Tobago, St. Lucia, St. Croix. Grenada, the Grenadines and St. Vincent), which produced sugar, rum and coffee, and the settlements in Senegal (Gorée), which supplied slaves for the West Indian plantations. There were also the colonies of Louisiana and in India. The Indian colonies carried the eastern trade as far as Canton. But there was no appreciation for the policy of the governors Benoît Dumas (1735–41) and Joseph Dupleix (1741–54), who equipped native battalions (sepoys) in European style, intervened in disputes between the princes with a view to promoting trade and ended by carving out a real empire, under the suzerainty of the great mogul, for the Compagnie des Indes. The colony of New France (Canada) was likewise underestimated, as it produced hardly anything but furs.

Before the Seven Years' War exploration was mainly by land, in America. In their search for the "western sea," Pierre de la Vérendrye and his sons explored Lakes Winnipeg and Manitoba, Saskatchewan and the prairie and, south of the Missouri, discovered the Rocky mountains (1743). Louis de Saint-Denis crossed Texas (1714–17), La Harpe reached to the Red river and Arkansas (1717–22), Bourmont explored Kansas (1723) and the brothers Mallet explored Kansas, Nebraska and Colorado (1739). After 1763, explorers turned their attention to the Pacific in their quest for the austral continent as compensation for the losses in India. Louis Bougainville discovered Tahiti, Samoa, New Hebrides and New Guinea (1768). Crozet took possession of New Zealand (1772). In his continuation of Cook's voyage, La Pérouse ascertained that there was no important stretch of land east of Paumotu and the Marquesas; he took bearings along the coast of America from 60° to 37° N. lat. and also on the Manchurian littoral; he was lost at Vanikoro (1785–89). (R. Mr.)

THE REVOLUTION OF 1789

The French Revolution is generally dated from the meeting of the states-general at Versailles on May 5, 1789. This body, the only institution in France which could claim to represent the nation, had last met in 1614. For 175 years the representatives of the clergy, nobility and bourgeois had not been consulted by the crown. If Louis XVI in Aug. 1788 decided to summon them, it was because this step was demanded alike by the 135,000 members of the clergy, many of whom wanted social and ecclesiastical reform, by the 400,000 nobles, who hoped to safeguard their privileges, and by the third estate. as they were called — the whole unprivileged commons of the realm, from merchants and professional men to farmers and labourers, 26,000,000 in all — who were determined to break down the monopoly of property and power in the hands of the privileged minority.

The king might have resisted this demand had not the prestige of the crown been weakened by his own lack of initiative, by the unpopularity of his Austrian queen, Marie Antoinette, by the lack of statesmanship in his chief minister, the honest and competent but slow-moving financier Necker, and by the bankruptcy of the treasury. Nor could he appeal to the army, as his predecessors might have done, since it was infected with democracy from the American war and with the revolutionary sentiments that were spreading throughout the country.

The states-general of 1789 comprised, in round numbers, 300 deputies of the clergy, 300 of the nobility and 600 of the third estate. In the old days there would have been 300 of each order, so that in every contest of opinion the privileged clergy and nobility could have outvoted the unprivileged third estate. The doubling of the number of the third estate's representatives — a concession to social facts and popular opinion made by Necker on behalf of the crown, against the wishes of the clergy and nobility, in Dec. 1788 — meant that if the states-general met as a single body and the deputies decided to vote individually (par *tête*), the third estate could, by winning a few supporters from the other orders, carry the day; and thus, because of the indirect method by which the third estate had been elected. the states-general would be controlled by the middle-class lawyers, professional men and businessmen who represented the mass of the people (suffrage, order by order, had been almost universal). These men were, apart from a minority of the clergy and nobility, the most intelligent class in the country. with the clearest idea of what reforms were required. They had expressed their views both in the cahiers de *doléances* (the credentials presented by each group of deputies, with the grievances and instructions of their constituents) and in the flood of political pamphlets which poured from the press at this time, notably Qu'est-ce que *le* Tiers *État?* by the abbé Emmanuel Joseph Sieyès, the most learned political theorist of the day, which claimed that the will of the nation should be expressed by the representatives of nine-tenths of its population.

The National Constituent Assembly. — For six weeks after its formal opening by the king the states-general met in three parts, each order in a separate place. But the third estate occupied the great *salle* des menus *plaisirs* du *roi,* the only one in which the whole assembly could sit together; and there it met daily. refusing to do any business until the clergy and nobility consented to join it and to constitute a single assembly. On June 17, under the leadership of Sieyès, Jean Joseph Mounier and Honoré Gabriel Riquetti, comte de Mirabeau, the members took the critical step of declaring themselves to be *l'assemblée nationale* and of ordering the payment of taxes to continue just so long as they were allowed to continue in session. The king prepared to quash this declaration at a *séance* royale, and ordered the salle to be closed meanwhile. The third estate anticipated him (June 20) by meeting in the local tennis court and taking a solemn oath to continue deliberations "until the constitution of the realm is set up and consolidated on firm foundations."

Fall of the Bastille. — On June 23, after ordering the three estates to sit separately and proposing a limited program of reforms to be carried out by the crown, Louis expected the third estate to disperse; they refused to budge, "except at the point of the bayonet." The king, who shrank from violence and could not trust his troops, gave way; he ordered the clergy and nobles to unite with the third estate (June 27), and thus in effect surrendered his prerogatives to a legislature in which representatives of all classes of society sat together as national deputies for the purpose of giving France a written constitution: an *assemblée nationale constituante*.

Paris was by geographical position, population and tradition the political and governmental centre of France. The Parisians had anxiously watched the contest at Versailles and applauded the victory of the third estate. When, a fortnight later (July 11) they heard that Necker was dismissed and that troops threatened the capital, they gathered in crowds and seized arms; and on July 14, led by soldiers who had broken prison, they stormed the Bastille, an antiquated fort and almost empty prison that seemed to the poor of the Faubourg St. Antoine a symbol of tyranny and feudalism. The appeal to force succeeded. Within three days the royal troops were withdrawn, Necker was recalled and the leaders of reaction at court, led by the king's youngest brother Charles Philippe de Bourbon, comte d'Artois, were in flight for the frontier. Louis himself visited the town hall, sported the city colours and approved the appointment of Jean Sylvain Bailly and the marquis de La Fayette as mayor and commandant of a bourgeois municipality and national guard. The first act of the Revolution was over.

The Foundation Deeds Enacted.—The constitution that the *cahiers* had demanded and that it was the business of the National Assembly to provide was supposed to make a change not from a monarchy to a republic but from an absolute monarchy to a limited one. Its fundamental principle was to be the sovereignty of the people, and the king—no longer *roi de France* but *roi des Français*—was to be the executive, but not (as he had been) the fount of legislation and the judicial court of appeal. The three powers of state were to be separated. as Montesquieu had mistakenly supposed they mere in the British constitution. But since the Revolution was not merely political but also social and ideological, the limiting of the prerogatives of the crown must go hand in hand with the abolition of class privilege and the safeguarding of human rights. So the National Assembly proceeded at once to enact the foundation deeds of the Revolution: the Declaration of Rights, the abolition of feudalism and the introduction of the suspensive veto. All three measures were hurried through within less than three weeks. partly because it was important not to give the king time to repent of his concessions and partly because the country people were beginning to pick the fruit of revolution before it was ripe—attacking the châteaux of their seigneurs. seizing the land, shooting the game and refusing to pay tithes or taxes.

1. The Declaration of the Rights of Man *(de l'homme et du citoyen;* Aug. *27)* was based on the American declaration of 1776 and laid down the "natural and imprescriptible" right of every citizen to liberty, equality, property and security; adding that it was the duty of every citizen to defend these rights, not for himself only but also for others, by sharing in the government, in the armed protection of the community and in the payment of taxes required by it. This declaration was a document of prophetic importance, expressing the "unconquerable hope" of humanity.

2. Feudalism was "abolished" by a few hours' debate on Aug. 4. Though the consequent legislation of Aug. 11 fell short of what the country had expected and though it took four years to complete the work of one night, yet that legislation was sufficiently drastic. The remains of serfdom were abolished; all feudal rights were made extinguishable by purchase; seigneurial privileges and monopolies were done away with; inequality of taxation ended; civil and military promotion was opened to all classes; justice was to be administered gratis; tithes and other clerical dues were abolished. It was not reform; it was a social revolution; it created modern France.

3. The third foundation deed, the limitation of the royal veto, might have been delayed indefinitely had not the king refused his sanction to the Declaration and to the measures of Aug. 4. The assembly was deeply divided between those who shrank from reducing the royal prerogatives and those who wished to deprive the crown of any veto on the will of the people. The suspensive veto (Sept. 11) was a compromise which left the executive with the power to delay and irritate the legislature without controlling it; and its use contributed no little to the fall of the monarchy three years later.

The Removal to **Paris.**—Meanwhile, still delaying acceptance of the measures of Aug. 4, the king had once more given way to the pressure of the reactionary party at court and summoned foreign mercenaries (the Flanders regiment) to Versailles, where the presence of the queen at a regimental dinner gave rise to anti-revolutionary demonstrations. The people of Paris—a capital now armed, discontented and short of food—once more intervened. On Oct. 5 a procession led by market women *(dames des halles)* set out for Versailles, followed by detachments of the national guard under La Fayette; their aim was to petition the king for bread and to demand his acceptance of the measures passed by the assembly. Late that night, after playing with the idea of flight, Louis gave way. Early next morning an unruly minority of the crowd, who had spent the night outside the palace. broke into the royal apartments and nearly succeeded in murdering the queen. The majority was not appeased until the royal family agreed to accompany them back to Paris to take residence in the Tuileries—as hostages, if not prisoners, of the Revolution. The court was follo ed by the assembly, except for about 300 of its more royalist members who feared the revenge of the Paris citizens. The capital now held within its grasp both executive and legislature; the views and interests of its citizens, six times more numerous than those of any other city in France, would sway the debates of the national representatives in the royal riding school (*manège*) on the north side of the Tuileries gardens. The politically minded members of its middle class would debate with those of the deputies who belonged to the Jacobin club *(amis de la constitution),* which met in the Dominican convent close by. Its papers would praise the friends and attack the foes of the "patriotic" program. In its clubs and cafés every measure would be debated; and if need be its spokesmen in the more unruly *faubourgs* could organize a riot or present a petition at the bar of the assembly.

Paris stood at the head of the Revolution; but it did not stand alone. At Lyons, Bordeaux, Marseilles, the great manufacturing and shipping centres of the south, and in the larger provincial towns all over France, bastilles were falling, feudal municipalities were being ousted by nominees of the *bourgeoisie* and royalist garrisons were giving place to national guards. The centralized system of local government, with its intendants and *généralités,* its military *gouvernements,* its judicial *bailliages* and *sénéchaussées,* was being swept away.

FALL OF THE MONARCHY, 1790–92

If Louis XVI had been a man of character and his wife, like the two previous queens, a political nonentity, he might have taken advantage of the overthrow of the privileged orders, whose alliance had compromised his position more than it had strengthened it. to put himself at the head of the Revolution; but he had no gift of leadership, no mind of his own and no ministers fit to advise him. He had read with interest the notes which Mirabeau—the ablest orator and politician in the assembly, but with more ideas than principles and handicapped by a disreputable life—addressed to him in 1790–91; but he did not act upon them. They advised a *rapprochement* with the revolutionary leaders (which he disdained), the organization of royalist support in the country (but the leading royalists were going into voluntary exile) or, as a last resort. retirement from Paris and an appeal to the provinces against the capital (which could mean nothing less than civil war). Louis had a horror of bloodshed. His courage was all passive, his patriotism all benevolent. He preferred to wait for a royalist reaction or for a split between the revolutionary parties, or for a war that might rally the nation behind the crown. Meanwhile the assembly extended its powers from legislative to executive functions. Through its financial, diplomatic, military and other committees it supervised and overruled the ministers; yet it found itself handicapped by royalist generals, by the old-fashioned tradition and personnel of the foreign office, by the passive resistance of local authorities and by the refusal of the people to pay taxes. The state of the country under the regime of 1789–91 was not anarchy. but it was decentralization ad *absurdum*.

An attempt was made to create a feeling of national unity by the Fête de la Fédération (July 14, 1790) held in Paris on the anniversary of the fall of the Bastille; but it would need a national emergency to make this feeling effective. The mass of the people were too busy exploiting the benefits of the Revolution to shoulder their responsibilities. In the countryside, the discontent of 1789 had been assuaged by the lightening of feudal burdens, by the occupation or purchase of seigniorial land and by the virtual abolition of tithes and taxes. The farmers and *métayers* (copartner tenants) were becoming small landowners with a stake in the country and supporters of the revolutionary regime—so long as it protected their newly won properties and profits. The workers in the big towns. particularly in Paris, were less contented. The year 1788 had brought a bad harvest and a bitter winter; in 1789 half a century's rise in prices reached a peak, especially in the necessities of the poor; and wages failed to keep pace with the rise in prices and rents. The emigration of so many rich people threw great numbers of domestics and workmen out of employment; and the loi Le *Chapelier* (June 14, 1791), which prohibited all professional associations, collective petitioning, strikes or workers' meetings, deprived them of any hope of improving their condition. But the inhabitants of the Paris slums, which lay mostly in the eastqrn and southeastern quarters of the capital, needed to be organized and led before they would attack a Bastille or burn down the house of a bad employer or hang a banker suspected of keeping back supplies. The Revolution at this moment was singularly free from mob violence.

The Civil Constitution of the Clergy.—The worst problem that the assembly had to face during its first two years was neither the opposition of the king nor the discontent of the workers but the bankruptcy of the treasury. How was the new regime to overcome the financial crisis that had proved fatal to the old? When Necker's loans were not subscribed, when the taxes were not paid and when forced contributions or voluntary gifts brought in too little to be worth collecting, only one remedy remained—a remedy long foreseen and justified by the theory of the monarchy: the nation would take over as its own the property and endowments of the French church. This was an immense and wealthy corporation, with 150 dioceses, 35,000 benefices and property in land and buildings reckoned as at least one-fifth of all such wealth in the country. Many bishops were very rich, most clergy very poor; the bishops out of touch with the people, the clergy at one with them by birth and way of life. The priest and the Mass, Catholic baptism, marriage and burial, were taken for granted by the common people, though increasingly slighted by the educated classes. Protestantism was disliked as un-French, and the Catholic church in its Gallican form was regarded as a necessary safeguard of public morals. To the middle-class majority in the assembly there would seem to be nothing but gain in nationalizing the church and in using its wealth to pay the way of the revolutionary government. The clergy themselves had, on Aug. 4, renounced their tithes and dues, expecting that the state would find them salaries. On Nov. 2, 1789, it had been decreed that "all church property is at the disposal of the nation." Land and buildings were to be sold by auction; clerical salaries (less for the bishops and more for the clergy than under the old system) to be paid by the treasury; and the other liabilities of the church—education, hospitals and the like—to be taken over by the state. This would involve much more than finance. The Constitution *civile* du *clergé* enacted on July 12, 1790, set up a new church establishment and raised political and ecclesiastical issues of vital importance to the course of the Revolution. The dioceses were rearranged to coincide with the *départements;* bishops and clergy were chosen, like civil magistrates and local officials, by popular election and took an oath of acceptance of the constitution. Regulations were laid down to prevent absenteeism, pluralism and neglect of duty. Some of these changes, long due, were intended rather to strengthen than to weaken the church; but even clergy who welcorned reform resented the highhanded may in which the assembly acted. They doubted whether the oath of allegiance to the constitution was consistent with their Catholic faith and duties; they waited to see what the pope would say about it. When the time came for taking the oath (Jan. 16, 1791) Pius VI's attitude was still obscure and nearly half the clergy in the country remained "nonjurors." When he finally decided to condemn the constitution (March 10, 1791) the church was split between "constitutional" and "refractory" clergy, the former, until 1794, receiving state support, the latter deprived of their livings and liable to penalties under a succession of punitive measures. This breach with the papacy strengthened the hands of the royalists and *émigrés,* dogged the footsteps of the revolutionary armies and deprived the government of its traditional support of the pulpit and confessional; the schism was not healed until the concordat of 1802.

The **Assignats.**—The sale of the nationalized church property was encouraged by the issue of government certificates entitling their holders to purchase houses and land. These assignats were soon given recognition as a paper currency and issued in such quantities, in order to meet the growing needs of government expenditure, that gold and silver were driven out of circulation and money values progressively depreciated; by 1793 the purchasing power of 100 fr. was but a quarter of what it had been in 1791. But the assignats saved the Revolution. National bankruptcy was staved off and business enterprise encouraged until the time came when the republican armies could refill the treasury with the indemnities and loot of the countries that they conquered or "liberated."

The Flight to **Varennes.**—By the end of 1790, after 18 months of revolution, there were signs that a new crisis was at hand. The country was being inundated with laws and decrees which the local authorities could not or would not put into practice. The church was divided into two antagonistic parties. The peasantry still suffered under feudal burdens which they could not afford to redeem. The townspeople complained of high prices, unemployment and food shortage. The assembly was increasingly hostile to the king and his ministers, who disliked and obstructed its policy; while Louis, who had never accepted his defeats in 1789, felt strong conscientious objections to the Civil Constitution of the Clergy. Mirabeau, failing in all his attempts to become a minister or to co-operate with Necker (who finally retired in Oct. 1790) or with La Fayette (whose wealth, popularity and command of the national guard, coupled with conceit and stupidity, made him cling to the status quo), now counselled Louis to leave Paris for Rouen, the centre of royalist Normandy, and there to raise the white banner of the Bourbons, even though it might lead to civil war. But the queen trusted none of these advisers and drew the king into plans. devised by the marquis de Bouillé, by the comte de la Marck and by her Swedish friend Hans Axel Fersen, for a flight toward the Rhine frontier, to end, if need be, in the arms of the emperor's troops and the *émigrés,* who would then march on Paris, dismiss the assembly and restore Louis to his throne.

Before his premature death on April 2, 1791, Mirabeau accepted this plan, for want of a better. The refusal of the Parisians, suspicious of some such intention, to let the royal family spend the Easter of 1791 at St. Cloud (April 18) finally determined the king's vacillating purpose, and on the night of June 20–21 he and the queen and their two children, disguised and with forged passports, escaped from the Tuileries and drove off on the road for Chblons and the frontier town of Montmédy. Their flight was not discovered till they were well away, and they would have escaped had they not been recognized at Ste. Menehould, pursued and eventually stopped, after 24 hours' journey, at Varennes. They were brought back ignominiously to Paris and practically imprisoned in the Tuileries.

During Louis' absence Paris had learned to do without a king. Less than a month after his return a mass demonstration organized by the left-wing club of the Cordeliers demanded his abdication and the setting-up of a new form of government, which could hardly (though the word was not used) be anything but republican. The petitioners were dispersed, with some loss of life, by the national guard (July 17) under the command of La Fayette, by order of the mayor (Bailly) and with the approval of the queen; the Jacobin club, which had halfheartedly supported the petition, lost its best members to the new club of the Feuillants and the leaders of the Cordeliers were proscribed. But the "massacre of the Champ de Mars" was not forgiven or forgotten; it was, with the flight to Varennes, an essential cause of the fall of the throne.

The Constitution of 1791.—Enacted bit by bit during two years of committee meetings, reports and debates, the constitution now came fully into being. The document headed *Décret de l'assemblée nationale du trois Septembre, 1791: La Constitution Française* opened with a revised Declaration of Rights and with a statement of the benefits won by the abolition of feudalism, which by now included the prohibition of religious vows and industrial guilds *(corporations)*. Title i added to the rights of man freedom to emigrate, freedom of petition and compensation for property confiscated by the state; it promised a poor law, an education bill. national festivals and a code of civil law. Title ii subdivided the old provinces and *généralités* (associated with feudalism and royal absolutism) into *départements*, districts, cantons and communes and defined civic status, with generous admission of foreigners. Title iii laid down the constitutional powers and functions of the *pouvoir exécutif* (the king and his ministers), the legislature (to be called *assemblée le'gislative)* and the judicature. Title iv dealt with the army, navy and national guard. Title vii provided a system of safeguards against any revision of the constitution so elaborate as to make a coup d'état the only hope of change. Yet was this constitution so perfect? Single-chamber legislation by 745 deputies who could not be dismissed under two years; a king who could not dissolve parliament, could not declare peace or war without its consent, could not choose his ministers from among its members, could not veto, even suspensively, constitutional or financial legislation, had no control over the army or the national guard (an armed force of about 2,000,000 men) and was financially dependent on a civil-list salary; a system of local government by a hierarchy of elected committees without central control; and a franchise (based on property and wages) confined to 4,000,000 out of 6,000,000 adult Frenchmen, with further discrimination against the working class in the great cities: was there not in these provisions material enough for further dispute, if the crown were to try to regain its prerogatives or the legislature to extend its powers or the workers to assert their rights against the political monopoly of the middle classes? Time was to show the futility of any attempt to impose a rigid form upon a growing organism.

The Legislative Assembly.—The defects and paradoxes of the new constitution were indeed hardly less important as factors of the general discontent than was resentment at the flight to Varennes and at the "massacre of the Champ de Mars." Thus when it was at last unwillingly accepted by the king (Sept. 18) and the Constituent was replaced by the Legislative Assembly, it became apparent that the sentiments which had created the constitution no longer existed to enforce it. One of the last acts of the outgoing deputies had been to pass a "self-denying ordinance" excluding themselves from re-election; consequently the Legislative Assembly contained none of the men who had initiated and carried through the Revolution, but many of its irresponsible critics and unsatisfied beneficiaries—men who, moreover, had the ungrateful task of implementing a constitution in which no class in the country fully believed. The majority of these new deputies, generally called the Girondists because their leaders came from the Gironde department, retained pre-Varennes and anti-Parisian views. They wished to keep the monarchy, but under the control of the propertied classes, and to discipline the city workers in the interests of economic monopoly and social order.

The minority, generally called the Jacobins and led by the Paris deputies, inclined toward destroying the monarchy and setting up a republic. Within a few months this quarrel was embittered by the approach of war. The king and queen, fearing not merely for the throne but for their lives, were again asking for foreign intervention and playing with the idea that war might bring the people back to the crown. The Girondists, led by Jacques Pierre Brissot, an impracticable idealist, preached the mission of the Revolution to emancipate Europe and the moralizing influence of war. The people grew alarmed at the presence of foreign and *émigré* troops on the Rhine frontier and the rumours of "second column" activities in the capital. On Jan. 14, 1792, Brissot brought matters to a head by demanding that the emperor should declare himself still the ally of France under the treaty of 1756, and ten days later made refusal to give such assurances equivalent to a declaration of war. The death of Leopold II (March 1) only postponed the crisis; his successor Francis II took up the challenge. A fortnight later Louis took a step which, if it had been taken earlier and *ex animo*, might have saved the throne: he appointed a new ministry nominated by the Girondists, including Charles François Dumouriez (their ablest soldier but an ambitious careerist) and Jean Marie Roland, the enemy of Paris. But now such a partnership was impossible; the king and his ministers were agreed upon nothing but war, and that for different reasons, neither of them patriotic. When, on April 20, Louis formally declared war upon the emperor, he was signing his own death warrant and inaugurating a period of hostilities between France and Europe which was to last almost without a break for 23 years.

The social and political effects of war are impossible to predict or to control. Within four months of the outbreak of hostilities the French monarchy, which had expected a revival of popularity, was overthrown; within a year the Girondists, who had counted on victory to establish their government, lost all political power and their leaders were proscribed; within two years the Jacobins, who replaced them, fell in their turn. Meanwhile the country was disrupted by civil war and the capital disgraced by the Terror. Reaction would follow, but it could only take one form, that of a dictatorship, committing France to a militarism foreign to its genius and fixing its character in that dual personality which has been its weakness ever since.

If war had been forced upon the country two years earlier. when the king was still popular, the assembly united and the people enthusiastic for its newly won liberties, victory might have established by national consent in 1792 the constitutional monarchy which was imposed by foreign arms in 1814. But now the court was known to be in sympathy with the *émigrés* and their foreign protectors, and the Tuileries was regarded as an outpost of the enemy; the assembly was divided between a majority which preached war with an eye to political power and a minority which opposed it as promising only military defeat, political revolution and perhaps the dictatorship of a reactionary or ambitious general. This party, Jacobin by name, Parisian in outlook and inspired by Maximilien Robespierre, whose platform was the Jacobin club and the *Défenseur de la Constitution*, was justified by events. The troops on the Belgian frontier, disorganized by revolutionary ideas and distrustful of their still largely aristocratic officers, were thrown back in their first offensive and murdered one of their generals. When Brissot's party tried to shift the odium of defeat onto the king, he dismissed the Girondist ministers. They attempted a more direct way to power by disbanding the household troops, establishing a camp of provincial volunteers (*fédérés*) under the walls of Paris and organizing a mass demonstration within the Tuileries (June 20). Louis was persuaded to don the cap of liberty *(bonnet rouge)* and to drink to the health of the nation; but his passive courage and the dignity of the queen defeated this attempt to coerce the crown. It was left to the Parisian Jacobins, led by an insurrectional committee from the more republican sections of the city, in conjunction with the *fédérés* of Marseilles, to organize an armed attack on the Tuileries (Aug. 10). The national guardsmen of the royalist sections, detailed to defend the palace, went over to their republican comrades who were attacking it; the royal family was persuaded to avoid bloodshed by taking refuge in the assembly; the attackers massacred most of the Swiss, whom Louis had ordered to cease fire; and the mob sacked the royal apartments. Forty-eight hours later the monarchy was once more "suspended," as it had been after Varennes, and the royal family were immured in the *petite tour* of the old Temple as prisoners of the Paris commune.

The Paris Commune.—Aug. 10, 1792, was as much a Paris affair as July 14, 1789. It was followed by an interregnum of six weeks during which the rump of the assembly was still the nominal legislature and the executive a provisional ministry appointed by the Girondist majority. In fact the Paris commune imposed its will on both, an episode which was never forgiven by its real enemies, the Girondists, or forgotten by its nominal friends, the Jacobins. What was the commune? For the elections of 1789 Paris had been divided into 60 districts, and these wards had acquired many of the functions of local government, while electing representatives onto a central *municipalité* (city council) popularly called the commune. By the municipal law of 1790 the 60 districts had been redistributed into 48 sections, with the intention of destroying their independence, but the 1,800 or so "active citizens" (*i.e.,* voters) in each section soon asserted their right to organize, to arm and to express their political opinions, to support the claims of the commune against the assembly or, if need be, to replace their own elected representatives by an insurrectional committee nominated to carry through a special plan (*e.g.,* Aug. 10, 1792; June 2, 1793). Yet, whatever its dangers and crimes, the communal regime inaugurated immense changes, working out the logical implications of the Revolution and imprinting upon it the character that it has borne ever since. For it was during these six weeks that the defense of the country was entrusted to an army of volunteers, that its government was put into the hands of a National Convention, that feudalism and privilege were finally destroyed, that the Catholic church was persecuted and in part proscribed, that the movement for the execution of the king and queen was set going and that "national justice" was exacted and political unity enforced by the Reign of Terror.

The leader in most of these movements was Georges Jacques Danton, the representative of the commune in the provisional executive and its most active member—a demagogue of unusual powers and a man who did not scruple to do what Robespierre only talked of doing; yet corrupt, unprincipled and inconsequent. It was Danton whose appeal to arms sent thousands of citizen volunteers to the front—the nucleus of the new army which in 1792–93 stopped the Prussian invasion at Valmy and pushed back the frontiers to the Netherlands and the Rhine; and Danton who invested with dictatorial powers a standing committee of the assembly which developed into the famous committee of public safety. But it was Danton too who inspired the peace overtures that followed the victory of Valmy; who joined Robespierre in his opposition to the anti-Catholic campaign of the Paris commune (*e.g.,* Pierre Gaspard Chaumette) and of some of the provincial agents of the Convention (*e.g.,* Joseph Fouché); and who endangered his party popularity by trying to save the life of the king and lost his own life in opposing the terrorist policy of the committee that he had originated.

The departure of volunteers for the front toward the end of August was made the excuse for the summary execution of about 1,200 priests. royalists, aristocrats and even criminals and prostitutes, whose presence in the prisons was alleged to be a danger to the unguarded civil population. The massacres were initiated by the *comité* de *surveillance* of the commune and were inspired by Jean Paul Marat, formerly a scientist and medical man with a Scotch degree, a royal appointment and a fashionable practice in prerevolutionary Paris, but now a Jacobin of the left, self-named *l'ami* des hommes, whose championship of the poor made him a ruthless terrorist; but Danton approved, Robespierre tried to proscribe Roland and neither assembly nor commune made any effective protest. The affair left a slur upon the Parisian Jacobins that kept their enemies in power for six months, embittered provincial feeling against the capital and inspired that fear of the people which was the underlying motive of the Reign of Terror.

THE FIRST REPUBLIC UNDER THE CONVENTION

The National Convention of 1792, elected under the influence of the fall of the throne, the prison massacres and the invasion of the northeastern frontier (the Prussians at the beginning of September were within 140 mi. of Paris), numbered 750 deputies, comprising lawyers, businessmen, merchants, manufacturers, tradesmen, a fair proportion of professional and literary men, a handful of aristocrats (including Louis Philippe Joseph, duke of Orléans, called Egalite), a very few members of the working class and one Englishman, Thomas Paine. Though one out of every three of its deputies had sat in the Constituent or Legislative assemblies and would too easily remember July 17, 1791, and Aug. 10, 1792, yet all were at the moment united in the defense of the country and in the founding of a republic. But no sooner had the first aim been attained, as it seemed. on the very day the convention met, by the victory of Valmy (Sept. 20) and the second secured, next day, by the laconic decree La convention *nationale décrète à l'unanimité que* la *royauté* est abolie en France, than the underlying differences between Jacobin and Girondist became apparent and a struggle began which ended in the destruction of both parties. This might not have happened if there had been any appeal from the free vote of a chance majority of deputies to a royal veto or to revision by an upper house; or if one of the two parties had constituted a government with power to act and the other an opposition ready to take its place when it failed. Without such safeguards parties dissolved into cliques, criticism became personal and irresponsible and important issues were decided by snap votes taken under some public or party pressure. In fact, the predominance of the Girondists in the convention, as measured by their success in the fortnightly elections of its president and in their majorities on its committees, lasted just so long as Dumouriez's invasion of Belgium went well (Jemappes, Nov. 6, 1792), the assignat did not depreciate too rapidly (its serious fall began at the end of the year) and the republic did not become involved with new enemies. The Girondists might have surmounted even these difficulties if they had not been worsted in three domestic controversies: the fate of the king, the new constitution and the claims of the commune.

The country had been of one mind in its rejection of the monarchy but was still royalist enough at heart to shrink from the logical sequel, the king's trial on charges that in any common case would involve the death sentence. To Robespierre, to Louis Antoine de Saint-Just and to the Jacobins of the Mountain (as the left-wing party came to be called, from their raised seats at one end of the mankge) Louis Capet was just another traitor, who had from the first been hand in glove with the enemies of the Revolution, who, under Mirabeau's advice (revealed by the discovery of the "iron chest" at the Tuileries, Nov. 20, 1792), had planned civil war and by whose orders patriot citizens had been shot down on July 17, 1791, and Aug. 10, 1792. Girondist deputies retorted that under the constitution of 1791 Louis was still inviolable or (alternatively) that he could not be held responsible for acts committed since the abdication implied in his flight to Varennes. There was no formal trial but after interrogation before the assembly Louis was found guilty by an almost unanimous vote. A Girondist proposal for a plebiscite, which was expected to evoke the royalism of the countryside, was defeated by a large majority. The final vote as to the sentence—exile, imprisonment, or death—was taken by *appel* nominal; *i.e.,* each deputy voted separately and might state reasons for his decision. A number of deputies spoiled their votes by qualifications, but 361 out of 721 declared for death sans phrase—a majority of one. A final proposal for postponement (*sursis*) of the death sentence was defeated by 70 votes. On Jan. 21, 1793, Louis was taken to the Place de la Révolution (modern Place de la Concorde) and there executed, amid cries of *Vive* la nation!

A king deposed by national consent and named a traitor by a National Convention would inevitably be a centre of intrigue, whether in prison or in exile. Public safety demanded the death sentence. But his execution could not remain a domestic affair. The Jacobin leaders, who had engineered it, thought of it as consolidating their party, uniting the country and challenging the crowned heads of Europe. Every deputy was now branded either as a regicide or as an *appelant* (one who had voted for the plebiscite with the hope of saving the king's life). The latter would soon fall under the charge of royalism; the former would have every motive for remaining in power and arming the republic against a monarchist reaction under which their property, if not their lives, would be forfeit.

Fall of the Girondists.—The weakness and disunity shown by the Girondists during the king's trial was matched by their failure to carry through the primary work of the National Convention, the creation of a French republic. Eight months after their first meeting the deputies had dealt with only 6 out of the 368 articles of the marquis de Condorcet's draft constitution, and this was known to be designed on such party lines that a Jacobin "shadow" constitutional committee was already preparing a rival document. This committee's proposals became the nucleus of the constitution of 1793—a skeleton plan on extremely democratic lines which never came into force but played an important part, at first as Jacobin and afterward as anti-Jacobin propaganda. The acceptance by the convention of the Jacobin constitution (June 24, 1793) was the coup de grâce to an already fallen victim. The constant attacks on the Paris commune by Roland, the minister of the interior, inspired by his Parisian-born but provincially minded wife Manon Phlipon, the political hostess of the party, had exasperated public feeling in the capital. When Dumouriez, the hero of Valmy and conqueror of Belgium, was defeated at Neerwinden (March 18), when, forced to retreat from the Netherlands, he planned with the connivance of the Austrians to march on Paris and set up a dictatorship and when, unable to carry his army with him, he went over to the enemy, it was easy for the more revolutionary sections of the capital to form an insurrectional committee and to organize another attack on the Tuileries—the seat (since the transference there of the assembly from the *manège* on May 10) of a Girondist majority that seemed to them to be once more betraying the country. But this was a bloodless revolution. On May 31 national guardsmen seized key positions in the capital. On June 1 they surrounded the Tuileries with arms and guns. On June 2 the convention sat all day, invested by thousands of armed and unarmed citizens who would not let the deputies go home till they had accepted a Jacobin resolution decreeing the suspension and arrest of 29 leaders of the Girondist party and of two ministers, Étienne Clavière and Pierre Marie Henri Lebrun-Tondu. Several of the expelled deputies (*e.g.,* Jean Baptiste Louvet and Maximin Isnard) escaped and survived; many (*e.g.,* Brissot, Armand Gensonné and Pierre Victurnien Vergniaud) were guillotined in the proscription following Charlotte Corday's murder of Marat (July 13). Some who escaped from detention and tried to raise revolt in Normandy were outlawed and perished by execution or suicide (*e.g.,* Jérôme Pétion and Charles Jean Marie Barbaroux). Of 63 leaders of the party only 25 survived the Revolution. The Girondists were the liberals of their age, presenting ideas which time has justified as the essence of the Revolution but which then carried no effective policy and were set aside by the necessity of national survival.

The **Jacobin** Regime.—The Jacobin party, which the coup of June 1793 substituted for the Girondists as the ruling group in the convention, took some time to establish a dictatorship that was to leave a mark upon the country in much the same way as did the Bourbon monarchy before it and the Napoleonic empire after. The main features of this regime were a small powerful executive, a legislature deprived of initiative, a centralized administration and a ruthless use of powers of summary arrest and execution. The committee of public safety (*comité* de *salut* public) took final shape with the exclusion of Danton on July 10 and with the addition of Robespierre on July 27, of Lazare Nicolas Marguerite Carnot and Claude Antoine Prieur-Duvernois (Prieur de la Côte d'Or) on Aug. 14 and Jacques Nicolas Billaud-Varenne and Jean Marie Collot d'Herbois on Sept. 6. All its members were deputies, re-eligible and re-elected monthly without change. They divided up among themselves the supervision of the army (Carnot, Jean Baptiste Robert Lindet and Prieur-Duvernois), of the navy (André Jeanbon Saint-André), of local administration (Collot, Billaud) and of foreign affairs (Bertrand Barère); while Georges Auguste Couthon, Antoine de Saint-Just, Marie Jean Hérault de Séchelles and Pierre Louis Prieur (de la Marne) were often away on special missions and Robespierre was responsible for expounding the policy of the committee and maintaining its liaison with the National Convention. But the whole committee met daily for conference and the signing of papers and in theory all its members were jointly responsible for the acts of each. It had no chairman or secretary. and if it was called "Danton's" committee before July 10 or "Robespierre's" after July 27 it was because Danton and Robespierre were in turn the dominating members—Danton by his patriotic reputation during the crisis of 1792 and Robespierre by his long experience in revolutionary party politics, his established position at the Jacobin club, his consistent championship of "the people" and the high moral tone of his speeches, backed by a reputation for incorruptibility and a flair for party intrigue.

This formidable committee soon succeeded by hard work and efficient centralization in extending its control over the ministries and administrative bodies, the judges, generals and commissaires of the republic. whom it appointed, purged or dismissed at will. Its dictatorship was exercised by leave of a diminished National Convention, the most active members of which were employed on missions away from the capital and which became increasingly subservient to its demands; it ruled by consent of the country and the commune, so long as there was fear of foreign invasion and a fair share of the benefits of the Revolution. In local government the Jacobins returned to the centralization of the prerevolutionary regime. The departmental and district directoires, still centres of Girondist *fédéralisme* (the "reactionary" theory which regarded Paris as no more than one of the 84 federated *départements*), were purged or overruled; while by an elaborate system of reports from *députés* en mission, commissaires and agents *nationaux* the committee of public safety kept itself informed as to what went on in the armies, the courts and the administrative bodies of the republic (in practice, however, no complete control or uniformity was secured until Bonaparte reinstituted, under the name of *préfets*, the intendants of the prerevolutionary regime). The authority of the committee rested ultimately upon its ruthless use of force: its travelling agents with power to dismiss, arrest or send to trial in Paris unsuccessful generals, officials who obstructed or opposed the government, dishonest contractors, profiteers and the like; its local or occasional courts (such as those dealing with armed revolt in the provinces), which might have power to inflict the death penalty; and the revolutionary tribunal in Paris, whose public prosecutor, Antoine Quentin Fouquier-Tinville, compiled dossiers concerning persons under arrest and presented them for trial and whose judges and jurymen, appointed and paid by the government, had personal as well as patriotic reasons for a ruthless interpretation of the wide laws against *incivisme* and *conspiration.*

Why did a regime so powerful and so efficient fail? First, because it had to fight constantly against opposition in the provinces because of traditional anti-Parisian feeling (particularly in the trading and manufacturing centres of the south) and the intrigues of royalist agents, nonjuror clergy and revengeful Girondists—opposition which flared up into civil war in the west and armed rebellion in the south, at Lyons, Marseilles and Toulon. In the Vendée massacre was answered by massacre; the rebel cities of the south were reduced, their buildings destroyed and their citizens subjected to mass execution. The lesson was learned, but the teachers were the more detested. The second reason for failure was economic. The depreciation of the assignats (the real value of 100 livres was 25 in July 1793 and not more than 30 a year later) discouraged farmers from selling their produce in the towns; the needs of the army necessitated wholesale requisitioning; in Paris (whose population of more than 500,000 was constantly on the edge of food shortage) bread and meat had to be rationed; a scheme to ensure supplies by enforcing the sale of consumer goods at fixed prices (the *maximum*) proved unworkable; and the coastal blockade enforced by the British fleet brought ruin to the ports and overseas trade. Munitions factories, no doubt, provided a living for many whom the liquidation of large fortunes and the closing-down of luxury trades had left unemployed; but this brought little improvement in wages or working conditions. Soon the grievances of the working class in Paris and the demand for the introduction of the democratic constitution of 1793 took shape in a movement to which Jacques René Hébert, who had replaced Marat as the most popular journalist of the time, gave his name. Its attempt to overthrow the committee was quashed; but the execution of 18 Hébertists on March 24, 1794, while it left the movement without leaders, also provided a fresh argument against the guillotine, most of whose victims were no longer priests or aristocrats but ordinary citizens accused of hoarding, profiteering or the various offenses included under the Law of Suspects. A new movement emerged from the ruins of he'bertisme—a movement to which Danton pledged his reputation (forgetting how short memories are in time of revolution) and Camille Desmoulins (in Le Vieux *Cordelier*) his clever pen. This movement again asked for the constitution of 1793, for a political amnesty for the Girondists and for a modification of what had by now become a Reign of Terror: the number of executions had risen every month (21 in September, 59 in October, 61 in November, 68 in December 1793, 61 in January, 77 in February and 121 in March 1794); and the Paris prisons contained about 8,000 prospective victims. But the committee saw in dantonisme an attack upon themselves and their monopoly of power; and within a fortnight Danton, Desmoulins and 13 of their associates followed Hébert and his 17 to the scaffold.

Thermidor and the Reaction. — During the next three months the dictatorship of the committee was intensified, but from fear, not from confidence; and differences between its members, hitherto concealed by their common front against *hébertisme* and *dantonisme,* became irreconcilable. Carnot quarrelled with Saint-Just over the conduct of the campaign in the Netherlands. The mainly anti-Robespierrist *comité* de *sûreté générale* was offended by the proceedings of the bureau de police *générale,* through which Robespierre and Saint-Just overrode its police functions. Robespierre's plan to nationalize religion in the form of a culte de *l'Être Suprème* (inaugurated on May 7) was disliked both by Catholics and anticlericals and contributed matter for attacks upon his too obvious pose as a prophet and martyr of republican idealism. The revolutionary tribunal struck out ferociously against supposed prison conspiracies and plots to assassinate the Jacobin leaders (the number of executions rose again from 258 in April 1794 to 345 in May and 688 in June). The enforcement of the maximum caused a degree of popular discontent that could not be assuaged by Saint-Just's unworkable plan (laws of Ventôse) to distribute the confiscated property of suspects to poor citizens or Barère's scheme for state pensions and sickness benefits (livre de la *bienfaisance nationale*). Robespierre's law of 22 Prairial, designed to speed up the work of the tribunal and (so they alleged) to remove the deputies' exemption from summary arrest, provided those who feared proscription (*e.g.,* Fouché) with arguments to win over the moderates in the National Convention and organize a movement against the committee. On July 26 (8 Thermidor), after six weeks' unexplained retirement from public life, Robespierre hit back in a speech full of appeals to those who would no longer hear them and of threats that he could no longer enforce. Next day the deputies shouted him down and decreed his arrest. The commune declared for him; the convention replied by a decree of outlawry. He was arrested at the town hall, with his brother Augustin. Franqois Hanriot, Couthon and Saint-Just. The same guillotine that on 9 Thermidor executed 45 anti-Robespierrists executed, in the following three days, 104 Robespierrists and brought the number of victims for the month up to the shocking total of 935. As Robespierre, for five years the champion of the people, was carried through the streets to his death on 10 Thermidor, he was greeted with derisive cries of *A* bas *le maximum!* The Jacobins were rejected by the class whose interests they had claimed to champion but whom in fact they had neither trusted nor consulted. Some of their leaders had used their power to save the country; some had thought to reform it; all had' punished and killed because they were afraid. The narrower the basis of their tyranny grew, the more easily it was destroyed.

The period following the fall of Robespierre is often regarded as a dreary and unimportant interlude between the revolutionary and Napoleonic eras, a period of political, military and economic decadence from which the country was rescued by the genius and energy of its greatest hero. It suited Bonapartist propaganda to publish this picture of the Thermidorian reaction and the Directory, but it is misleading. The period was one of exhaustion, during which France gradually absorbed the shocks and countershocks of Girondism and Jacobinism, royalism and republicanism, democracy and bureaucracy, liberty and compulsion, till it was too weak to oppose the regime of the consulate. The coup d'état of 18 Brumaire claimed at once to abolish and to consummate the Revolution. But the regime that ended in 1799 was not unfruitful, Napoleon owed more than he cared to admit to the men of Thermidor and the Directory. The coup of July 1794 was primarily a reassertion of the rights of the National Convention against the committee of public safety and of the nation against the Paris commune. It was followed by the disarming of the committee and the tribunal, the emptying of the prisons, the purging of the clubs and *sociétés populaires* that had been cells of Jacobinism and the recall of the extruded Girondist deputies. In Paris the *jeunesse dorée* staged anti-Jacobin demonstrations; in the provinces massacres of Jacobins under the white terror were hardly less bloodthirsty than the massacres of their opponents under the red. The abolition of the unpopular *maximum* (Dec. 1794) was followed, however, by just such a food shortage as it had been designed to prevent. The rump of the Jacobin party seized the opportunity to demand once more the constitution of 1793 (Germinal, March–April 1795). Their opponents retaliated by proscribing those members of the committee who had escaped at Thermidor (Barère, Billaud) and by executing Fouquier-Tinville and the judge of the revolutionary tribunal, M. J. A. Herman. The food and finance crisis, however, soon led to another outbreak (Prairial, May 1795), which was suppressed by the execution or suicide of the last few Jacobin leaders and followed by a renewal of the white terror in the Midi. This in its turn roused the royalists to a countereffort. They took advantage of discontent and disorganization in the republican army to land an *émigré* force in Quiberon bay, transported by British ships and joined by Chouan rebels. But they were met and annihilated by Lazare Hoche (July 20–21); and more than 700 of the invaders were summarily executed.

Constitution of the Year 111.—In the flush of this success the National Convention decided to introduce the constitution of the year III, a republican revision of the monarchical constitution of 1791 with a wider franchise, a second chamber (no longer dangerous now that the privileged orders had been destroyed) and an executive designed to prevent either dictatorship or democracy. The mistake (as it now seemed) that the deputies of 1791 had made in refusing re-election was to be avoided by a decree that required the re-election of two-thirds of the new legislature from the personnel of the old. This measure roused one more public revolt, that of 13 Vendémiaire, which was only suppressed by force and by the skilful use of artillery by a young Corsican officer, Napoleon Bonaparte. So (Oct. 26, 1795) ended the National Convention, which had founded the French republic and saved the country from civil war and foreign invasion at the cost, however, of antagonizing the civilized world.

THE DIRECTORY

The government of the Directory, as it is generally called from the executive of five directeurs set up by the constitution of the year III, lasted for just four years (Nov. 1795–Nov. 1799). This it was able to do because the two chambers—the anciens and the cinq-cents—included representatives of all parties in the country, from royalists to regicides; because the legislature had no control over the executive, and the executive none over the legislature; and because the treasury and the judiciary were independent of both. Thus the five directors (originally Louis Marie de La Révellière-Lépeaux, Jean Franqois Reubell, Paul Franqois Jean Nicolas Barras, Charles Louis Franqois Honoré Letourneur and Carnot), though inheriting many of the centralized powers of the committee of public safety (control of foreign policy, of the army, of the police and of local administration), yet had no funds to finance or courts to enforce their will. If they were to remain in power—the one ambition that they all shared—they must play off one rival interest against another, by a policy of political seesaw (bascule), or, in the last resort, appeal to arms. The pattern set by the recurrent crises of the past year would be preserved; a royalist revival would be met by concessions to Jacobinism; a Jacobin revival would bring better terms for the royalists. The Quiberon affair and Hoche's suppression of rebellion in the Vendée, coupled with the continued depreciation of the currency and a recurrence of food shortage, encouraged François Noel Babeuf, an eccentric Jacobin who had long entertained utopian designs for an equal distribution of land and income, to head a *conspiration* des kgaux, supported by leftist Jacobins such as Michel Philippe Buonarroti, who were by now beginning to revere Robespierre and Saint-Just as prophets and martyrs of socialism. Babeuf was executed (May 28, 1797); but in the anti-Jacobin reaction that followed the royalists won the elections of the year V, carried the constitutionalist Franqois marquis de Barthélemy onto the Directory in the place of Letourneur and brought forward measures in favour of the *émigrés* and counterrevolutionary clergy. The policy of *bascule* could not cope with this situation, and recourse was had to the argument which was to decide all political issues for the next 18 years—the army.

The Army and the Italian Campaign.—The emergence of the army as the decisive political factor was the most important event of the years 1794–99. How had it come about? The volunteers who, with a stiffening of veterans and the help of the royal artillery, had won the day at Valmy and Jemappes had virtually disappeared during the winter of 1792–93. The new army created by the Jacobin government in 1793–94 was formed by the compulsory enlistment (*réquisition permanente*) of all Frenchmen between 18 and 25; these recruits were amalgamated with the remains of the old army—one old soldier to every two new; and this meant the republic was able to put into the field no less than 13 armies, totalling about 750,000 men. On the whole they represented pre-Terrorist Jacobinism at its patriotic best, and their disciplined isolation lent itself to uniformity of opinion and a professional esprit de corps which the party politicians of Paris regarded with apprehension. Many officers of the new army had been elected from the ranks; many of its generals were appointed less for military experience than for patriotism and loyalty to the government—they had been politicians before they were soldiers. Supervised and spied upon by civilian *commissaires aux armées,* they chafed under governmental control; and a sufficiently successful general, such as Bonaparte in Italy, might shake it off and make the directors as afraid of him as he was of them.

Every victory of an army in the civil war (Lyons. Marseilles, Toulon) had increased the soldiers' dislike of the civilians who stabbed the country in the back; every victory on the frontiers increased their confidence in themselves and in their generals and their readiness to impose their will on a government which too often starved them of food and arms. As this danger of military intervention increased, so was the government itself tempted to call on the support of a successful general.

Napoleon Bonaparte's appointment to the army of Italy and the Alps (March 2, 1796) had been followed by a spectacular series of victories: Millesimo (April 13) and Dego, leading to an armistice with Sardinia (April 28); Lodi (May 10), followed by the occupation of Milan (May 15); an advance to Brescia (May 27) and Verona (June 3), securing all Austrian Lombardy; a fortnight's march into central Italy—Bologna, Livorno, Florence (June 30); Wurmser defeated at Castiglione (Aug. 5) and invested in Mantua (Sept. 1j); Rivoli (Jan. 14, 1797) and the capture of Mantua (Feb. 2); a second expedition into central Italy—Bologna (Feb. 1), Ancona (Feb. 9) and Tolentino, where a treaty was signed with the papacy (Feb. 19); and finally an advance on Vienna by Gorizia (March 22), Villach, Klagenfurt, Judenburg, Graz and Leoben (April 13), where Bonaparte signed preliminaries of peace with Austria (April 18). (See FRENCH REVOLUTIONARY WARS.)

Since then he had established his headquarters at Mombello, outside Milan, in a style almost royal, confident in the devotion of his troops and in the vast quantities of captured flags, money and works of art which, after providing for the upkeep of two armies, he had been able to send to Paris.

18 **Fructidor.**—When Hoche was dead, it was natural that Barras, La Révellière-Lépeaux and Reubell, when they were faced by the crisis of Sept. 1797, should remember the loyal addresses that Bonaparte had sent from the army at Milan and that his envoy Gen. Pierre Augereau should be put in command of the Paris garrison which enabled them to carry through the coup d'état of 18 Fructidor (Sept. 4), whereby Carnot and Barthélemy were expelled from the Directory and Philippe Antoine Merlin (de Douai) and Franqois de Neufchbteau appointed in their place.

Two years were yet to run before the second Directory, as it might be called, outlived its success of Fructidor and gave way to the consular government of Nov. 1799. It was a period of undisguised dictatorship, penalizing priests, royalists and *émigrés* (of whom hundreds were shot or deported to Guiana and thousands held in prison), suppressing opposition papers, purging and overriding local authorities, reducing the legislature to impotence and re-establishing the police regime of the Terror, though without its Law of Suspects, its tribunal or its guillotine. But it was a dictatorship that could remain effective only so long as the people were diverted from politics to war and found in victory abroad a compensation for hardship and repression at home. The last two years of the Directory laid down clearly enough the pattern of the Napoleonic dictatorship. France was indeed living on its frontiers. At sea the British blockade prohibited any but short-distance coastal traffic (cabotage), and privateering was soon countered by the introduction of the convoy system. But plans for the invasion of Ireland or England were constantly revived: an attack on the Channel Islands (1793), Hoche's fruitless attempt to land in Bantry bay (1796), the American Colonel Tate's few hours' Welsh invasion at Fishguard (1797) and J. J. A. Humbert's Irish expedition (1798) pointed the way to the invasion of England, which Bonaparte declared impossible in the spring of 1798 but seriously undertook in 1801–05. The French colonies in the West Indies had either fallen to the British navy or were prevented by the blockade from importing the sugar, coffee and other goods that Europe could not obtain elsewhere. On the continent the republican armies held firm in Holland, along the Rhine and on the crest of the Alps, till Bonaparte's seizure of Malta and Egypt in 1798 and his invasion of Syria roused Russian as well as Turkish hostility. With the appearance of a Russian fleet in the Adriatic and a Russian army in Lombardy in the spring of 1799 all the successes of the last three years were in jeopardy. The crisis was met by the introduction of conscription (loi Jourdan, Sept. 1798) and by a fresh stiffening of the Directory with Jacobins and generals on June 18, 1799 (30 Prairial), when La Rèvellière-Lépeaux, Merlin and J. B. Treilhard (who had taken Neufchbteau's place) were superseded by J. F. A. Moulin, L. J. Gohier and Pierre Roger Ducos, Reubell having already been replaced by Sieybs in May 1798. Defeat was at last turning to victory in Switzerland (Ziirich, Sept. 25, 1799) and Holland (Alkmaar, Sept. 18) when the return of Bonaparte from Egypt (Oct. 9) brought upon the scene the one man who was capable of finishing the war, reorganizing the government and exploiting the gains of ten years of revolution.

THE CONSULATE

When Napoleon Bonaparte got the title of first consul at the age of 30 he was more than five years older than William Pitt had been when he became prime minister; but he knew much more about life. He had come to Paris from Corsica with as remote claims to nobility as Boswell brought to London from the Highlands. But (though technically a Frenchman) he was not merely a foreigner; he was a poor man, with many poor relations; and his political background was suspect. There were several bad marks on his military pay sheet. Yet at Toulon, on the Riviera, on the secretariat of the committee of public safety, with the army of the Alps, in Italy and in Egypt he had proved himself the ablest young soldier and administrator of the day; and this was in a society that had discarded gentility and under a government whose existence depended upon the army.

18 **Brumaire.**—The situation that Bonaparte found in Paris in Oct. 1799 was very different from what he had left 18 months before. The new landowners wanted security of property against the threat of a royalist restoration; the clergy wanted recognition and reunion with the papacy and their parishioners wanted the priest, the Mass and the church bell; merchants, manufacturers and shopkeepers wanted peace and social order; and the politicians wanted a new constitution, which would somehow secure stability without

despotism and a republic without Jacobinism. Bonaparte set himself to sound public opinion and was soon convinced of what shrewd observers had foreseen at any time in the past ten years—that the Revolution could only be consummated in a military dictatorship. The coup d'état of 18 Brumaire (Nov. 9. 1799) got rid of the Directory and the constitution of the year III; and the law of 19 Brumaire made Sieyès, Ducos and Bonaparte consuls. The constitution of the year III (4 Nivôse; *i.e.,* Christmas day 1799) had been devised by Sieyks to provide a balance of powers, with no unchecked control; but by a stroke of the pen, which substituted an active first consul for a figurehead "grand elector" and gave him the last word on all policies and appointments, Bonaparte — abetted by the former episcopal Talleyrand and the anti-Catholic Fouché (the two ablest survivors of the Terror) and encouraged by the constitutional friends of Mme. de Stael (Necker's daughter, perhaps the cleverest and most talkative woman of the age) — transformed it into an instrument of autocracy.

Government and Administration. — The legislature was now divided into a tribunat which talked, a corps *législatif* which voted and a se'nat conservateur which "guarded the constitution." The executive was in effect the first consul, whose decisions were taken after consultation with his honorary associates the second and third consuls (Cambacérès and C. F. Lebrun from 22 Frimaire) and with a conseil d'e'tat consisting of ministers and others summoned at his will. There was no cabinet, Bonaparte finding it more effective to consult ministers individually. Sometimes he delegated semiministerial functions to members of the conseil. Legislation was initiated in the conseil and submitted to the tribunat and corps *legislatif;* but it was not long before Bonaparte found this process too slow and employed the se'nat to give his decisions force of law as *sénatus-consultes* or went over the head of the legislature by means of direct orders to his ministers. Legislation by decree, the Jacobin way of dealing with urgent issues, now became normal; political measures were dictated like army orders and diplomatic business dealt with in the same way as manoeuvres in the field.

This autocracy was erected upon a basis of universal suffrage. Six million Frenchmen elected 60,000 of themselves onto a liste communale, from which justices of the peace and local officials were chosen; the 60,000 were reduced to 6,000 (liste *départementale*) and 600 (liste nationale) by further elections within their own number, and from these lists of names the departmental and national representatives were chosen — the members of the legislature by the se'nat and the mayors of all large towns by the first consul or by his personally appointed and dismissed *préfets* and *sous-préfets,* who ruled the *départements* as the intendants had ruled the *généralités* of the prerevolutionary regime. Bonaparte counted on this pretense of representative government to keep the country content, and his coinage, as late as 1809, bore on the obverse his head, with "Napoléon Empereur," and on the reverse the inscription "République Française." It would add little to describe in detail the transition from the first consulship of 1799 to the life consulship of 1802 (16 Thermidor year X) and the empire of 1804 (see NAPOLEON I). Both steps were excused by attacks upon the head of the government and designed to substitute the guarantee of a de *jure* dynastic succession for the de facto insecurity of a self-appointed ruler. Neither did much more than regularize methods of government already established in practice.

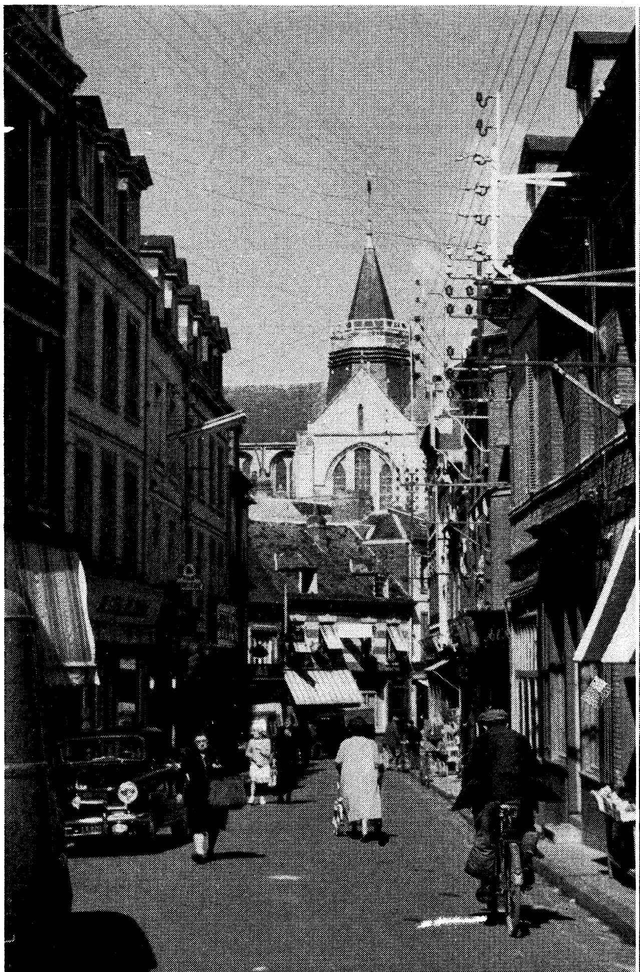
But in fact the real security of the Napoleonic regime rested on its appeal to all parties, its legislative achievements, its solution of the church question and its military successes. From the first Bonaparte made a point of employing in his service men of energy and ability whatever their political past — a few irreconcilable Jacobins and royalists excepted. Of the first 29 members of the conseil d'e'tat, 10 were lawyers, 13 administrative officials, 4 generals or admirals. Having chosen the best men, he trusted them, and continuity of policy was secured by long tenure of office: 7 of the original members were still in office at the end of 15 years; 35 more served for 10–15 years. As the members of the committee of public safety had done, they specialized in finance, mar, the navy, justice, foreign policy or police; but all the sectional committees met in the first consul's apartments at the Tuileries. Bonaparte presided, took the sense of the meeting and made his own decisions.

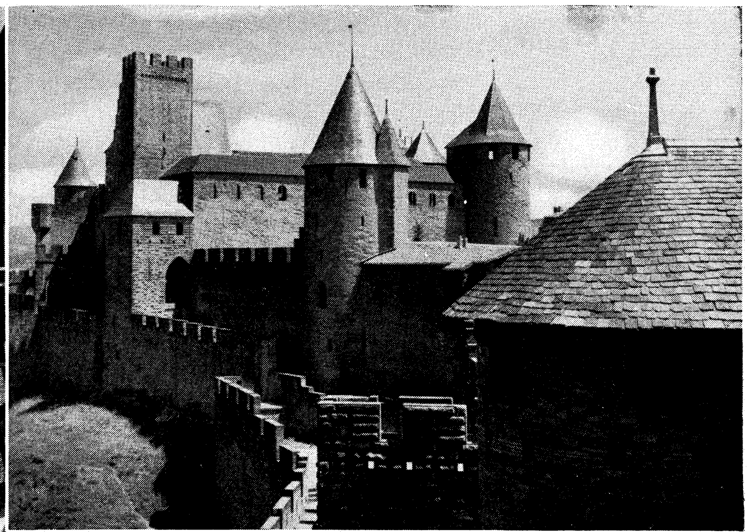
Public opinion, which had feared Robespierre's committee and despised the Directory, soon came to respect the work of Bonaparte's *conseil.* No Frenchman much cared whether his franchise was effective so long as he was well governed, and the cleverly timed and worded plebiscites which confirmed the Napoleonic regime were genuine evidence of the loyal approbation of the people. Even Jacobins forgave the censoring of the press and the reintroduction of indirect taxation; even royalists regarded the empire as easing the way for a Bourbon restoration.

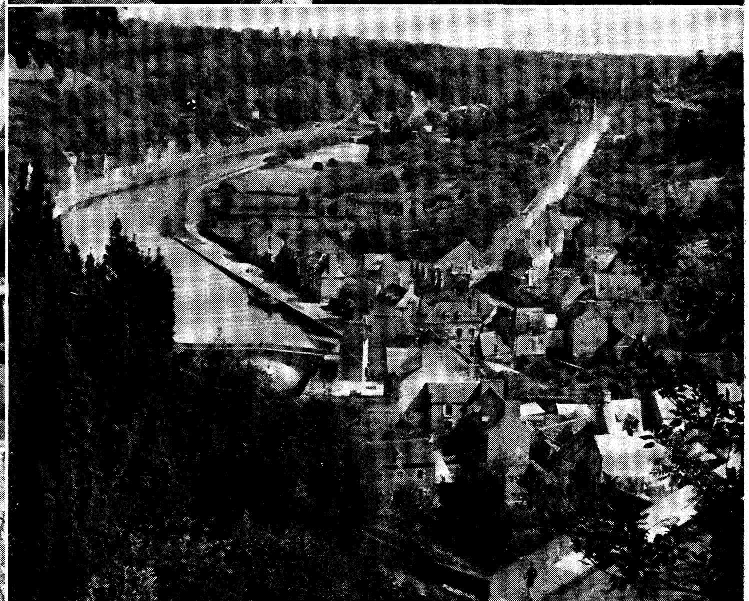
Bonaparte's administrative reforms were secured through the centralized system by which the pre'fet of each *département* was responsible for the supervision of *maires* and communes, for the maintenance of roads and bridges, for the distribution of food, for the suppression of brigandage and for the upkeep of schools, prisons and hospitals. Able men were appointed to these posts and supported by the personal interest and energy that Bonaparte himself gave to the work: letters answered, complaints considered and every detail mastered by a mind that could deal with small things as readily as great. It is good evidence of the success of this system that the de'partements, *préfets* and *maires* of France remained in the fourth republic essentially what they were under the consulate 150 years earlier. The administrative system was reinforced by a hierarchy of courts rising from *juges* de paix through tribunals of arrondissement and *département* to the *cour* de cassation; and most of the judges were appointed by the first consul. The judicial system had worked well under the republic: it worked even better under the empire.

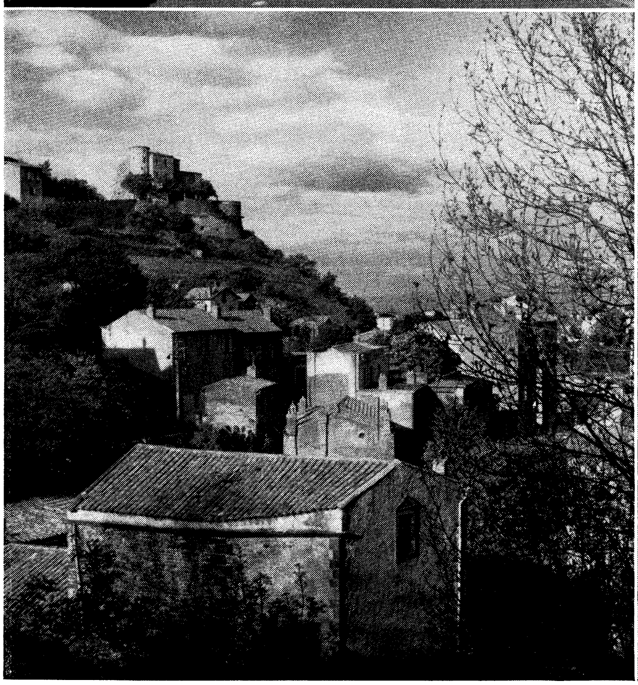
The Code. — But neither courts nor officials could function effectively until the state of the law was known. There had been no codification of French law since the time of Colbert and the code of Louis XIV; and the Revolution had inconsiderately enacted thousands of additional laws and decrees with little reference to the principles or practice of the past. Bonaparte set a committee of lawyers to work to draw up a code of civil, criminal and rural law which should reduce this new legislation to order in the light of Roman principles and French tradition. The civil code, finally enacted in 1804 and known as the Code Napoléon (*q.v.*) from 1807, was logical and laconic, providing in about 120,000 words not merely a legal guide for French citizens but also a framework into which the laws of many other countries, European, American and even Asiatic, were later fitted. Only in some of its provisions, notably as to marriage, divorce and parental authority, it registered a reaction (which Bonaparte approved) against the liberal views of the Revolution.

The Concordat. — The other fundamental act of the consulate, upon which Bonaparte counted to reinforce the code, to add the sanctions of religion to those of reason and to enlist the authority of the church under the banners of the state, was the concordat signed in 1801. For ten years, from 1791, the French Church had been split into two parts: a "constitutional" church served by bishops and priests who took the oath prescribed by the Civil Constitution of the Clergy, and a "refractory" church whose bishops were mostly in exile and whose clergy, though some still worked in secret, had refused to conform. Since 1795 no state support had been given to either body. The papacy had anathematized the French Church settlement and refused to consecrate any bishops under it; its clergy were cut off from any communication with Rome. Bonaparte, an 18th-century sceptic and realist, was determined to enlist the clergy on the side of his regime. On his way back from Marengo in 1800 he made proposals to Pius VII for a reconciliation of the papacy and the French Church. After difficult negotiations, these took shape in the concordat of 1801 and in the *loi* des cultes of 1802, by which Bonaparte attached, without the pope's consent, the so-called "organic articles," strengthening the hold of the state over the church. From this time *départements* and dioceses coincided, and the exhortations of the bishops and clergy supported the orders of the prefect and his officials in the raising of recruits, the payment of taxes and the upholding of public order. There was even









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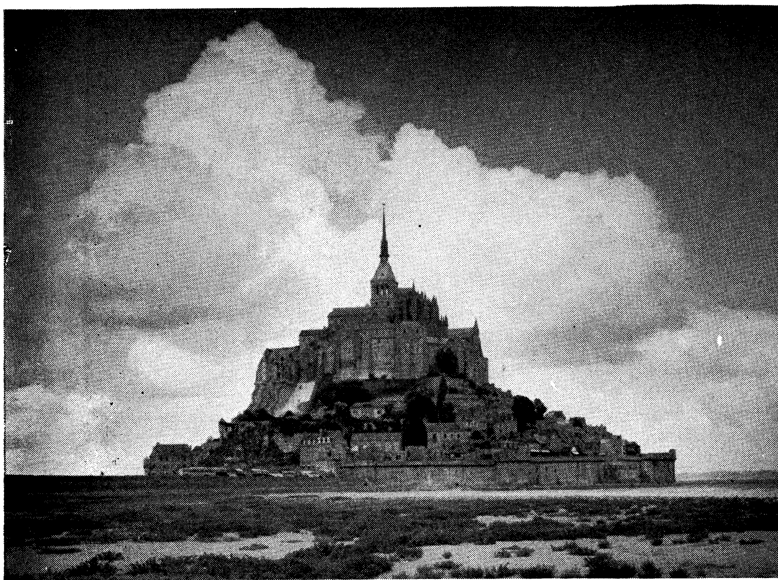
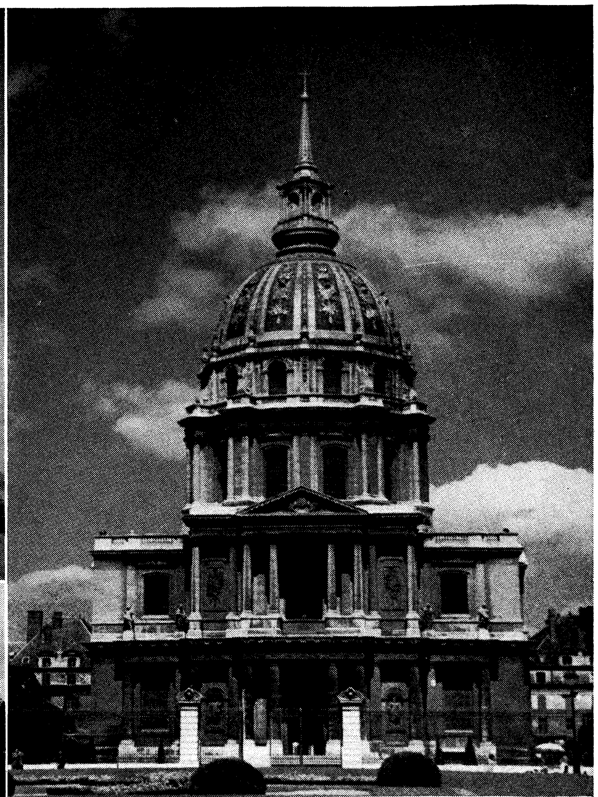
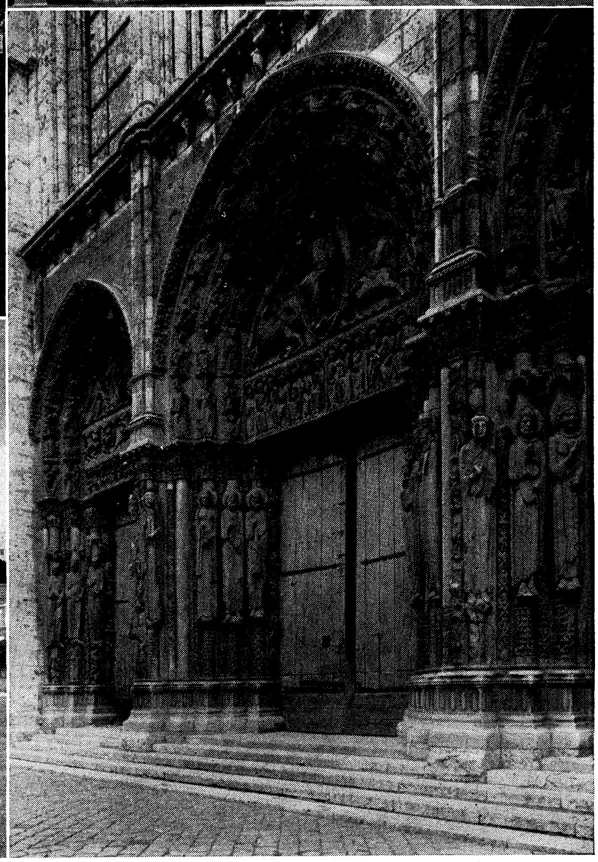
FRENCH CITIES AND TOWNS

Top left: Street scene in Eu, northern France
Top right: Towers aid battlements of Carcaisonne
Centre right: Dinan, on the river Rance, Brittany
Bottom left: Hillside town of Royat, Auvergne
Bottom right: Café on a street of Bayonne, southwest France near the Spanish border

FRANCE







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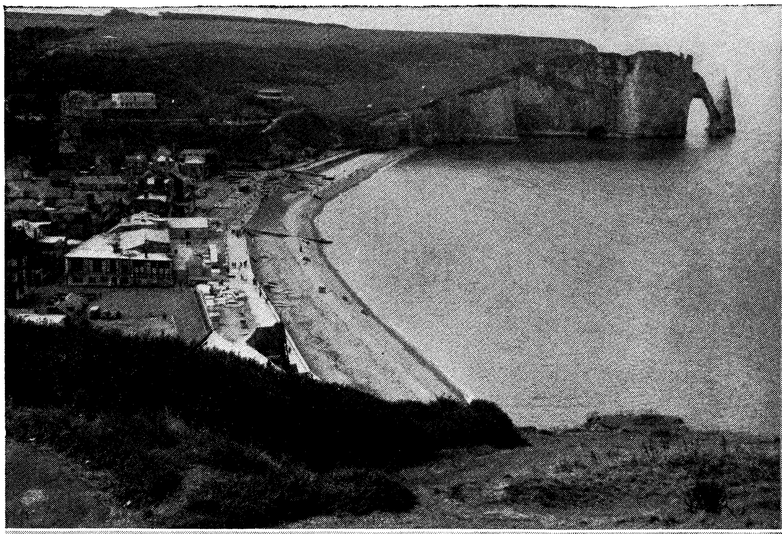
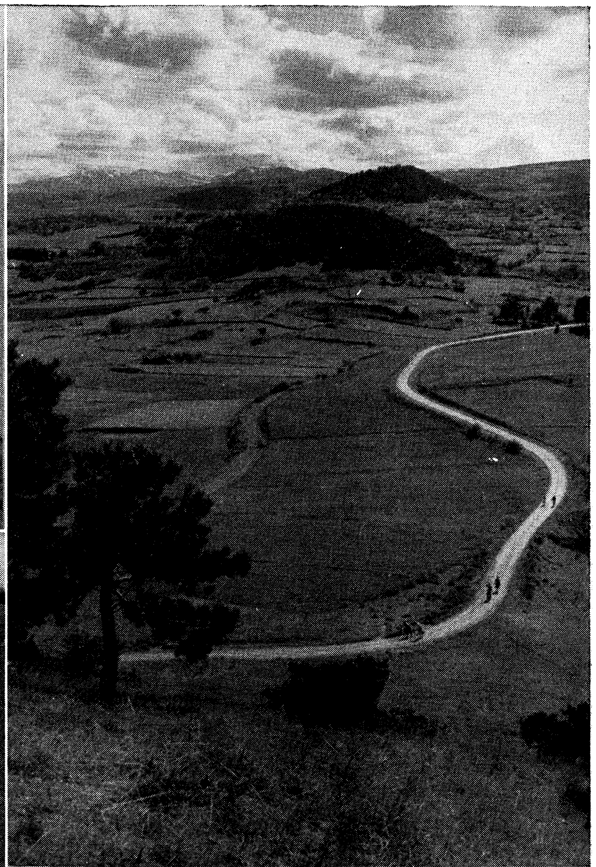
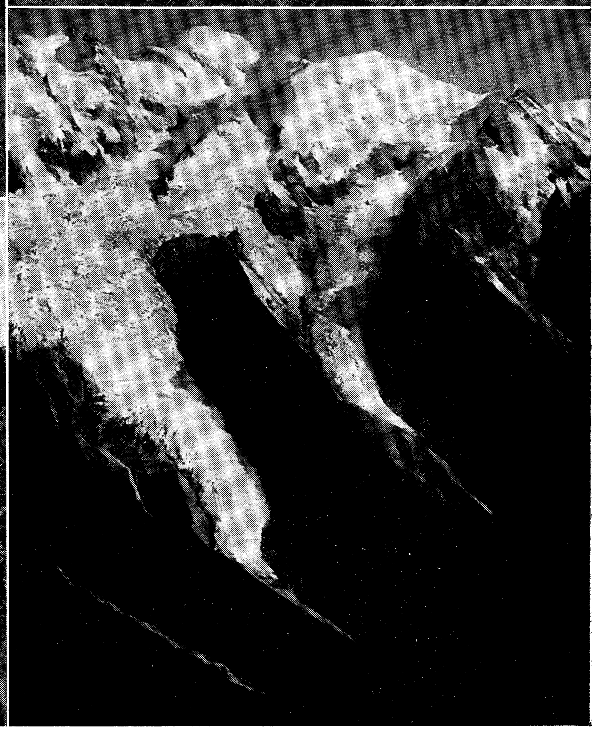
EXAMPLES OF FRENCH ARCHITECTURE

Top *left:* Mont St. Michel, Normandy
Top right: Dôme des Invalides, Paris
Centre left: Chateau Chenonceaux, on the river Cher
Bottom left: Fontainebleau palace
Bottom right: The west door of Chartres cathedral







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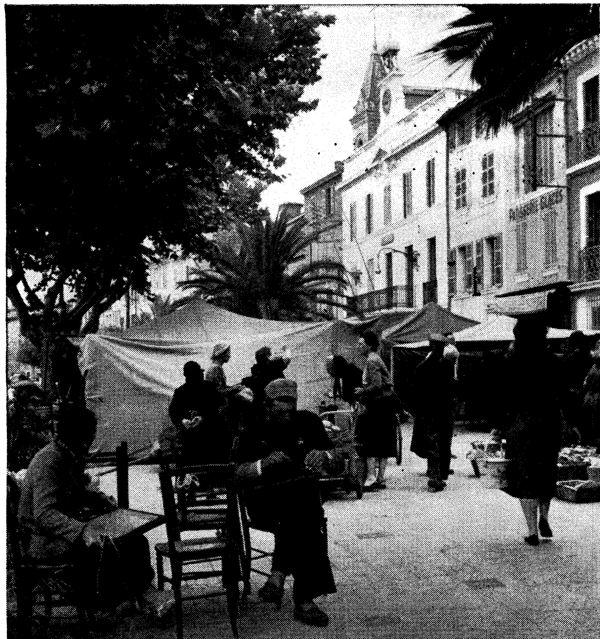
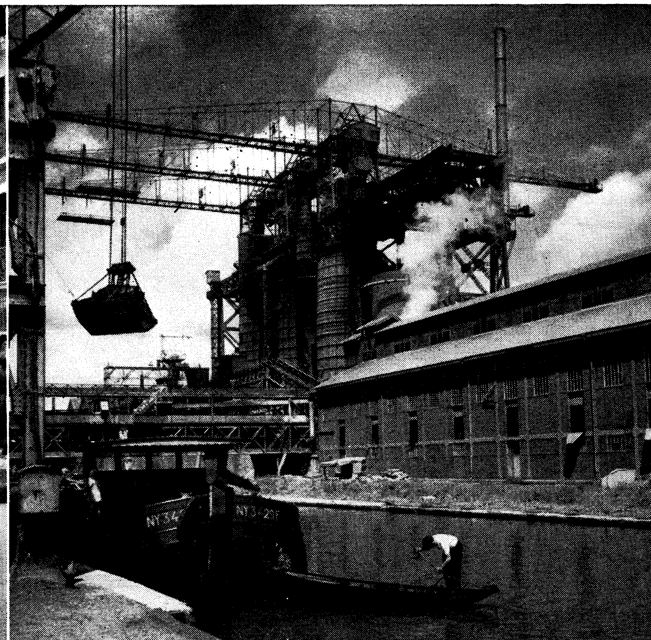
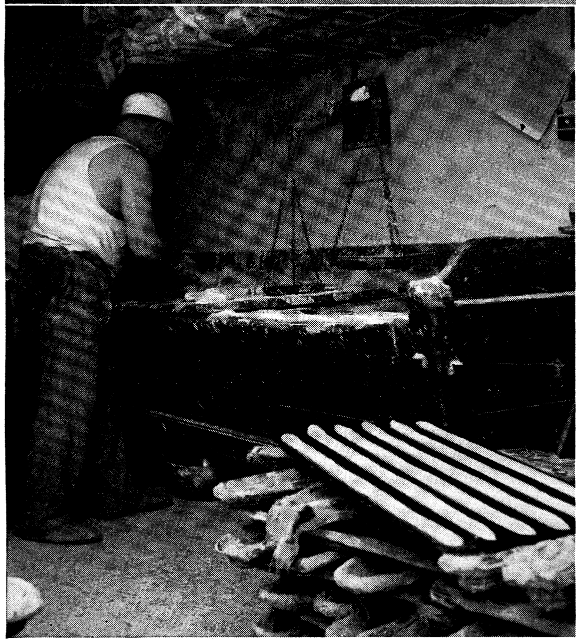
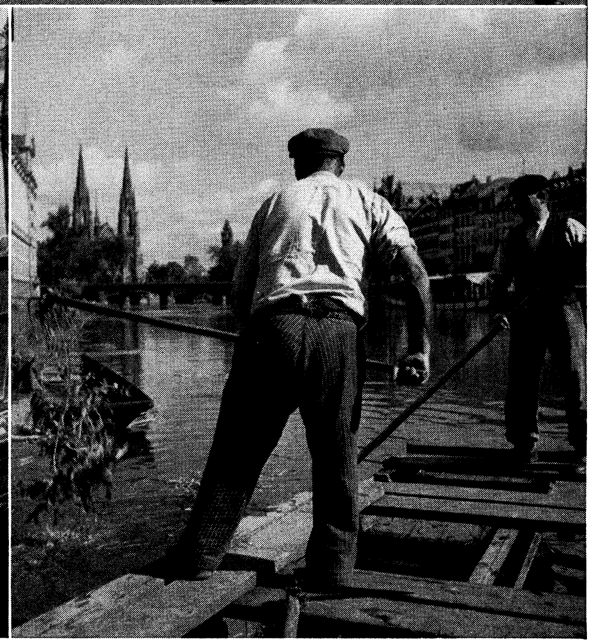
THE FRENCH COUNTRYSIDE

Top left: The coast at Étretat, Normandy
Top right: The pastures, wooded hills and mountains of Auvergne
Centre left: A sheepdog guarding flock on a farm near Caen
Bottom left: Typical thatched-roof farmhouse of Brittany
Bottom right: Mont Blanc, highest mountain in the French Alps









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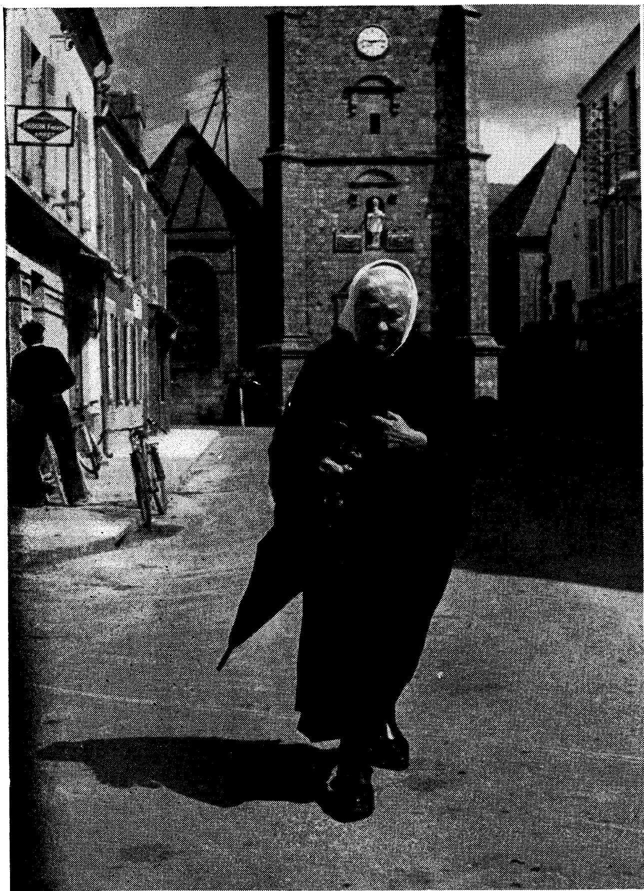
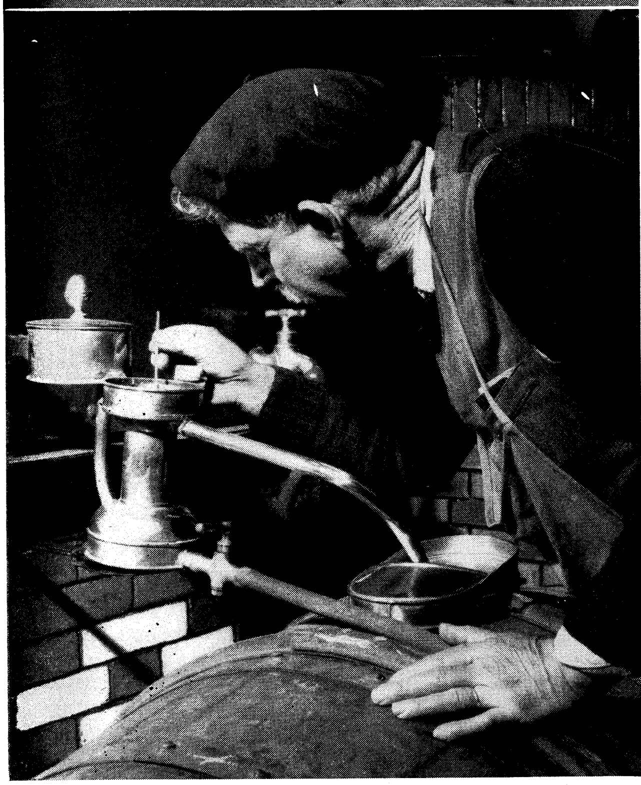
FRENCH PEOPLE AT WORK

Top left: A couple weaving cane chair seats in the market place of Sanary-sur-Mer, southern France
Top centre: A barge tender working in the shadow of a coal plant in Paris
Top right: Workers in Les Halles, principal market of Paris

Bottom left: Bakers rolling out dough for bread
Bottom centre: Fishermen of Brittany inspecting their nets
Bottom right: Rivermen cutting weeds in the Ill in Strasbourg





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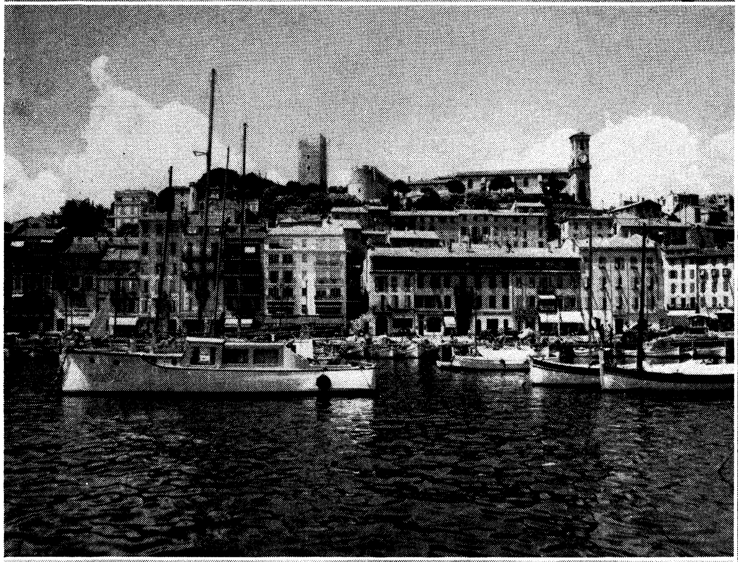
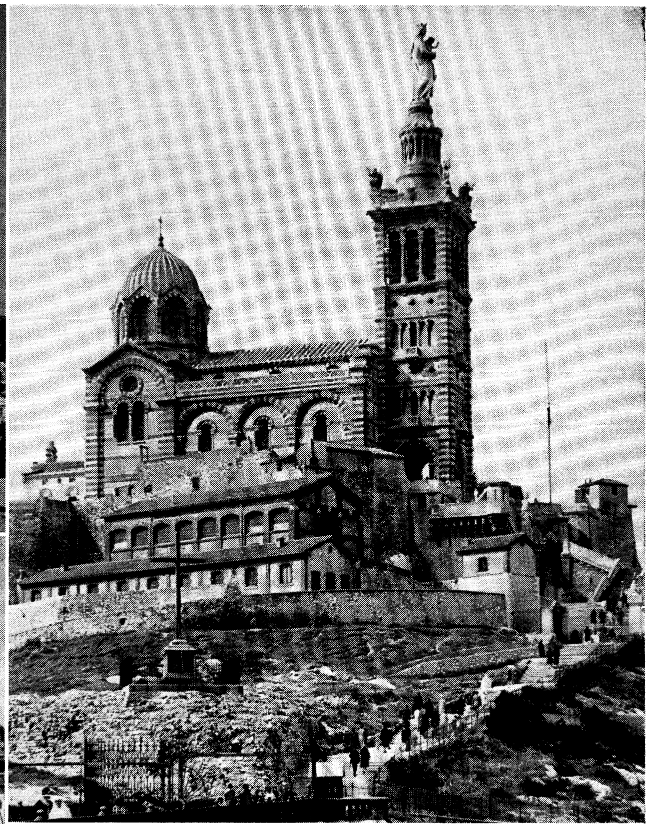
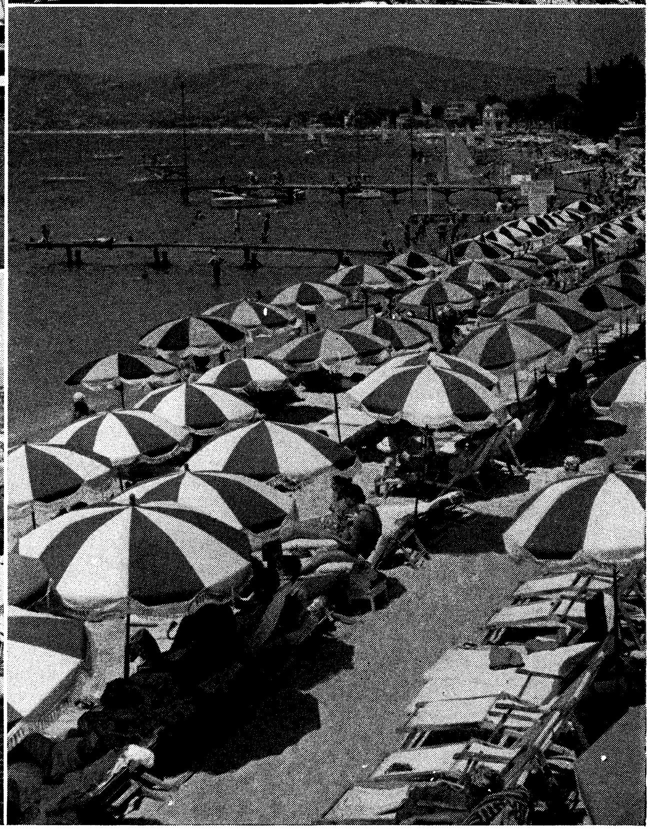
PEOPLE OF URBAN AND RURAL FRANCE

Top *left:* An old woman of Brittany in national dress and bonnet
Top *right:* Women in the market place at Clermont-Ferrand, Auvergne
Centre right: The proprietor of a cafe on the Île St. Louis, Paris
Bottom left: A cognac distiller
Bottom right: French farm family eating dinner







PHOTOGRAPHS, (TOP LEFT) DEANE DICKASON FROM EWING GALLOWAY, (TOP RIGHT, CENTRE LEFT, BOTTOM LEFT) EWING GALLOWAY, (BOTTOM RIGHT) SEM PRESSER— ABCPRESS FROM BLACK STAR

MARSEILLES AND THE RIVIERA

Top left: Promenade des Anglais, Nice. The casino is shown on the left
Top right: Notre Dame de la Garde, on a hill overlooking the harbour, Marseilles
Centre left: Yachts in the harbour at Cannes
Bottom left: Fishermen bringing in their nets for drying along the quay-side, Marseilles
Bottom right: The beach at Juan-les-Pins on the Riviera

a catechism in which Catholic children were taught that "to honour and serve the Emperor was to honour and serve God himself" and that those who did not do so "rendered themselves worthy of eternal damnation." The concordat not only gave Bonaparte the support of the clergy and their congregations: it also deprived the royalists of their chief argument and ally against his regime.

Education, Censorship and Police.—Behind code and concordat lay an educational system that picked out clever boys from the bourgeoisie to be trained in *lycées* (secondary schools) as officers or civil servants (the more liberal education of the *écoles centrales* was suppressed), though primary education was neglected and girls were trained only as housewives; a censorship that suspended all but a few government papers primed with official news and prescribed what operas and plays should be performed; and a police system that, under Fouché's expert control, relied more on careful espionage than imprisonment or execution, though in an emergency—the Opera plot (1802) or the conspiracy of Jean Charles Pichegru and the affair of the duc d'Enghien (1804)—punishment was quick and severe. Bonaparte spared no trouble to patronize art and literature, to conciliate merchants and manufacturers. and to entertain the canaille (which he always feared) by providing food and work for the poor, by beautifying Paris with new streets and triumphal arches, by exhibiting pictures in the Louvre and captured banners at the Invalides, by holding reviews and by *fêtes* and fireworks. Life was no longer dangerous for the man in the street.

THE FIRST EMPIRE

The culmination of Bonaparte's career was the joint celebration of the pacification of Europe (the peace of Amiens), of the appeasement of the church (the concordat) and the life consulship, by the ceremony at Notre Dame on Easter day 1802. The more magnificent coronations of Napoleon two years later, as emperor of the French in Paris (Dec. 2, 1804) and as king of Italy at Milan (May 26, 1805) already pointed to the causes of his fall: a state of war with England and therefore with the continent; an uneasy alliance with the papacy that would soon engender a fatal feud; the first move toward the divorce of Josephine; and the creation of an imperial court, whose formalities and flattery gradually degraded the character of the empire and of the emperor. This new orientation of French history is marked by the fact that, whereas for five years after Marengo (June 1800–May 1805) Napoleon seldom left Paris and never travelled outside French territory, one day out of every three during the next nine years was spent abroad, in the endless and fruitless pursuit of that complete control of the continental ports and capitals which would enable him to exclude English ships and subsidies from all Europe and to force London to accept terms of peace dictated from Paris. For such is the most rational explanation of a policy so tinged with personal and dynastic ambition and so cleverly publicized as a crusade for the liberation and enlightenment of Europe that historians have been unable to agree in their verdict upon it.

Napoleon's Campaigns.—The Marengo campaign in 1800 lasted less than two months (May 6–July 2); a bold crossing of the Alps, a failure to relieve André Masséna's force besieged in Genoa and Michael Melas' Austrian army defeated, when it had caught Bonaparte unprepared, by the opportune arrival of Louis Desaix de Veygoux. The treaty of Luneville with Austria was clinched by Jean Victor Moreau's victory at Hohenlinden (Feb. 9, 1801); and the treaty of Amiens with England, the result of exhaustion on both sides, followed (March 27, 1802). The renewal of war with England (May 18, 1803) intensified Bonaparte's preparations for the invasion of that country; and two years were spent in training an expeditionary force. building landing craft and planning naval movements to obtain command of the channel. When these finally failed in Aug. 1805, two months before the battle of Trafalgar (Oct. 21) made the whole enterprise impracticable, and when Austria was known to be arming, the Grande Armée was suddenly diverted to the Rhine. The incautious Karl Mack was surrounded and forced to surrender at Ulm (Oct. 15); Vienna was occupied (Nov. 14); and on Dec. 2 the combined Austrian and Russian armies were defeated at Austerlitz. Ten months later Prussia, which had missed its chance of intervening before Austerlitz, foolishly declared war; within a week its armies were destroyed at Jena and Auerstadt (Oct. 14, 1806). Russia remained, and checked Napoleon's winter advance into Poland at Eylau (Feb. 8, 1807); but next spring Napoleon marched again, won a lucky victory at Friedland (June 14) and concluded with Tsar Alexander I the treaty of Tilsit (July 7). At this moment Napoleon had achieved all that he might reasonably expect: Italy reconquered, Austria weakened (but antagonized, and its power of recovery underestimated), Prussia treated as a French dependency and Russia induced, by specious offers in the near east, to close the Baltic to British shipping—thus completing that retaliatory blockade of the sea from the land which already extended from the Adriatic to the North sea and was designed to exclude Great Britain's exports and ruin its economy. The one gap in the circle was the Iberian peninsula. Yet neither Spain nor Portugal offered so profitable a market for British goods as their possessions overseas, which were beyond Napoleon's reach and were thrown open to England by his attack. Napoleon could not bear to see Lisbon, Cádiz and Gibraltar in the hands of the British navy; and he needed subsidies from Spain, his nominal ally. So he embarked in 1808 on a campaign in the peninsula which dragged on for six years, absorbed about 300,000 of his best troops and discredited his fame by the capitulation of Bailén and the convention of Cintra (1808) and the forced abdication of the Spanish royal family. His own short visit to the country at the end of 1808 was ended by the news that Austria, helped by British subsidies (the fifth coalition), was again arming. There followed the war of 1809, which began with a minor but brilliant victory at Eckmiihl (April 22), a second occupation of Vienna (May 13) and a defeat at Aspern-Essling (May 21) and ended in a hard-won but decisive victory at Wagram (July 6). The treaty of Vienna the same year once more punished Austria without disabling it. Napoleon thought he had secured the emperor Francis' support when in March 1810, having divorced Josephine, he married his daughter the archduchess Marie Louise, in the hope that she would give him a son and heir to continue his dynasty. A year later (March 20, 1811) the king of Rome was born. Once more Napoleon seemed to be at a summit of power.

The Fall of Napoleon.—But the agreement of Tilsit, though reaffirmed at the conference of Erfurt a year later (Oct. 12, 1808), was breaking down under the pressure of the continental system, which deprived Russia of British goods without giving it any compensation in French markets; and while the tsar resented the continued presence of French troops in Prussia and feared Napoleon's designs on Poland, Napoleon remained apprehensive that Russia might support a fresh rearming of Austria. Moreover Napoleon's imperial claims, not those of an individual any longer but those of a dynasty, more than ever offended the Habsburgs and the Hohenzollerns, not to mention the deposed kings of Spain and Naples and the tributary princes of Germany; while his appeals to the precedent of Charlemagne embittered his relations with the papacy. The war with Russia upon which Napoleon now embarked (1812) epitomized faults that had been growing upon him for ten years: belief in war as a more effective argument than diplomacy; the desire to destroy a rival power disguised as a crusade to liberate Poland and rid Europe of the threat of a "barbarian invasion"; a megalomaniac's dream of an army of invincible size marching into the "mysterious" east; a blind trust in his "star" that disregarded the plain facts of the situation; an insensibility which could sacrifice 250,000 men so long as he himself returned safely; and at the back of it all, fear—fear that the Russian army might escape him, fear that Alexander might not treat for peace, fear that his own life was in danger and fear that revolution might break out in Paris before he could return home.

With the retreat from Moscow the Napoleonic edifice came toppling down. The defection of Prussia—a new Prussia, inspired by the patriotism of Queen Louise and the reforms of Heinrich Friedrich Karl, baron von Stein and Gerhard von Scharnhorst—enabled the Russians to seize in turn the lines of the Nieman, Vistula and Elbe. The tributary states of western Germany only waited for a safe moment to declare against their "liberator." Austria, for whom Metternich (priding himself on being the one man able to outwit Napoleon) had through five years of planning prepared just this opportunity for revenge, at last threw its armies into the fight. Even Bernadotte, now prince royal of Sweden, turned against his old commander. At Leipzig (Oct. 18, 1813) Napoleon's hastily recruited second army was surrounded and destroyed, and the remnants were driven across the Rhine. A year later his third army, striking right and left against the allied invaders, was put out of action by the surrender of Paris (March 31, 1814), and Napoleon signed his first abdication (April 11). His defeat was the result not merely of military failure, though that was what hurt him most; but of the damaging effect of his economic policy, which had sacrificed French commerce to the attempt to destroy British trade, and the industries of his allies to the promotion of those of France; to the burden of requisitioning, recruiting and taxation imposed upon every country that he had conquered or "liberated" (it made little difference which); to the five years' imprisonment and bullying of Pius VII, which sacrificed the benefits won by the concordat; and to the war weariness and disillusionment of the mass of the French people, who showed no enthusiasm either for national defense in 1814 or for a Napoleonic restoration in 1815. With the return of the Bourbons in the person of Louis XVIII, a brother of the former king, the Revolution came back to its starting point and France secured the constitutional monarchy based upon the bourgeois predominance that it had desired in 1789. The charter of June 4, 1814, known as la *Charte octroye'e* (as having been granted by the king to his subjects and not accepted from them), established a bicameral parliamentary system after the English model. The king was to appoint ministers, to convene and, when occasion arose, to adjourn or to dissolve the chamber of deputies and to sanction legislation passed by it and by the chamber of peers.

The Hundred Days.—Here the history of the Revolution should end. All that happened in 1815 was an anticlimax. The Napoleon who returned from Elba had lost the magic of victory. The veterans of the Grande Armée came to his call; but many of his generals refused to take up arms against what they had recognized as the legitimate government of their country. The clergy were content under a Bourbon king. The merchants hated the idea of another war. The constitutionalists did not believe Napoleon's protestations of liberalism (the *Acte Additionelle*) and suspected that a victory in the field would be followed by a restoration of the empire. As soon as the allies at Vienna (where the congress was still sitting and quarreling) heard of his return and of the flight of Louis XVIII, they acted with unexpected promptness and unanimity, declaring that Napoleon "had placed himself outside the pale" of society and recalling their armies for a fresh invasion of France. Napoleon struck first at Brussels, in front of which a Prussian army under Gebhard Leberecht von Blucher and a mixed British, German and Dutch-Belgian army under the duke of Wellington were caught almost unprepared. The Prussians retreated from Ligny and the British from Quatre Bras. Napoleon pressed on, but not quickly enough, being confident of isolating and destroying Wellington; and at Waterloo (June 18) he met with such stubborn resistance that Bliicher was able to come up in time to turn a defeat into a rout. Napoleon's second abdication followed four days later and on July 7 Louis XVIII entered again into his capital. (J. M. T.)

THE BOURBONS RESTORED

Louis XVIII, From 1815.—Although the events of the first restoration had raised doubts of the Bourbons' fitness to rule, the allies could not agree upon any alternative. Ten days after Waterloo, therefore, Louis XVIII was once more in France. The Hundred Days did much to complicate his task, since the allies were now resolved to punish the French people for the support that had been given to Napoleon. The second treaty of Paris (Nov. 1815) modified France's eastern frontier to its detriment, imposed an indemnity of 700,000,000 fr. and subjected its eastern *départements* to a period of occupation by allied troops. In France the rifts in society were widened and the bitterness engendered by Napoleon's adventure was reflected when the elections of Aug. 1815 returned an Ultraroyalist chamber known as la *ckambre introuvable,* and when Catholic Royalists in the south paid off old scores in a minor white terror. The forces of revolution and counterrevolution were no less opposed than before, and in spite of the liberalism of the charter of 1814, it would be far from easy for the king and his government to recreate a national unity and rally all Frenchmen to support the new Bourbon experiment in parliamentary monarchy.

The violence of the white terror was, however, a transitory phenomenon. Although malcontents in France, as elsewhere after 1815, formed secret societies and occasionally attempted insurrection, the main importance of the period lies in the parliamentary struggle and the gradual acclimatization of constitutional habits.

If England was taken as the chief pattern of constitutional government, the working of parliament in France was often very different. There were two chambers, that of peers and that of deputies, but members sat in a semicircle, an arrangement that made more for oratory and less for informal debate. The king was not obliged to choose his ministers from the majority and there were no disciplined parties, But there were three fairly definite groups whose struggle for power makes up most of the parliamentary history of this time. On the right, the Ultraroyalists (largely representing landed interests, the aristocracy, the clericals and former *émigrés*) may be called the party of the counterrevolution, because of their opposition to the egalitarian and secularizing principles of the great Revolution; but they did not aim at restoring the *ancien régime* with all that that implied, being rather concerned with manipulating the new constitutional machinery in order to regain an assured political and social predominance. On the left, at first very few in number, were the Independents, a miscellaneous group of Bonapartists, Liberals and Republicans, whose chief bonds were distrust of the Bourbons, dislike of clericalism and belief in the Revolution and national sovereignty. In the centre the Constitutionalists, opposed to revolution and to reaction alike and sincerely concerned to operate the regime of the charter, comprised many men of great intellectual distinction and enjoyed the support of the king, whom they provided with most of his ministers before 1820. Louis indeed saw the unwisdom of much of the Ultras' policy and knew that many of them had no conception of the real temper of the nation. This was shown in 1816 when he at length dissolved the *chambre introuvable* and when fresh elections gave the Constitutionalists a comfortable majority. For the next four years ministers and parliament worked more harmoniously, and much of the constructive work of the restoration was achieved. The finances were overhauled and credit restored, and financial buoyancy enabled France to pay the war indemnity and so to be rid of the army of occupation in the shortest possible time, namely three years. The last occupying soldier left French territory in Nov. 1818. In the same year the *loi Gouvion-St. Cyr* established the basis upon which France's army was recruited during the next half century. Henceforward it was essentially a small professional force, raised by the conscription of an annual levy chosen by lot—in the first place for six or eight years. A military spirit was carefully cultivated, and governments might hope to rely on such a force as a defense both against foreign invasion and against internal disorder; but, shy of putting arms into civilian hands, they omitted to provide for an effective trained reserve.

The Constitutionalists also legislated concerning the franchise and the press. Measures of 1817 and 1818 confined the vote to men over 30 years of age who paid 300 fr. a year in direct taxes and eligibility to men over 40 who paid considerably more; and the press laws of 1819, the most liberal of the restoration period, abolished the censorship as a restraint upon libel and allowed press offenses to be tried by jury instead of by special police tribunals. Yet the Constitutionalists' days of power were soon numbered. The great increase in the number of Independents elected in 1819 caused widespread alarm and helped to split the Constitutionalists' ranks. When in 1820 revolutions broke out in various parts of Europe and a fanatic assassinated Charles Ferdinand, duc de Berry, Louis XVIII's nephew and heir presumptive to the French throne (Feb. 13), the Ultras quickly exploited the situation and induced the aging king to dismiss his ministers and to form, under the duc de Richelieu, a cabinet much further to the right, which paved the way for their accession to power. The electoral laws were drastically revised: scrutin de liste, whereby the elector voted directly in the chief town of his *département* for as many deputies as were allotted to the *département,* was replaced by the system of scrutin *d'arrondissement,* its great rival throughout the 19th century, in which he cast a single vote in the chief town of the arrondissement; the wealthiest electors, who paid 1,000 fr. or more in direct taxation, were given a double vote. As a result, the 1821 elections were an Ultra triumph, and a new cabinet was headed by one of their ablest leaders, the comte de Villkle. In 1823, not content with this success, they rigged the electoral arrangements still further, made parliament septennial and secured a new chamber so zealous that it was dubbed *la* chambre retrouve'e.

Thus Louis XVIII had abandoned a middle-of-the-road policy and by the time of his death was much under Ultra influence. But despite the swing to the right the dynasty appeared to be firmly established. The country as a whole was economically prosperous; the activities of the Charbonnerie and other secret societies, notably in 1822, had been easily repressed; the regime had gained prestige from the speedy payment of the war indemnity and evacuation of foreign troops, from its subsequent admission to the Concert of Europe and from the success of the war undertaken in 1823 to restore the authority of Spain's Bourbon king, Ferdinand VII.

Charles X (1824–30).—Louis XVIII was succeeded by his brother Charles, hitherto the comte d'Artois, a man of much personal charm but far less political sense, who had long been the avowed chief of the Ultras. With him as king, the Ultras might be expected to fulfil their program and maintain their ascendancy for a long period. Clerical control of education, already largely secured, was confirmed when in 1824 a prelate, D. A. L. de Frayssinous, became minister of education and ecclesiastical affairs; in 1825 the *émigrés* who had lost their estates in the Revolution were compensated, on a nominal basis of 1,000,000,000 fr., with interest derived from a conversion loan. But an extraordinary law making sacrilege a crime punishable by death (1825) remained a dead letter, and the Ultras failed in their attempt to renew the territorial aristocracy by re-establishing the right of primogeniture (1826). In fact, although they had reduced opposition in the chamber, they were unable to stifle it outside. Villkle's conversion loan antagonized many middle-class investors, and people in all sections of society were alienated by the growing influence of the church. The reappearance of the Jesuits, the activities of other religious societies (in particular the sinister role erroneously attributed to the Congregation, a society founded in 1801 to revive religious life in France), the prominent part taken by the royal family in religious ceremonies, all helped to fan the flames of anticlericalism and to strengthen opposition. Furthermore Villèle's dismissal of François René Chateaubriand from his post as minister of foreign affairs split his own ranks and antagonized one of the most powerful writers in the country. The Royalists were divided still further when in 1826 the Gallican comte de Montlosier published a resounding attack upon clericalism. A violent press campaign ensued which Villkle could see no way to counter save by a more drastic press law, but this was virtually rejected by the chamber of peers, often notable for its sense and moderation during this period. Accordingly, by the end of 1827, when his government had incurred still more odium because of its peaceable foreign policy—the battle of Navarino in which the Turkish fleet was destroyed was fought against his instructions—and its dissolution of the Paris national guard, Villèle decided to pack the upper house and to dissolve the lower in the hope of securing a more disciplined chamber through new elections. But he was disappointed. The opposition gained a majority of 60, and after a brief attempt to continue in office Villkle resigned.

With an ill grace Charles X bowed to the storm and replaced Villkle by a cabinet headed by the vicomte de Martignac and recruited largely from the right centre. This cabinet pursued a conciliatory policy that relieved tension. But it never had the king's loyal support or confidence. Charles continued to intrigue with his old friends and, in 1829, replaced Martignac by the prince de Polignac and a cabinet still more fanatically Ultra and unpopular than that of Villèle. Such a choice was a challenge both to the chamber and to public opinion, tantamount, as Metternich declared, to a counterrevolution. As soon as the chambers met in March 1830 there was a clash. The king's speech from the throne implied that he would brook no opposition; but the deputies replied with an address of no confidence. Charles's answer was to dissolve the chamber and order new elections. Thus the problem whether or not the king must choose his ministers from the majority and part with them when they lost the confidence of parliament came to a head.

The dissolution was followed by intensive campaigning, but neither official pressure nor Polignac's ambitious foreign policy, with the brilliant capture of Algiers in June, was of any avail to win support for the ministry. The opposition returned still stronger from the elections of July. Nevertheless Charles remained obdurate. The result was disastrous for the monarchy.

The Revolution of 1830.—The act which precipitated revolution was the publication on July 26 of three ordinances: the chamber was once again dissolved; freedom of the press was virtually abolished; and the electoral law was modified so as to reduce the electorate to about 25,000 persons, almost all landed proprietors. In issuing the ordinances Charles invoked article xiv of the charter, which empowered him in case of need to make the necessary regulations and ordinances for the safety of the state. But his action was wholly contrary to the spirit of the constitution. Printers' strikes and journalists' protests were followed by armed demonstrations, and soon barricades were erected all over the capital. After three days' fighting (les trois glorieuses) the insurrection triumphed. Blind to the dangers of the situation, Charles had taken no serious precautions to ensure the success of his coup; and when he sought to preserve his throne by making concessions it was too late. When at last he abdicated in favour of his grandson the duc de Bordeaux, known to French Legitimists henceforward as Henry V but to others, generally, as the comte de Chambord (*q.v.*), the fate of the dynasty had been decided in Paris. The elder branch of the Bourbons was set aside, and the son of Philippe Egalité, Louis Philippe, duke of Orléans, who had fought at Jemappes in 1792, was now hailed as a citizen king devoted to the Revolution.

The July Monarchy (House of **Bourbon-Orléans**).—The revolution of 1830 was a victory of the bourgeoisie over the aristocracy, most of whom remained loyal to Charles X. It was a triumph for Paris and a vindication of the charter and of popular sovereignty. The upper middle class now secured the political and social ascendancy for which it had fought in 1789. The new king became not Philip VII, king of France, but Louis Philippe, king of the French, and the deputies themselves imposed upon him a revised charter (la Charte *bâclée*). The chamber of peers was transformed from a hereditary into a nominated house, the censorship and the special tribunals were abolished, the franchise was extended, the alliance of throne and altar came to an end, the white flag of the Bourbons was replaced by the tricolour and a law of 1833 was to provide for the establishment of state-aided primary schools in every commune. Yet, although these changes were generally accepted, the revolution of 1830 initiated a period of considerable unrest. At home economic difficulties, accentuated by the revolution and by the hard winter that followed, led to unemployment and to widespread distress, and numerous workers' demonstrations culminated in a veritable insurrection at Lyons in Nov. 1831. In Paris, too, there were violent political demonstrations against Charles X's unpopular ministers, as well as anticlerical riots in which the archbishop's palace was sacked. Moreover, there were sharp differences of opinion concerning the purpose of the revolution. While the moderates, soon known as the Party of Resistance, held that its aims had already been achieved, the Party of Movement, headed by Jacques Laffitte and others on the left, regarded it as the first step in the initiation of a new era of liberty and wished the government to pursue an active policy abroad as well as at home and to support the revolutions which, inspired by France's example, broke out in Poland, Italy and Belgium.

But Louis Philippe was opposed to rash adventures, and his prudence helped to consolidate his government's position in Europe. He agreed with Talleyrand that France must join with Great Britain in solving the Belgian question and in forcing the Dutch to recognize Belgian independence. He resisted all temptation to annex Belgian territory and refused the new Belgian throne for his son Louis, duc de Nemours. Thereby he secured England's friendship without diminishing French prestige. In Italy, too, while refusing to support revolution, he demonstrated France's abiding interest in Italian affairs and concern with the balance of power by sending French troops to occupy Ancona (1832–38) so long as Austrian soldiers remained in the Papal States.

But the Orléans government found that the task of establishing a regime acceptable to all Frenchmen was far from easy. Louis Philippe's assumption of the crown created a new schism, that of Orleanists and Legitimists, and it might have been better for the Royalist cause in France had he been content to act as lieutenant governor of the kingdom or regent for Henry V. As it was, his government faced insurrectionary fire from two flanks. On the right there were the irreconcilable Legitimists who regarded him as a traitor and some of whom followed the duchesse de Berry in a futile attempt to raise the Vendée in 1832. On the left there was the Bonapartist pretender, Louis Napoleon, who made two equally futile attempts at insurrection in 1836 and 1840; and, much more formidable, there were the Republicans. These had gained, in the 1820s, many new adherents among workmen, students and others and, in the July revolution, had seized the Hôtel de Ville in Paris and made a bid for power. After a momentary acceptance of the new regime they resumed their opposition, intensified their propaganda and multiplied their secret societies. Confined mainly to urban areas, they were more formidable than the Legitimists as being more concentrated and better versed in insurrectionary technique; and their vigour attracted new recruits from among the discontented. Thus the government had to face several Republican outbreaks, of which the 1834 risings in Paris and Lyons were the most serious. Numerous attempts to kill the king were also a feature of the first decade of his reign. The consequence of such disturbances was that the government took repressive measures and identified itself increasingly with the Party of Resistance, to which Louis Philippe, by no means content to be a king who reigned but did not govern, a-as in any case, temperamentally inclined. The right of association was restricted in 1834 and the press laws were considerably revised. By the end of the 1830s opposition had been muzzled or driven underground, and during the ascendancy (1840–48) of the historian François Guizot some years of internal peace and prosperity ensued.

But this stability was illusory, since the basis of the regime was rapidly being undermined. A movement to extend the franchise had been set on foot without success before 1840, and Guizot was no less unyielding when a new campaign was launched in 1847. Thus the regime which claimed to represent the *juste milieu* kept the vote from an important and growing section of the middle class that included many educated men and confined it to the 200,000 wealthiest citizens, among whom the new aristocracy of the manufacturers was conspicuous. This failure to broaden the basis of the regime politically was the more serious because of the government's neglect of social problems.

Industrialization had gained considerable momentum since the late 1820s, especially in the cotton and textile industries of Alsace, Normandy and the Nord, the silk industry in and around Lyons and the metallurgical industries of the Loire basin and Lorraine. It led to the sudden growth of towns and of an urban population that lived a precarious existence in crowded and unsanitary conditions, subject to long working hours, to disease and to sudden unemployment. This new proletariat was primarily interested in the improvement of its living and working conditions, but successive governments pursued a rigid policy of *laissez faire*, holding that it was none of their business to interfere between employer and employed. The only significant social measure, the first Factory act of 1841, remained largely ineffectual for lack of a proper system of inspection. When the government and the majority of the employers gave no thought to their relief the workers naturally looked elsewhere. They found many prophets and teachers to give them encouragement, as this period of French history was conspicuous for the fertility of the ideas provoked by the new phenomenon of industrialization. While the ideas of the comte de Saint-Simon (1760–1825) were immensely important for their emphasis upon industrial power and its efficient organization, J. C. L. de Sismondi (1773–1842) attacked the principle of *laissez faire* and advocated state intervention to regulate the use of property, Louis René Villermé (1782–1863) and others investigated and made public the evils of working-class conditions, and a host of theorists and reformers put forward proposals for the regeneration of society. It was now that socialism for the first time became a factor of importance, with the pre-Marxian Communists, heirs of Babeuf, with the Christian Socialists influenced by the great liberal Catholics Hugues Lamennais and Jean Lacordaire, with the Fourierists, whose leader is regarded as the father of consumers' co-operatives, and with the supporters of state socialism such as Louis Blanc, who published his *Organisation du travail* in 1839. These movements and the writings of such people as Flora Tristan and P. J. Proudhon (whose famous *Qu'est-ce que la propriété?* appeared in 1841) did much to arouse a social conscience. They meant, moreover, that many who looked to a republic for salvation envisaged it now as a social democracy. Underneath the seemingly calm surface there was a great fermentation of ideas, which was strengthened by the presence. in Paris especially, of many foreign political exiles and by the existence of a new cheap press.

The turning point of the latter part of Louis Philippe's reign came with the economic crisis of 1846, which originated in the failure of the corn and potato crops over a great part of northern and western Europe. The price of wheat rose sharply—1847 was known as "the year of dear bread"--purchasing power declined and the agricultural depression was soon followed by an industrial one, on top of which came a financial crisis resulting largely from overspeculation in the first French railways and from shortage of investment capital. Thus Guizot had to face widespread discontent, which was aggravated by revelations of corruption in high places and by the setbacks and unpopularity of his foreign policy. During Adolphe Thiers' ministry of 1840 the Anglo-French entente had been virtually shattered by the eastern crisis, when France's championship of its Egyptian protégé Mohammed Ali had led to a rift in the Concert of Europe (*see* EASTERN QUESTION) and to a danger of war in which France risked complete isolation. Guizot had temporarily patched things up; but the question of the Spanish marriage in 1846—when Louis Philippe's son Antoine, duc de Montpensier, married the infanta Maria Luisa Fernanda (the heiress presumptive of Spain)—led Lord Palmerston to think that he had been tricked. This made the rupture final and encouraged Guizot and his master to align themselves more closely with the conservative powers. The unpopularity of such an alignment when the breezes of liberalism were once again stirring throughout Europe was not mitigated by the completion of the conquest of Algeria and even in parliament, in the manipulation of which he had shown himself a past master, Guizot's tenure of power looked less secure. It was in such an atmosphere that, in 1847, the new movement for parliamentary reform, the famous banquets campaign, was launched.

The Revolution of 1848.—The culminating banquet, arranged to take place in Paris on Feb. 22, 1848, was banned. Nonetheless on that day crowds gathered near the rendezvous and demonstrated against Guizot. Barricades and red flags also appeared in working-class districts, and Louis Philippe, alarmed by these signs of public feeling, at last dismissed his unpopular minister. It looked as though all trouble was over. Unfortunately, as the result of an incident in front of the ministry of foreign affairs on Feb. 23, troops fired upon a crowd of demonstrators. The temper of the populace at once changed, and peaceful manifestations became armed insurrection. On Feb. 24 Louis Philippe, now more than 74 years old and greatly discouraged by this new turn of events and by his lukewarm reception when he reviewed the national guard, abdicated in favour of his ten-year-old grandson Philippe, comte de Paris, and withdrew to exile in England where he died three years later. But his departure did not save his dynasty, for the revolutionaries ignored his grandson's claims and set up a republic.

Thus another attempt to found a permanent system of government after the English pattern had foundered, and a revolution in Paris was once again meekly accepted by the provinces. There was no attempt to raise the Orleanist standard. The house of Orléans had represented little more than a useful expedient of middle-class governance, and once the middle classes began to lose faith in it there were none to defend it.

THE SECOND REPUBLIC

While parliament would doubtless have accepted a regency for the comte de Paris, its authority was swept aside when the Palais Bourbon was invaded by crowds and when revolutionary leaders set up a republican government at the Hôtel de Ville. This proclamation of a second French republic aroused the gloomiest fears and the most extravagant hopes in France and Europe. Both were to prove unwarranted. The new rulers of France, most of them middle-class lawyers and journalists, might abolish slavery in the French colonies but were not the men to set Europe ablaze in a new revolutionary crusade for the emancipation of peoples; in spite of a good many fine words the second republic was eminently pacific. Nor on the other hand could they transform France into the blissful socialist utopia imagined by some of their supporters. In fact the new regime laboured from the outset under two serious disadvantages. Its leaders were themselves divided and they represented but a minority of the country at large. As in 1830, so in 1848 there were two opposing views of the purpose of the revolution, and the provisional government at the Hôtel de Ville represented an uneasy compromise between them. For the majority (Alphonse de Lamartine and others), the revolution was a political change whereby a monarchy with a restricted franchise was to be replaced by a free democratic republic based upon universal suffrage; but for the minority, men such as Louis Blanc and A. A. Ledru-Rollin, it also heralded a social and economic transformation. The clash between these two conceptions was at the outset symbolized by the unsuccessful attempt of the extremists to supplant the tricolour by the red flag. But although Louis Blanc and his friends were a minority in the government they had many supporters in the streets. and their colleagues were obliged to make important concessions to their ideas when they reduced working hours, proclaimed the right to work, appointed Louis Blanc chairman of a permanent commission to investigate labour problems and established *ateliers nationaux* (national workshops) to relieve the more acute unemployment. This was a radical departure from the *laissez faire* policy of the July monarchy. Equally radical politically was the decision to give all Frenchmen over 21 years of age the vote. The decree of March 5 fixing elections to a national constituent assembly brusquely increased the French electorate from about 200,000 to approximately 9,000,000, many of whom, in spite of the education law of 1833 and the growth of the press, were illiterate. However generous the gesture, it contributed to the undoing of the republic, for acceptance of the February revolution did not mean that the majority of Frenchmen had become convinced Republicans. Not only were they not so, but measures such as the addition of 45 centimes to direct taxation, rumours of Socialist threats to private property and reports of continued disturbances in the capital aroused their fear and distrust. Thus although most candidates called themselves Republicans, a great majority of the new deputies were returned as Conservatives and champions of order. The Radicals and Socialists won only 100 seats out of 876 and clearly still represented only an urban minority whose preoccupations were very different from those of France as a whole. The result was growing tension between the majority in the new assembly and the extremists in Paris, who on May 15 made a vain attempt to set up at the Hôtel de Ville a new government more to their liking.

The June Days.—The great clash occurred, however. over the problem of unemployment which the upheaval of the revolution had itself increased. The *ateliers nationaux* as set up by the provisional government and organized by Alexandre Thomas Marie and Pierre Emile Thomas were a travesty of those envisaged by Louis Blanc and became little more than a gigantic system of outdoor relief which attracted the idle and workless from far and near, demoralized them and increased the risk of disorders. The assembly therefore decided that the *ateliers* must be dissolved, young bachelors enrolled in the army and the rest given employment privately or sent to public works in the provinces. Toward the end of June the executive commission, which had succeeded the provisional government when the assembly came into being, implemented the decision, and dissolution was decreed. Thereupon the workers, furious at what they considered the government's treachery in ignoring its guarantee of the right to work, determined to resist, and the working-class districts of the capital rose in sympathy with them. The insurrection of the June days, unlike the earlier disturbances, was less a political affair than an outbreak of the class war, a rising of exasperated and often hungry workers in defense of what they believed to be their rights; and as such it was fought and repressed with great ruthlessness. But it had important political consequences. It thoroughly alarmed the middle and upper classes, it discredited the Socialists and it led to the restriction of many of the liberties granted earlier. The host of clubs, born of the February revolution, were placed under supervision, new press laws introduced and working hours again lengthened. "The Republic is dead," exclaimed Lamartine, and this was certainly true of the social republic, for the conservative tendencies of the assembly and temper of the country at large were immensely strengthened. Socially moreover, the June days laid bare and intensified the unhappy new cleavage between the proletariat and the rest of society in France.

The Prince-President and the **Coup d'État.**—The republic however, continued in name, and the constituent assembly proceeded with its main task of constitution making. The new constitution voted in November reflected the reaction against parliamentary monarchy after the English pattern and harked back to 1789. It insisted on the separation of powers and on a single chamber or legislative assembly elected by universal suffrage. But it provided that the president of the republic should also be elected by universal suffrage, it devised no machinery for resolving any conflict between executive and legislature and it made the constitution very difficult to revise. These were to prove grave defects.

The first part of the new dispensation came into being when the president of the republic was elected in December. The man elected was the enigmatic conspirator Prince Louis Napoleon, who had spent most of his life out of France but had been chosen deputy by a number of *départements* in by-elections earlier in the year. Many of those who knew him personally thought him a nonentity, but he bore a magic name which stood for order, glory and prosperity and which the growth of the Napoleonic legend and his own clever propaganda helped to popularize. He received an overwhelming majority, handsomely defeating such leading republicans as Lamartine, Ledru-Rollin and Louis Cavaignac. His election was to complete the overthrow of the republic, for he regarded it as his mission to restore the empire.

During the next three years Louis Napoleon worked for his ambition with patience and astuteness, building up a personal following, winning popularity by a series of tours in the provinces and putting his henchmen in control of the army; he also gained the support of the majority of French Roman Catholics by using French troops originally intended to defend the Roman republic against Austria for the restoration of Pope Pius IX and by supporting the *loi Falloux* of 1850, which gave to the free or private schools mainly run by religious orders the recognition for which they had been contending for 30 years. The main obstacle to his designs was the legislative body that had been elected in May 1849. The majority of the new deputies were Royalist, yet unable to restore the monarchy because the schism between Legitimists and Orleanists remained unhealed. Accordingly all that they could do was to try and resist the pretensions of their rivals. But their action in disfranchising a large number of Republican voters, in spite of Louis Napoleon's opposition, by a modification of the electoral law in 1850 and their refusal to amend the constitution to permit his immediate re-election as president enabled him to represent them as reactionary and obstructive. By the summer of 1851 relations between executive and legislature had become decidedly strained, and the political future appeared the more uncertain because the term of each was due to expire in 1852. Determined to retain his power but debarred by the assembly from doing so, the president had no recourse save to a coup d'état, which after careful preparations he carried out on the night of Dec. 1–2, 1851. The chief party leaders were arrested, the chamber was occupied by troops and the assembly was dissolved. Full universal suffrage was promptly restored, and the president announced that a new constitution would be promulgated and submitted for popular approval through the typical Napoleonic device of a plebiscite. Although not formally restored until Dec. 2, 1852, the empire was virtually in being from the day of the coup.

THE SECOND EMPIRE

Although he had broken his oath to the constitution and there was a show of Republican resistance in the south and elsewhere, Louis Napoleon's coup was widely popular. The plebiscite in Dec. 1851 approved it by an overwhelming majority, and the vote in favour of the restoration of the empire was almost as large. For most Frenchmen were tired of parliamentarism and of internal unrest and ready enough for a time to surrender constitutional liberties to a strong government if it could ensure continued order and increasing prosperity. It remained to be seen whether Napoleon III, as Louis Napoleon now became, could recreate a real unity among Frenchmen, rally them around an authoritarian government and establish a dynasty. During the first eight years the omens were good.

The Constitution of 1852.—Napoleon's system of government and the constitution of 1852 gave little scope for political activity. The upper house or senate consisted of nominated or ex officio members; the lower house or legislative body (corps lkgislatif) sat for only three months in the year and could neither choose its own president nor publish its debates. General elections occurred only once every six years and then were subject to strong official pressure and to the gerrymandering of constituencies. The press was strictly controlled and all members of parliament, magistrates and officials were required to take an oath of allegiance.

Thus political life was effectively stifled, the number of political daily papers dropped sharply and even in 1857 the elections returned only five opposition deputies, many opponents of the regime being either in exile or preferring to abstain from active politics if being a deputy meant taking the oath.

Economic and Social Affairs.—But the absence of political excitement was compensated by economic activity, splendour at home and prestige abroad. The great depressions that had started in 1846 and been aggravated by the disturbances of 1848 had come to an end. The Second Empire saw a great French economic development in which much of the economic structure of modern France was built. The railways, begun under Louis Philippe, were more than trebled in extent, and the fact that most of the big lines radiated from it made Paris more than ever the economic, social and intellectual capital of the country. Encouraged by the emperor, Saint-Simonians like the brothers Emile and Isaac Pereire founded great credit institutions such as the Crédit Mobilier or joint-stock banks such as the Société Générale. In consequence there was intense speculative activity and a big increase in the number of small investors. At the same time France's overseas trade was nearly quadrupled in value between 1851 and 1869, while the progress of industrialization had transformed the country by 1870 into a considerable industrial power. These developments had social and international significance. The growth of towns continued, while families, for example that of Paulin Talabot, built up financial empires extending well beyond the French frontiers. There was a greater concentration of wealth in the hands of a few and a still greater contrast between their wealth and the poverty of the many. But if France now counted much more as a financial and industrial power it must be remembered that these developments directly concerned only relatively small sections of the total population. Essentially France remained a land of artisans and peasants.

Splendour also entered into Napoleon's calculations. Whereas the July monarchy had appeared drab and humdrum and the second republic disorderly, the Second Empire shone by its magnificence, by its public ceremonies (in which the army often took a conspicuous part), by its great exhibitions (1855 and 1867) and, after the emperor's marriage in 1853 to the beautiful Spanish countess Eugénie de Montijo, by its sumptuous court *fêtes*.

Foreign Affairs, to 1867.—But the crucial issues depended now, far more than under the restoration or July monarchies, upon foreign policy, since his name, his ambitions and his system of government all impelled Napoleon to a forward policy abroad. There initially he obtained remarkable success. Suspect at the outset as a parvenu adventurer, he was by 1856 recognized as the foremost sovereign on the continent. A lifelong student of Napoleon I's career and his imitator in so much, he saw that his uncle's great blunder had been to antagonize England. So when in 1853 Russian intervention in a dispute concerning the Holy Places of Jerusalem reopened the whole eastern question and once again imperilled the existence of the Ottoman empire. he seized the opportunity to stand by Great Britain and engaged France to fight in the Crimea as an indispensable ally. This enterprise brought France no tangible gains but was of great importance diplomatically. The English alliance gave Napoleon respectability while the defeat of Russia and the holding of the peace congress at Paris in 1856 brought France prestige. Once again the empire shone in comparison with the two preceding regimes. Moreover, the birth of an heir, Napoléon Eugbne Louis Jean Joseph, the prince imperial, in 1856 enhanced the dynasty's prospects of continuance.

***The* Italian War of 1859.**—But this brilliant opening was soon clouded, for Napoleon's ambitions to overthrow the Vienna settlement and redraw the map of Europe led him into courses wholly contrary to France's traditional interests and impaled him upon the horns of a dilemma. As a Bonaparte and a former Carbonaro wha had taken part in the Romagna rising of 1831, he had particular sympathy with Italy; and many of his entourage urged him now that he was emperor to espouse the Italian cause. Felice Orsini's dramatic attempt upon his life in Jan. 1858, instead of deterring him, impelled him to action. In July, at a secret interview with Count Cavour at Plombières, he promised Sardinia France's aid for a war against Austria which should rid Italy of the Austrian yoke "from the Alps to the Adriatic" and regroup its states in an Italian confederation under the presidency of the pope. For its services France was to receive Nice and Savoy. Had all gone according to plan Napoleon might well have scored a signal triumph, earning the gratitude of the Italians for their liberation and the applause of his own people for an addition to his territory in defiance of the treaties of 1815 and for a solution of the Italian question that would have eliminated Austria and made the Italians grateful clients of France. Unfortunately, once the war had broken out in April 1859, events outran his control.

The reactionary Pius IX was highly unpopular, and a series of plebiscites in central Italy favouring union with Piedmont swept away Napoleon's papal confederation before it had begun to take shape. Moreover, the strength of Austria's resistance, Prussia's menacing attitude on the Rhine and criticism at home led him to make peace before he reached the Adriatic. The war was successful as far as it went, and Napoleon obtained Nice and Savoy; but it was at a high cost. He had disappointed the Italians by not completing the expulsion of the Austrians; he had given the impetus for the union of the whole of the peninsula under the house of Savoy in spite of his wish to keep it divided; and he had aroused the bitter hostility of the pope yet found himself obliged, in deference to French Catholic opinion, to maintain French troops in Rome to preserve what remained of the temporal power of the papacy. Moreover, by annexing Nice and Savoy in spite of public protestations that he had no designs on them he did much to alienate England.

The Italian war was also a turning point in the internal politics of the Second Empire. It estranged the French Catholics because of the diminution of the temporal power and thus impelled Napoleon to angle for the support of the left by granting an amnesty that led to the return of many political exiles, by relaxing control of the press and by extending the powers of the legislature. At the same time the Anglo-French commercial treaty of 1860 marked a step in the direction of greater freedom of trade and was a notable departure from the rigid protectionism characteristic of French economic policy since early in the Restoration. But these changes, instead of winning Napoleon fresh supporters, angered many manufacturing interests and encouraged his political opponents to take advantage of their greater freedom. Once again there emerged an opposition comprising both the left and the right: after ten years the emperor had failed both to disarm all the adherents of former regimes and to win the allegiance of the masses of the industrial workers, who were increasingly attracted by the Socialist theories of Proudhon, Marx and Mikhail Bakunin. In the elections of 1863 opposition candidates polled about 2,000,000 votes and gained 35 seats and, significantly, the big towns such as Paris, Lyons and Marseilles voted mainly Republican. This new opposition, which included such notable figures as the Legitimist A. P. Berryer, the Orleanist Adolphe Thiers and the Republican Jules Favre, pressed for further liberal reforms and a return to full parliamentary government. It was the opposition to the authoritarian empire that now attracted the main political and journalistic talent, and the regime was weakened by the lack of outstanding personnel.

The Seven Weeks' War.—In Europe after 1860 Napoleon seems to have cherished two main ambitions, to complete the liberation of Italy by inducing Austria to cede Venetia and to win territory in the Rhineland or Belgium for France as a reward for services in assisting either Austria or Prussia toward the unification of Germany. He achieved the first by devious means but failed ingloriously in the second. The German question was the crucial issue for the balance of European power in the 1860s, and in his handling of it Napoleon, now a victim of a painful disease and aging rapidly, fumbled disastrously. He negotiated with both Prussia and Austria but failed or neglected to secure from either binding agreements to further his own territorial designs. When the Seven Weeks' War began in 1866 he expected that it would be a protracted affair in which he could profitably intervene as mediator. He was completely taken aback by Prussia's swift and overwhelming victory over Austria at Koniggratz. Austria did indeed appeal for Napoleon's good offices and cede Venetia, which he proceeded to hand over to Italy; but as he hesitated to back his mediation by force Prussia could snap its fingers at his suggestion that France should be compensated for the alteration in the balance of power by an extension of its eastern frontiers. The fact that France was obliged to accept the unification of northern Germany under Prussian hegemony without any compensation was universally recognized as a grave blow to its influence and prestige. The simultaneous failure of the costly expedition to Mexico, where Napoleon had hoped to create a new French sphere of influence by setting up an empire under the Austrian archduke Maximilian, was a further blow.

Liberalism.—In consequence of these setbacks Napoleon found it necessary to appease French opinion by fresh liberal reforms. In 1867 he granted the legislative body the right of interpellation and relaxed the laws controlling the press and public meetings. In 1869, after general elections had increased the opposition votes to 3,000,000, he finally decided to restore parliamentary government. In Jan. 1870 Emile Ollivier, one of the five opposition deputies of 1857, formed the first ministry of the Second Empire that was responsible to parliament, and in May the French people were asked to pronounce in a plebiscite their approval of the reforms introduced by the emperor since 1860. This recourse to the plebiscite, denounced by the Republicans as a denial of parliamentary sovereignty, was a clever move, for it was an invitation to give a vote of confidence in the empire. As such, it was a signal success: more than 7,000,000 persons, nearly as many as had approved the coup d'état of 1851, once again voted "yes." In spite of a growing number of strikes, the multiplication of revolutionary societies and the 1,500,000 "nos" (mainly in the big towns), the empire seemed to have gained a new lease on life. Yet within four months an egregious blunder in foreign policy was to precipitate its downfall.

The Franco-German War.—Ever since 1866 French feeling against Prussia had been growing, and in July 1870 the news that Prince Leopold of Hohenzollern-Sigmaringen was candidate for the vacant throne of Spain aroused great excitement and fears of encirclement. When Vincent Benedetti, the French ambassador in Berlin, induced King William I of Prussia to secure the withdrawal of this candidature, France won a great diplomatic victory. But Ollivier and his foreign minister, the duc de Gramont, threw it away by proceeding to demand a formal guarantee that the candidature should never be renewed. This mas an insult to the Prussian king, who had given his word, and it gave Bismarck the desired opportunity to provoke France into a war that would enable him to complete Germany's unification. The famous Ems telegram goaded both French and German opinion, and the French government, in spite of the warnings of Thiers, declared war on July 19.

Although such a war had been expected and was confidently accepted by the majority of Frenchmen, France was diplomatically and militarily ill-prepared. Napoleon's attempt after 1866 to form a triple alliance with Austria and Italy had broken down, largely because of his reluctance to abandon Rpme; and his wise proposals for military reforms had been frustrated largely because of the unimaginativeness of the high command and the parsimony of the legislative body, both of which completely underestimated Prussian power. The result was an overthrow almost as swift as that of Austria in 1866 and still more complete. (See FRANCO-GERMAN WAR.) The French armies fought with accustomed gallantry, but they were outgeneralled, outnumbered and outmanoeuvred. Defeat followed upon defeat, and with each new blow trust in the empire ebbed away. By the end of August Achille Bazaine was blockaded in Metz and the fate of the empire depended upon the only remaining force of any size, the army commanded by Marshal Marie MacMahon and accompanied by the emperor. It attempted a junction with Bazaine only to meet defeat in the great battle of Sedan. On Sept. 2 the whole army capitulated and, with it, the emperor. The empress Eugénie, who had acted as regent in Napoleon's absence from Paris, had no hope of maintaining a regime that had brought such disasters upon France. On Sept. 4 there was a bloodless revolution in Paris, and a republic was once again proclaimed. The empress fled to England and was later joined by Napoleon, who died there in 1873 a sick and broken man. The Second Empire like the first had ended in defeat and invasion. (J. P. T. B.)

THE THIRD REPUBLIC, TO 1914

The Government of National Defense.—The capitulation at Sedan on Sept. 2, 1870, left the deputies of the legislative body debating what sort of provisional government should take the place of the empire. The Republican opposition fell into two groups: the moderates led by Jules Simon and Jules Favre, and the radicals led by Léon Gambetta, whose electoral manifesto at Belleville of the previous year became the textbook of the new radicalism. As in 1830 and 1848, they decided to proclaim the new republic at the Hôtel de Ville. Favre and Gambetta did this on Sept. 4 and proceeded to set up an emergency government of national defense to keep at bay the revolutionary groups. It was headed by Gen. Louis Jules Trochu, governor of Paris, and was composed of the deputies for Paris and of those who had been elected in Paris but had chosen another constituency. Yet another French revolution had been made in Paris, and this time it was a bloodless one. It was the men whom Paris had chosen, including Favre, Simon and Gambetta, who now ruled France.

A fortnight later Favre, as minister for foreign affairs, met Bismarck at Ferrières. He failed to come to terms, so the government was confronted with the threefold task of defending Paris, seeking foreign support and rousing the provinces to defend the country. On Sept. 19 the German armies besieged the capital.

Thiers was sent on a tour of the European capitals to seek foreign help. As the government was shut up in Paris it had to maintain a delegation at Tours, headed at first by Isaac Moïse "Adolphe" Crémieux, minister of justice. On Oct. 7 Gambetta, as minister of the interior, escaped from Paris in a balloon, floated safely over the German lines and reached Tours. There he created virtually a personal dictatorship, designed to infuse fresh energy into the war effort of the provinces.

The government failed in all three tasks. The siege of Paris lasted four months, and the city endured great hardships. Thiers failed to gain foreign help. Gambetta raised large forces by a *levée* en masse, but they were sadly short of arms and supplies. On Oct. 27 Bazaine capitulated at Metz. Gambetta's new levies met with successive defeats. The winter was exceptionally severe. and the food supplies of the besieged capital ran out. On Jan. 18, 1871, the king of Prussia was crowned as emperor of Germany in the Hall of Mirrors in the palace of Versailles. Ten days later the French government was compelled to sign an armistice. Bismarck insisted that a national assembly be at once elected, competent to conclude a treaty of peace. General elections were arranged for Feb. 8, and the new assembly met at Bordeaux on Feb. 13 to accept the resignation of the government of national defense.

The "Government of M. **Thiers."**—The elections had been inevitably held in conditions of extraordinary confusion, and their central issue had been peace or war. Because the Bonapartists were discredited by Sedan and the Republicans were associated with carrying on the war, the electorate—which mainly wanted peace—turned to the Royalists. The national assembly was composed of about 180 Legitimist Royalists and 220 conservatives, predominantly Orleanist Royalists; 200 Republicans, divided almost equally between moderates and extremists; and about 30 Bonapartists. It thus had a Royalist majority and was by a large majority in favour of concluding peace with Germany. The veteran Thiers, on Feb. 17, 1871, was appointed "chief of the executive of the French Republic." He was to work "under the control of the national assembly and with the help of ministers, whom he shall choose and over whom he shall preside." In this way began the "government of M. Thiers" which undertook the formidable tasks of concluding peace, liberating France and restoring public order.

The Treaty of *Frankfurt.*—On March 1 the assembly affirmed the overthrow of Napoleon III and his dynasty and ratified by 546 votes to 107 the terms of the peace treaty that Thiers and Favre had negotiated with Bismarck. The terms were harsh and had both immediate and long-term importance for France. France undertook to pay an indemnity of 5,000,000,000 fr. and to maintain the cost of German forces of occupation in its northern provinces until the indemnity had been paid. The other two main provisions rankled even more than the indemnity: France gave up Alsace and Lorraine to Germany and agreed that German troops should make a formal triumphal march through Paris. The former provision bred in the next generation of Frenchmen a desire for revenge and for recovery of the lost provinces; the latter contributed, with other factors, to the outbreak of the Paris commune on March 18. The treaty was signed at Frankfurt on May 10.

The *Commune (1871).*—During the Franco-German War there had been several revolts, mostly led by the small but active class of professional revolutionaries such as Auguste Blanqui. The commune was the product of the social upheavals of the long siege of Paris, the aftermath of disastrous war and the social discontent bred by Bonapartist dictatorship. It was precipitated by a sense of outraged civic pride when German troops marched down the Champs Élysées and when it became known that the national assembly had decided to move from Bordeaux not to Paris but to Versailles. It seemed that a restoration of the kingdom might be proclaimed, by a Royalist assembly, from the palace of the kings. Many of the wealthier citizens of the capital had left it, and about 40,000 *évacués* and refugees from the German-occupied provinces had poured in. Paris, which had proclaimed the republic on Sept. 4, now tried, under more extremist Republican leadership, to provide once again the model of revolutionary action for the whole of France. It appealed to the traditions of 1793, just as on Sept. 4 the moderates had appealed to the traditions of 1830 and 1848. Its example was followed, by Lyons, Marseilles and St. Étienne, with fainter responses in Toulouse, Narbonne and Limoges. But it failed, and the government of Thiers retook the city by force of arms. On May 21 the troops of Versailles entered the city. The merciless repression that followed recalled the June days and for a time destroyed the revolutionary parties, as well as the leadership of Paris. The destruction of the commune paved the way for a more conservative republic. Meanwhile, the preliminary tasks, which Thiers undertook to fulfil without prejudging the constitutional issues of the new regime, were speedily and ably carried out.

Economic Recovery.—When Thiers in June 1871 floated his first loan to pay the first instalments of the indemnity, it was oversubscribed two and a half times. It was a remarkable tribute to the resilience of France and to the firm leadership of Thiers that there was such confidence in the new government. The second loan a year later for the remaining 3,000,000,000 fr. was oversubscribed 13 times. By getting Bismarck to agree to the earlier withdrawal of troops in proportion to payment of the indemnity, Thiers ensured that France was completely liberated by Sept. 1873, which was two years sooner than Bismarck had contemplated. By his overhaul of French military organization he laid the basis, at the same time, for the future military recovery of France.

The economic reasons for this remarkable recovery of France were that the two years after Sedan saw the climax of a phase of expansion which had begun in 1859. Between 1859 and 1869, French imports had increased in value from 1,640,000,000 fr. to 3,153,000,000 fr.; its exports from 2,266,000,000 fr. to 3,075,000,000 fr. Its total tonnage of shipping had increased in the same decade by more than one-third. Its industrial output, especially in the heavy industries and in textiles, had grown fairly steadily. In some respects the defeat at Sedan and the exacting terms of the peace gave an impetus to greater production. It stimulated public spirit and encouraged Frenchmen to work harder and more purposefully. The previous decade of railway building, rising prices and wages and agricultural prosperity laid the basis of a boom in the years 1870–73. During these years the factories were working at full speed; coal and steel output, in spite of the loss of the rich areas of Alsace and Lorraine, were on the upgrade; and prices and wages continued to rise. The index of prices, which had stood at 144 in 1869, stood at 159 in 1873, and wages tended to follow suit. Thiers used these economic opportunities wisely and well, and when he fell from power on May 24, 1873, he had earned the title of "liberator of the territory."

Republicanism Consolidated.—By that time, too, the balance of political forces which was to shape the constitution of the new republic had become clearer. Gambetta, after the elections of Feb. 1871, had carried out an intensive campaign of propaganda throughout the French countryside in favour of republicanism. It was he, by pen and spoken word, who taught the French peasant proprietors that they owed their land not to Bonapartism but to republicanism. The fruits of these labours were a series of gains by the Republican party at by-elections: of 158 contested by-elections to the national assembly between Feb. 1871 and Sept. 1874, the Republicans won 126. Gambetta co-operated with Thiers to ensure the erection of a conservative republic and founded the new "Opportunist" or moderate section of the Republican party. At the same time the forces of royalism were thrown into disarray by their repeated failure to amalgamate Legitimists with Orleanists. During the government of Thiers three successive attempts at fusion were attempted. but all in vain. The Legitimists were headed by the comte de Chambord ("Henry V"), grandson of Charles X; the Orleanists by Louis Philippe Albert. comte de Paris, grandson of Louis Philippe. Chambord had no heirs and was 51 in 1871, whereas the comte de Paris already had a son and was only 33. The purpose of fusion was an agreement to put Chambord on the throne, to be succeeded on his death by the comte de Paris. Chambord issued a series of ill-timed and stiff-necked manifestos, refusing to accept the tricolour flag and insisting on the white flag of the Bourbons. The combination of a growth of moderate and conservative republicanism with the obvious hopelessness of royalism convinced Thiers that the future lay with a conservative republic; and the national assembly, now comprising a more even balance between the two parties, proceeded to draft such a constitution.

The Constitution of 1875.—Thiers resigned in May 1873. He was succeeded by Marshal MacMahon, who on Nov. 20 was given the "presidency of the republic" for seven years. As early as Aug. 1871, Thiers had been accorded the title "president of the French republic." So a republic had long been formally accepted in principle. The issue was still whether it should be a conservative republic, so devised as to check the forces of radical democracy and perhaps even prepare the way for a restoration of constitutional monarchy, or whether it should be sufficiently radical to prevent a restoration. Around this issue the debates of the assembly in 1875 mainly revolved. Already the champions of conservatism had won a tactical victory by the appointment of MacMahon as president, and they regarded him as forerunner of a future monarch. Their leader was Jacques Victor Albert, duc de Broglie, a shre d politician and an astute parliamentarian, who became president of the council of ministers when Thiers fell and held office for a year with the support of the right-centre and left-centre parties in the assembly.

During the formation and early years of the third republic, France found itself on a downward curve of the economic cycle. A phase of economic depression began in 1873, in striking contrast to the preceding three years of boom. Its deepest impact was on France's chief national industry, farming. Development of railway and steamship brought grain from the rapidly expanding agriculture of the United States, Canada and Argentina to compete on favourable terms with that grown in the old world. *Phylloxera* was ravishing the vineyards and cattle disease was ruining French stock. The index of prices fell from 159 in 1873 to 130 in 1879. There were bad harvests in 1878 and 1879. French industry, too, ran into special difficulties. The loss of the highly industrialized districts of Alsace and the iron ore and metallurgical industries of Lorraine began to matter; and in 1878, when the Thomas and Gilchrist methods of smelting phosphorus ore were invented, it was Germany that reaped the benefits. France had lost about 1,500,000 persons, including many of its best miners and metalworkers. In addition, it had lost about 139,000 men killed and another 143,000 disabled in the war, as well as the heavy losses of the Paris commune. Industry was grievously weakened immediately before it suffered the shock of the depression. The remark "How attractive was the Republic under the Empire!" had an economic as well as a political significance.

Against this clouded economic background, the assembly passed the series of constitutional laws which together composed the constitution of the third republic.

The two chief characteristics of the constitution were its basic compromises and its piecemeal nature. Its makers did not set out to formulate general principles or doctrines, or to build an entirely new system. They redefined only those organs of government which the major political parties of the time considered to be in need of overhauling. As they were mostly somewhat conservative parties, they left almost intact whatever they could: for instance the system of central and local administration, mainly derived from Napoleon I; the judiciary, a blend of former royal and imperial regimes; and the arrangements between church and state. The basis of universal male suffrage, on which the elections of Feb. 1871 had been held, was also preserved.

By the constitutional law of Feb. 25, 1875, legislative power was vested in the national assembly. which consisted of a senate of 300 members (constitutional law of Feb. 24, 1875) and a chamber of deputies. At first 225 senators were elected for a term of nine years (one-third of their number retiring every three years) by electoral colleges representing mainly the municipal councils; the other 75 mere nominated for life by the assembly (organic law of Aug. 2, 1875). But by the law of Dec. 9, 1884 (made possible by the constitutional amendment of Aug. 14 of that year), the senate became totally elective, though still on a system of indirect election which gave the preponderance to the large number of rural communes as against the few large towns. The chamber of deputies, elected directly on universal male suffrage for a term of four years, at first rested on the *arrondissements* as single-member constituencies (organic law of Nov. 30, 1875). But in 1885 a system of *scrutin de liste* was established, with the *de'partement* as the constituency and with each elector having as many votes as there were seats ascribed to the *département;* then in 1889 single-member constituencies were restored; in 1919 a system of *scrutin de liste,* combined with a very restricted method of proportional representation, was again tried; but this too was abandoned in 1927, when single-member constituencies were again restored. Throughout, a system of second ballot was used. Article 18 of the law of Nov. 1875 laid down that "No one is elected on the first ballot unless he has won (1) an absolute majority of the votes cast; (2) a number of votes equal to a quarter of the electors on the register. At the second ballot a relative majority is sufficient." The interval of a week between the two polls left room for bargaining and shuffling on the part of the parties and their candidates. Though often criticized as encouraging sordid politics, this device was probably on balance an advantage in the very complex and fluid party system which grew up under the third republic. It prevented an excess of "wasted votes."

Since laws had to be passed by a majority of both the senate and the chamber, the two houses had nominally equal legislative power. In practice, a ministerial defeat in the chamber was more serious than one in the senate, and it was only in the last decades of the republic that a ministry felt obliged to resign if it was defeated in the senate alone. Money bills had to originate in the chamber.

The president of the republic, elected by a joint session of the national assembly for a period of seven years and subsequently re-eligible, had the initiative in proposing legislation, concurrently with the members of the assembly. He promulgated laws and ensured their execution and so had a suspensory veto on legislation. He presided at all state occasions and had the direction of the armed forces, the appointment to all civil and military offices and the right of pardon but not of amnesty. Ambassadors were accredited to him.

But every act of the president had to be countersigned by a minister, and it was ministers who were "collectively responsible before the chambers for the general policy of the government, and individually for their personal acts." This meant that the real executive power lay with the body of ministers. No specific provision was made for the office of prime minister, but it gradually established itself as a consequence of the law of March 1873. This law permitted the president to communicate with the assembly only by previous permission to appear before it and speak or by means of messages normally read in the assembly by a minister; nor could debate take place in the president's presence. Devised originally to gag Thiers, this arrangement was perpetuated in the constitutional law of July 16, 1875, which determined the relations between the organs of power, with the result that the bulk of the president's executive powers had to be wielded by the ministers, and the "vice-president of the council of ministers" (subsequently known as the president of the council of ministers) became the operative leader of the government.

However, by the constitutional law of Feb. 25, 1875 (article 5), the president of the republic could, with the agreement of the senate, dissolve the chamber before its four-year mandate had expired. But this power was used only once, by Marshal MacMahon in 1877, when it failed in its purpose. Thereafter by custom the chamber acquired immunity from dissolution and security for its full four years of existence. This fact, often lamented by parliamentary reformers of the third republic, weakened the ministry vis-à-vis the assembly, the executive vis-&-vis the legislature. But it is doubtful whether even if used the power of dissolution would have contributed to greater ministerial stability; ministries were to be weak not only because of constitutional principles but because they consisted of combinations of leaders from the various parties and groups in the assembly, who could neither command the support of a majority nor even be sure of controlling their own supporters.

The Party Politics in the 1870s and 1880s.—In the first general elections held under the new constitution, in Feb. 1876, a Republican majority of about two-thirds was returned to the chamber of deputies. Of the 36,000,000 citizens of France, only about 10,000,000 were qualified to vote, and only three-quarters of them actually voted in 1876. More than half this electorate lived by agriculture, a little more than 3,000,000 were engaged in industry and about 750,000 in business and trade. Democracy in France still meant a rural democracy, and political life centred ultimately on the 36,000 communes of the countryside. Gambetta, the most dynamic leader of the Republicans until his death in 1882, conceived a democracy of peasant proprietors and small businessmen. It was to these new social strata, given political power by universal suffrage and constitutional advantage by the composition and powers of the senate, that the Republicans especially appealed. And although these classes wanted a republic, they wanted the republic to be conservative in bias. By 1879 the Republicans had won a majority in the senate as well as in the chamber; and with the accession of the veteran Republican Jules Grévy to the presidency in that year there began what is known as "the Republic of the Republicans."

But in this year of its victory the Republican party, hitherto united under the leadership of Gambetta in a common front against both Royalists and Bonapartists, split into two halves. The moderate and conservative wing, led by Gambetta and Jules Ferry, became known as the Opportunists because its aim, as defined by Ferry, was to adopt "a political and parliamentary method which consists in not tackling everything at once, in limiting the scope of reforms and in avoiding disruptive issues." The wing that demanded more rapid reforms and took its stand on Gambetta's Belleville manifesto of 1869, was led by men like Georges Clemenceau and Charles Floquet. It became known as the Radicals and wanted such reforms as a revision of the constitution to make it more broadly democratic, the separation of church and state, the election of judges, a graded income tax and greater local communal self-government.

From 1879 onward, labour organizations also were to exercise influence on French politics. They had been forming in the 1870s, and the economic depression of the later years of that decade made them more active. Socialist congresses were held in Paris in 1876. at Lyons in 1878 and at Marseilles in 1879. At Marseilles it was decided to form a Socialist Labour party. Like the Republicans the Socialists soon split, between the more extreme Marxists and the more moderate opportunists or "Possibilists," led by Paul Brousse. Divisions within the Socialist ranks multiplied during the next 20 years, despite the repeated efforts of men like Jean Jaurès to unify them. But syndicalist organizations had established themselves in French economic and social life, they took part in the Socialist congresses and it is likely that the estimate of F. H. R. Allain-Targé, in a report to the chamber in 1881, that there were 500 unions with about 60,000 members, was an underestimate. Five years later the first national congress of trade unions was held at Lyons and decided to set up a national federation of unions. In 1884 trade unions were legally recognized, and sporadic strikes became an almost permanent feature of French life. The links between organized labour in industry and the Socialist movements in the country and assembly were never stable.

The instability thus induced in the parties of the left had its counterpart among the parties of the right. The failure of successive attempts at fusion on the part of the Royalists left Legitimists separated from Orleanists. The Bonapartists moreover remained a force that could not be neglected during the 1870s: they gained 75 seats in the chamber of 1876. Above all, the issue of clericalism revived, to cut across other live issues splintering French public opinion.

From 1876 the Royalists sponsored the cause of the church more actively. The ultramontane clericals, on their side, expected that a restoration of the monarchy would secure for them that control over policy which was denied them by the Republicans. The church was by now not only competing openly with the republic in the matter of education but also trying to make France the champion of papal interests both against the new Italian kingdom and against Bismarck's *Kulturkampf* in Germany. The crisis of May–June 1877 was indeed a twofold conflict: between Royalists and Republicans and between clericals and anticlericals. This crisis came about with the so-called *"coup d'état du Seize Mai,"* when President MacMahon, on May 16, 1877, sent to the Republican prime minister, Jules Simon, a letter reproaching him for his conduct of affairs in the chamber; whereupon Simon and his cabinet resigned. An *"union des gauches"* was forthwith formed in the chamber in protest against MacMahon's action; and in June, when the new prime minister, the duc de Broglie, asked the senate on MacMahon's behalf to dissolve the chamber, the chamber passed a resolution of no confidence in the ministry by 363 votes against 158. On the senate's dissolving the chamber, the 363 deputies of the left presented themselves en bloc to the electorate. Gambetta and Thiers once more co-operated, and when Thiers died (Sept. 3) in the midst of the electoral campaign, Paris turned his funeral into a Republican demonstration. The Republicans won 326 seats and, by the invalidation of about 75 of their opponents' elections—on the grounds that improper official pressure had been used during the polls—raised their strength in the chamber to about 400.

This Republican victory, great enough to check the monarchists' schemes against the constitution, was not great enough to dispel fear of clericalism. Gambetta's chief anxiety in foreign affairs was to win international recognition for the new republic—then the only republic in Europe apart from the Swiss—and to remain on good terms with the Italian kingdom. In 1877 he visited King Victor Emmanuel in Rome, but he had scarcely returned to Paris when the king died. A month later Pius IX died, and his successor, Leo XIII, adopted a more conciliatory policy. But the tradition of hostility between church and republic and the extent of clerical power and influence over education in France combined to make another two decades of strife inevitable. In 1880 decrees were issued disbanding the Jesuits, and twp years later Jules Ferry made primary education free, compulsory and secular.

Throughout the formative period of the parliamentary republic, therefore, a mixture of diverse issues split public opinion; and this split was reflected in the multiparty system that, more than any other single factor, determined the nature of the republic. Every ministry had to be a coalition of several groups—either a fairly cohesive *"union des gauches,"* as in the crisis of 1877, or a looser combination of centrist groups, as were most ministries of the 1880s. Any such coalition, being based on only a limited area of agreement, tended to be short-lived and to collapse as soon as one or two marginal elements deserted it. Ministerial instability became the most outstanding and decisive characteristic of the French parliamentary system; and 30 ministries held office during the first two decades of the new constitution.

Colonial Expansion.—A further issue which divided the ranks of the Republicans was that of colonial expansion. During the decade after Sedan French opinion was too much concerned with recovery and reconstruction at home and with the aim of *revanche* against Germany in Europe to countenance overseas expansion. Such adventures were associated with the kings and with Bonapartism; a big insurrection in Algeria in 1871 strengthened anticolonial sentiment; and in 1874 the duc de Broglie's government evacuated Tongking. The Radical wing of the Republicans remained opposed to colonial expansion, but the Opportunists, led by Jules Ferry and Gambetta, by 1880 began to favour it. In 1881 the bey of Tunis, Mohammed VI, after a short and inexpensive military campaign, was made to sign the treaty of Bardo, which turned his territories into a protectorate of France. By the end of the year the whole of Tunisia was virtually under French control. Ferry's ministry fell under the attacks of the Radicals and the right. But he returned to power between 1883 and 1885 and resumed his forward policy. He strengthened French control in Madagascar; the expeditions of Pierre Savorgnan de Brazza in the Congo basin led to the establishment of French Congo; and in Indochina Tongking was retaken and

Annam made a protectorate. Again, despite these remarkable gains, Ferry was swept from office in a tremendous outburst of parliamentary and popular hostility. But overseas expansion went on for the rest of the century, and the French empire in Africa and the far east became, next to the British, the most extensive in the world.

The background to this overseas expansion was economic boom and slump at home. The 20 years before 1873 had been a period of expansion and prosperity interrupted by short, sharp periods of crisis and slump. The 20 years after 1873 were a period of depression interrupted by short periods of sudden prosperity. The first of these periods came in the years 1880–82, when credit expanded, new companies were formed, railways were built and speculators were active. The output of pig iron jumped from 1,400,000 tons in 1877 to 2,069,000 tons in 1883. Agriculture prospered and grain crops were good. But the hectic speculation between 1880 and 1882 was followed by a flutter of bankruptcies and financial crises. The index of prices fell from 133 in 1880 to 122 by 1883 and to 111 by 1890. Ferry saw in Indochina a new market for French industry and a remedy for trade depression.

Although the development of the newly won colonies was hampered by shortsighted economy imposed from Paris, great administrators like Paul Doumer, who was governor general of Indochina, built roads and railways and developed the empire's economic resources, and Joseph Simon Gallieni strove to overhaul the life of Madagascar as Hubert Lyautey was soon to reorganize Morocco. The more conservative service families found an outlet for their energies in the colonial army and the colonial administrations, while the church found new fields for its missionary activities. One function of the new empire was to ease the pressure of Royalist hostility to the republic at home by opening new opportunities for the service of France overseas.

Boulanger.—By the 1880s the foundations of the parliamentary republic seemed to have been firmly laid. The constitution was working reasonably well; the party system had taken shape and the Republicans had consolidated their regime; the clerical issue, by no means dead, had almost reached a stalemate; the system of state secular education had been launched; a great new overseas empire had, despite popular hostility, been founded; and French industry and agriculture were on the whole making slow yet solid progress. The state clung to its protectionist and mercantilist traditions and was developing certain standards of industrial welfare. In 1874 the employment of children under 12 years old in factories had been prohibited, and factory inspectors had been appointed to enforce the law. The tariffs of 1881 cushioned farmers against the worst consequences of agricultural depression. But the sky was not clear, and the first big cloud to loom over the republic was the movement of Boulangism.

The Radical Republicans had allied themselves with the right and even with the extreme champions of revenge against Germany in opposition to Ferry's colonial policy. It was Georges Clemenceau, leader of the Radicals, who got Georges Ernest Jean Marie Boulanger included in the government in 1886 as "the only Republican general." Boulanger became minister of war and made himself popular both by his energetic execution of measures to reform and "republicanize" the army and by his dashing appearances at military reviews. No one since Gambetta had succeeded so well in capturing the hearts and imagination of the common people. But a people's army was valued mainly as a weapon of revenge, and Boulanger was given the enthusiastic backing of Paul Déroulède and his League of Patriots. When Bismarck, in his *reichstag* speech of Jan. 1887, named Boulanger as the greatest obstacle to good relations between France and Germany, popular opinion was left in no doubt: General Boulanger became "Général Revanche." He began to sponsor the demands of the Patriots for a revision of the constitution so as to produce a stronger and more directly popular executive. Thrown out of power when the ministry fell, in May, he was ready to conspire in order to further his own career. It was the Wilson scandal which gave him his chance.

It was discovered that Daniel Wilson, son-in-law of President Grévy, had conducted a thriving traffic in decorations and honours from the Élysée itself; and the scandal' implicated Gen. Jean Thibaudin, former minister of war and military governor of Paris. In the long crisis which ensued both the ministry and the president were forced to resign. The Royalists and Bonapartists began to pay court to Boulanger, and the royalist duchesse d'Uzès (Marie Clémentine de Rochechouart-Mortemart) lavished money upon his cause. He became the focus for all the forces hostile to the parliamentary republic. He was elected on the lists of several constituencies at once and in Jan. 1889 won a resounding triumph by getting elected for Paris itself. A coup d'état was staged. It failed mainly because Boulanger lost his nerve at the last moment. His incorrigible frivolity and laziness proved to be his downfall. The ministry, given breathing space as by a miracle, acted swiftly. It abolished the electoral device of *scrutin de liste* and the system of multiple candidatures which had made his successes possible. The new premier, Pierre Emanuel Tirard, took action against the League of Patriots and threatened to bring Boulanger to trial before the senate. Boulanger took fright, fled to Brussels on the appropriate date of April 1 and committed suicide on the grave of his mistress 30 months later.

The pattern of events, by which a dramatic revelation of parliamentary or ministerial corruption and weakness gave rise to a threat of insurrection and popular disorder, was to be repeated in later years. Boulangism was defeated, as MacMahon had been. by the formation of an "*union des gauches,*" a rally of the parliamentarians to save the republic. The regime was strengthened and its opponents weakened by the farcical failure of Boulangism. But the root causes of the crisis, a tendency to parliamentary corruption and to ministerial instability and the failure to reconcile many classes to the regime, remained. The years of Boulangism were also years of falling prices and wages, which induced an atmosphere of economic depression and considerable hardship. It was when such conditions coincided with a political crisis that the republic was most immediately in danger.

The Panama Scandal.—In 1889, when the Boulangist crisis reached its climax, the Panama Canal company failed. Eight years earlier the project had been launched for constructing a Panama canal by a company directed by Ferdinand de Lesseps of Suez canal fame. The difficulties of the undertaking had proved enormous, and it had received no official support until the end of 1888. By a succession of loans it had raised 1,040,000,000 fr., and when it went into liquidation the shareholders appealed to the government to safeguard their interests. Lesseps and some of his colleagues were charged with corruption, and although the charges were not proved the Boulangist deputies and their supporters in the country could again raise the cry of corruption in high places. In particular, it was alleged that deputies had been bribed by a Jewish financier, Baron Jacques de Reinach. When Reinach was found dead and another Jewish financier, Cornelius Hertz, who had been blackmailing Reinach, fled to England, a commission of inquiry had to be set up. Clemenceau, who had uncomfortably close associations with Hertz, was denounced as being in the pay of the British foreign office. Proceedings were started against five deputies and five senators, including five ministers or former ministers. Although in the end only a former minister of public works was convicted (on his own confession) and the allegations against Clemenceau rested mainly on forgeries, the whole affair came too soon after the Wilson scandal and the Boulangist scare to be comfortable for the regime. The short-range effects were to end the career of Charles Floquet and to check the career of Maurice Rouvier, to oust Clemenceau for a time from the chamber in which he had sat continuously since 1876 and to bring to the fore new and younger men such as Paul Deschanel and Théophile Delcassé, Jean Louis Barthou and Raymond Poincaré. Anti-Semitism, which had been growing since 1885, received fresh impetus. In the elections of 1893 the Radicals collaborated with the Socialists and drew further away from the right-wing Republicans, while Socialist deputies increased in number from 12 to 49.

Labour Organizations, to 1902.—Syndicalist organizations had grown faster after trade unions were legalized in 1884. Membership of legally constituted unions was only 140,000 in 1890, but grew to 420.000 by 1895; it reached a total of 589,000 by 1901. In 1892 the *bourses du travail* (labour exchanges), which had become local centres for syndicalist activities, formed themselves into the national Fédération. Three years later, in 1895, the trade unions formed the Confédération Générale du Travail (General Confederation of Labour), which competed with the Fédération for the support of workers and their unions. In 1902 the Fédération was merged into the C.G.T., which henceforth became the official national representative of organized labour movements.

The prevalent doctrine of the C.G.T. was direct action: that is, it sought to promote workers' interests not by political action and not by supporting Socialist parties in the assembly but by collective bargaining and use of the favourite revolutionary weapon of the general strike. In 1893 more than 3,000,000 man-days of labour were lost by stoppages. Within its ranks were included a wide variety of revolutionary doctrines, Marxist and anarchist and syndicalist, and there remained few links and often little sympathy between organized labour and the parliamentary Socialist groups. This profound cleavage within the ranks of left-wing movements weakened them while it also weakened the authority of parliament. The 19th century ended with a decade of strikes and the 20th began with another. The social legislation passed around the turn of the century was not far-reaching: a ten-hour factory act in 1900, accompanied by more thorough factory inspection; joint consultative councils of labour and employers, to advise the government and to mediate in labour disputes. But it was denounced as feeble bribery by the revolutionaries of the C.G.T. for whom the class war was an article of faith. These two decades were a period of rising prices and industrial expansion, coinciding with the influx of gold from South Africa. The aim of labour organizations was, partly, to ensure a larger share of the profits of expansion for the workers and to force up wage levels to keep pace with prices; but it was also to propagate revolutionary doctrines among the French working classes. This divergence of ends led to a conflict about means. While parliamentary Socialists like Jean Jaurès, Aristide Briand and Alexandre Millerand preached some reconciliation of classes within the state, the C.G.T. preached the class war. In consequence, material gains were sacrificed for ideological differences.

The Dreyfus Case (1894–1906).—It was against this background of mounting social tensions and political controversies that there occurred the most famous and far-reaching of all the sensational *affaires* of the republic: the Dreyfus case. In 1894 Capt. Alfred Dreyfus, of the staff of army headquarters, was accused of having sold military secrets to Germany. He was condemned, disgraced and sent to Devil's Island. Most Frenchmen accepted the verdict that the young Jewish officer was guilty, until in 1897 his family's efforts to prove his innocence received unexpected support from Col. Georges Picquart of the intelligence service. He found strong evidence that the memorandum which had served as the main documentary proof of Dreyfus's guilt had been forged by a shady artillery officer, M. C. F. Walsin Esterhazy. He reported this to the vice-president of the senate, Auguste Scheurer-Kestner, who joined with the Dreyfus family in bringing a formal charge against Esterhazy. The great novelist Bmile Zola and the formidable fighter Clemenceau took up their cause.

Esterhazy was duly acquitted by a secret court martial and hailed as a popular hero. But Zola, in an open letter to the president of the republic headed *J'Accuse*, threw down a challenge that no parliamentary government could ignore. He alleged an army conspiracy to condemn Dreyfus despite his innocence. When he too was tried and condemned, public opinion still showed itself to be against Dreyfus. Crowds shouted "Death to the Jews" and even "Death to Zola." It was 1898 before the tide turned.

In that year the new Radical minister of war, Jacques Marie Eugène Godefroy Cavaignac, disclosed in the chamber some of the evidence on which Dreyfus had been condemned. Picquart offered to prove that one of the documents produced did not refer to Dreyfus and that two of the others were false. Colonel Henry, who had been appointed to Picquart's post in the intelligence service and who had been involved in the conspiracy, committed suicide after confessing his own guilt. Esterhazy escaped to England. These events made a retrial inevitable, and now public opinion was wildly excited and swinging over to the Dreyfusard side. The rights and wrongs of Dreyfus as an individual dropped out of sight, and the affair became a highly explosive national controversy. Nationalists, clericalists and right-wingers tended to be anti-Dreyfusard; Republicans, anticlericals and Socialists tended to be Dreyfusard. Dreyfus became a symbol of the conflict between militarist, nationalist authoritarianism and civilian, republican concepts of individual rights.

All other events—such as the sudden death of the president of the republic, Félix Faure, in 1899, and the election of Émile Loubet instead of Jules Méline to succeed him—were interpreted as items in the *affaire Dreyfus*. It was only the formation of a new ministry headed by René Waldeck-Rousseau in 1899 that brought the matter to a culmination, for demonstrations and counter-demonstration~were threatening public order.

The new ministry, like its predecessors in the MacMahon and Boulangist crises, was an *"union des gauches"* for Republican defense. It took strong measures, arresting and punishing even Déroulède himself. The retrial of Dreyfus, which began at Rennes in Aug. 1899, attracted world-wide attention. He was again found guilty of "intelligence with the enemy," but "with extenuating circumstances"; and he was shortly after pardoned by President Loubet. It was 1906 before the Rennes verdict was also quashed and Dreyfus was restored to full rights by a resolution of the chamber of deputies.

Probably the reason why the Dreyfus affair was so disruptive in French life must be sought beyond the apparent battle of political forces which filled the stage at the time. The church was a weaker challenge to the republic after the period of *ralliement* inspired by Pope Leo XIII in 1892, and this weakness showed itself in the relative ease with which, by 1905, church was separated from state. Popular opinion lost interest in it when the issues became so complicated; and the affair played a very small part in the general elections of 1898. There is evidence that the middle-class centre parties were more anxious about the growing threat from the left than about the challenge of the right, and Waldeck-Rousseau undoubtedly helped to split the Socialists when he took Alexandre Millerand into his ministry. There is a background of economic unrest and social discontent to the Dreyfus case as much as to Boulangism. Moreover, in historical perspective the affair can be seen as one further reason for the slow advance of social reforms in the republic before 1914.

Church and Army, From 1890.—Conflict between the church and the republic, so active in the 1870s, became latent for a short time in the 1890s because of the movement known as the *ralliement.* It was the most serious and hopeful effort to reconcile Catholicism with the republic. Beginning in 1890, it took clear shape in 1892 when Pope Leo XIII ordered Catholics in France to obey the laws of the republic. It bore fruit in the work of Comte Albert de Mun and a new leniency in the application of the anticlerical legislation. But the bitterness aroused by the Dreyfus case undid most of its benefits. The quarrel entered upon a new phase in 1901 when the formation of free associations was, for the first time, fully allowed in France, but religious congregations could be formed only with special authorization and could be dissolved by decree. This measure was aimed especially at the Assumptionists and the Jesuits. Then Émile Combes, a high dignitary of Freemasonry, who succeeded Waldeck-Rousseau in 1902, suppressed nearly all the congregations and took away their right to run schools (1904). The conciliatory Leo XIII had died in 1903, and his successor, Pius X, upheld papal claims more inflexibly. The conflict revived quite suddenly with the conjunction of intractable leaders on either side, and separation of church from state was the inevitable result.

Accordingly, in 1904, Combes introduced a bill for the separation of church and state and for ending the concordat. Although he fell two months later (Jan. 1905), his successor Rouvier passed the bill into law in Dec. 1905. The republic guaranteed freedom of worship for all but ceased to give any official recognition or subsidy to any form of worship. Church endowments and revenues were to be handed over to new *associations cultuelles,* which would maintain religious services. But when the pope refused to countenance this, the state sequestered church property and handed over its funds to public charitable organizations. The separation was thus effected with more hardship and bitterness than was either intended or necessary. But it did much to kill the old anticlerical bitterness as a political force and freed the church itself from state interference.

To Republicans, clericalism and militarism were linked. There was substance in this connection, in that many families produced both priests and soldiers and clung to the traditions of monarchical France. The higher ranks of the army and navy mere traditionally held by men of Catholic traditions, and the Dreyfus affair brought this fact to notoriety. Since 1871 it had been a constant dilemma of Republicans that to defend French national security by conscription and by heavy military expenditures was also to undermine the republic by placing enormous influence and power in the hands of such men. Even a good "Republican general," as Bonaparte and Boulanger had shown, was prone to develop ambitions of caesarism. The problem of how to democratize the French army attracted the attention, in turn, of Gambetta. Clemenceau and Jaurks. The Dreyfus affair showed the strength of antimilitarism, which was bred of the boredom of conscription and of a military life in which no differentiation was made between the peasant and the scholar. The Radicals, intensely patriotic in the days of Gambetta, found themselves becoming antimilitarist. The Socialists, internationalist by doctrine and suspicious of a law of conscription that could permit the call-up of strikers to defeat a strike, were also strongly antimilitarist.

Jaurks, in his great work on *L'Armée nouvelle,* later tried to reconcile socialism with a democratic military organization. But a decade before 1914 the left parties were tending to be hostile to a large military establishment, whereas the right—identified with a policy of peace and of internationalism in the 1870s—was emerging as a more aggressively militarist and ultranationalist force in political life. This reversal of attitudes which occurred during the first half of the republic's existence was to be itself reversed again during the second half, when the right became defeatist or even "collaborationist" and the left the parties of "resistance" to Fascism.

International Relations (1870–1914).—The counterpart to the maintenance of a strong army and to preparation at first for a war of revenge against Germany and subsequently for self-defense against encirclement by Germany was a system of reliable alliances. Bismarck's aim after his triumphs of 1870 and 1871 was to keep France isolated in Europe and, if possible, embroiled in conflicts with its neighbours. For this reason he favoured a republic, as being least likely to find an ally among the monarchies of Europe, and welcomed French colonial expansion as likely to embroil it with Great Britain and Italy. For this reason too he sought alliances himself with Russia, Austria and Italy.

It was, therefore, the inevitable policy for the republic to win recognition for the regime, to settle colonial disputes with Great Britain and Italy and to win allies. Thiers did much to win European recognition for the republic. In 1893 France took the momentous step of entering into a treaty of alliance with Russia. Delcassé, minister for foreign affairs continuously from June 1898 until June 1905, was the main architect of French diplomacy. He strengthened the Russian alliance by lavish loans to the tsar. He made a commercial treaty with Italy in 1899 and allayed the fears that it had entertained about the French conquest of Tunis. In the same year he settled successfully the Fashoda incident, in which France and Great Britain fell into conflict about the Sudan, by agreeing to a definition of their spheres of influence there. In 1904 he crowned his work with the Anglo-French entente. The two countries defined their separate interests in Newfoundland, West Africa, Siam, Egypt and Morocco. Bismarck's plans were thus completely frustrated by 1904; but the price was the division of the European powers into two rival camps, for the triple alliance of Germany, Austria and Italy had been forged by 1882, and the triple entente of France, Russia and Great Britain was completed in 1907 by the agreement between Great Britain and Russia which French diplomacy helped to facilitate. The *entente cordiale* became the cornerstone of French foreign policy in the west, her alliance with Russia its counterpart in the east.

Once made, the entente was consolidated as much by German aggressiveness as by French diplomacy. When the German emperor William II visited Tangier in March 1905 and Delcassé advocated resistance, he was unsupported by his colleagues and resigned (June). But the fact that the French foreign minister had been forced out of office under German pressure only strengthened the entente. Likewise, the Algeciras conference of 1906, for which Germany pressed, mas in effect a victory for France because Germany gained little whereas it was agreed that France and Spain should police the Moroccan ports. By 1912 a French protectorate was formally set up in Morocco, and Great Britain entered into naval agreements whereby France concentrated its main naval forces in the Mediterranean and Great Britain transferred part of its Mediterranean squadron to the North sea. Although Great Britain was not bound by any formal alliance to defend France against German attack, these arrangements and the persistence of naval rivalry between Great Britain and Germany made it possible for France to rely on British help if need should arise.

The Political Scene in 1914.—The Radical ministry of Clemenceau and Joseph Caillaux, which came to power in 1906, set out an extensive program of reforms. It included provision for old-age pensions. income tax (hitherto not imposed in France), workmen's compensation, an eight-hour working day and governmental control of labour contracts and of the mines. It was the counterpart to the contemporary liberal reforms in England, but it mas obstructed at every stage and came virtually to nothing. The ministry ran into conflict with the C.G.T., and the decade before 1914 was a period of great social unrest. At the congress of Amiens in 1906 the C.G.T. formally dissociated the organized labour movement from any political party and so from parliamentary action and affirmed the general strike as the main weapon of revolutionary syndicalism. Strikes and riots in the big towns (Paris, Marseilles, Le Havre, Dunkirk) in 1907–08 spread to the countryside, and there was a strike among the vinegrowers of the south. A strike among post-office workers in 1909 was followed by a call from the C.G.T. for a general strike. It failed, but the need to repress such strikes split the Socialists from the Radicals and aggravated the already complex working of the multiparty system. Clemenceau had to rely more and more on his former enemies, the moderate and conservative Republicans, which was one reason why his original 17-point program of social reforms came to so little.

At the beginning of the 20th century it seemed as if the chronic ministerial instability of the republic was diminishing. Of the six ministries of the years 1899–1909, Waldeck-Rousseau's lasted three years, Combes's two and a half and Clemenceau's two and three-quarters. But between the fall of Clemenceau (July 1909) and the outbreak of World War I in 1914, ten ministries followed one another in quick succession, and only one (Briand's first ministry) lasted more than a year. So the political background to World War I was the reappearance of ministerial instability in an aggravated form. This weakness of the political leadership of France lasted throughout most of the war years, until Clemenceau formed his great ministry of Nov. 1917.

The main political triumph of the immediately prewar years was the passing of the three-year military service law under the leadership of Poincaré, who was elected president of the republic in Jan. 1913. In 1905, at the height of antimilitarist feeling engendered by the Dreyfus affair and by the growth of internationalist socialism, the length of compulsory military service had been reduced from three years to two and military expenditure drastically reduced. In 1912–13 Germany and Austria-Hungary increased the size of their armies, and the French military authorities, backed by Poincaré and Barthou, ielt compelled to restore the three-year period of service. But the measure was extremely unpopular. It met with energetic opposition from the Socialists and from most of the Radicals, who won striking victories in the elections of May 1914 by making opposition to the law one of the main planks in their policy. Only the stubborn persistence of the president and the actual outbreak of war in July saved the law from repeal.

As in Great Britain, the prewar years revealed signs of impending crisis in the parliamentary system and a decline of faith in constitutional methods of government. Outbreaks of violence, connected with the syndicalist movement, party conflicts and revolutionary anarchism, were becoming increasingly frequent. Parliamentary governments showed little sign of ability to deal with such developments. National finances were in grave disorder, the system of taxation defective and out-of-date.

Yet the pressure of local and sectional interests on deputies had increased, encouraging the lavish outlay of public funds on whatever projects were most likely to win votes. Issues irrelevant to the most pressing problems of the time, such as anticlericalism and controversies about proportional representation, still tended to oust more urgent matters from the attention of electorate, parties and parliament.

Cultural Prestige (1870–1914).—Whatever the shortcomings of the prewar political system, it had the supreme merit of allowing a high degree of freedom to the individual, and this made possible a remarkable flowering of French national genius in nearly every field of the arts and sciences. In literature, Anatole France, Émile Zola, Guy de Maupassant and Alphonse Daudet for prose and Paul Verlaine, Stephane Mallarmé and Charles Péguy for poetry; in philosophy, Henri Bergson; in science, Louis Pasteur, Pierre Curie and Marcellin Berthelot; in music Claude Debussy, Jules Massenet, Camille Saint-Saens, Georges Bizet, César Franck, Gabriel Fauré; in painting, Edouard Manet, Claude Monet, Auguste Renoir. Edgar Degas, Paul Cézanne and Paul Gauguin; in the social sciences, Georges Sorel, Gabriel Tarde and Émile Durkheim; on the stage, Sarah Bernhardt: these names are some index of the French contribution to European culture made by this era of freedom. Paris retained much of its old role as a fountainhead of European thought and progress. Writers, musicians, artists could find there a large and appreciative public eager to pay them respect. Even the tensions of French national life helped evoke some of the most original and persuasive writings of the period: those of Maurice Barrils and Charles Maurras, of Julien Benda and Robert de Jouvenel, of André Gide and the young François Mauriac. Some of the greatness was to depart after 1918, but at least before 1914 it was a veritable renaissance.

WORLD WAR I

The declaration of war by Austria-Hungary on Serbia on July 28, 1914, led to full mobilization by Russia and therefore to a declaration of war by Germany against Russia (Aug. 1). Germany declared war against France two days later and, on the next day, invaded Belgium. This precipitated Great Britain's declaration of war on Germany. Within a week, the two rival systems of alliances were brought into action, and the Anglo-French entente became a formal alliance.

The German plan, devised a decade earlier by Alfred von Schlieffen, was to deliver a knockout blow to the heart of France. German armies, advancing in a great hammer sweep through Belgium and northern France, were to envelop Paris. The Belgian army and the British expeditionary force took the first shock of the blow, but the German armies came perilously near to Paris. Only the cool courage of Joseph Joffre and his troops and the enterprise of Joseph Gallieni saved the capital. In the decisive battle of the Marne in September the Schlieffen plan was foiled. Both sides dug themselves in, and from the Vosges to the sea an improvised line of defenses became the French frontier. This deadlock on the western front was not much altered until 1917 and not broken until 1918. It meant prolonged occupation of France's northern provinces, much of which country was turned into a battlefield.

The crises of the war in the west were, for France, the checking of the initial German offensive, which was achieved by the end of 1914; the battle for Verdun (Feb.–Aug. 1916); the mutinies and unrest in the French armies (autumn 1917); and the checking of Ludendorff's offensive in 1918, which led to ultimate victory under Ferdinand Foch. The battle of Verdun originated in an attempt, not unlike that of the Schlieffen plan, to knock France out. The German chief of staff, Erich von Falkenhayn, hoped that, with an all-out offensive against so crucial a point as Verdun, he could "bleed France to death" by annihilating its best troops. It was a serious miscalculation to expect that a limited and local action could yield such decisive results, yet he succeeded in smashing several French divisions and inflicted heavier losses than he suffered. But, at heavy cost of life and material, the French held Verdun, and Gen. Henri Pétain became a national hero. The Franco-British offensive on the Somme, in July 1916, brought some of the fiercest fighting of the war. So, too, did the costly and unsuccessful offensive under Robert Nivelle in the spring of 1917. Disheartened by losses and prolonged strain and by the spread of pacifist feeling, sections of the French army mutinied. Pétain, as the hero of Verdun, was sent to quell the mutiny, and by severe measures he succeeded. The entry of the United States brought little relief immediately, whereas the withdrawal of Russia from the war, after the October Revolution, freed Germany from the burden of major offensives on two fronts. Both events made the battles of 1918 a desperate climax to the whole war.

Before these decisive battles, the western powers set up a supreme war council. The French forces, under Pétain, had to defend Paris; the British, under Douglas Haig, had to defend the channel ports. There was danger that the Germans by striking at the junction of the two forces might split them. At last, in April 1918, Foch was appointed commander in chief of the Allied armies. German offensives failed, and when Foch counterattacked on the Marne German retreat began. U.S. backing in men, equipment and supplies now became decisive. The simultaneous collapse of Germany's allies in Bulgaria, Turkey and Austria-Hungary forced it to sue for peace. An armistice was signed on Nov. 11, 1918, in Foch's railway carriage in the forest of Compiilgne.

France's northern industrial areas had been ravaged by 52 months of unbroken warfare. Towns and mines, factories and farms, were in ruins. About 1,400,000 Frenchmen had been killed and as many again disabled. Direct war expenditure had been about 150,000,000,000 fr. The economic dislocation and human misery caused by the war were incalculable. The war bequeathed to France vast tasks of reconstruction with a depleted labour force, a declining population and a public debt of about 219,000,000,000 fr. On the other hand the invader had been expelled and defeated, and France recovered the rich provinces of Alsace and Lorraine, lost in 1871; so that the menace which had haunted the previous 50 years seemed, for a time, to be removed. The mood of the French people in 1918 was a mixture of exhaustion and relief, combined with a resolve that from enemies and allies alike some reliable guarantee should be sought against any recurrence of the disaster.

The parliamentary republic, too, seemed to have been vindicated and, in the mood of optimism about the future of democracy that prevailed in 1919, was no longer the potential pariah among governments that Bismarck had tried to make it in 1871. Parliamentary governments, it was true, had not emerged brilliantly from the early years of the war. France's political leaders had been small and undistinguished men unworthy of leading a great nation in crisis, and it was to the generals and the millions of common soldiers that the nation had turned in time of need. But there was one exception: Clemenceau, who at the age of 76 had become the real organizer of victory in 1917 and had been mainly responsible for getting Foch made commander in chief. His ministry was formed mostly of nonentities whom he himself described as "the geese that saved the Capitol." With the simple maxim, *Je fais la guerre*, he had ruled almost autocratically and often arbitrarily. But drastic suspensions of normal parliamentary powers and civil liberties were widely accepted as unavoidable in wartime. The *union sacrée* in face of national peril, always more a psychological conception than a political reality, rested on the surrender of virtually dictatorial power to the government. The control of finance by the chambers practically lapsed, save for periodic outcries about extravagant expenditure.

The Conference of Paris (1919).—It was appropriate tribute to the part of France in the war that the peace conference should be held in Paris and that Clemenceau should serve as its president. The question which dominated the old man's thoughts was how the settlement could best serve the permanent interests of French security. The program, for France, was "restitution, reparation, guarantee." Restitution meant recovering the provinces of Alsace and Lorraine. The eighth of Pres. Woodrow Wilson's fourteen points of Jan. 1918 had declared: "All French territory should be freed, and the invaded portions restored, and the wrong done to France by Prussia in 1871 in the matter of Alsace-Lorraine ... should be righted ..." Reparation meant that Germany should contribute to the reconstruction of the devastated areas. Guarantee meant ensuring that Germany should fulfil its obligations and also establishing material and diplomatic guarantees from the allies for French security. Foch wanted control of the bridgeheads of the Rhine, and Clemenceau produced a plan for separating the whole Rhineland from Germany.

By the treaty of Versailles, signed on June 28, 1919, the left bank of the Rhine was demilitarized, along with a zone about 30 mi. E. of the Rhine, and allied armies were to occupy the left bank and the bridgeheads for a period of 15 years. The amount of reparations to be paid by Germany was to be decided by the Reparations commission. It was a much more flimsy guarantee than France had hoped; and instead of indefinite occupation or separation of the Rhineland, France mas given a joint Anglo-American promise of support if it were attacked by Germany.

As Great Britain and the United States rejected his plan, Clemenceau was placed on the horns of a dilemma at the conference. He had to choose between holding on to the material guarantees at the cost of diplomatic isolation and exchanging the material guarantees for diplomatic assurances. He chose the second course, but when the U.S. senate refused to ratify the treaty and renounced U.S. assurances, Great Britain also renounced its.

France was therefore left, in the end, with neither material nor diplomatic guarantees, save the hope of exacting crippling reparations from Germany and the general prospect of "collective security" provided by the covenant of the League of Nations (articles x, xvi, xvii). France entered the postwar years with an acute sense of insecurity aggravated by a feeling that it had lost some of the most precious fruits of the victory so dearly bought with French lives.

The remaining material securities had three defects from the French point of view. Germany was to pay reparations only for all damage done to civilians and their property, not for the whole cost of the war. The coal mines of the Saar were ceded to France not permanently, as Clemenceau had asked, but for only 15 years, at the end of which a plebiscite was to be held. Likewise the military occupation of the Rhineland areas was also to last for only 15 years. This, it could be argued, was just the time needed for German recovery and resurgence, so that these securities would expire at the very time when France might need them most.

French enthusiasm for the new League of Nations was, moreover, very restrained. During the discussions of the project Leon Bourgeois had produced a plan to give the League power to enforce military sanctions with an army of its own. This plan had been rejected by Great Britain and by the United States; and even the covenant itself was rejected by the United States, which did not become a member of the League. So the League was, in French eyes, most unlikely to provide the substantial security against war and against defeat in war that France needed. Yet the success of the League would now clearly depend on how far Great Britain and France together could give it leadership. Within or without the League, relations with Great Britain were to remain the crucial problem of French foreign policy after 1919, as they had been in the years before 1914.

INTERWAR PERIOD, 1919-39

In parliamentary life, peace brought a reaction against wartime discipline and a reversion to close parliamentary control over the executive. For the general elections of 1919 the method of *scrutin* de *liste* was revived, in conjunction with a restricted variant of proportional representation which favoured the most highly organized parties. The resulting *chambre bleu horizon* was dominated by ex-servicemen who constituted the conservative Bloc National, which cut across the Radicals but excluded the Socialists. Clemenceau, who was attacked for his failure to get better terms in the peace treaties, resigned in Jan. 1920, having held power for just more than two years.

He was succeeded as premier by Alexandre Millerand and failed to be elected president of the republic. His persistent anticlericalism put him out of sympathy with the right-wing majority of the chamber and senate, and his overthrow was in part a reassertion of parliamentary power against the man who had himself, before the war, smashed so many ministries.

Paul Deschanel, chosen as president in preference to Clemenceau, had a breakdown in Sept. 1920 and was succeeded by Millerand, whose place as premier was taken by Georges Leygues. Millerand's aim was to be strong with Germany and with the chamber at home. From 1922, when Poincaré became premier, French policy abroad became increasingly intransigent. Chamber, premier and president were agreed on a nationalistjc policy toward Germany. Briand had been forced by Millerand to resign, in Jan. 1922, because he showed signs of making concessions to Germany.

This showed a new authority and vigour for a president of the republic. But Millerand's attempt, after the victory of the Cartel des Gauches in 1924, to reassert the right of president and senate to dissolve the chamber was vigorously resisted by the Cartel, and he was forced to resign. It was almost a repetition of the MacMahon crisis of 1877 and ended similarly. No subsequent president repeated the attempt, and after 1924 the presidency reverted to the pattern of the prewar years.

The policy of the Bloc National was further discredited by the relative failure of its most drastic action against Germany, the occupation of the Ruhr in 1923. Germany was behind in its payment of reparations, and Poincaré decided to "put the bailiffs in," despite British disapproval. But he did not succeed in making Germany pay; the French troops met with passive resistance by the Germans; and the franc suffered from the additional financial burden and from the sharp decline of international confidence that resulted from the French action.

Poincaré was trying, in effect, to retrieve some of those material securities which Clemenceau at the conference had exchanged for diplomatic guarantees. But the choice had been made once and for all then, and France now had no real alternative but to cling to collaboration with Great Britain.

The reaction against this policy was embodied in Aristide Briand. A man of the left with a fervent and almost mystical belief in internationalism, he came to wield a curious power in the exhausted France of the postwar years. He became the main spokesman of France at Geneva and one of the leading figures in the League as the "apostle of peace" and rivalled the prewar Delcassé in his length of tenure of the ministry of foreign affairs. He was 11 times premier of France and, from April 1925 until Jan. 1932 (a few weeks before his death), he was except for one day continuously in charge of French foreign policy. He accepted, as Poincaré would not, the only alternative left to France: wholehearted support for the League, close co-operation with Great Britain and a policy of *rapprochement* with republican Germany. Thus, by 1924, foreign policy was in essentials fixed in the pattern that it was to follow, with occasional hesitations, until 1940.

There was, however, another aspect of it which was a consequence of French disappointment with the terms of the peace treaty. The postwar governments sought separate alliances to shore up the League's provisions for security. France made a military alliance with Belgium in Sept. 1920 and with Poland in Feb. 1921. In the course of the following years it was also to make alliances with the states of the little entente: with Czechoslovakia in 1924, with Rumania in 1926 and eventually with Yugoslavia in 1927. The Bolshevik Revolution in Russia had confronted the peacemakers with a new and mysterious terror; and the idea of a *cordon sanitaire* in the east, which should insulate Europe from Bolshevism, coincided with French desires to encircle Germany with a ring of friendly and allied states. It was felt that the new and the augmented states of central and eastern Europe, owing their frontiers to the postwar settlement, would inevitably be opposed to any revision of it and so would be reliable allies against a resurgent Germany. But these additional securities, it must be noted, were still in the nature of diplomatic rather than material guarantees and engaged France to extended commitments in eastern Europe.

The economic aftermath of war was, for France, even farther reaching. Its finances had been constantly neglected since 1914, and it had financed the war largely by borrowing at home and abroad. It had relied for revenue chiefly on indirect taxation. Income tax, in a complicated and inadequate form, had been introduced only in 1917. Excessive reliance on short-term loans and unbalanced budgets linked public confidence—and therefore the franc—with governmental prestige at home and national credit abroad. In 1918 the franc stood at half its prewar value. By 1920 real wages fell below the 1911 level, although by the next year they were in general higher. The peace therefore began with a return to the large-scale strikes which had marked the prewar years. In 1919 there were about 2,000 strikes involving many more than 1,000,000 workers. At the Socialist party congress at Tours in 1920 occurred the split between the adherents of the old second international and those of the new third international, centred upon Moscow. A new French Communist party was formed, and the same split occurred within organized labour, leading to the Communists' founding the Confédération Générale du Travail Unitaire (C.G.T.U.) in rivalry with the C.G.T.

The structure of French industry was greatly changed by the reorganizations and dislocations of wartime production. Heavy industries and mining developed faster than ever before, and postwar France was a much more highly industrialized nation than the France of 1914. A total of 100,000,000,000 fr. was spent on reconstruction of the devastated areas, and the recovery of Alsace and Lorraine augmented both the industrial resources and the industrial manpower of France. The size of units of production and the methods used were different. The silent French revolution of 1914–18 was the displacement of the prewar industrial worker, technically skilled, alertly intelligent and politically individualist, by the operatives of mass production, herded into the big towns and including in their ranks many foreign immigrants. The influx of foreign workers, welcomed because France's manpower was dwindling, went on until by 1931 there were more than 1,500,000 of them in France. Agriculture, prosperous outside the occupied areas in wartime, remained one of France's greatest sources of wealth. Protected fiscally from world depression and gradually adopting more scientific methods, it was still the greatest single industry. But the conflict of interests between farmers, who wanted high tariffs and high prices for food, and industrial wage earners, who—especially in times of inflation—wanted lower tariffs and lower prices for foodstuffs, was now more than ever acute.

Recovery and Crisis (1924–1936).—By 1924 the worst problems of the aftermath of war seemed to have been overcome. Most of the devastation had been made good, and newly equipped and modernized factories were producing more goods. The franc, still shaky because of the persistence of unbalanced budgets, had at least been stabilized for a time by Poincaré. The treaties of Locarno (1925) inaugurated the new phase of international conciliation identified with the reign of Briand at the Quai d'Orsay; and the Dawes plan for reparations payments restored allied unity on that issue. Germany became a member of the League in 1926. The Cartel des Gauches, led by Edouard Herriot, gained a large majority in the elections of 1924 and for the next two years Herriot, Paul Painlevé and Briand alternated in ruling France.

The major problem confronting these governments of the left was still the financial problem of inflation and the stability of the franc. The old anticlerical issue raised its head once more when secular education was introduced into Alsace and Lorraine, and the antimilitarist issue recurred in the form of left-wing hostility to military service and advocacy of disarmament. But the fiscal and financial problems were the most intractable. By 1926 the franc fell to 240 to the pound (as against 70 two years before), and the Radicals broke with their Socialist allies in the Cartel and rallied to Poincaré and the conservatives. The chamber granted Poincaré powers to deal with the crisis by decree laws—a power which it had denied both Briand and Caillaux six months before; and by the law of Aug. 10, 1926, the national assembly, convened at Versailles, modified the constitution to establish a sinking fund (caisse autonome . . . d'amortissement). Poincaré succeeded in checking the decline of the franc and restored confidence. By a policy of stringent economy and cheap money, combined with the sinking fund, he inaugurated another three years of relative calm and prosperity.

The Union Nationale of Radicals and Poincarists fell apart after the elections of 1928. Poincaré gave up the premiership in 1929 because of ill-health, and the stage was left free for a succession of younger but lesser men such as André Tardieu, Camille Chautemps and Pierre Laval: adept parliamentary politicians and party tacticians, but lacking the qualities of statesmanship needed in the gathering storm.

The difficulties confronting the nation called for supreme statesmanship. The world economic crisis broke in 1929. Its immediate effects on France, thanks mainly to its relatively well-balanced economy, were less catastrophic than in Germany, Great Britain or the United States. The nation depended less on foreign trade for its prosperity, and not until 1931 was it seriously affected. But in Germany the effects were startling and they nurtured the growing National Socialist party, which won more than 13,000,000 votes in the German presidential election of 1932. Laval, the French premier from Jan. 1931 to Feb. 1932 (and again from June 1935 to Jan. 1936), countered the economic crisis with a lavish use of decree laws at home and the international crisis by personal visits to Berlin, Washington, Rome, Warsaw and Moscow. He tried to win Italian support as a counterbalance to Hitlerite Germany and opposed League action against Italy when it attacked Abyssinia in violation of the covenant of the League.

It was a period of acute ministerial instability. Between the resignation of Poincaré in 1929 and the formation of the popular front government under Léon Blum in 1936, there were no fewer than 20 ministerial crises. No government could rely on a large majority, and neither the Union Nationale nor the Cartel des Gauches could re-form. It was the gloomiest phase in the history of the parliamentary republic and the period of most undistinguished leadership.

The Staoisky Affair.—In the midst of these difficulties the parliamentary regime was beset with a scandal reminiscent of the 19th century. In Jan. 1934, when the effects of the world crisis had at last begun to make themselves more acutely felt in France and unemployment figures were rising, the shady financier Serge Alexandre Stavisky, whom the police were pursuing, was found dying, It was widely believed that his alleged suicide had been "arranged" by the police, in conspiracy with the premier, Chautemps, and that the motive was to prevent revelations of corruption involving politicians, police, judiciary and eminent businessmen. The affair, coming at this moment of social discontent, evoked street demonstrations and riots and rumours of plots to overthrow the regime. Right-wing and paramilitary formations (Action Française, Jeunesses Patriotes, Croix de Feu), which had grown up in France, as in most other European countries after the war, staged protests: the left, led by the Communists, staged counterdemonstration~. Riots on Feb. 6, 1934, aroused echoes of earlier Paris revolutions, and within a week a general strike was proclaimed. Edouard Daladier, the alleged "strong man" of the Radicals who had become premier only a few days before, resigned. It looked as if the government was abdicating in the face of disorder, for it was the first time in the history of the republic that a ministry with support in the assembly had given way before extraparliamentary pressure. It was the lowest ebb of the third republic.

Gaston Doumergue was summoned, as veteran statesman, to form a new government of national union. It comprised all parties in the chamber save the Socialists and Communists. It restored confidence, quelled the disturbances and ruled by decrees. Again, the chamber saved itself by abdicating power, for the emergency, to the executive. But the armed right-wing leagues were not disbanded, and the deflationary policy of the government soon lost it the support of the Radicals.

The German Occupation of the *Rhineland.*—Meanwhile, the flimsy safeguards which France had won from the peace settlement disappeared one by one. The allied troops left the Rhineland in 1930 (five years before evacuation was due). A plebiscite held in Jan. 1935 in accordance with the treaty returned the Saar to Germany, whereupon Germany announced rearmament, in violation of it. Then. on June 18, 1935, came the Anglo-German naval agreement, which shook French confidence in Great Britain and strengthened Laval's argument that France must seek an understanding with Germany. When Hitler occupied the Rhineland on March 7, 1936, and denounced its demilitarization as well as the treaties of Locarno, France, which had no longer any reason to rely on the discredited League but had at this point both the means and the justification for independent action, did nothing against the aggressor. Thenceforward it was left facing a militant Germany, without faith in former allies (Belgium declared its neutrality in Oct. 1936, in departure from the alliance of 1920) and without any of the guarantees of security so laboriously sought since 1918.

The Popular Front (1936–38).—The elections of April–May 1936 were fought by the Radicals in collaboration with the Socialists and Communists within a new "popular front." The result was a decisive victory for the left, with antifascism replacing anticlericalism as the cement of this new version of the Cartel des Gauches. Although the Communists did not take part in the government formed by Léon Blum, the Socialist leader, the government was a much more broad-based left-wing coalition than any of its predecessors. Its program, moreover, on which it came into power, included a more comprehensive series of social and economic reforms than any previous one, and these reforms were supported by the Communists.

With 500,000 unemployed receiving relief and many others out of work, the economic crisis was at its most acute. Since 1919, despite two periods of left-wing rule, only two social measures of importance had been passed by the assembly. One, of 1928 and 1930, provided for a scheme of social insurance; another, of 1932, set up a system of family allowances. The popular front's program included schemes of public works, a national grain board, more extensive unemployment relief and old-age pensions, control of the Bank of France by the state, the nationalization of armaments industries and—most controversial of all—a reduction of the working week to 40 hours and a more steeply graded income tax. Faced from the outset with an epidemic of "stay-in" strikes, staged by the extreme left to "push the government," Blum managed to bring the C.G T. and the employers' representatives together in the Matignon agreement. This recognized collective bargaining contracts, an all-round wage increase ranging from 7% to 15% and the creation of workers' delegations to deal directly with factory managements. Léon Jouhaux, general secretary of the C.G.T., hailed it as "the greatest victory which the working class has won in its whole history." The agreement was confirmed by the Collective Bargaining act (June 1936). The 40-hour week and holidays with pay were also introduced by legislation. Within two years, the popular front government succeeded in implementing all major points in its electoral program. It was the most intense period of social reform in the history of the republic. None of its achievements, except the 40-hour week, was subsequently undone.

In June 1937 Blum gave way to a revised popular front government under Chautemps, a Radical, and the chamber gave him plenary powers to deal with the financial situation which had deteriorated under Blum. The gold stocks in the Bank of France had shrunk to a figure below the 50,000,000,000 fr. deemed essential for security. The franc was taken off the gold standard and was devalued. The rise in prices and wages, the expenditure on armaments, a decline in production and a deficit in the trade balance all conspired to create yet another financial crisis. At no period between the wars did France gain a position of financial stability.

During 1938 the popular front disintegrated. In January Chautemps remodelled his cabinet as a purely Radical ministry, but it was unsupported by the Socialists and Communists and lasted only two months. Its resignation coincided with the annexation of Austria by Hitler. Blum's attempt to establish another popular front ministry lasted less than a month. In April Daladier formed a new Radical ministry, which held power when World War II broke out in Sept. 1939.

The popular front experiment was not without its successes, nor was it overthrown. It was smothered by the looming clouds of war, and its greatest failures were in the field of foreign policy. Its policy of nonintervention during the Spanish Civil War, in which it was backed by Great Britain, and its failure to arrest the progress of Hitler's Germany toward the domination of Europe have been severely criticized. But it is arguable that after the German occupation of the Rhineland in March 1936 no decisive action to stop Hitler without war was practicable. Thereafter the helplessness of France in face of the relentless course of events and its inevitable drifting along in tow of Britain left it with little or no initiative.

The latter years of the republic were marked by open conflict between parliamentary forces on the one side and the forces of both fascism and communism on the other. The international tensions were reflected in its internal conflicts. Blum took vigorous action against the right-wing forces: in June 1936 he disbanded the Croix de Feu, Col. François de la Rocque's league (immediately revived as the Parti Social Français, it was again to be declared illegal in Dec. 1937); and in Nov. 1937 he exposed the monarchist conspiracy of the Cagoulards or Comité Secret d'Action Révolutionnaire (C.S.A.R.) under Eugène Deloncle, which aimed at overthrowing the republic by armed insurrection. Daladier took action against the Communists. defeating the attempt at a general strike in Nov. 1938 and arresting Communist leaders on the outbreak of war. But both fascism and communism were rooted in the recurrent economic crises and social distress of the period, and political action against them did nothing to destroy the roots from which they drew strength. One was to gain strength during the wartime governments at Vichy, the other was to revive with renewed power after the war.

WORLD WAR II

Though the length of compulsory military service and the strength of the professional army had been greatly increased in view of the growing international tension after 1934, France in 1938 found itself committed to a small professional army and static defenses—the Maginot line had been built along the Franco-German frontier—rather than to massive forces and mechanization. It maintained a strong fleet, but the air force in 1939 was pitifully small. Given the greater manpower resources of Germany, only complete solidarity with Great Britain could enable France to hold its own, even in defense. Daladier could do no other than follow the lead of Neville Chamberlain, the British premier, in making the Munich agreement which dismembered Czechoslovakia in 1938. In March 1939 he likewise followed suit in promising support to Poland if it should become the victim of aggression from Germany. In September, when Germany invaded Poland, the French declaration of war came about five hours after the British.

There followed, until May 1940, the phase known as "the phony war." At the outbreak of war France immediately mobilized all available manpower and manned the Maginot line. After Poland had been overrun by German and Russian forces and partitioned, France stood waiting for the attack. It did not come for eight months, and the strain of waiting was greater in France than in Great Britain. German propaganda seeped into many sections of French opinion, and boredom sapped morale. In May 1940 Paul Reynaud succeeded Daladier as prime minister; the German attack began on May 10, through the Netherlands, Belgium and Luxembourg. Five days later the Germans broke through the defenses of the Meuse and enveloped Sedan. Within two months this defeat led to the collapse of the French armies and to an Italian declaration of war on France. Deficient in armour and aircraft and ill-trained and ill-equipped for a war of fast movement and armoured weight, the French armies could not resist the German armoured divisions and air force. Great Britain could send only ten divisions and inadequate air cover. Reynaud's government fled to Bordeaux in confusion, and on June 16 Reynaud resigned and made way for

Marshal Pétain, who had throughout favoured coming to terms with Hitler before total collapse,

The Armistice (1940), Vichy and Resistance.—Pétain sought an armistice, and on June 22 it was signed in Marshal Foch's old railway carriage in the forest of Compiègne. Two days later a similar convention was signed with Italy. The French government was left in nominal control of the whole of France and its colonies except Alsace and Lorraine, which were annexed to Germany. But the Germans claimed the "rights of an occupying power" in all areas north and west of a line drawn across France from the Swiss frontier near Geneva through Bourges to a point east of Tours and then southward to the Spanish frontier at St. Jean-Pied-de-Port. The country thus fell into two zones, and the line of demarcation remained the limit of German military occupation until Nov. 1942. Paris and the main industrial areas of the north, as well as the channel and Atlantic coasts, were in German hands. The unoccupied zone was mainly agricultural but included the Mediterranean coast, which gave access to the North African colonies. Germany held about 2,500,000 French prisoners of war, required the French to pay the costs of occupation and allowed them a small army of 100,000 men and the whole of the powerful French fleet, though this was to be disarmed. The whole arrangement was designed to be a stopgap until Great Britain had been conquered.

Although France was taken out of the war by the armistice and was to be ruled for the next four years by the governments of Vichy under the name of Marshal Pétain, parts of the French nation continued the fight. Even before the armistice was signed Gen. Charles de Gaulle, who had recently been made undersecretary of state for war by Reynaud, escaped to London and founded the Free French movement. During the second half of 1940 the equatorial colonies of Chad and the Cameroun were led over to the Free French, and General de Gaulle found himself not only leader of a voluntary movement of Frenchmen to continue the war but responsible for administering a large colonial area. Inside France, by the end of 1940, various local movements of resistance had also formed, designed to frustrate the occupying forces. In course of time these movements not only grew and consolidated themselves but formed links with the external resistance of the Free French. When the battle of Britain had made it clear that calculations of British collapse were wrong and that the war in the west was by no means over, even some elements at Vichy found new possibilities for resisting the pressure of increasingly desperate German demands. Possession of the fleet and of the North African colonies and the right to administer the unoccupied zone without direct German interference gave Vichy certain foundations for independence. France therefore remained an important factor in World War II even after its military collapse.

Although not a member of the government when the armistice was signed, Pierre Laval joined it the following day and became the main architect of the Vichy regime. It was he who on July 10, 1940, persuaded the national assembly (summoned at Vichy to ratify the armistice) to grant Pétain authority to promulgate a new constitution (569 votes in favour, 80 against, 18 abstentions), so that Pétain was able, next day, to assume in his own name full legislative and executive powers in the "French state" (*état français*). The Vichy governments in fact survived for four years by never promulgating a new constitution. Their policy, and the elements moulding policy, changed in tune with the fortunes of the war. When the close collaboration adumbrated by the Montoire meetings of Pétain and Laval with Hitler and Ribbentrop in Oct. 1940 proved impracticable, a plot was formed at Vichy against Laval, who fell from power in Dec. 1940 and was succeeded as premier for a short time by Pierre Étienne Flandin and then by Adm. Jean Darlan. Backed by Charles Maurras's Action *française* (a paper that found in Vichy a chance to try out its traditionalist, semiroyalist doctrines inherited from the days when it had been founded to oppose the Dreyfusards), Pétain and Darlan embarked on a period of attentisme ("wait and see") in their dealings with Germany. Vichy became, at least superficially, a corporative state. The republican slogan of "Liberty, Equality, Fraternity" was replaced by "Work, Family, Fatherland." A labour charter was passed, and there was much talk of a Pétainist "national revolution." But in foreign relations Vichy looked to the United States for support and aimed at keeping Germany to the strict terms of the armistice.

In April 1942 Laval returned to power and contrived to convince the Germans that they could get more active collaboration from him. Germany was now engaged in massive war with Russia and with the United States and needed greater security in the west. But six months later the whole basis of Vichy's position was transformed. United States and British forces landed in North Africa, the main units of the French fleet were scuttled by their crews at Toulon, and Germany occupied the whole of France and disbanded the "armistice army" of Vichy.

Henceforth Vichy had no assets with which to bargain, except the cult of loyalty to Pétain (which still kept many Frenchmen, at home and overseas, obedient to the armistice) and the nimble wittedness of Laval. It became increasingly a tool of German policy and, by March 1944, included extreme collaborators such as the former Cagoulard Joseph Darnand and the National Socialist Marcel Déat. Admiral Darlan was assassinated in Dec. 1942 in Algiers, where he had aligned himself with the Allies.

Meanwhile the Free French movement had also been transformed in character. A French National committee, set up in 1941 under General de Gaulle, came to include spokesmen of various parties and resistance movements. In June 1943 it merged with the North African administration, under Gen. Henri Giraud, heir of Darlan, to form the French Committee of National Liberation. Its authority was enhanced by the creation of a provisional consultative assembly in Algiers, representing mainly the resistance movements of metropolitan France. After the Allied invasion of France on June 6, 1944, it moved to France and became the nucleus of a provisional government.

The internal resistance movements grew rapidly in strength and significance as large numbers of young men fled to the hills and open country to escape the German forced-labour laws. Living as outlaws in the *maquis* and aided by the country people and by supplies dropped by aircraft from Great Britain, they harassed German communications and transport in preparation for Anglo-American landings. The French forces of the interior were led by Gen. J. M. P. Koenig. The six months preceding D-day were a period of civil war in France, between the men of the maquis and the German gestapo aided by Vichy militias.

Thus the provisional government, based on resistance, took over from a regime in utter collapse immediately after a phase of acute civil strife. As operations against Germany continued for nine months after the liberation of Paris (Aug. 1944), it had to start rebuilding a regime in wartime conditions.

The Provisional Governments (1944–46).—In Sept. 1944 the provisional government was reorganized. It declared Pétain's "French state" abolished, together with all its laws, and announced that "legally the Republic has never ceased to exist." It won formal recognition by the Allies. The elections of Oct. 21, 1945, however, based on female as well as male suffrage, were not only to return new deputies to the assembly but also to decide whether the constitution of the third republic was to be maintained or not, and 95% of the electorate voted for the drafting of a new constitution. The constituent assembly contained three major parties almost equal in strength: the Communists, the Socialists and the Mouvement Républicain Populaire or Christian Democrats (M.R.P.). It had seven months of existence, in which to draft a new constitution and submit it to popular referendum. It proclaimed General de Gaulle head of the provisional government and entrusted him to form a ministry acceptable to the assembly. His ministry embarked on a program of immediate reforms which included the nationalization of credit, electricity and insurance and reform of the public services and civil service. But in Jan. 1946 he announced suddenly that he would resign. The Socialist Félix Gouin succeeded him.

Gouin's ministry was, in composition and policy, a continuation of General de Gaulle's. It was a coalition of the three largest parties. In May the draft constitution was rejected in the referendum, and a second constituent assembly was elected to try again. Georges Bidault now headed the ministry. In October the new draft was accepted by 9,120,576 votes against 7,980,333, but nearly one-third of the electorate abstained from voting. The new draft met with energetic criticism from General de Gaulle and his supporters and little enthusiasm from the country in general. It was accepted, like that of 1875, as the form of government that divided Frenchmen least.

THE FOURTH REPUBLIC

The electoral basis of the new regime was very different from that of the old. Women now had a vote. Proportional representation was adopted. The second chamber, now called the council of the republic, was granted very little power over legislation and was only a shadow of the old senate. But in all other major respects the constitution of 1946 was a continuation of the third republic. The centre of gravity of political power still lay in the lower chamber, now called the national assembly and elected for five years instead of four. Ministries were still perforce coalitions of parties and subject to the same bias toward instability.

The president of the republic, with the same tenure and functions as before, was still chosen by the chambers for his most unexceptionable qualities, and in Jan. 1947 the Socialist Vincent Auriol was elected the first president. The system of local administration through the *préfets* and of local elected assemblies remained substantially as before. (See *Government,* below.)

The most important differences arose not from the formal constitution itself but from the new balance of social classes and from the new alignment of political parties, which were more highly disciplined and organized than before. Postwar conditions in general favoured the agricultural interests as against the industrial workers. Inflation, shortages, a lag of wages behind prices and an endemic black market all tended to improve the standard of living of the countryman and depress that of the industrial wage earner and the salaried and professional classes.

Politically, the most important new factor was the power of the Communist party inside and outside parliament; a development closely connected with wage earners' plight in a period of rapid price rise and with the role of resistance movements in the period of liberation. From Nov. 1945, when De Gaulle first admitted Communists to the government, they had held for nearly two years some key posts in the national economy. This ministerial power was used to "colonize" large areas of industrial administration and management. At the same time, the party gained a strong grip on organized labour through the C.G.T. Throughout the first national assembly it was also the strongest single party, although after May 1947, when Paul Ramadier expelled the Communists from his cabinet, they were deprived of power. They relied increasingly on direct action to harass the government. and strikes were as much a feature of the early years of the fourth republic as they had been of the later years of the third.

In Dec. 1946 Léon Blum formed the only single-party ministry in modern French history. But his Socialist cabinet was designed as a caretaker one, pending the election of the president and completion of the new constitution; and lasted only six weeks. All subsequent ministries, until 1951, were variations on three-party coalitions of Socialists, Radicals and the Mouvement Républicain Populaire. with the addition of a few Independents and technicians

The M R.P. was mainly a creation of the resistance period and became the rallying ground for moderate opinion, including much Catholic opinion. In addition to Blum's ministry, there were ten such coalition cabinets during the life of the first national assembly (Nov. 1946–July 1951), an instability exactly comparable to that of the third republic, though with the same remarkable continuity and recurrence of personnel. The Socialist Jules Moch held an important post in every ministry, including Blum's, and in all ten cabinets foreign affairs remained with either Georges Bidault or Robert Schuman, both of the M.R.P.

These three-party coalitions came to be known as the "third force," because in April 1947 De Gaulle formed the Rassemblement du Peuple Français (R.P.F.), appealing to all forces of discontent with the existing system as well as to fear of communism. It made considerable gains in local elections and, in 1951, secured 120 seats in the new national assembly.

The "third force" governments had to meet a challenge both from the extreme left and from the extreme right but contrived, during 1947–49, to survive great strikes without help from the R.P.F. Meanwhile trade unionism was further split when the Force Ouvrikre, led by the veteran syndicalist Léon Jouhaux, left the Communist-controlled C.G.T.

The Monnet plan, designed to modernize and re-equip French industry within four years, made reasonably good progress. Production, both in industry and in agriculture, reached or surpassed the levels of 1939. Marshall aid from the United States assisted economic recovery. But financial instability, inflation and industrial unrest remained acute, and the war in Indochina, waged from the end of 1946. put constant strain on resources. The "third force" governments were too unstable and too much preoccupied to tackle these basic problems.

The general elections of June 2, 1951, opened a new phase in parliamentary politics, as the new national assembly was divided into six roughly equal groups. the Communists,; the Socialists; the M.R.P.; the Radicals and their allies; the Independent Republicans and their allies (the Conservative group); and the R.P.F. The Socialists passed into opposition, and the five ministries which held office between July 1951 and June 1954 moved steadily toward the right. In March 1952 a group of deputies of the R.P.F. seceded from the main body to support the conservative premiership of Antoine Pinay, and in May 1953 De Gaulle formally dissolved the movement as a parliamentary party, while preserving it as a movement outside parliament. This freed the Gaullist deputies to share in government and facilitated the drift toward the right.

When a new president of the republic had to be chosen by parliament at the end of 1953, the parties further discredited themselves by a prolonged deadlock; 13 ballots had to be taken before René Coty was elected on Dec. 23, by 477 votes to 329.

In June 1954 general exasperation gave a unique opportunity to Pierre Mendks-France, who was elected prime minister by the unusual majority of 419 in an assembly of 627. Choosing a ministry drawn mainly from new men of the right-centre and the right, he offered France a "new deal" and undertook to end the war in Indochina within a month before proceeding to tackle the problems of the European Defense Community and economic reforms. His prestige soared when he succeeded in ending the war and in substituting for the E.D.C. treaty, which parliament rejected, the wider project of western European union involving British military commitment in Europe.

Mendks-France was defeated over his North African policy in Feb. 1955, but was succeeded by his former minister of finance, Edgar Faure. Faure successfully concluded, on April 22, the Franco-Tunisian negotiations, but Algeria and Morocco were causing grave concern. In Morocco Mohammed V ben Yussef was restored and on Nov. 6 France proclaimed its resolve "to raise Morocco to the status of an independent state," united with France by the "permanent links of interdependence."

Elections held on a snap dissolution on Jan. 2, 1956, produced an even less coherent assembly and a series of left-centre governments whose failures to end the war in Algeria brought about the death of the fourth republic. Military operations against the nationalist rebels, which had continued since Nov. 1954, engaged nearly 500,000 French troops and induced unrest in the army. On May 13, 1958, when Pierre Pflimlin succeeded, after a prolonged political deadlock, in forming a new ministry, he was confronted with an ultimatum from the French generals in Algeria and the committees of public safety formed by the exasperated French *colons.* They demanded a new government headed by General de Gaulle, and were backed in this demand by the more extremist right-wing parties in France.

THE FIFTH REPUBLIC

Pflimlin, though invested with wide emergency powers, warned the national assembly that France was "threatened with civil war" and resigned. On June 1, 1958. General de Gaulle was installed in office with emergency powers for six months and authority to reform the constitution. On Sept. 28 his draft constitution was accepted by a huge majority in a popular referendum. Out of an electorate of 26,603,464, a total of 22,596,850 (84.9%) went to the polls and there were 17,668,790 "yes" votes (64.4% of the electorate, 79.2% of valid votes). The new constitution provided for a smaller and weaker national assembly, and gave wider powers to the president of the republic and to the government. It also gave overseas territories an opportunity to sever their links with France or to enter into a new Community, described as federal in character. In the referendum only French Guinea chose to sever all connections; elsewhere votes were overwhelmingly in favour of the new Community. In Algeria, where the army remained in power, 79.6% of the electorate went to the polls and 96.5% of valid votes went in favour of continued links with France.

On Nov. 23 and 30, 1958, elections were held for the new national assembly. The electoral system had been changed from proportional representation to a majority system of single-seat constituencies and two ballots. In the first ballot an absolute majority was necessary to be elected; in the second a relative majority was sufficient. The result was that in metropolitan France the Union pour la Nouvelle République (U.N.R.), a new party of the right, obtained 188 seats out of a total of 465. The Conservatives obtained 132 seats, the M.R.P. (split in two groups) won 57, the Radicals (split in four groups) won 35, the Socialists obtained 40 and the Communists only 10. De Gaulle was elected president for seven years on Dec. 21 and took office on Jan. 8, 1959. The municipal elections in March showed a swing in French opinion against the government, but despite such minor setbacks De Gaulle's program continued to make gains during 1959 and the early part of 1960. When Europeans in Algeria revolted in Jan. 1960 over De Gaulle's insistence on self-determination for the Algerians, the insurrection was subdued without bloodshed. Following this, on Feb. 13, France successfully tested its first atomic device in the Sahara desert. In May, Paris was the setting for a conference of the heads of state of France, Great Britain, the U.S. and the U.S.S.R. This "summit" conference never officially commenced because Soviet Premier Nikita S. Khrushchev refused to confer with Pres. Dwight D. Eisenhower when Eisenhower rejected his demands that the U.S. apologize for its high-altitude reconnaissance flights over the U.S.S.R. (D. Tn.; X.)

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POPULATION

The population of France on Jan. 1, 1955, was estimated at 43,300,000. This figure represented an increase of 2,797,000 over that given by the census of 1946 and of 1,393,000 over that of 1936. The increase following World War II had more than made up for the losses sustained through causes peculiar to the war years and the yearly increment contrasted with the regular decrease of the immediate prewar period.

A principal cause for such increase in population was the financial assistance given by the state to encourage larger families, in the form of family bonuses, allowances and facilities for medical treatment.

The progress in Frsnce's population from the beginning of the 19th century is shown in Table II.

TABLE *11.—Population of France (with Corsica)*

Year	Area in sq. mi.	Population	Year	Area in sq. mi.	Population
1801	207,765	27,349,000	1896	207,135	38,517,000
1821	207,591*	30,461,000	1911	—	39,605,000
1841	—	34,230,000	1921	212,736§	39,209,518
1861	212,736†	37,386,000	1936	—	41,907,056
1866	—	38,067,000	1946	—	40,502,513
1876	207,135‡	36,906,000	1954	212,821‖	42,777,174¶

*After territorial losses under the treaties of Paris (1814). †After the cession of Savoy and Nice by the kingdom of Sardinia (treaty of Turin, 1860). ‡After the loss of Alsace-Lorraine to Germany (treaty of Frankfurt, 1871). §After the recovery of Alsace-Lorraine (treaty of Versailles, 1919). ‖After territorial gains on the Italian frontier (treaty of Paris, 1947) and border rectification on the Franco-Spanish frontier in 1949. ¶Excluding 187,000 military personnel and civilians temporarily abroad and 38,000 persons who were absent from their homes when the takers of the census called.

The totals of Table II are those of the habitually resident or de *jure* population. There were 2,454,000 resident foreigners in 1936, but their numbers fell to 1,671,000 in 1946 and to 1,451,752 in 1954, the reduction being explained mainly by naturalization.

In comparison with that of other countries, France's population was slow in growing. From 1800 to 1850 the country was, after Russia, the most populated in Europe. Thereafter the rate of increase slowed down considerably and was handicapped by the defeat of 1870, with the loss of Alsace-Lorraine, and by World War I (in which losses were equivalent to 1 in 31 or 10.5% of the young and middle-aged male groups).

Deaths exceeded births fairly frequently; even during years of peace (*e.g.*, between 1920 and 1938) this occurred during five years. An increase in population was, however, considerably assisted by immigration. It has been calculated that between 1850 and 1930 net immigration contributed 3,500,000 new inhabitants, as compared with a natural increase of 2,000,000. Between 1946 and 1951, however, these figures were reversed, and a gain of around 2,000,000 comprised 1,600,000 excess births over deaths and 400,000 immigrants.

Details (rounded to the nearest thousand) are shown in Table III.

TABLE *111.—Demographic Studies*

Year	Marriages	Divorces	Live births	Deaths	Excess or deficit of births
1913	312,000	15,000	790,000	731,000	+59,000
1922	383,000	33,000	760,000	689,000	+71,000
1938	274,000	23,000	612,000	647,000	−35,000
1942	256,000	14,000	542,000	632,000	−90,000
1947	423,000	57,000	863,000	533,000	+330,000
1953	306,000	30,000	797,000	550,000	+247,000

Despite this substantial increase of births over deaths, France remained a country whose population was aging. Already in 1936 it was the "oldest" country in the world, and this situation was accentuated in later years. The proportion of adults, despite the war losses, remained high. From 55.2% in 1936 it stabilized itself in postwar years around 54.5%. Age structure in detail at the beginning of 1949 (figures for 1936 in parentheses) was: 0–4 years, 8.5% (8.0%); 5–14 years, 13.1% (16.8%); 15–19 Years, 7.7% (5.5%); 20–29 years, 15.7% (15.3%); 30–39 years, 12.2% (15.8%); 40–49 years, 14.9% (12.6%); 50–59 years, 11.7% (11.5%); 60 and more years 16.2% (14.5%). Infant mortality in 1954 amounted to 37 in every 1,000.

TABLE IV.—*Active Population by Occupations*

(in 000s)

Item	1906	1921	1931	1946	1951	1954
Agriculture, etc.	8,855	9,023	7,718	7,484	6,741	5,138*
Industry (incl. transport)	7,400	8,036	8,459	7,162	8,459	6,450†
Commerce (retail)	2,100	2,350	2,778	2,416	2,735	2,300
Others.	2,366	2,311	2,657	3,458	3,265	—
Total employed	20,721	21,720	21,612	20,520	21,200	19,017
Registered unemployed	—	—	45‡	57	120	183

*Excluding dependents of self-employed. †Excluding office workers. $469,963 in 1936

Density. — Despite France's increase in population, the density of population was a low one when compared with some of the neighbouring countries. It reached 197 per square mile in 1936 and 201 in 1954.

As in most countries there was a gradual drift, after the middle of the 19th century, from rural areas (particularly mountainous regions such as Savoy and the Massif Central) to urban. In 1954 23,939,131 persons were urban dwellers as against 18,835,314 rural or 56% against 44% (cf. 80% against 20% in Great Britain). Approximately 50% of the inhabitants lived (1954) in small parishes of less than 2,000. Of the 38,000 odd communes, 31,407 had less than 500 inhabitants and 37,024 less than 2,000.

The greatest density of population was found (1) in the centre of the Paris basin, where the capital, its suburbs, outer suburbs and numerous satellite towns form the *départements* of the Seine and of Seine-et-Oise; and (2) in the industrial region of the *départements* of the Nord and the Pas-de-Calais which are studded with numerous and often adjacent towns.

Towns.—In 1886 there were only 10 towns with a population of 100,000 inhabitants or more (Paris, Lyons, Marseilles, Bordeaux, Lille, Toulouse, Nantes. Le Havre, St. Étienne and Rouen). The number of such towns had risen to 18 in 1936 and to 24 in 1954.

Racial Types.—The population of France is broadly composed of three principal types. First, there are the descendants of Mediterranean peoples who moved, c. 3000 B.C., into the south of the country and penetrated inland chiefly by way of the Rhône valley. They are chiefly found now along the Riviera and along the Rhône.

A second element is the Alpine or Celtic type (in many areas now intermingled with the Mediterranean and also with the Nordic), which came from the east by the Alpine valleys during the Neolithic and Bronze ages; its representatives now form the basic element of central and southwestern France and also of Brittany, into which Celts from Britain immigrated under pressure from the Anglo-Saxon invaders.

The Nordic type (at first chiefly represented by the Belgae) flowed into the northeast of the country in the centuries immediately before the Christian era but was reinforced early in the Christian era by the Saxons, the Visigoths and, particularly, the Salian Franks, who pushed into the far south and eventually became masters of the whole country; a final Nordic element arrived with the Norsemen, who carved out for themselves the duchy of Normandy in the 10th century.

Apart from these three types are the Basques of the western Pyrenees (about 700,000), who have succeeded in preserving to a large extent the racial entity.

Languages.—Following the subjugation of Gaul by Julius Caesar, the spoken Latin of the Roman conquerors gradually spread through the country and, by the 4th century A.D., had replaced the Celtic language. Later, barbarian invasions weakened the link between Gaul and Italy, so that the spoken Latin of Gaul developed certain peculiarities; moreover, local variations began to arise within the country itself.

Two main divisions (within which were numerous dialects) of the spoken language became the *langue d'oïl* of the north and the langue d'oc (see PROVENÇAL LANGUAGE) of the south. In the north the dialect of Paris and its district began inevitably, in the 10th century, to acquire a supremacy as both the written and the spoken vernacular.

Dialect differences were eliminated from the written language in the 17th century, under the influence of the educated classes, grammarians and authors. But uniformity or knowledge of standard French still remained generally unknown in some areas, particularly in country districts and in the south especially, even toward the end of the 18th century. Centralization of government during later years and other modern factors reduced the importance of dialects and spread a knowledge of the standard tongue. (See FRENCH LANGUAGE.)

Within France, however, there still remained in the middle of the 20th century a considerable number of nationals whose mother tongue was not French. Thus, in Corsica. the natives spoke Italian dialects; along the southern France-Italian border was an Italian-speaking area; Provençal was still heard in Provence; in Roussillon the Catalan language was still in use; in Gascony the Basque language held on with tenacity; in the western half of Brittany, Breton was still widely spoken; along the Franco-Belgian frontier Flemish still survived; and finally in Alsace and the Moselle *département* of Lorraine dialects of German were spoken as well as varieties of French patois.

RELIGION

Roman Catholicism.—France is the "eldest daughter of the church." There are 17 archbishoprics in metropolitan France; viz., Aix, Albi, Auch, Avignon, Besançon, Bordeaux, Bourges, Cambrai, Chambéry, Lyons, Paris, Reims, Rennes, Rouen, Sens, Toulouse and Tours. In addition to 68 suffragan bishoprics there are two bishoprics depending immediately on the Holy See; viz., Metz and Strasbourg. The archbishop of Lyons is styled primate of the Gauls. The number of clergy is around 51,000.

The association of the Roman Catholic Church with the French monarchy dates traditionally from the baptism (496) of **Clovis,** king of the Franks.

In succeeding centuries the church acquired extensive estates and great wealth and gained an exclusive hold on education. With the development of a stronger monarchy, relations between the French clergy and the papacy became at times difficult. The monarchy, often backed by the episcopate, claimed a certain independence of Rome in the matter of ecclesiastical jurisdiction. This tendency, known as Gallicanism (*q.v.*), reached a climax in 1764, when the Jesuits were expelled from the country. The Jesuits. however, had meanwhile triumphed over Jansenism (*q.v.*); but it was the bull Unigenitus (1713), which had originally served both their purposes and those of the Gallican and centralizing Louis XIV, that eventually provoked the reaction against their ultramontane spirit.

During the Revolution religious orders were suppressed and the property of the church confiscated. Some attempt was made to get the clergy to support a national established church. By the constitution of the year III, however, church and state were declared separate. In 1801, during the consulate, Napoleon negotiated a concordat, whereby the church surrendered its claim to former property and the state undertook to subsidize the clergy. This concordat lasted (except for one short suspension) until 1905.

With the Bourbon restoration in 1814, a closer collaboration was initiated between papacy and state, and this continued on Napoleon III's accession to power. Within the church itself, however, developed a more liberal Catholicism which encountered opposition from the pope and from French authoritarians.

In the first years of the third republic, the government rejected the policy of co-operation for one of secularization and neutrality. One important source of disagreement was education, in which, by the *loi Falloux* of 1850, the church had been given certain privileges. From 1880, measures were taken to restrict the church's influence in education and to limit religious orders, which were debarred, in 1886, from teaching in state schools. In 1901 religious congregations were forbidden unless authorized, and any member of an unauthorized congregation was banned from teaching. This ban, which was really aimed at the Catholic Church, was in 1904 extended by Émile Combes to any member of a religious congregation.

Such action led to an open breach with the papacy, and in 1905 the Act of Separation, while guaranteeing liberty of conscience and public worship, withdrew state recognition and subsidizing of religion. Property of the religious bodies was transferred to associations for public worship (associations *cultuelles*), which had to be self-supporting.

Such a step considerably reduced the standard of living for many clergy, but tended to throw them into a closer contact with the working classes. The return of Alsace-Lorraine added more Catholics (who had been unaffected by the anticlericalism of the third republic) and partly prompted the government to resume diplomatic relations with the Vatican. In the following years there was a gradual return of religious orders to the country. A Catholic political group of the left gained parliamentary representation.

The Vichy regime showed pro-Catholic tendencies. Pétain repealed the prewar disabilities. Clergy and religious orders took up teaching posts and religious schools were subsidized. Such a policy inspired the leaders of the church to support, at least initially, the new regime. But the less important clergy sided on the whole with the resistance.

On the liberation, the Vichy religious laws were abrogated. In the more Catholic areas (Brittany, La Vendée, Ille-et-Vilaine, Maine-et-Loire) this provoked serious unrest. The church, however, adopted a cautious attitude to politics. The rank and file and more liberal-minded of the upper hierarchy tended to favour the Mouvement Républicain Populaire (Christian Democrats); the church as a whole was resolutely opposed to Communists.

Catholics were easily the largest religious element of the country, but a clear distinction existed between practising and non-practising. About 80% of the population were baptized, married and buried by the church. The practising element amounted to around 25%. As a whole the masculine element of the petite *bourgeoisie* was indifferent or anticlerical.

Catholicism flourishes particularly in Normandy, Brittany, the central eastern *départements* and in those of the Pyrenees. It is least strong in the industrial areas.

Protestantism. — Luther, Calvin (himself a native of Picardy) and other reformers of the 16th century quickly gained adherents in France. In 1535 the extermination of "heretics" was ordered, and a long period of emigration began. Between 1563 and 1570 intermittent civil war broke out between the Catholics and the Reformers (Huguenots). By the treaty of St. Germain in this latter year, the Huguenots obtained liberty of conscience and worship with four fortified towns, La Rochelle, La Charité, Cognac and Montauban, as pledges.

In 1572 the massacre of Huguenots in Paris on St. Bartholomew's day initiated a widespread slaughter; by their desperate resistance the Huguenots gained in 1573 an amnesty and the promise of liberty of worship in a few towns. But hostilities again broke out and continued intermittently until Henry IV by the Edict of Nantes granted the Huguenots liberty of conscience and of worship and full civil rights, together with the possession of numerous fortified towns as a guarantee. *(See* above, *History.)*

On the murder of Henry IV in 1610 persecution was renewed, and during the next 20 years the Huguenot strongholds were gradually reduced and revolts crushed. But they were allowed liberty of worship. Under the centralizing policy of Louis XIV steps were taken to close Huguenot churches and schools, and in 1685 came the revocation of the Edict of Nantes. The result was a gradual and considerable emigration (estimated around 400,000) until 1801, when Napoleon restored to the Huguenots full political, civil and legal rights. In the first years of the 19th century they numbered around 700,000, of whom the majority were Calvinists.

During the 19th century the Reformed Church grew considerably, but various schisms took place. The total number of Protestants in the middle of the 20th century was around 1,000,000 (roughly 600,000 Calvinists, 350,000 Lutherans and small minorities of Baptists). In 1905 most groups of French Protestants were united into a single amalgamation, the Protestant Federation of France. Its chief elements were: the Evangelical Reformed Churches and the Reformed Churches (comprising most of the French Calvinists) ; the Evangelical Lutheran Churches; the Free Evangelical Churches; the Evangelical Methodist Churches; the Federation of Evangelical Baptist Churches; and two Alsace-Lorraine bodies, the Reformed Churches of Alsace-Lorraine and the Church of the Augsburg Confession (Lutheran). Various other independent churches and missionary organizations also were established.

Protestantism flourishes particularly in Alsace-Lorraine (around 300,000). Protestants in France belong for the most part to the middle classes and by reason of their affluence and probity played a role out of proportion to their numbers under the third republic, to whose institutions they gave strong support.

Judaism. — France granted Jews full equality by a succession of measures passed during the French Revolution. At first their assimilation was helped by this policy and by their relatively small numbers. Under Napoleon Jews were given a special consistorial system, which lasted until the Act of Separation in 1905. By 1910 there were about 95,000 Jews in France. Their number was considerably increased in the 1930s by refugees from Germany and eastern Europe and was about 250,000 in 1939 and 400,000 in 1940. During the German occupation of France they were treated at first with some moderation by the government, but by the middle of 1941 persecution had set in. They regained all their rights on the liberation and rapidly reassumed their prominence in certain commercial and industrial spheres and to a lesser extent in professional and intellectual circles.

EDUCATION

Before the French Revolution religious bodies and establishments, of whom by far the greater proportion were Catholic. controlled education. The Revolution, antagonistic to the church, broke its monopoly and established freedom of education. Napoleon in his turn made education a national public service with a highly centralized system. The Imperial university, constituted in 1808, trained all teachers and prescribed the nature of instruction in secondary and higher education. The concordat of 1801, however, enabled the church to teach under the inspection of the university; and primary education also remained free of the direct control of the state.

Under the succeeding regimes the church gradually secured its freedom in education from this control established by Napoleon. Thus in 1833, when primary schools were being brought under the authority of the state, private primary schools were allowed provided that their teachers had obtained the qualifying certificate. In 1850 the *loi Falloux* extended this freedom to secondary education, and membership of an authorized cult was considered sufficient qualification to teach. By 1875, when permission to establish Catholic universities was granted, freedom to instruct in all branches of education had been won.

Victor Duruy. who was minister of education from 1863 to 1869, wanted to make education free of charge and obligatory. He succeeded at least in widening the curriculum and in increasing the number of schools for girls.

With the increasing radicalism of the third republic the struggle between state and church was resumed. Royalists aligned themselves with clericals, and the church came to be regarded as a bulwark of monarchist tradition in France. To curtail its influence the government abandoned Napoleon's policy of co-operation and adopted one of secularization. Between 1880 and 1906 religious instruction was abolished in all types of state institutions. In 1904 members of religious congregations were forbidden to teach in any school, public or private.

Nevertheless religious schools continued to survive, especially in the more Catholic areas. In 1934 roughly 80% of pupils receiving primary education attended state schools, though only 58% receiving secondary education went to them. But from the end of 1934, when secondary education was made free of charge, Catholic institutions, which relied chiefly on pupils' fees, began to lose much of their attendance to the state secondary schools.

Under Vichy there was a reorganization of the educational system. The law forbidding clergy to teach was repealed. Voluntary schools were allotted a share of the funds hitherto confined to state schools, and their pupils became eligible for scholarships to higher education. After World War II, the main features of the prewar system were restored, but reforms were progressively introduced.

The educational system was highly centralized. Primary, secondary and university education were administered by the ministry of national education; technical education (together with youth and sports) by another department. The country (with Corsica and Algeria) was divided into 17 *circonscriptions acadkmiques;* viz., Paris, Caen, Lille, Nancy, Strasbourg, Besançon, Dijon. Lyons, Clermont-Ferrand, Grenoble, Aix, Algiers, Montpellier, Toulouse, Bordeaux, Poitiers and Rennes. Each *acade'mie* was administered by a rector appointed by the ministry and advised by a local council. The rector had control over all types of instruction, though for primary schooling the *préfet* of the *département* was responsible for certain routine matters. Under the rector were a varying number of inspectors, one of whom was usually in charge of a particular area *(dkpartement* and *arrondissement)* within the territory of the *acade'mie.* A further category of inspectors was responsible and reported to the ministry. Within each *dkpartement* there was also a council, headed by the *préfet* and composed of officials and teachers, which formed a general consultative and advisory body.

Schools were divided into three broad types: *premier degrd* comprising *écoles maternelles et enfantines* (nurseries and kindergartens) ; elementary schools and complementary classes ; *deuxibme degré* or secondary, with primary and advanced stages; and "apprentice centres" for technical training, technical colleges, professional schools, etc. Higher education was chiefly supplied by the 17 state-controlled universities, the seats of which coincided with the centres of the 17 academic circumscriptions. Competition for university places was keen. and even success at the *baccalauréat* (matriculation), taken usually in two parts in successive years as the culmination of secondary training, did not ensure entrance. The state universities were supplemented by a number of institutions for advanced study such as the Collège de France, by the *écoles normales* (for training teachers) and by numerous technical colleges specializing in agriculture, the sciences, engineering, etc. In addition there were a few free (Catholic) institutes devoted principally but not exclusively to theology, law and the humanities. Financial support of education was increasingly taken over by the state, and the contributions of the communes were largely devoted to maintenance of buildings. The question of state subsidies to Catholic schools still remained a considerable issue, the chief dpponents of such grants being the Radicals, the Socialists and the Communists.

Little local control or individual freedom was left in the matter of syllabus or teaching methods, which were almost entirely laid down by the ministry with a view to passing the examinations required by the state. The result was that French education tended to become inflexible and academic: but there came to be an increasing demand for a wider curriculum and more varied methods of teaching. Technical instruction, in which France was seriously deficient, was also more widely introduced. French parents and employers remained inclined, however. to look upon education as the academic means of supplying a pupil with a *brevet* or *certificat* at the age of 14 and with the *baccalaure'at* at 17.

In 1954–55 the numbers attending the various educational establishments amounted to about 8,000,000 (approximately 20% of the population). State nurseries and kindergartens looked after 1,056,000 infants, "private" (*i.e.,* religious) ones after 215,000; elementary schools and complementary courses were attended by 4,184,000 state and 795,000 private pupils, secondary (*deuxième degré*) schools by 530,500 state and 430,000 private and technical by 537,000 state and 150,000 private. There were 6,307,500 state and 1,590,000 private establishments. The attendance at universities (with Paris predominating) was approaching 150,000. Until 1950 the only subsidized confessional (Catholic) schools were in Alsace, where the interests of the church were still safeguarded by the concordat. In 1950, however, legislation was passed giving a certain measure of financial aid to confessional schools in other parts of the country.

LABOUR AND SOCIAL LEGISLATION

Trade Unionism. — The *loi Le Chapelier* of 1791, which forbade the combination of workers in pursuit of their common interests was abrogated in 1884, when the *loi Waldeck-Rousseau* legalized, with certain restrictions. the formation of trade unions Before this, labour organizations had existed more or less as secret associations. The early years of trade-union development were characterized by a syndicalism often of a revolutionary nature. The unions were in opposition to the government and to the employer, a policy inherited from their struggles against repression, which had been particularly severe after the failure of the Paris commune in 1871. The Association Internationale des Travailleurs. created in 1864 (before legalization), numbered about 300,000 members by 1870. Despite repressive measures, there were about 135 *chambres syndicales* in France by 1876, when the first workers' congress was held in Paris. Following the passage of the *loi Waldeck-Rousseau* two workers' associations were set up, the Fédération Nationale des Syndicats (heir to the former Association Internationale des Travailleurs) and the Fédération des Bourses du Travail. In 189j the Confédération Générale du Travail (C.G.T.) was formed from an amalgamation of these two bodies, though it was not until 1902 that a centralized constitution was created. In these early years two schools of opinion fought for control. The syndicalists rejected the idea that norking-class aims could be attained by the parliamentary process of persuasion and held that strike action and violence were indispensable to bring about the social revolution. The reformists on the other hand maintained that labour reforms should be by constitutional action. Some desired collaboration with the Socialist party in the chamber of deputies; others sought to repudiate any political connections and to concentrate solely on economic demands.

In 1906, at the congress of Amiens, the revolutionaries gained the day by forcing through a resolution, known as the charter of Amiens, which rejected dependence on any political party or doctrine and endorsed the opinion that the best results for the working classes could only be obtained by direct action, by means of the general strike. About the same lime the C.G.T. as a body began in addition to assume a pacifist and international character.

From 1914 the unions tended to accept the supremacy of the constitutional authority and to demand legislation for a better standard of living and of working conditions. though there were occasions when a minority rejected this policy. It was the outbreak of World War I, the "ordained opportunity" for revolutionary action, that had the effect of depriving the revolutionaries of the control of labour. Under the influence of Léon Jouhaux and the reformists. who had suffered defeat in 1906, the C.G.T. decided to co-operate with the government. With the advent of the Russian Revolution, however, there emerged an important minority both in the C.G.T. and in the Socialist party (with which that body had now allied itself) which adopted an antiwar policy and desired affiliation with the Moscow Trades Union International (the Profintern). The collaboration of the C.G.T. with the government was. however, confirmed in 1918 by the formulation of the C.G.T. "minimum program." This statement repudiated revolutionary tactics, renounced the use of the general strike and supported the League of Nations; in return it demanded more comprehensive rights for trade unions than those granted by the *loi Waldeck-Rousseau,* the acceptance of collective contracts and the constitution of a national economic council and regional councils on which there should be trade-union representation; and it further urged that monopolies should be taken over by public state boards or co-operatives representing the producer and the consumer and that individual enterprise should be regulated, as regards conditions of work and profits, by the state. As the government made no immediate response. the C.G.T. created in 1919 its onn national economic council, comprising representatives of the co-operative societies and the civil servants' association. as well as the unions. In 1925 the Herriot government officially adopted the idea of a national economic council, adding representatives of the employers to the existing unofficial one.

The elements sympathetic to communism remained strong, however. and their tactics led in 1921 to the exclusion by the C.G.T. of all affiliated organizations which were under revolutionary influence. The latter thereupon formed themselves into a new confederation, the Confédération Générale du Travail Unitaire (C.G.T.U.), which was affiliated to the Soviet-sponsored Profintern. Before this split the C.G.T. had attained a peak figure of about 2,500,000 members; but this was reduced to 1,500,000 during the year 1920 by the economic difficulties and resulting ineffective strikes, which disappointed the hopes of the workers. Until 1936 (in which year the C.G.T. and the C.G.T.U. fused) the membership of both confederations fluctuated but on the whole increased, that of the C.G.T. being usually twice to three times as strong as that of the C.G.T.U.

The first strongholds of trade unions were in the Nord and Pas-de-Calais *départements* and in and around the large towns. Recruitment was, however, hampered by the hostility of the big industrial concerns. which often introduced a rival paternalism in the shape of various benefits for their workers; and secondly by the spirit of individualism prevalent in the widespread small-scale industry of France, which made the organization of its employees very difficult. The C.G.T. drew its principal strength from government employees (civil servants, post-office officials, railwaymen, school teachers: local-government officials and workers in government establishments such as arsenals: dockyards, etc.), from the miners and from the employees of public utility industries. The C.G.T.U. members were mostly railwaymen, builders and metalworkers, particularly from the Paris and northern areas. As well as these two bodies. there existed the Confédération Française des Travailleurs Chrétiens (C.F.T.C.), founded in 1919 and based upon Catholic social and anti-Marxist principles. By 1936 this body claimed about 500,000 members, principally drawn from the black-coated workers and women employees in business or factories. Though the C.F.T.C. rejected the theory of class warfare, it nevertheless collaborated occasionally in strikes with the C.G.T. A fourth confederation, which began a brief life in 1936, was the Confédération des Syndicats Professionels Français (C.S.P.F.), inspired by the semifascist social doctrines of La Rocque. After the occupation of France the C.S.P.F. gave its support to Pétain.

The C.G.T. itself, despite the losses in membership after World War I, continued to exercise considerable influence among the workers. The spirit of "reformism" prompted it to seek reforms through parliamentary pressure, and it became increasingly the ally of the Socialist party. In industrial disputes the local unions tended to use the good offices of the ministry of labour, of the *préfets* and of other public bodies. The old institution of the conseils de *prud'hommes,* composed of elected representatives of employers and workers, was used also for the settlement of local disputes between employers and individual workers; and there was increasingly frequent resort to the expedient of mixed committees of workers and employers for the consideration of many other labour questions. In 1934, amplifying its "minimum program" of 1918, the C.G.T. called for the nationalization of credit and banking and of the key industries. It demanded also the 40-hour week, collective contracts and other concessions to labour. Many points of this program were incorporated in the platform of the Rassemblement Populaire of 1935, a coalition of left political parties which led to the formation of the popular front government in 1936. In 1936 also, after the alliance of the Socialist and Communist parties, the C.G.T. and the dissident C.G.T.U. were amalgamated. The new union, which was to last until 1939, had about 5,000,000 members: and, through co-operation with the popular front administration, gained many concessions for labour (*e.g.,* wage Increases, paid holidays, the right of creating the offices of shop stewards, the principle of collective bargaining and compulsory arbitration on labour disputes). On the outbreak of World War II in Sept. 1939, Communists within the C.G.T. came under attack hoth from the government and from the non-Communist majority of the federal bureau of the confederation; and within the month those who approved the action of the U.S.S.R. in invading Poland were expelled from the various unions. The Communist party itself, outlaued by the decree of Sept. 26, 1939, sought to continue its activity under the legal cover of the unions and to regain its hold upon them by the infiltration of its militants into the membership and by the clandestine proselytism of the unions' rank and file.

The German occupation of northern France and control of the Vichy government resulted in the dissolution of the central confederations, both of labour and employers. The individual federations and departmental unions themselves, however. were finally allowed to continue. The ranks of the C.G.T. were now split into three groups: a very small proportion became wholehearted collaborationists, embracing the social principles of National Socialism; the Belin group (around the Vichy minister of labour René Belin), though accepting the new regime, advocated the independence of trade unions from political activity and adhered to the labour policies of the former popular front; and finally a third group. led by Léon Jouhaux, organized some kind of underground resistance. Meanwhile, the Communist element was able to snipe effectively at the officially sanctioned federations and at the *Charte* du *Travail* permitted them by their German overlords. All the arguments of traditional syndicalism were employed against this Vichy Charte. When the Germans attacked the U.S.S.R., Communist policy was appropriately changed. Before that event it had consisted solely of conquering the syndicates in order to ensure a liaison with the labour masses, which meant opposition to all the former leaders of the C.G.T. who had demanded the expulsion of the Communists in Sept. 1939; now the indiscriminate attack against all reformist elements was abandoned, and the creation of a front unique, excluding only those acquiescent to the existing regime, mas preached on the basis of the Charte *d'Unité,* adopted at the Toulouse conference. But a syndical medium was required to mask the true political orientation of the campaign (in which the party acted, indeed, as a secret French government allied to the U.S.S.R.), so as not to alienate workers distrustful of Communist doctrines. Hence the creation of *comités populaires,* which were in effect local Communist cells but could appeal to the worker with an authority wider than the sectarian political one.

Meanwhile the strength of the resisting reformist elements of the unions was growing, and in the south there was created the Mouvement Ouvrier Français, an alliance of the C.G.T. and the C.F.T.C., which began to work in close collaboration, with the Gaullist resistance movement. Its activities were, however, far more cautious and less direct than those of the Communists. By the time of the liberation, then, the Communists had not only acquired among the workers a far greater prestige as being the effective architects of the resistance movement but had also succeeded in securing a dominating foothold in many of the labour organizations, particularly those of the C.G.T.

Two aims now Influenced the policy of the C.G.T.; to take the lead in voicing the inevitable demands of labour for higher wages, despite the opposition of the government; and on the other hand, as it was almost the official labour organization of the Communist party, to support the policy of a government in which Communists were participating.

Serious industrial unrest was, however, provoked initially by certain autonomous unions. At the first postwar congress in April 1946 representatives of individual syndicates and unions had complained that the confederal body was attempting to impose too rigid a supervision upon the component parts and to dictate a policy of a Communist nature. Within the ranks of the C.G.T. there existed increasingly rebellious elements which demanded independence of action and sometimes broke off into splinter groups to form autonomous unions. These later linked themselves together as the Confédération Nationale du Travail (C.N.T.).

At the same time the number of strikes continued to grow, despite the partial concessions granted by the administration. Then some leaders, who in Nov. 1947 had shown their desire to break away from Communist policy, brought C.G.T. Force Ouvrière into being. This body held its first conference in April 1948, when it numbered a total of 30 departmental unions and 35 federations, with an aggregate membership of about 1,000,000 (though it claimed considerably more).

The C.G.T. itself emerged from these strikes weakened in membership and in prestige. For a time, at the beginning of 1948, its policy was to avoid any serious agitation, to attract members of the Force Ouvriere and other splinter groups back to the fold and to restore the morale of its own disheartened followers. In the course of the year, however, it became clear that the rival unions could not hope to outdo its propaganda, backed by better organization and greater funds, by its control of the key industries of engineering, mining, building, etc., and by the Communist party's wholehearted support. Thenceforth the C.G.T. became self-avowedly synonymous with the Communist party; its chief policy was to hamper the economic and military revival of France and western Europe by opposition to the European Recovery Program, to western union and to the Atlantic pact.

The C.G.T. remained the largest, best organized, most energetic and effective confederation, with about 2,000,000 members in the early 1950s. Its main strength was among the miners, the workers in heavy industries and the dockers. The dissident Force Ouvrière probably numbered about 500,000 members, its strength being among the civil servants and clerical workers and including a big minority in the railways and textiles and a smaller one in engineering (it was weak in the mining industry and among the dockers). Though it had no official connection with the Socialist party, it was in fact its labour parallel. The Christian unions of the C.F.T.C. also had about 600,000 members, recruited chiefly among the clerical and distributive workers and the women employees in business and factories. On their left wing were an increasing number of industrial federations of manual workers. The Christians based their appeal on the spiritual as well as material defense of labour and tended to associate themselves politically with the M.R.P.

A fourth powerful confederation was the Confédération Générale d'Agriculture (C.G.A.), which, taking the place of the Corporation Paysanne (founded under the Vichy regime and dissolved after the liberation), became the sole peasant organization.

A fifth and much smaller organization was the Confédération Générale des Cadres, created after the liberation to safeguard the interests of senior staffs (such as foremen) and of the more qualified workers (technicians, etc.). The other confederations, who had their own special organizations for the cadres (senior staffs) and desired to increase their influence among them, were naturally hostile to the C.G.C.; and, on the ground that it was not sufficiently representative and, moreover, linked to the *patronat,* would not admit it into the mixed official bodies set up for the benefit of labour interests.

Still another organization came into being with the Gaullist labour-capital association. Under this scheme collaboration was between worker and employer, to take place within the framework of the factory and to be sealed by a deed of partnership; and a basic remuneration for workers and management and a basic rate of interest for capital were to be established. It failed, however, to secure a hold on labour and, with the decline of Gaullism, became a moribund organization.

Finally there were the autonomous unions, mostly small groups in separate factories. These were established in some cases by former members of the C.G.T. who had left that body before the split in Dec. 1947, chiefly because they objected to the increasing discipline imposed by the central authority (also, sometimes. because they disliked the Communist nature of the movement). Some had left during the split, but decided not to join the newly established C.G.T.F.O.

Other unions had been started by officials who had compromised themselves during the German occupation. For the most part they claimed to represent the pure nonpolitical and revolutionary tradition in French trade unionism. At the beginning of 1948 some of these autonomous unions were linked loosely by a committee; others were already members of the C.N.T. In Nov. 1948 a conference of all these autonomous bodies decided to establish a national federation of autonomous unions and a cartel for joint action. Toward the end of 1949 these unions formed the Confédération du Travail Indépendante, later entitled the Confédération Générale des Syndicats Indépendants. Numbering about 150,000 members and confined to a few areas and to certain large factories, they had little influence on the labour movement as a whole, being a small minority of extremists ready to exploit every grievance and to promise the workers the impossible.

Social Legislation. — Various legislation was passed after 1841 to govern labour conditions and promote social welfare in France. Laws limiting the hours of work were enacted in the second half of the 19th century, and a system of state inspection was established in 1883. Concurrently with the development of trade unionism, additional labour and social legislation mas introduced. Under a law of 1899 the state assumed the power to regulate conditions of work in factories engaged on government orders. In 1900 a further law provided for the progressive introduction of the ten-hour working day into factories. Six years later the ministry of labour was created to supervise industrial conditions.

The workers obtained in 1919 an eight-hour working day and a 48-hour working week despite considerable opposition from the employers. General application of the rule was slow, and it was not introduced into some trades until 1936. There was, however, an increasing collaboration between the government and the trade unions to promote better industrial conditions and relations. Disputes were submitted to the ministry of labour, to the *préfets* and to various official bodies. The *conseils de prud'hommes* or courts of elected representatives of employers and workers became widely used to judge differences on principles of equity, and appeal could be made from them to the civil courts.

The economic depression of the early 1930s stimulated industrial unrest, which produced further demands on the part of labour. With the advent into power of the popular front government in 1936, such claims as the right of collective bargaining, paid holidays, the institution of shop stewards and the introduction of the 40-hour (or five-day) working week were conceded. In addition the existing machinery for conciliation and arbitration over wages was reorganized. The innovations of the popular front were partly neutralized by the Daladier government in Nov. 1938.

The Vichy government introduced a stringent control, chiefly with the object of alleviating unemployment by directing labour into certain channels. Hours of work varied considerably from industry to industry. As the German grip on the country tightened there was a growing regimentation of labour.

After the end of the German occupation the rights of the worker to social benefits through legislation and to participation in fixing labour conditions and in the management of industry were laid down in general terms. But even before the new constitution of 1946 was passed the 40-hour working week had been reintroduced, with increased payment for any overtime and holidays with pay. The election of joint labour tribunals and of workers' delegates, which had been eliminated by the decree laws of 1938–40 or had fallen into disuse during the Vichy period, was restored, and they themselves were granted extended powers. Wages continued throughout the postwar years to be the subject of repeated claims to the administration by the trade unions as the cost of living increased. A minimum wage was usually demanded, plus varying bonuses. Wages were freed from state control in 1950, and the negotiation of collective agreements in various branches of industry was resumed. The government retained, however, the right to fix a national minimum.

The beginnings of social security had been introduced at the start of the 20th century by legislation to safeguard the worker and compensate him for accidents. Some tentative steps to provide for unemployed were taken in 1905, when the state first subsidized for that purpose the funds of trade unions; and in 1914 a national unemployment fund was created, through which contributions were granted to relief organized by many county and municipal councils. Meanwhile unofficial organizations, supported mainly by private subscriptions, were the chief sources of protection against sickness, old age and unemployment. Family allowances, which had been given by certain firms in the 19th century, were adopted by the state for its employees during World War I; and later pensions were added.

The question of social insurance came to the forefront after 1918, but a comprehensive measure was delayed by the unwillingness of the government and the assembly to incur the necessary expenditure. Finally, in 1930, a law was enacted which introduced some additional degree of social assistance. Insurance was made compulsory for all employed persons under a certain annual wage. Benefits for sickness, maternity and death were paid out of departmental funds or out of those of trade unions, mutual aid associations and employers' institutions. Old-age and disability benefits came from national or private funds. The scheme was financed by contributions from the insured and the employer, amounting to 8% of the basic wage, supported by state subsidies (already granted to cover liabilities under a previous scheme for workers and peasants in 1922), plus an additional grant. Maternity benefits were payable to insured women (who were also given sick pay) and to the wives of insured men. Invalidity allowances and treatment were granted to people incapacitated, and there was a pension for workers on retirement at the age of 60. Despite this measure, social insurance before 1939 remained piecemeal, limited in scope, inadequate in its benefits and largely left to local bodies whose efficiency varied considerably.

Thus, until the end of World War II the majority of French labour was very much at the mercy of the fluctuations of the economic situation. After 1945 the problem of extension, coordination and uniformity in the somewhat haphazard system was quickly tackled. The ministry of labour and social security was made responsible through a directorate-general, which prepared the necessary regulations of the scheme and supervised their execution. Under regional directorates local boards of two kinds were set up, one devoted to social insurance, the other to family benefits. The local offices were to collect and administer funds. To the boards for social insurance were elected workers (75%) and employers (25%); on those for family benefits, independent representatives were to take the place of a percentage of workers.

The burden of social-service expenditure borne by the state increased substantially after 1945. In 1938 the total figure had been 22,070,000,000 fr. (22% of the total expenditure); in 1953 it was 896,670,000,000 fr. (26.4%).

After World War II funds specifically for social insurance were entirely provided by the contributions of workers and employers (of whom the state was the largest). Benefits, now made far more comprehensive and generous, comprised the following: social insurance against sickness, against disablement preventing or handicapping employment, against old age, against retirement and against death, together with expenses for maternity and for injuries incurred at work; and family benefits varying according to the number of children. Grants were also made available for medical research toward the prevention of occupational diseases and for the maintenance of private hospitals belonging to individual firms, etc. Reciprocal agreements relating to medical treatment were concluded with many neighbouring countries.

Family Allowances.—Family allowances had been officially and partially introduced by the government after 1918, their object being to check the decline in the French population. They were at first developed voluntarily under both government and private auspices. In 1933, under an act of 1932, family allowances became compulsory for all employees in certain branches of industry (*e.g.*, textiles, mining and chemicals); they were later extended to other branches, to commerce and finally, in 1936, to agriculture. The amounts allotted were. however, insufficient to have any marked effect. In the Paris area, where the rate was the highest, the yearly allowance for nonstate employees in 1938 was 720 fr. for the first child, 1,200 fr. for the second, 1,680 fr. for the third and 2,400 fr. for any additional children; yet the population continued to decline. Then, in 1939, the government introduced the Code de la Famille, which inter *alia* gave a birth bonus of 2.000–3.000 fr. to the first child if born within two years of marriage. Allowances were also extended to cover independent workers. the liberal professions, etc. The rate of allowance became 10% of the average departmental income (with two scales, an urban and a rural) for the second child and of 20% for three children, with an additional 20% for every succeeding child. These allowances were increased somewhat by the Vichy government.

The first revision of the system to take place after World War II was that of May 1946. which made the rate of allowance a function of a hypothetical basic monthly salary; and this principle was maintained throughout the subsequent revisions. This basic monthly salary was fixed at 17,250 fr. for the Seine *département* in Oct. 1951 but was depreciable by as much as 20% elsewhere in France. By 19jj the family allowance was available to families including two or more children under school-leaving age (14 years; but see the modifications listed below), as follows: for two children, 20% of the basic salary per month; for three, 50%; and for every child after the third, 30%.

As well as this, wage earners and persons of equivalent status received (1) monthly sums of 934.3 fr. for two children and 1,437.5 fr. for every child after the second; and (2), provided that their household numbered only one wage earner, the single-salary allowance, calculated for two children as 40% of the basic salary and for three or more as 50%, with a supplementary 20% for the last child. Moreover, as single-salary allowances, childless couples of beneficiary status in the first two years of their marriage could receive 10% of the basic salary; families with an only child under five years old, 20%; and families with one between five and ten, 10%. The age limit for the children could be extended beyond the school-leaving age for children not gainfully employed (to 15 years), for apprentices (to 17) and for students, for invalids and for an elder daughter looking after younger brothers and sisters at home (to 20). Furthermore, an increase of 5% of the basic monthly salary was allowed every child over ten years old with the exception of the first.

Apart from this system, three other sorts of allowance were available: (1) antenatal allowances for mothers during pregnancy; (2) lodging allowances, for recipients of one of the above-mentioned allowances who were paying rent or debts incurred in taking possession of their dwelling; and (3) maternity allowances, a single payment made to persons of any status for live children of French nationality born (a) the first before the mother's 25th birthday or else within two years of the marriage; (b) the second within three years of the first or five years of the marriage (unless the mother was still under 25; and (c) the third within three years of the second, six years of the first or eight years of the marriage.

GOVERNMENT, POLITICS AND LAW

Constitution.—The constitution of the fourth republic, promulgated on Oct. 27, 1946, is an elaborate document when contrasted with the pragmatic set of laws which made up that of the third (see History, above). Its preamble reaffirms the rights of men and citizens set forth in the declaration of 1789 and adds certain economic, political and social principles, such as equal rights for women, the right to social security measures and, for the worker, the right to belong to trade unions, to strike and to participate in the regulation of labour conditions.

The basic principle of government lies in sovereignty exercised by all adults through elected representatives or by referendum. The composition, the functions and the procedure of parliament are defined at length. Parliament is to consist of two chambers, the national assembly and the council of the republic, the former elected for five years and the latter, by electoral colleges, for six (but with half its members renewed every three years). The method of voting for both chambers was from 1946 the subject of alteration, either a proportional or a mixed proportional and majority system (see *Electoral* Law and Representation, below).

The relative importance of the two chambers is made plain in the constitution. The national assembly is the sole lawmaking body. When bills have been passed at a first reading of the assembly, they are considered by the council of the republic. Should a divergence of opinion occur, the amendments of this latter body are considered by the assembly, which can override the wishes of the council. But a majority vote in the council requires a like one in the assembly to negate it. The collective and individual responsibility of ministers is to the assembly alone, and votes of confidence can only be put to and voted on in that body. Further provisions also stress the constitutional supremacy of the assembly. A premier designate must obtain its approval both for himself and his proposed administration. It secured a tighter grip on finance, and its speaker, the president of the assembly, assumes the duties of president of the republic or of prime minister in the event of an interregnum. In various other ways the privileges of the council fall short of those possessed by the pre-World War II senate. It acquired. for example, no judicial functions or powers; its share in the revision of the constitution was considerably curtailed.

The chief effect of all these changes was to create an upper body which could perform the duty of a *chambre* de *réflexion* and place in some degree a brake on the actions of the assembly. But no longer could disputed measures be shuttled endlessly, as under the third republic. between the two chambers, or the upper house bury the proposals of the lower as did the former senate, which had acquired the title of "the cemetery of laws."

The president of the republic is elected by an absolute majority jointly by the national assembly and council of the republic for a period of seven years, after which he can only once be elected again. He is the official representative of the state in diplomatic and international negotiations. He invites, after preliminary soundings among party leaders, a politician to form an administration and presides over the council of ministers (in a formal capacity), over the supreme council of justice and over the committee of national defense. Every action of the president must be countersigned by the president of the council of ministers and by another minister. Thus, the president of the republic is the representative of the most "permanent and immutable interests of the state."

The constitution of the third republic referred but briefly to the council of ministers and entirely ignored the office of the president of the council, that is to say, the prime minister. The constitution of 1946, however, devoted an entire chapter to the council of ministers. Before 1875 the chief minister had been considered the intermediary between the head of the state and the legislature and the choice rather of the former than of the latter. After 1875 the prime minister still remained the nominee of the president of the republic, though responsible to parliament. With the diminution of presidential authority, however, the influence of parliament upon his selection and continuance in office naturally increased.

The constituent assembly of the fourth republic hesitated upon this question as to who should choose the leader of the executive and finally compromised in two somewhat ill-drafted provisions. Article 45 of the constitution states that the president of the republic, "after the usual consultations," designates the president of the council of ministers at the beginning of each legislature or after any resignation, death or other cause. On a dissolution the assembly's president assumes interim power. The designate president of the council submits to the national assembly the program and the policy of the cabinet which he intends to constitute, and he and his ministers can take office only after he has himself been granted the confidence of the assembly by public vote and an absolute majority. Article 46 then states that the president of the council and the ministers chosen by this body are to be appointed by a decree of the president of the republic.

In fact the practice at mid-20th century was as follows. The president of the republic first invites a politician to explore his chances of forming an administration and then, if they appear favourable, designates him as president of the council of ministers. The designate must later secure in the national assembly an absolute majority for himself and for his policy, and this the assembly can at its will either refuse or else grant sa reluctantly that his tenure of office may plainly be of a stopgap nature only. A further trial which must then be endured by the president of the council is a vote of confidence (not requiring an absolute majority) in the ministerial team that he has chosen. There was in the constitution of 1946 no mention of this latter procedure (the established custom of the third republic); but it was used to reject a new government, and the successful imposition of it was evidence of the assembly's intention to keep a tight rein on the executive.

The powers of the president of the council of ministers are further defined by two subsequent articles. He is stated to be responsible for the execution of laws (article 47), and he makes appointments to all civilian and military posts except those of ambassadors, magistrates (excluding public prosecutors), generals, rectors of universities, *préfets,* etc., which are vested in the presidency of the republic. He controls in fact the armed forces and co-ordinates the work of national defense. Thus he became constitutionally possessed of certain powers which under the third republic belonged, in theory at least, to the president of the republic; viz., in his control of the civil executive power and of the armed forces.

In giving to the chosen leader of the administration the power of nominating the ministers of the council, whose appointment is then sanctioned by decree of the president of the republic, the constitution of the fourth republic formally enacted what had in practice become a long-standing tradition under the third. Moreover, the president of the council of ministers came in practice to have the liberty (strictly illegal) of creating new or abolishing existing offices within his cabinet.

Under the charter of 1814, ministers had been responsible to the king but could be impeached by parliament; a decree of Napoleon III had reasserted this principle in 1869; but in 1875 the ministers had been made collectively responsible, for the general policy of the government and for their individual actions, to the two chambers and liable to impeachment by the lower house and judgment by the upper. In 1946 government responsibility to the directly elected representatives of the nation was held to be the characteristic distinguishing a parliamentary regime from the presidential regime which it was desired to avoid. By article 48 of the new constitution, therefore, the collective responsibility of the ministers to the national assembly for the general policy of the cabinet and their individual responsibility for their personal actions was established, with a proviso, moreover, that they were not to be accountable to the council of the republic, which was an indirectly elected body.

The question of confidence can only be raised by the president of the council himself, and a public vote in the assembly takes place one clear day (to allow opportunity for reflection) after it has been put. A refusal of confidence, to the cabinet must be made by an absolute majority in order to entail its collective resignation (article 49). Similarly a vote of censure, originating only in the national assembly, must be adopted by an absolute majority by public vote, one day after it has been tabled, in order to entail the cabinet's resignation (article 50). These provisions were inserted to give greater stability to ministries. They contrasted with practice under the third republic, when a simple defeat on questions of confidence in either house meant the resignation of the administration.

The constitution of 1946 then proceeds to tackle the problem of dissolution of the national assembly. Under the third republic this power had been vested in the president of the republic and the senate, but after its use by MacMahon in 1877 had never been employed, so that the defeat of administrations had merely entailed a change or reshuffling of ministers without appeal to the electorate. Political groups or individuals were thus immune from the consequences of irresponsible action for defeating ministries.

The constitution of 1946 attempted to amend this state of affairs. If, during a period of 18 months, two cabinet resignations occur as a result of refusal of confidence or votes of censure, the dissolution of the national assembly may be decided by the council of ministers after consultation with the president of the assembly. Such a provision is applicable only at the end of the first 18 months of the legislature and if the defeated government has been in office for more than 15 days. It proved ineffective.

To safeguard against any excessive control by the central executive the constitution defines the procedure of legislating. The members of parliament have the equal right with the council of ministers to initiate legislation. The council of ministers has no power to secure precedence for its own bills in the assembly; and bills of individual members and bills of the administration are considered without distinction by various parliamentary commissions, which may drastically modify them. Finally, the executive was clipped of any right to legislate by decree laws or delegated legislation, a practice which was common in France between World Wars I and II.

In addition a series of legal safeguards (not always in the constitutional document itself) further strengthened, after 1946, the national assembly in its relations with the executive. Parliamentary control over foreign policy was extended. The national assembly, unlike the former chamber of deputies, acquired the power to fix its own session, the total length of whose interruptions cannot exceed four months, and it must meet annually on the second Tuesday of January for as long or as often as it wishes. Its own bureau, when the assembly is not sitting, "controlling the acts of the cabinet, can convene parliament" and must also do so at the request of one-third of the deputies as well as of the president of the council of ministers. Thus the principle of a permanent legislature was legally established and at least a minimum of eight months' parliamentary activity assured.

French constitutional and parliamentary practice tended. therefore, to take a different line from British. In Great Britain the democratic system was based on the predominance of the executive within parliament, offset to some extent by the tradition of permitting the expression of dissent and of coming sometimes to terms with the opposition. France, on the other hand, apprehensive from its past experience of relatively unfettered executives, preferred to entrust much of the duty of legislating to the deputies, either within the assembly or on its permanent commissions. The result was to increase the weakness of administrations—already somewhat insecurely based upon coalitions—and to make the executive machinery of government in many respects less effective than in other countries.

Revision of the Constitution.—The question of constitutional revision is dealt with in the penultimate chapter of the constitution of 1946. A resolution expressing the object of revision must be passed by an absolute majority of the national assembly. The resolution must then pass the council of the republic by a like majority. If it does not. the assembly must endorse again its first decision. The assembly then drafts a bill for implementing the object of the resolution, which is submitted and must pass both houses in the manner of ordinary legislation. If the bill is adopted by a majority of three-fifths in each house or, alternatively, by a two-thirds majority at a subsequent second reading in the assembly, it becomes law. Failing this, it must be submitted to a national referendum. If, however, any proposal for revision concerns the existence of the council of the republic, it must secure the required majority in that body or be submitted to referendum.

In order to safeguard against any infringement of the constitution by ordinary legislation, a constitutional committee was created. This committee comprises the president of the republic, the president of the national assembly and seven other persons elected annually by, but not members of, the assembly, and the president of the council of the republic and three other persons elected by, but not members of, the council. The committee examines legislation passed by the assembly that may have infringed the terms of the constitution. If in the opinion of the committee the legislation does entail some alteration of the constitution, it is returned to the assembly for a new reading. Should it still be accepted. it is then treated as a specific proposal for revising the constitution and is subject to the procedure set forth above.

For the constitution of the French union see *Overseas* Possessions, below.

Electoral Law and Representation.— Under the third republic France vacillated in a choice of electoral law between a majority system with the second ballot within single-member constituencies (scrutin d'arrondissement) and one using party lists for a varying number of seats within the de'partement (scrutin de *liste*).

After World War II a system of proportional representation was introduced. The first consultative assembly was elected, on Oct. 21, 1945, on a list system within the ddpartement, whereby seats were allotted according to the rule of the highest average (la *règle* de la plus forte moyenne), but no preferential voting (*i.e.,* altering the party order of the list) or panachage (*i.e.,* selecting candidates from more than one list) was allowed. In the following elections for the second consultative assembly and for the first national assembly, some modifications were introduced, such as preferential voting and panachage. This system tended to give an approximate reflection within the assembly of the party strengths in the country. If anything, the smaller parties were somewhat penalized, but by no means so much as they had been under the majority systems of the third republic. (These majority systems. however, continued to be used in municipal and cantonal elections.)

Election to the council of the republic was indirect. A complicated hybrid system of majority and proportional voting was used.

In the elections for the second national assembly in June 1951, the coalition parties of the government succeeded in forcing through a new electoral law, which was designed to clip the wings of the Communists, still the strongest single party in the country. This law established, for the metropolitan area, a simple majority vote with the de'partement as the constituency, except in the Paris area, where a full proportional system was preserved. The majority system was as follows: each de'partement was to have a varying number of seats according to its population; parties were to submit lists of candidates; parties that submitted lists in at least 30 *départements* might combine their lists; any list or combination of lists that obtained 50% of the votes was to take all the seats; when a combined list succeeded in taking all the seats they were divided in ratio to the votes cast among the partners; if no list or combination of lists obtained 50% of the votes the seats were divided on a proportional basis. This system naturally penalized the Communists and to a lesser extent the Gaullists, neither of whom could easily find allies. Eor a combined poll of 51% the parties supporting the government secured 64% of the seats. (For the distribution of the seats among parliamentary groups see Table V, below.)

For the national assembly elected in June 1951 the total of seats was increased to 627, the distribution being: France and Algeria (metropolitan France), 574; overseas ddpartements and territories, 53.

Parties and Parliamentary Groups.— Political parties in prance are not always well-organized national groups, nor are local executives and their policies closely linked or controlled by the central executives. Successful candidates, especially those of the centre parties, often show a great degree of individual independence or may even form parliamentary sections giving a varying allegiance to the party under whose aegis they have contested the election. The larger groups and minor sections often join in loose and temporary coalitions for the purpose of forming ministries. The loyalties which hold them together are often slender, and the differences, though temporarily sunk as an expediency, quickly emerge, particularly when some political advantage can be gained or unpopularity avoided.

The individualism and parochialism of the French elector exercises a further influence toward disunity on the deputies' part. Thus. within the broad divisions, right, centre and left, there exist many shades of opinion, each one conscious of the regional interests that it must satisfy and prepared, for reasons of political expediency, to sacrifice the life of a coalition or even to break the unity of a party in the hope of retaining support in the constituencies. In addition the post-World War II electoral laws were usually of such a character as to permit small parties to secure some representation. Thus there were 20 administrations between 1945 and 1955, all based on coalitions of parliamentary groups whose executive and leaders were unable to exercise a strict discipline over the rank and file.

The general distribution of the chief parliamentary groups in 1955 was as follows: on the right (1) the former Gaullist and dissident Gaullist groups (formerly linked in the Rassemblement du Peuple Français), (2) the Républicains Indépendants and their allies of the Parti Républicain de la Liberté and (3) the peasant groups; in the centre (1) the Radicals and the Union Démocratique et Socialiste de la Résistance, who together formed the Rassemblement des Gauches Républicains in the upper house, and (2) the Mouvement Républicain Populaire; on the left the Socialists; and on the extreme left, the Communists. The Radicals, the M.R.P. and the Socialists or two of the three groups in coalition formed the governments of the "third force," to which the Gaullists on the one hand and the Communists on the other constituted the principal opposition—the government being usually able to rely on the smaller parties of the right (who later contributed ministers) for some support. The characteristics of the groups were as follows:

Rassem*blement* du *Peuple Français* (R.P.F.).—The R.P.F sprang from the Union Gaulliste, which was officially founded in July 1946 by Gen. Charles de Gaulle and his adherents. De Gaulle had retired from the leadership of the provisional government in January and re-emerged in June to attack the text of the proposed constitution as hammered out by the first constituent assembly for approval by referendum. The Rassemblement, inaugurated in April 1947, was defined not as a political party but as a movement above parties working to accomplish its aims in the political field. In the constitutional sphere it desired the establishment of a strong executive under a president possessing wide powers, akin to the system of the United States. It was also directed against the power and ascendancy in French political life of the Communist party. Gaining strength steadily in 1947, it tried with varying success to ally itself with the parties of the centre and the right.

The first congress of the movement was held at Marseilles in April 1948. It now claimed to have about 1,500,000 supporters and had established a Gaullist intergroup within the national assembly, comprising about 50 members chiefly drawn from the P.R.L. and the U.D.S.R. At the congress it called for immediate elections to determine a new national assembly and attacked capitalism and communism alike.

The national elections for the second council of the republic in Nov. 1948 provided the movement with a "trial run" in the field of national politics. Its policy, which met with varying success, was not only to put its own candidates forward but also to persuade nominees of other parties (particularly of the smaller centre groups) to run under its aegis and to accept its program. The movement eventually claimed to have won a total of 127 out of 320 seats for itself and for its allies or protégés and took its place in the council of the republic under the title of the Action Républicaine et Démocratique (A.R.D.). Its claimed strength of 127 proved somewhat deceptive. Many of those elected, who as candidates had been willing to give some allegiance to the movement, as senators acquired a certain amount of independence or openly reverted to their original parties.

In the assembly itself the R.P.F. emerged after the election of June 1951 as the strongest single party, winning 121 seats out of 627. Each of the candidates pledged in writing his allegiance to General de Gaulle's leadership, but as early as March 1952 a split occurred in the Gaullist parliamentary group, 27 of its members revolting against their party's decision to abstain when Antoine Pinay, an Independent Republican, was a candidate for the premiership. Protesting against the sterile policy of negation, they formed a left-wing Action Républicaine et Sociale, which at the beginning of 1955 had 33 members. The right-wing Gaullists formed the Groupe des Républicains Sociaux, which had 73 members. Some of the former Gaullists remained independent. Meanwhile the R.P.F. itself was dissolved as a political factor by its founder on May 6, 1953.

To speak broadly, there were three groups among the electorate who supported the movement. The enthusiastic Gaullists, reduced in numbers since the end of World War II, formed an inner core around which gathered persons who believed that France needed a national leader to replace the ineffective and "discredited" party politicians. A second group, who were partially financing the movement, were the people of property and capital, drawn from the P.R.L. and its supporters and seeing in General de Gaulle the only reply to the Communist menace. The third and largest group were those who belonged to the petite bourgeoisie, the professional classes and skilled workmen, who, though good republicans and attached to parliamentary government, were now tired of the constant party strife and fearful of political and economic chaos.

Conservatives.—French Conservatives described themselves before World War I as "Left Republicans" and after World War II as "Independent Republicans." Before World War II the major Conservative party had been the Alliance Démocratique (founded in 1901), whose representatives adhered to several groups in the assembly. Its policy of appeasing Germany brought it into disrepute, and its members after World War II reappeared at first in two groups in the parliament, the Républicains Indépendants and the still more conservative Parti Républicain de la Liberté (P.R.L.). Both parties sought to revive the constitutional structure and parliamentary practice of the third republic and were opposed to the "third force" government's policies of dirigisme and nationalization. The P.R.L. had intended to become a great fourth party in French politics but was frustrated in this ambition by the emergence of the R.P.F., which gathered to itself much of the right-wing opinion that the P.R.L. had hoped to organize. It then allowed its deputies to join the Gaullist intergroup and its candidates to combine with the Gaullists in electoral lists; but to resist total absorption by the R.P.F. its representatives in the assembly of 1951 formed one group with the Républicains Indépendants, which had originally been a rather smaller body there (though always much stronger in the upper house).

Peasant Groups.—The Parti Paysan d'Union Sociale was founded after World War I and reorganized in 1946 with the intention of giving the small peasant proprietors some voice in the national representation. Too small to contest alone the election of Nov. 1946 without support, it had allied itself with other Conservative groups and secured seats for 14 of its candidates; only 8 of these, however, formed a Peasant group in the first national assembly, the remaining 6 joining other groups. Shortly before the election of June 1951, as the result of splits in other parliamentary formations, the Peasant group had grown to comprise 30 members; and in the second national assembly its numbers increased to 40. A split between pro-Gaullist and pro-M.R.P. Peasants occurred in Nov. 1951; but in June 1952 the two wings reunited under the name of Independent Peasant group. This fusion came to an end in Nov. 1953. By the end of 1955 there were two Peasant groups in the national assembly: one, with 14 members, representing the Peasant party; the other, with 23, being that of the Independent Peasant deputies.

Radical Socialists.—The Radical Socialists stood for the oldest republican tradition in French politics, the spirit of the Jacobins and of the men of 1848. They were the main political representatives of the secret freemasonry. Their policy, evolved from Louis Philippe's time (when their main points had been universal suffrage, the separation of church and state, compulsory secular education, liberty of the press, etc.), was a mixture of practical common sense and idealism, reflecting the conflicting desires of the small man of property brought up in the cult of the ideals of the great Revolution. Their official name, Parti Rkpublicain Radical et Radical-Socialiste, is a misnomer: they were "radical" only in their anticlericalism and were actually opposed to socialism as the defenders of private property.

Until 1940, except during the period of opposition to the right-wing Bloc National, the Radicals were a government party under the third republic. Having swung toward the right before 1934, they then once more turned to the Socialists and, after some hesitation, joined the popular front coalition in 1936. After World War II, however, the party was but a shadow of its former self and greatly inferior in strength to the rival parties on its left. It suffered from the association of its leaders with the policy of appeasement and with the debacle of 1940. On the constitutional question (1945–46), the Radicals wanted to maintain the third republic in being.

With the advent of the R.P.F. on the political scene the Radicals had to seek a line of policy that would define their attitude toward it. After the Communists had been expelled from the government in May 1947, the party had joined with the M.R.P. and the Socialists in various "third force" administrations. Their regret for the old constitution and their decided opposition to Communist and even to Socialist principles might have tempted them into some alliance with De Gaulle; but they mistrusted him as a possible dictator. Thus, while individual members did accept a double allegiance and though the party was prepared when convenient to form joint lists in elections, the Radicals as a body insisted upon preserving their individuality and safeguarding their republican traditions.

Their insistence on independence became more marked with a later increase in their electoral and representative strength. After their gains in the elections of Nov. 1948 to the council of the republic, where they and their allies now formed the largest single group (the Rassemblement des Gauches Républicaines), they enjoyed more influence in "third force" administrations; but their increasing insistence on economic principles antagonistic to the dirigisme of the M.R.P. and the Socialists often led to crises that threatened to and finally did break up the coalition.

Union *Démocratique et Socialiste* de la *Résistance* (U.D.S.R.).—The U.D.S.R., a small but influential group, seated to the right of the Radicals in the national assembly, described itself as a non-Marxist party of the left and belonged in fact rather to the centre. With the Radicals, it formed part of the Rassemblement des Gauches Républicaines. Generally sympathizing with the parties that advocated a more liberal economic policy (for example the rapid abolition of government controls and a root-and-branch reform of the nationalized industries), it came to be regarded as one of the moderate centre groups.

Mouvement Républicain Populaire (*M.R.P.*).—The M.R.P., formed after World War II, had its origin in resistance groups and in prewar Christian syndicalist or political movements such as the Dkmocratie Chrétienne and the Parti Démocrate Populaire. The Parti Démocrate Populaire, founded on Nov. 16, 1924, by Paul Champetier de Ribes, advocated proportional representation, votes for women and plural votes for heads of families, the reform of company law and the organization and control of credit. It adopted an attitude of moderation toward the popular front and gave support to most of its measures. In foreign affairs the Popular Democrats were inspired by a strong belief in the League of Nations. Deeply antifascist, they favoured throughout strong measures both in internal and external politics to deal both with the right-wing leagues in France and with Germany and Italy.

After World War II the M.R.P. contemplated in all innocence coming to some arrangement with the Communist party. But the religious nature of the movement and its antagonism toward the principles of Marxism constituted a ditch too wide to bridge. On the other hand the centre position held by the prewar Parti Dimocrate Populaire element became equally untenable for two reasons: the more advanced elements objected to the economic "injustices" of liberalism and the syndicalist elements desired as great a measure of nationalization in industry as was possible. Support for the M.R.P. came chiefly from the proletariat and from lower-grade office workers of more religious inclination. Thus it was in some measure a rival of the Socialist and, to a lesser extent, of the Communist party. But it could also count on a fair support from the Catholic bourgeois and also—though to a lesser extent, except in certain districts where faith was strong—from the peasants.

At the election of June 1951 the M.R.P. was the greatest loser: its total vote declined from 5,058,307 (Nov. 1946) to 2,353,544 and its seats from 164 to 94.

The members of the M.R.P. stood apart from their two fellow groups, the Radical Socialists and the Socialists, on the religious question, insisting as they did that the state should subsidize free (that is, Catholic) schools; they differed, moreover, from the Radical Socialists in offering a more advanced labour policy and in their acceptance of *dirigisme* and nationalization; and they competed with the Socialists for the working-class vote. Also, they had to suffer a cross fire from the Gaullists who, making their appeal in some measure to the same religious principles as the M.R.P. but being less advanced in constitutional or labour theories, concentrated upon detaching the more bourgeois and right-wing element of the party.

The Socialists (P.S., *S.F.I.O.,—Parti Socialiste,* Section *Francaise* de *l'Internationale Ouvrière*).—The French Socialist party was formed in 1905 as a party of class struggle and revolution, aiming to transform capitalist society into a communist association in accordance with Marxist doctrine. During World War I, however, Socialists participated in the government, though certain elements were pacifist. After 1920, when the left wing seceded to form the Communist party. the Socialists tended to ally themselves with their neighbours on the right, the Radical Socialists, until in 1933 a majority element forced the group to conclude a pact for united action with the Communists. At the elections of 1936 they secured 155 deputies (with 19.9% of votes), and their leader Léon Blum became prime minister. They later entered into other coalition governments with the Radicals, though their left-wing elements still preferred the Communist alliance.

In World War II the party took an active part in the resistance movement, both in France and under General de Gaulle. After World War II the Communists attempted to secure the alliance of the Socialists, whom they wished to transform into their junior partner. In the first elections of the fourth republic the party experienced a progressive decline. They preferred to associate themselves with their neighbours on the right rather than with the Communists. Thus they lost a certain amount of working-class support. This was offset in later years by the discredit that the Communists incurred from their near-revolutionary policy. At the election of June 1951 the Socialist vote fell from 3,431,954 (Nov. 1946) to 2,764,210, but, thanks to the revised electoral law (see above), they increased their seats from 101 to 107. The party showed an increasing reluctance to join in the "third force" administrations but continued to give them general but by no means constant support.

Communists.—The French Communist party was founded in Dec. 1920 after the Socialist congress at Tours by delegates who voted for affiliation with the newly constituted third international of Moscow. It had only a small parliamentary representation until the elections of 1936, when it gained 72 seats (15.5% of votes) in the chamber of deputies (cf. 10 seats in 1932). Its policy was mostly dictated by the Comintern executive. In 1936 the party entered into alliance with the Socialists to support but not to join the popular front government under Léon Blum. It attacked the Munich policy of the Edouard Daladier government. yet later defended the Soviet-German pact of Aug. 1939. Because of its opposition to the war after the Soviet invasion of Poland, the party was suppressed by decree on Sept. 26, 1939. After the Franco-German armistice the Communists for a time supported a policy of collaboration with Germany. When the latter declared war on the U.S.S.R. they took part in the movement of resistance and gained many adherents by their effective action and propaganda.

During the later stages of the war the party established contact with General de Gaulle's government and became associated with his administration. In elections after the liberation they secured at first enough seats to make them the most powerful single party. Their later subservience to the U.S.S.R. raised against them the opposition of the remaining parties. They also lost many supporters through disruptive economic tactics. The parliamentary strength of the party was severely reduced by this and by the effect of a new electoral law in 1951, but their support in the country was only slightly diminished.

The structure of the party in the early 1950s was briefly as follows: at the head was the bureau *politique;* under it. a larger *comité* central, elected by the congress of the party, meeting every two years. The congress itself was formed of delegates from departmental federations; these federations themselves were composed of sections; and the sections of cells. The membership of the French Communist party fell from more than 1,000,000 in 1946 to 506,250 in May 1954. They obtained 5,489,288 votes in the election of Nov. 1946 and 5,038,587 votes in that of June 1951, when, moreover, their seats were reduced from 190 to 106. The circulation of their main daily newspaper, *L'Humanité,* fell from 530,000 in 1946 to 121,000 in 1954; their evening newspaper, Ce *Soir,* with a circulation of 590,000 in 1946, was discontinued in 1953.

Table V shows the distribution of seats among the several groups in the parliament from 1919 to 1956.

TABLE V.—*Distribution* of *Seats* in *the* National *Assembly*

Parliamentarian groups	1919	1924	1928	1932	1936	1946	1951	1956
Rightwing	27	20	25	11	11	—	—	3
Poujadists	—	—	—	—	—	—	—	52
Gaullists*	—	—	—	—	—	10	121	21
Conservatives†	209	117	82	76	88	38	51	81
Independent Republicans‡	139	57	119	99	84	28		
Peasants	—	—	—	—	—		40	14
Christian Democrats§	—	—	18	23	23	164	94	76
Radical Left	58	75	93	65	31	43	72	14
Radicals	84	139	107	158	116			57
Socialist Republicans‖	34	35	25	66	37	26	16	19
Socialists	70	104	112	97	146	101	107	94
Communists	—	29	11	10	72	190	106	150
Others	—	—	19	10	10	11	20	12
Total	621	576	611	615	618	619	627	593¶

*The Rassemblement du Peuple Français split in 1953 into Groupe des Républicains Sociaux and Action Républicaine et Sociale. Only the former claimed to be "Gaullist" in 1956. The latter allied itself with the Conservatives. †Republican Federation from 1919 to 1936. ‡Left Republicans irom 1919 to 1936. §In 1919 and 1924 the Christian Democrats joined the group of Republican Federation. After 1946 their official name was Mouvement Républicain Populaire. ‖From 1946, Union Démocratique et Socialiste de la Resistance, ¶This is the total of 544 deputies oi metropolitan France apd of 49 elected in the over-seas *départements* and territories. No election could be held in Algeria which was entitled to 30 deputies.

Local Administration.— French local government was by no means well developed, and much of the local administration is carried out by representatives of the central authorities. Though efforts were being made after World War II by local bodies to obtain a greater autonomy and though the constitution promised that special laws would be enacted to extend municipal and departmental liberties, little progress to this end was made. The post-World War II system was a legacy of the ancien *régime* and of the Revolution. To a certain extent it suited the habits of a people preferring local state-paid officials to the unpaid services of elected representatives.

By the last years of the ancien *régime,* France was divided into 32 *grands* gouvernements, corresponding roughly to the larger provinces or groups of provinces of the kingdom; and at the same time into a rather larger number of *généralités* or intendances (see INTENDANT). For these divisions the Constituent Assembly in 1789 substituted 83 de'partements. The new units, however, continued to be controlled by the central administration from Paris. Special problems of France's diverse regions tended to be ignored, and a uniform pattern of administration was applied to the whole country. In the 1950s the number of de'partements was go. They were divided into 281 arrondissements; further subdivisions were the cantons (3,028) and communes (38,014).

At the head of each *département* is the pre'fet (see below), who represents within his area all the government departments and is responsible for enforcing the national laws relating to the public services. He is assisted in his administration by an advisory body of civil servants (conseil de *préfecture*). He also conducts the domestic administration of the *département* with the help of an elected conseil *général;* this includes control of such matters as finance, police, highways, public assistance and health, education and many of the postwar social services. Finally he is responsible for supervising activities of the small units of administration.

The authority of the de'partement is the conseil *général* which is elected every six years, with half its personnel renewed every three, and meets as a whole usually twice a year (though its executive committee is virtually in constant session). The conseil *général* is a purely advisory body with no executive power; its resolutions can only be put into practice if approved by the pre'fet, who submits business to it, prepares its budget and drafts its regulations (many of which originate in decrees issued by the central ministries). Within the smaller division of the arrondissement is the subordinate of the pre'fet, the *sous-préfet,* who is assisted by a council composed of members elected by the cantons. The powers of this council are negligible. In theory its chief role is to allot to the various communes the incidence of taxation, but this has been taken over by treasury officials, and the various resolutions that it may pass cannot take effect without the approval of the pre'fet.

The commune is the basic unit of local administration. More than half of the 38,014 have less than 500 inhabitants and less than zoo have more than 20,000. Every commune elects its own municipal council (serving for six years) and its mayor. The mayor acts as the executive agent of the council and as the principal administrator of the commune (supervising the police, public works, etc.) and, as the immediate subordinate of the pre'fet, he is in charge of the execution of statutes and decrees. But the authority of the mayor and council is limited in the larger communes by the power of the professional civil servant. The pre'fet, moreover, approves the annual budget, appoints many of the civil officers and has power to suspend for a certain period both mayor and council. They can also be suspended by the minister of the interior and even dismissed by him or by the president of the republic.

The office of pre'fet had been created under the consulate in 1800, by the law of 28 Pluviôse year VIII, with a view to strengthening the power of the central administration as the intendants had strengthened it under the ancien re'gime. According to a statute of June 1950, which limited sources of recruitment, prkfets were to be nominated by the president of the republic after proposals by the minister of the interior. *Sous-préfets* were to be appointed by the president of the council on the recommendation of the same minister but had to be selected, in the proportion of eight out of ten, from the principal secretaries (chefs de cabinet) of *préfets.* The chefs de cabinet themselves were appointed by the ministry of the interior from its own staff or from persons who had passed through the official school of administration.

In April 1948, because of disturbances created by the Communists in the preceding winter, the government appointed eight "superprefects," with the title of inspectors general, who were each to assume administrative control of a particular group of de'partements in the event of further disturbances. They thus constituted civil authorities with powers corresponding to those of the commanders of the military regions into which the country was divided.

Legal System.—French law is largely codified, being based on the Code Napoléon (*q.v.*) and on the codes de *Procédure* civile, de Commerce, *d'Instruction criminelle* and *Pénal* by which it was followed. This body of law (1804–10) was, of course, supplemented and altered later by much statutory law and decree, and there came to exist also a certain proportion of judge-made law. But French legal tribunals rely in the main upon the codified law.

There are two categories of law, administered by two different sets of courts: the civil law and courts deal with all criminal offenses or noncriminal disputes concerning the individual; the administrative law and courts judge litigation to which public authorities are a party. In the case of a conflict between these jurisdictions or of doubt as to their respective competence, the matter is submitted to a *tribunal* des *conflits,* a joint body drawn in equal numbers from the highest civil court, the *cour* de *cassation,* and from the highest administrative court, the conseil d'e'tat.

The hierarchical structure dealing with civil and criminal cases (both of which most magistrates are competent to judge) is as follows: Courts of the lowest jurisdiction (tribunaux de simple police), one in each canton, are presided over by juges de paix and deal with petty offenses (contraventions) or disputes. Above them are tribunaux de *première* instance or *tribunaux civils,* collegiate bodies in the arrondissement, which judge more important cases (*délits* if criminal) or constitute a court of appeal against the decisions of the juge de paix. A third category is the collegiate *cours d'appel,* covering groups of de'partements and dealing on appeal with noncriminal disputes and with the less serious criminal offenses (*délits*). Serious criminal offenses (crimes) are judged in departmental *cours d'assise,* which are the only tribunals employing a jury and are specially constituted for each of their sessions. As a final court of appeal in civil and criminal jurisdiction is the *cour* de *cassation,* which deals with appeals only on points of law and of procedure, not on points of fact, but has the power to annul a judgment after which a new trial is held by the first court.

Criminal procedure in France dates back in some of its aspects to the ancien *régime.* Proceedings are begun by an inquiry (*l'instruction préparatoire*) before a juge d'instruction (investigating officer). Before the latter has been seized of the case, the police map, before but not after charging the suspect, hold an official interrogation (interrogatoire de *première comparution*) and inquiry, at which the statements taken form part of the dossier. If a prima-facie case is established by this an indictment is prepared (L'instruction *définitive*). In court itself the presiding judge interrogates the accused (who cannot refuse to give evidence) at length; and witnesses are heard and questioned by the judge, by prosecuting council and, through the judge, by defending council. Summing up is embodied in a series of questions put by the judge to the jury, which returns a majority verdict.

Administrative law is composed of statutes, decrees and decisions of the conseil *d'état.* This specialized tribunal, which comprises about 150 carefully selected specialists, had its origins in the ancien *régime* and is a markedly French institution. Its function is twofold: first, to advise the government and the executive upon the implications and validity of administrative regulations; second, to judge through its litigation department (section du *contentieux*) any disputes which may arise between the state or public bodies and the individual citizen. Regional councils covering a number of *départements* may deal in the first instance with certain types of cases, but an appeal lies from them to the conseil d'e'tat, which, moreover, deals in the first instance with matters outside their competence. In the execution of its duties the conseil d'e'tat is the defender as much of individual rights as of the rights of the state or of public bodies. Any person or group that considers an order or action affecting him to be outside the authority of a public service may bring the issue before the conseil d'e'tat, acts of parliament alone being excepted. On receiving a complaint the conseil calls upon the appropriate ministry for a justification of its actions and, if the ministry fails to reply, can put it en demeure (*i.e.,* summons it) or even passes judgment on the hypothesis that the plaintiff's allegations are correct. On receipt of a reply, the *conseil* inquires into its validity and can, if so minded, proceed to forbid any action or to quash any disputed regulation or order its amendment.

To make the judiciary less dependent on politics, a *conseil supérieur de la magistrature* was created under the constitution of the fourth republic. This body, responsible among other things for appointing all judges and magistrates, comprises the president of the republic, the minister of justice, six representatives chosen by the national assembly for six years, four representatives chosen by the magistrates themselves and two persons appointed by the president of the republic. Thus the minister of justice lost much of his former power to nominate members to the judicature. *(See* FRENCH LAW *AND* INSTITUTIONS for historical survey.)

Police. — *The* task of ensuring the internal security of the state is exercised under article 47 of the constitution by the president of the council of ministers. The minister of the interior is in fact the head of the various police bodies; under him, within the *départements,* the *préfet* is responsible for public security. Within communes of less than 5,000 inhabitants the mayor is head of the municipal police; in the larger communes the responsibility for police organization is assumed by the municipal councils. The chief executive of the *pre'fet* and the professional colleague of the mayor in the various districts is the *commissaire de police,* who is appointed by the ministry of the interior. He is responsible both to the *préfet* for the work of the administrative police and to the *procureurs généraux* of the courts of justice for that of the judicial police.

Police are divided into two classes; viz., the administrative and the judicial police. whose duties may sometimes overlap. Some officials may be also members of both the administrative and the judicial police as, for example, the *préfets,* mayors and *commissaires.* To speak broadly, the function of the administrative police is prevention of breaches of the law and of public order. either generally as regards the security of the whole territory, or locally as regards the commune; thus, a large element of the municipal police are administrative and perform the usual routine duties. The judicial police concentrate on the investigation of crimes and the collection of evidence for the courts. There are, however, repressive services of the judicial police such as *brigades territoriales* in the Paris area for tackling more serious crimes of violence, while the administrative police in other areas have attached to them *brigades mobiles,* which are concerned with criminal investigation.

The central police authority, whose control spreads over the whole country except the Paris area, is the Sûreté Nationale, a body immediately controlled by the ministry of the interior. Besides exercising a general supervision of the municipal police forces. and the active direction of the judicial police, the Sûreté Nationale is responsible for the security of the state in general measures against sabotage and espionage, in the control of foreigners and the supervision of frontiers, etc.

The Préfecture de Police, an autonomous body directly under the control of the minister of the interior. is responsible for the policing of the Paris district. It comprises both administrative (general and municipal) and judicial services, together with special departments dealing with such tasks as the suppression of fraud and the black market *(police économique).* The general administrative police is mostly concerned with foreigners and travellers; the municipal (divided into *arrondtssements)* deals with the maintenance of public order and with traffic. The judicial police are grouped into various brigades such as *la brigade criminelle* (for serious crime), *la brigade de voie publique* (crimes on the public highway), *la brigade mondaine* (prostitution, cabarets, etc.), *la brigade financière* (tax evasion, etc.) and the mobile *brigades territoriales,* each patrolling a certain section.

In addition to the above classes of police, there exist the *gendarmerie* (a body of about 33,000 in the 1950s), which, though part of the army, exercise police duties under the minister of the interior; the departmental *compagnies re'publicaines de sécurité* for special duties; the *police sanitaire* (health); and the *garde champêtre* (rural duties).

Two central and specialized organizations are the Service de Documentation, d'Enquêtes et de Contre-Espionnage (S.D.E.C.E.), a police body with the particular duty of guarding the security of the state against sabotage. spying and propaganda; and the Section Internationale, the French branch of the International Police.

DEFENSE

Army. — In France the transition from the feudal armies of the middle ages into those of more modern times began in the last decades of the Hundred Years' War. By an ordinance of 1439 Charles VII created out of the mercenary forces at his disposition permanent *compagnies d'ordonnonce.* These companies, whose strength and number varied at different times, constituted the foundation of a national standing army and became finally the cavalry units of later centuries. Charles VII also attempted to create a national infantry by forming in 1448 the francs-archers who were furnished and equipped by the parishes of the realm. He sought to establish the principle that only the monarch could raise troops; and he instituted a system of regular pay in order to improve discipline and loyalty.

With the wars in Italy during the early part of the 16th century came the formation of larger forces. To supplement the standing army, bodies of foreign mercenaries were once more recruited. The professional army became grouped under Charles IX and his successors into regiments and companies, and, though nominally royal troops. the greater part of these were mostly the property of their commanding officers. The royal army thus lost that uniformity and cohesion which it had begun to assume at the end of the previous century.

The reforms of the marquis de Louvois *(q.v.)* under Louis XIV were directed to creating a more efficient and homogeneous force. Louvois restricted as much as possible the proprietary system and increased the number of regiments. He also insisted on commanders' carrying out their military duties and introduced the practice of inspection of the forces. He attempted to standardize training, weapons. uniform, pay and promotion and paid particular attention to the development of the artillery and engineering arms, to the building of fortresses, depots and hospitals. His work gave France a force which until the middle of the 18th century was to be recognized as the first in Europe and which during the Revolutionary period was to provide an efficient nucleus for the people's army. Under Louis XIV the size of French forces in time of war attained a total of more than 300,000 when supplemented by levies of militia; the peacetime strength was nearly 200,000, a figure which was more or less maintained until the end of the *ancien régime.* In 1770 the division was introduced by Victor François de Broglie to replace the former tactical units of wings, advance guards, etc.

On the outbreak of the Revolution the militia system was suppressed, and in 1789 a national guard was created, to which, in theory, all able-bodied males between 16 and 60 belonged. The ranks of the professional army, particularly of officers, were seriously depleted; and. to supplement this, recourse was made—with no great success—to volunteers, who were organized in new battalions. As the threat of invasion increased, the Revolutionary leaders resorted to the *levée en masse.* The heterogeneous regiments of professional, volunteer and conscript soldiers were amalgamated and organized into trained, disciplined armies, chiefly through the energy and ability of Lazare Carnot. In the campaigns of 1794–96 these armies repelled the threats to the new republic. So depleted, however, became their numbers that in 1798 the Directory introduced, by the *loi Jourdan,* compulsory military service for males between 20 and 25. By the following year French forces (excluding those under Napoleon in Egypt) numbered about 170,000, divided into five armies.

Napoleon extended conscription to practically the whole of the able'-bodied male population. He replaced the existing army divisions by the larger *corps d'armée.* The divisional cavalry and most artillery were formed into separate corps troops. The services of the army were developed and perfected. Under Napoleon the size of French armies fluctuated considerably. With each recurrence of war there were more desertions and conscription was increasingly evaded; thus, more use was made of foreign elements, who were usually organized as national units. The Grande Armée in Oct. 1806, about the time of the battle of Jena, numbered about 225,000 men; and for his expedition into Russia Napoleon raised 640,000, half of whom were foreigners. An increasing dearth of men marked the final years of the first empire. In 1814 a *levée en masse* raised about 140,000 men, and during the Hundred Days Napoleon gathered together a first-line force of about 182,000 and a reserve garde mobile of 200,000.

Conscription was abolished on the restoration, but a modified kind was reintroduced within three years, under which those not required for the immediate demands of the service were given furlough. The national guard was, however, retained in certain larger towns. Under Louis Philippe the method of recruitment was again changed. At first a conscript could secure exemption by providing a substitute; later, exemptions could be bought by the payment of a certain sum to a fund out of which the state paid volunteers. By 1866, out of a total establishment of 400,000, only 120,000 were conscripts. Under Louis Philippe recruitment was first begun for the foreign legion.

Against the threat of Prussia, a measure for the reorganization of the army was introduced by Marshal Adolphe Niel which became law in 1868. By universal compulsory service it was hoped to create a first-line army of 800,000, half on active service and half in the reserve. But before this could have much effect war broke out in 1870. The French forces then numbered around 375,000, of whom about 250,000 were capable of being mobilized. A garde mobile, which was to have been composed of those exempted from military service, existed only on paper. After the first disasters of Metz and Sedan additional formations amounting to about 1,700,000 were hastily raised, but lack of equipment and training rendered them largely ineffective.

Under the third republic reorganization of the army was based upon obligatory universal service, to last long enough for a maximum of men to receive some training. The period was five years in 1875 (when the effective strength of the army was 430,703); it was reduced to three in 1889, to two in 1905 and increased to three once more in 1913. After their spell of training, the conscripts were classified according to aptitude, as fit for active service and for the active reserve or for the territorial army and its reserve (home service). In addition a colonial army, specifically for overseas service, was created, chiefly of professional soldiers.

This system of training allowed France to mobilize during World U'ar I a total of nearly 8,000,000 troops (supplemented by nearly 500,000 native colonials) without impairing the quality of the effectives too seriously. French casualties amounted to 1,357,000 dead and 4,266,000 wounded.

In 1928 came some major reorganizations of the French army. The total length of military service became 28 years. Of this, 1 year (on attaining the age of 21) was to be on active service, 3 years on furlough, 16 years in the first reserve and 8 in the second. In 1935 the period of active service was increased to two years. The active army was recruited by calling up the annual contingent and enlisting volunteers. This army of 25 infantry and 5 cavalry divisions was divided into the metropolitan forces (strength 465,000) stationed permanently in France; the colonial army (249,000) in French overseas possessions; and mobile reserves (50,000), normally stationed in France or North Africa.

On the outbreak of World War II, France mobilized 89 divisions, which comprised 1 armoured, 3 light mechanized, 5 cavalry and 80 infantry. The nation was, thus, very deficient in armoured and mobile forces, partly because its military strategy had since 1918 been dictated by defensive and traditional considerations. In May 1940 France had 115 divisions available, four-fifths of them in France.

Navy. — France's sea power was relatively late in developing, largely because during the middle ages so many of the maritime fiefs were often held by vassals strong enough to confine the authority of the crown to its inland demesne. Ships were usually hired to supplement the small royal fleet from such maritime nations as the Venetians and the Genoese. Until the time of Louis XIV the fleet was alternatively developed or neglected. The main theatre of maritime activity in the 15th century was the Mediterranean. With the discovery of the new world, the country, from its geographical position, had inevitably to pay attention to maritime strength. Yet Henry IV left no navy to his successors. Richelieu himself took the colonies and navy into his especial charge and built up a fleet of 20 men-of-war and 80 smaller ships.

Mazarin failed to continue Richelieu's work in this sphere. But Colbert enlarged the navy from 30 mostly small vessels (1661) into 107, of which one-fifth carried 120 guns (1683). In addition, the port and arsenal of Toulon was established and various ports were fortified and naval schools established. To provide recruits Colbert instituted the inscription maritime, which still survives. This was a list of Frenchmen exercising the calling of sailors who could be called on to serve and who were granted certain privileges and pensions.

After Colbert's death (1683) the navy was again neglected. By 1747, toward the end of the War of the Austrian Succession, it numbered 31 ships of the line, as against 136 British; then two naval defeats in that year virtually destroyed it. Its strength was again rebuilt to some extent during the Seven Years' War. In 1758 the navy numbered 77 ships of the line, but around half were soon lost in battle. Between 1763 and 1789 rebuilding again took place, and by 1778 ships of the line numbered 80. The British victories of the Revolutionary and Napoleonic periods reduced the French fleet to impotence and ended any further attempts to secure naval supremacy.

During the 19th century the navy kept abreast of such developments as the introduction of steam and the creation of ironclads. But after the Franco-German War construction lagged, and on the outbreak of World War I the fleet, though large, was to a great degree obsolescent. Its total tonnage was 816,000 (37% of the British), and its operations were chiefly confined to the Mediterranean and the channel. After 1918 financial difficulties hampered the building of capital ships; construction was chiefly devoted to light craft and submarines. Tonnage in 1939 was around 400,000 (surface craft). During World War II most of the fleet was destroyed or fell into British or German hands.

The home bases of the fleet, which were the core of the naval arrondissements, were Cherbourg, Brest, Lorient, Rochefort, Toulon and Bizerta (North Africa), where building and outfitting yards and arsenals were established. The areas came under the command of a *préfet* maritime (admiral). The fleet was chiefly manned by volunteers or selected conscripts, mostly Bretons.

Air Force. — The French air force came into existence in 1909, and a directorate of military aviation was established within the war ministry in 1912. During World War I, 40,000 aircraft were built and 17,000 pilots trained. In 1928 an air ministry was created, which assumed control of the existing military, naval and colonial arms. The number of aeroplanes at the outbreak of World War II was 3,205, when production was at the rate of 250 a month.

Defense After 1945.—Toward the end of World War II the reconstruction of French armed forces, particularly of the army, was pushed forward, and by the end of 1945 the effective strength of land forces in Europe and overseas was around 700,000. In the class immediately following, the period of military service was fixed at one year; this was extended in 1950 to 18 months. A major reorganization for the purpose of co-ordinating the three services more closely than before the war was made in 1948. This widened the powers of the ministry for national defense, to which the three service departments were subordinated, and created various interservice committees of high command.

By the provisions of the constitution of 1946 the president of the republic was made the titular head of the forces, while the president of the council of ministers was responsible for co-ordinating the military and civil aspects of defense throughout the French union. In this the latter was advised by the Comité Militaire Permanent (un *organe de décision*), and his executive was the general staff of national defense. Two other (advisory) bodies, the Conseil Supérieur de la Défense Nationale and the Comité de la Défense Nationale, presided over by the president of the republic, were also created.

The ministry of armed forces (later called ministry of national defense) was responsible for the training, mobilization employment, administration, etc., of the forces in metropolitan France. The minister was directly assisted by a Comité des Chefs d'États-Majors Généraux and its staff, which integrated representatives of the three services. Under him was also an Inspection Générale des Forces Armées, which controlled the training of all three services. The individual service departments themselves were each under the administration of a secretary of state.

Army.—France is divided into ten military regions, as follows: (1) Paris; (2) Lille; (3) Rennes; (4) Bordeaux; (5) Toulouse; (6) Metz; (7) Dijon; (8) Lyons; (9) Marseilles; (10) Algiers. By the middle of 1955 there were five more or less full-strength divisions and nine so-called M+30 divisions (*i.e.,* mobilizable within from 3 to 30 days, the state of their equipment and of their training being, however, doubtful). The effectives of all army units, including the gendarmerie and the colonial troops, amounted to 706,000.

Air Force (*Armée* de *l'Air*).—By 1955 there were five *régions aériennes*: (1) Dijon; (2) Paris; (3) Bordeaux; (4) Aix-en-Provence; (5) Algiers. There was also an independent command, part of the North Atlantic Treaty organization, called 1st CATXC (Corps Aérien Tactique), with headquarters in Germany, at Lahr in the Black Forest. The smallest operational unit was the *escadrille* (squadron); these were grouped into escadrons (wings) and escadres (groups). There were 38 fully formed escadrons in all (including 30 jet-propelled), with a total of 2,100 aircraft, 41 air bases and 130,000 effectives.

Navy (*Marine* de *Guerre*).—There were four territorial commands: (1) Cherbourg. covering the channel coast line from the Belgian frontier to Mont St. Michel; (2) Brest, covering the coast from Mont St. Michel to the Spanish frontier; (3) Toulon, covering the country's European coast line on the Mediterranean; (4) Algiers. By 1955 the navy comprised 2 battleships, 3 light fleet aircraft carriers, 1 escort carrier, 5 cruisers, 18 destroyers, 51 frigates and escort vessels, 14 submarines and a number of mine sweepers and other auxiliary vessels; in all. 430,000 gross tons of ships, as well as 900 aircraft. Effectives numbered 71,000.

Defense Budget.—The total defense budget for 1954 amounted to 1,100,000,000,000 fr. including 39,000,000,000 fr. for the common section, 280,000,000,000 fr. for the army, 270,000,000,000 fr. for the air force, 170,000,000,000 fr. for the navy and the rest for new armaments.

OVERSEAS POSSESSIONS

The French colonial empire of the ancien *régime* was largely lost during the second half of the 18th century (see History, above); and after the Napoleonic Wars the treaties of Paris (1814 and 1815) left France with Guadeloupe. Martinique, trading ports in Senegal and India, French Guiana and Réunion only.

However, succeeding governments expanded this remainder to create the second largest empire of the world. The conquest of Algiers in 1830 began the establishment of French rule on the Algerian coast and on the high plateaus. Trading ports mere set up in the Gulf of Guinea, a protectorate over islands near to Madagascar and in the South Pacific. The Second Empire established French rule in the Algerian Sahara; transformed the trading ports of Senegal into an important colony; acquired Obok and Amabo in Somaliland: began to gain a foothold in Cochin-China around the mouth of the Mekong; and took Cambodia under its protection. Finally, the third republic extended these acquisitions and co-ordinated them.

Tunisia was acquired as a protectorate in 1881, most of Morocco in 1906. Senegal served as a springboard for the occupation of west African territories. The small trading ports of Gabon were extended into a hold on what later became French Equatorial Africa. The conquest of the whole of the Sahara by 1900 knitted together on the banks of the Chad the three areas of North. West and Equatorial Africa. In the Indian ocean Madagascar was acquired in 1895 and its governor general's authority extended to the Comoro Islands in 1908. The footholds in Somaliland were consolidated after the foundation of Jibuti (Djibouti) in 1888. In Asia French control spread to the kingdoms of Annam, Tongking and Laos (1885–1903); in the Pacific, to the Society Islands with Tahiti (1903) and to the New Hebrides (1904).

After 1918, certain German possessions in Equatorial Africa, which had been taken irom France in 1911, were returned to it; and important parts of Togoland, the Cameroons, Syria and the Lebanon were acquired under mandate from the League of Nations. After World War II France relinquished its mandate over Syria and the Lebanon and handed Chandernagore over to India.

Constitutional Organization Before 1946.—Under the ancien *régime* and under the first republic the colonies were subject to laws applying to the metropolitan area; subsequently, until 1852, they were governed by the enactment of special laws. Then the Second Empire gave the senate the power to legislate on colonial matters, and in 1854 this body granted a constitution to the older colonies of Martinique, Guadeloupe and Réunion but left the other possessions to be governed by decrees of the emperor, pending a formulation of their status.

The constitution of the third republic remained silent on the position of the colonies, and throughout its existence France's increasing overseas possessions were controlled politically and economically by the central authority. Their population of about 70,000,000 in 1939 (of nhom only a very few were French citizens) continued for the most part to be governed by decree and largely administered by a central bureaucracy, though parliament could always discuss colonial questions and indeed legislate on them. Some of the colonies too were represented, through the suffrages of resident French citizens and a small minority of privileged natives. in the two houses of the central legislature. Yet the average Frenchman was seldom interested in the realities of his empire.

During the 20th century the increasing extent and diversity of France's possessions led to controversy upon governing by decree 1 The system was defended on the grounds that it offered a supple. rapid and appropriate method of administration according to the differing needs of the heterogenous areas; and attacked on the grounds that it could never bring unification to this growing and complex body. Another problem was the assimilation of the indigenous population within its territories, which French official policy encouraged. In the 20th century it was increasingly appreciated that some native cultures (*e.g.,* the Islamic) were too powerful to supplant. Moreover. an increasing dearth of manpower prevented France's sending enough colonists to influence local customs radically. Thus colonial administration was forced into a policy of "association." whereby local government was in some measure delegated to the influential local chiefs, and elements of the native civilization were retained. The ".assimilated" native was still encouraged to acquire French citizenship, though by 1939 only 2,500,000 (including those of European stock) had done so.

The French Union.—By 1939 many French politicians had come to see that a policy of complete assimilation was doomed to failure. Already local national parties were springing up in many territories. demanding political equality and some measure of self-government. The defeat of France in 1940, combined with the fact that resistance to Germany and Vichy conticued to flourish in many overseas possessions, placed the colonies in a strong position to demand some reform. The Brazzaville conference of 1944 between the Free French leaders and colonial notables made some attempt to meet native wishes. Although it rejected the principle of autonomy, the conference recommended a political reorganization to guarantee the unity of the French world and to encourage local self-government.

By the constitution of 1946, metropolitan France and its overseas possessions were linked together under the title of the French union. The organization of the union was complex. Three institutions seated in Paris, viz., parliament, the assembly of the French union and the high council of the French union, had each a voice in affairs. Each of the countries within the French union sent members to one or more of those bodies. In addition. the majority of them possessed local representative assemblies, while the territories forming French West Africa and French Equatorial Africa also elected territorial assemblies representing either group as a whole.

Of the national representative bodies, parliament had the right to pass legislation, while the assembly of the French union and the high council of the French union were purely advisory bodies. The assembly of the French union was composed half of delegates from overseas and half of representatives from the national assembly. It was thus a microcosm of the latter, with the addition of a strong coloured element; and its effective influence was small. The high council, composed of delegations from metropolitan France and from each of the associated states, did not play any significant role either. Thus, effective control of most parts of the union was exercised by parliament and by the ministries concerned with the various territories.

The countries of the French union, in addition to the metropolitan area, fell into five categories, each having a different political status. *(See* Table VI.)

First, there were the overseas *dkpartements* which included those colonies, Martinique, Guadeloupe, Guiana and Réunion, whose inhabitants are largely of French or mixed stock. Being relatively easy to administer, they were assimilated to the political system of the metropolis and given a French type of local government which consisted of a *préfet* and a *conseil général.* French laws were automatically applicable to these territories; and the inhabitants enjoyed full rights of French citizenship. The responsibility for their administration came under the minister of the interior. Algeria, as the oldest French possession in Africa with a numerous French minority, also belonged to this category, though with certain differences in status as provided in the Statute of Algeria of 1947. The degree of autonomy thus granted —by the creation of an Algerian government and assembly—was, however, relatively small.

The second category was that of French overseas territories, comprising the least advanced areas under French rule. These were French West Africa, French Equatorial Africa, Saint-Pierre and Miquelon, Madagascar, the Comoro Islands, French Somaliland, French India, New Caledonia and the French Pacific Islands. Their inhabitants enjoyed French nationality, though they did not necessarily exercise the rights of citizenship in the same way or to the same extent as the inhabitants of metropolitan France. French laws were automatically applicable in some spheres of legislation; in others the president of the republic made them so by decree. Government was carried on by a French governor general, who in some cases was bound to consult the local representative assembly. The powers of these local assemblies were very limited and mostly concerned details of tax collection and local finances. Ministerial responsibility for the overseas territories lay with the ministry of overseas France.

The third category was that of associated states. According to the French constitution, "the status of each associated state in the French Union is determined by agreement defining its relationship with France." Thus, an associated state was envisaged as a political unit enjoying some degree of internal sovereignty and linked to France by an instrument resembling an international treaty. Up to 1953 three states had been granted this status, Laos, Cambodia and Vietnam (including the former colony of Cochin-China). They were represented in the assembly of the French union and in the high council, but not in the parliament, since they possessed their own governments and parliaments, They formed part of the French union but, unlike the overseas *départements* and territories, not of the French republic. Their inhabitants retained their own nationality and enjoyed also a "citizenship" of the French union which was common to all the inhabitants of the union. French ministerial responsibility for relations with them belonged to the ministry of overseas France.

The final category of overseas possessions was that of associated territories, the former mandated territories of Togoland and the Cameroons (Cameroun), held under trusteeship from the United Nations. Their status was similar to that of the overseas territories, though their inhabitants did not possess French nationality. They had local representative assemblies and also sent representatives to the parliament and to the assembly of the French union.

The protectorates of Tunisia and Morocco did not form part of the French union and strongly resisted any attempt to incorporate them in it. Thus neither of the countries sent representatives to the various assemblies in Paris. Responsibility for their administration rested with the ministry for foreign affairs.

While local representative assemblies (admittedly with very little power) were created to meet their increasing desire for autonomy, the colonial peoples were at the same time encouraged to look, for the satisfaction of their political ambitions, to the various assemblies in metropolitan France. Thus the prestige—as well as the powers—of the local assemblies was very small, and the best talent of the native population was drawn toward the metropolis. This policy of political assimilation, which was reinforced by one of cultural, often resulted in a genuine loyalty to France, particularly among the more educated natives, who, however, sometimes became so French in outlook as to lose caste with their own people.

The traditional tendencies and future intentions of French colonial policy were expressed in the conclusions of the Brazzaville conference of 1944, on which the subsequent development of the French union was based. They read:

> The objectives of the work of civilization accomplished by France in the colonies exclude any idea of autonomy, all possibility of evolving out of the French colonial bloc. The establishment, even in the distant future, of self-government in the colonies is to be excluded. . . . It is essential that the representation of the colonies in the central administration of metropolitan France should be far more adequately and effectively ensured than in the past.

By offering to the native peoples representation in the political institutions of metropolitan France and thus a share in the government of the whole French union, the French hoped to induce them to renounce their ambitions for self-government. By 1952 the 627 seats in the national assembly were divided as follows: France and Algeria (metropolitan France) 574, overseas *départe-*

TABLE VI.—*The French Union, 1954*

Country	Area (sq.mi.)	Population* (in thousands)	Capital	Status
Algeria	846,124	9,529†	Algiers	Group of three *départements*
French West Africa	1,831,079	17,726	Dakar	
Mauritania	416,061	560	St. Louis	Overseas territory
Senegal and Dakar	80,617	2,158	St. Louis	Overseas territory
Sudan	460,540	3,461	Bamako	Overseas territory
Upper Volta	105,946	3,200	Ouagadougou	Overseas territory
Ivory Coast	123,282	2,309	Abidjan	Overseas territory
French Guinea	106,216	2,262	Conakry	Overseas territory
Niger	494,633	2,227	Niamey	Overseas territory
Dahomey	43,784	1,549	Porto Novo	Overseas territory
Togoland	21,235	1,070‡	Lomé	Associated territory
French Equatorial Africa	969,111	4,406§	Brazzaville	Group of territories
Gabon	103,089	409§	Libreville	Overseas territory
Middle Congo	132,046	684§	Pointe Noire	Overseas territory
Ubangi-Shari	238,224	1,072§	Bangui	Overseas territory
Chad	495,752	2,241§	Fort Lamy	Overseas territorv
Cameroun	166,793	3,116‡	Yaoundé	Associated territory
French Somaliland	8,494	64‡	Jibuti	Overseas territory
Madagascar and dependencies¶	230,165	4,740‡	Antananarivo	Overseas territory
Comoro Archipelago	832	170	Dzaoudzi	Overseas territory
Réunion	969	274	St. Denis	Overseas *département*
saint-pierre and Miquelon	93	5	St. Pierre	Overseas territory
French Guiana	35,135	28†	Cayenne	Overseas *ddpartement*
Guadeloupe	687	229†	Basse-Terre	Overseas *département*
Martinique	425	239†	Fort-de-France	Overseas *département*
Vietnam‖	65,726	11,500	Saigon	Associated state
Cambodia	65,958	4,100	Pnom-Penh	Associated state
Laos	91,506	1,425	Vientiane	Associated state
New Caledonia and dependencies	7,654	50§	Nouméa	Overseas territory
New Hebrides	5,700	53	Vila	Franco-British condominium
French Pacific Islands	1,544	60§	Papeete	Overseas territory

*1954 estimate if not otherwise stated. †1954 census, ‡1955 estimate. §1950 estimate. ‖Southern Vietnam only.
¶Dependencies are part of Austral and Antarctic territory.

ments and territories 53. In Algeria (30 seats) and in the overseas territories, there were two electoral colleges, one for French citizens, the other for natives. In the council of the republic, out of 320, there mere 44 overseas members and 14 from Algeria; again, many of these were French. In the assembly of the French union half the members were nominated by the political parties in metropolitan France, but on the high council the overseas d&-*partements* and territories had no separate representation. Such representation failed to give overseas native peoples an effective voice in either local or union government. For the changes under the fifth republic *see* FRENCH COMMUNITY.

ECONOMY

France's economy has been assisted by the possession of certain natural resources and also by the characteristics of its geographical position. The soil is fertile, the climate equable and the river system far reaching. Mineral deposits are fairly varied, iron ore being notably plentiful. The physical conformation of the country makes internal communications easy; and coasts and estuaries offerample opportunity for the development of ports. Moreover, France occupies a central position between the old world and the new and has easy access to Africa and to the near east. Nevertheless, economic development has been constantly hampered or interrupted by disastrous foreign wars and civil strife.

During the 12th and 13th centuries the Capetian kings encouraged land reclamation in the shape of forest clearing. drainage and the improvement of the soil by the admixture of ashes, chalks and marl. The productive capacity of the country, especially in grains and wines (of which it became an early exporter), developed considerably. Industrial and commercial life flourished, particularly in the north and in coastal towns. By the beginning of the 14th century, it is estimated, France had around 23,000,000 inhabitants of whom 17,000,000 were rural.

This growing prosperity was ruined by the Hundred Years' War (*q.v.*), in the course of which vast areas fell into waste, towns and ports decayed, industrial life was halted and maritime trade was lost. Repeated campaigns by France's enemies, chiefly the English, and accompanying pestilences contributed to a large decrease in population. But rapid recovery took place in the latter half of the 15th century, chiefly because of the intrinsic physical advantages of the country. In the first part of the 16th century began the era of French expansion in the east and in the new world across the Atlantic; but again the tide of national prosperity was checked, this time by years of internal religious wars.

Early in the 17th century, Henry IV's government began to rehabilitate agriculture and commerce. Large areas were brought under production. manufactures were encouraged, roads and canals were built, commercial treaties concluded. Richelieu, under Louis XIII, continued the work of reconstruction, chiefly by building a navy and encouraging overseas expansion. Colbert, under Louis XIV, promoted the extension of France's maritime trade and conquests in North America, in the West and East Indies and in Africa and did much to stimulate manufactures and improve communications at home. Indeed he imposed on French industrial life a pattern which it continued thereafter to bear—that of the small specialized manufacture. But the later policy of Louis XIV and that of Louis XV in endeavouring to continue overseas expansion and at the same time to win territorial acquisitions in Europe proved too great a burden to allow France to resist the challenge of Great Britain; by 1763 most of the French possessions abroad and conquests in Europe had been lost. Internally the country had been considerably impoverished by excessive taxation of the commercial and lower classes.

Under Napoleon much mas done to promote industry and commerce (*e.g.,* the promulgation of the *Code* de *Commerce* in 1808); trade by land was considerable; and great progress was made in the development of public works. But France emerged from the Napoleonic era with its external trade seriously curtailed and the technical progress of the Industrial Revolution retarded. During the 19th century the nation was rapidly overtaken by Germany and Great Britain in population, industrial production and commercial wealth. In the middle decades, however, exploitation of the country's mineral potentialities and a mechanization of its industries did begin to make a tardy headway. But large-scale industrialization was slowed down at first by the existence of a widespread cottage industry, by the individualism of the French *patron,* who tended to oppose integration within large-scale organizations, and by the insufficiency of the country's coal resources. Thus, during the first part of the 19th century the urban working class in France did not grow at all rapidly; towns were slow in developing and few became very large. In industry the small *patron* or the family business remained a common unit; the craftsman resisted the transformation into the skilled or unskilled labour of large undertakings. The mechanization of French trades was, therefore, largely incomplete, and their output lagged behind that of more scientifically industrialized rivals.

Agriculture continued to be the predominant occupation and to provide a large stable and conservative element within the country. But toward the end of the 19th century the drift from rural into urban areas began to increase, and the rural population fell from 75% to 50% during its latter half. The causes for this were the reluctance of peasants in the more infertile regions to struggle against the relative unproductiveness of the soil; competition from abroad; mechanization. which deprived the labourer of employment; and the partial supplanting of the cottage industries by the more mechanized urban ones.

After the Franco-German War France went through a period of depression. Two of its richest provinces, constituting 2.5% of its territory, had been lost and a considerable war indemnity had to be faced. To stimulate essential economic activities a policy of stronger protection was introduced and commercial agreements were more widely sought. France also turned increasingly to the development of its existing overseas possessions and to the further expansion of its colonial empire. World War I again halted economic progress. In 1918 the country faced many problems created by heavy losses of manpower, by the devastation of its northern and eastern provinces and by its heavy debts to its allies, the U.S. and Britain. On the credit side of the balance sheet there was, however, the recovery of Alsace-Lorraine and the occupation of the Saar, whose coal was for several years to supplement France's own somewhat meagre resources.

After 1918 a more progressive policy in industry was adopted, particularly in the modernization of equipment; communications were improved; the integration of the country's colonial units was pursued.

When the economic depression of the late 1920s hit the world, France proved more capable of resistance than many other nations. The strength of its agriculture, the existence of small-scale industries. well-balanced production and a lesser reliance on international trade contributed to this. However. an attempt to maintain the franc on the gold standard. together with political dissension, corrupt and inefficient administration and strikes, began to weaken the country when other nations were beginning to recover. Unemployment (for which the country had an inadequate relief system) increased. The policy of wage increases, shorter hours and paid holidays introduced by the popular front government (1936) was only an attempt to appease the working classes and offered no solution to the economic ills. In 1938 a more resolute policy was adopted. Strikes were suppressed, hours of work increased and the franc was devalued.

After World War II France began a major reorganization and modernization of agriculture and industry. In addition a more thorough exploitation of the tremendous water resources of the country for hydroelectric power was undertaken, as well as the improvement of communications. Substantial progress was made in most economic spheres, though it was handicapped by the instability of administrations, tax evasion, strikes, high costs, lack of confidence in the franc, considerable sacrifices for the cause of European defense and the costly war in Indochina.

During this period the government was attempting to solve economic difficulties by more effective price .control and wage freezes, by budgetary economies, by reorganizing of the nationalized industries, by lengthening of the working week, by revision of credit policy, etc. For labour, see *Population,* above.

AGRICULTURE, FORESTRY AND FISHERIES

Climate, relief and soil have all contributed to assist the development of agriculture in France. The oceanic climate of the north and west produces a moderate temperature and adequate rainfall for all kinds of crops. In the centre and south an increased prevalence of sunshine, yet without serious drought, has added to the variety of produce. Though the mountainous areas occupy nearly a quarter of the country, only the highest are completely infertile. Cultivation has extended far up the Alpine, Pyrenean, Vosges and Jura valleys and over the lower plateaus of the Massif Central. The soil of the country is varied, but three main types predominate: the fertile loamy mixture of clay and sand (limon), which is widespread over the low plateaus and plains of the north and the northern centre and in parts of Alsace; the calcareous earths covering large stretches of Lorraine, of Champagne and of Burgundy in the east and of Saintonge, of Périgord and of Quercy in the central west and also the lower mountainous areas; and the third type, which includes the rich volcanic deposits in certain areas of the Massif Central, the alluvial deposits of the many river valleys, the poor acid soils of central Brittany and the sandy stretches of the Landes.

Serious development of cultivation began around the 11th century, with the clearing of forests and the foundation of villages; much of this work was inspired by the monastic orders. In later centuries (particularly in the early 17th) attention was turned to the draining of marshlands and then to irrigation. But until the 18th century French agriculture was in a relatively primitive state. Under British influence a more intensive and scientific cultivation was begun by the enclosure of common lands, by the introduction of fallow break, manures and better mechanical aids, by the cross-breeding of stock, etc.

In the production of cereals there was a tendency to concentrate, where possible, on the superior grains (*e.g.,* wheat) or to extend the growth of fodder crops for the support of stock (particularly cattle and pigs).

The existence of a landowning peasantry dated from long before the French Revolution, by which time almost half the country belonged to small holders. who formed nine-tenths of the landowners. The policy of the Revolutionary and Napoleonic regimes was to establish the peasant freeholder as the backbone of the nation. Inheritance laws required the subdivision of land among the sons. Agriculture was and continued to be well guarded by tariffs. and the peasant was relieved of too heavy a taxation. Such a policy of protection had its disadvantages. Advanced methods of cultivation were slow in being introduced; productivity remained relatively low; and any considerable rise in the standard of living was hampered.

Despite the encouragement given to the peasantry, agriculture from the 1860s began to suffer from the increasing industrialization of the country and from overseas competition. Agriculture was the occupation of about 48% of the active population in 1866, of 42% in 1906, of 36% in 1931 and of less than 30% in 1954. The decline affected cultivated areas, at whose expense there was an increase in pasture. In 1892, 25,600,000 ha. were under cultivation; in 1934, 21,700,000; in 1937, 20,300,000; and in 1953, 18,-546,000. Corresponding figures for natural pasture were 5,900,-000, 10,800,000, 12,060,000 and 12,347,000. (See Table VII.)

TABLE VII.—*Land Utilization*

(in ooo ha.)

Type	1892	1913	1938	1947	1950	1953
Arableland	25,387	23,651	20,196	18,045	18,573	18,546
Market gardens	387	267	437	598	542	.
Permanent grassland	5,920	10,048	11,775	12,292	12,279	12,347
Forests and woodlands	9,522	9,887	11,076	11,106	11,400	...
Vineyards	1,800	1,617	1,605	1,544	1,574	1,454
Unused but potentially productiveland	6,226*	3,793	5,680	6,321	5,687	...
Total†	52,857	52,953	55,099	55,104	55,160	...

*Incomplete returns. †Includes orchards, olive groves, horticultural and nursery gardens, etc., and waters.

Nevertheless, agriculture in the middle of the 20th century was still the major occupation of the people. Before 1945 technical progress had been only slightly encouraged by government assistance; but later the industry received considerable subsidies (6,340,000,000 fr. in 1948; 19,250,000,000 fr. in 1950; 9,550,000,-000 fr. in 1952) and loans (14,350,000,000 fr. in 1948; 53,600,-000,000 fr. in 1950; 18,000,000,000 fr. in 1952). More rural areas were electrified and modem amenities were made more widely available. There were also increased facilities for stocking and cold storage and more irrigation. Furthermore, various small and too unproductive areas were taken into larger and more economic units.

By far the greater proportion of land was divided among small cultivators, either owners or tenants. Only a few score of estates exceeded 1.000 ha.; about 100,000 were between 50 and 500 ha., 700,000 between 10 and 50 ha. and 4,500,000 less than 10 ha. The-larger estates were found in Normandy, Brittany, La Vendée and Flanders and around Paris. The smaller ones extended throughout the country, but were most numerous in the eastern provinces, in the southwest and in the south or along the river valleys. In the 1950s remembrement, the combining of small unprofitable holdings, was being increasingly practised. While the majority of the small holders cultivated their own land, usually with the assistance of their family or hired labourers, a certain number of farms were leased. In the Paris area, in the north and in the west, the tenant farmer predominated. A second system was that of *métayage* (a method more prevalent in previous centuries and found mostly in Berry, Limousin, La Vendée, Aquitaine and Provence), under which the owner (who supplied capital) and the cultivator (who supplied labour) took either half and half or one-third and two-thirds of the produce respectively.

French experts agreed at mid-20th century that, if agriculture were better exploited, it could support a population of 70,000,000. Yet France was then importing three times as much corn as it exported; and in 1952 agricultural imports were valued at 108,-000,000,000 fr. as against exports at 51,000,000,000 fr. In 1953 and 1954 there was, however, a marked development in agricultural production with a corresponding decrease of imports of foodstuffs; and by the middle of 1955 a favourable trading balance in agricultural produce had been created. Requirements were an increased use of fertilizer; more tractors and equipment; further extension of irrigation in such areas as Languedoc, Gascony and the western marshlands; the instruction of farmers in scientific methods; and a better system of marketing.

Cereals.—The effect of a warm temperature and moderate rainfall has assisted the cultivation of wheat over a large area of France. Somewhat more than half the area devoted to cereals produces wheat. The more important regions are in Flanders and in the Paris basin (Soissonnais, Brie and Beauce), where a thick covering of *limon* well mixed with azote and potash offers a soil capable of greater yields than any in Great Britain (*e.g.,* on an average, 35 cwt. of wheat, 15 tons of potatoes and 20 tons of beet to the acre). Other regions giving a high yield are the alluvial terraces of the Seine and its tributaries, the Charente district in northern Aquitaine, the coastal plains of Brittany and Normandy, the Alsace terracelands, the lava soils of Languedoc and the lower valleys of the Alps.

The area under wheat tended to decrease after the end of the 19th century, particularly in Normandy and in the southern districts (*e.g.,* from 6,542,000 ha., excluding Alsace-Lorraine, in 1913 to 4,319,000 in 1950), though it rose somewhat in the second half of the 20th (4,482,000 ha. in 1954) and the yield per hectare increased (1,240 kg. per hectare in 1840; 1,720 for the years 1896–1905; 1,960 in 1952; 2,346 in 1954). In the 20th century, as the demand for better bread increased, grain had to be imported, whereas formerly there had been a surplus for export.

Oats constitute the next important crop after wheat. They are most grown in the damper northern half of the country, particularly in the stock-raising areas. Barley is a less important crop, grown in parts of Alsace for brewing and in the northern areas as fodder. Rye is mostly confined to the poorer soils of the Massif Central, the Landes, central Brittany and the eastern Pyrenees. Maize is grown in the warm damp areas of the east and southwest, chiefly as a fodder crop. The production of main cereals is shown in Table VIII.

TABLE VIII.—*Main Crops*
(area in ooo ha.; production in ooo metric tons)

	1913		1934–38 av.		1948–50 av.		1951–55 av.	
	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.
Wheat . . .	6,542	8,692	5,224	8,143	4,258	7,806	4,362	9,093
Oats , , .	3,979	5,183	3,278	4,752	2,409	3,303	2,210	3,572
Barley . . .	760	1,044	742	1,074		1,425	1,167	2,164
Rye. . . .	1,176	1,272	663	769		631	418	478
Potatoes. . .	1,548	13,586	1,524	17,158	1,158	14,317	1,065*	14,789
Sugar beet . .	249	5,939	318	8,785	293	8,427	350	9,470
Maize . . .	458	543	342	541	308	353	355	769

*1951–54 average.

Root Crops.—Potatoes are the most important root crop grown for human consumption and were increasingly and widely cultivated after their introduction into France in the 18th century. The crop provides a surplus for pig food and for the manufacture of alcohol and starch. A fair quantity of new potatoes is exported. Fodder beets are widely grown on the northern plain; sugar beets are more localized in the extreme north (Pas-de-Calais) and around Paris and are used by sugar refineries and by distilleries.

Vines.—France is the most important wine-producing country in the world. though Italy has a larger area under vineyards. The yield per hectare in France is almost double what it is in Italy and the production of superior vintages is far greater. Production considerably decreased after the end of the 19th century. The area of vineyards was 2,345,000 ha. between 1870 and 1880, for example. but only 1,454,600 ha. in 1953. This decrease was largely the result of wartime destruction. attacks of disease (which sometimes desolated extensive districts), lack of labour, restrictive tariffs abroad and foreign competition, which made many cultivators turn to dairy farming instead. Cultivation is mostly in the hands of small holders. Roughly half of the output comes from the southern part of the country, particularly from the lower RhBne and Hérault districts. A second area, producing high-grade vintages, lies in the southwest along the valleys of the Garonne, Dordogne and Charente; in the southwest too are the brandy-distilling districts of Cognac and hrmagnac. A third area lies along the Loire valley in Anjou and Touraine. Three smaller vine-growing districts, Cbte d'Or, Chablis and Beaujolais, are in Burgundy. Another area is in Champagne, particularly on the slopes of the Montagne de Reims and of the Côte des Blancs and in the Marne valley. There are also vineyards in Alsace-Lorraine (on the Vosges slopes) and in the Jura. Overproduction in post-war years forced the government to buy a substantial amount of wine and distribute it free to the "impoverished classes." Long-term plans were laid down for reducing the area under vines; this aroused the antagonism of the powerful winegrowing interests.

Miscellaneous Crops.—Minor crops include flax in the Scarpe and Lys valleys of the northeast, tobacco in the southwest and in Alsace, hemp along the Loire valley, hops in Alsace and in Burgundy, oilseeds, rape, poppy and olives in the south. (*See* Table IX.)

TABLE IX.—*Miscellaneous Crops*
(area in ooo ha.; production in ooo metric tons, except mine, in ooo hl.)

Crop	1913		1934–38 av.		1948–50 av.		1951–55 av.	
	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.
Flax fibre . .	30.5	22.0	32.0	20.7	37.0	25.4	51.0*	34.7*
Hempfibre. .	12.5	11.3	3.0	3.9	5.0	5.0	4.0*	3.8*
Tobacco . .	15.7	26.0	18.0	35.7	29.0	47.0	29.0	53.9
Olives . . .	...	38.4	...	39.0	75.0	27.0†	70.0‡	35.0§
Rice . . .	—	—	—	—	8.0	27.0	20.0	74.0
Wine . . .	1,538‖	44,172‖	1,620	62,640	1,562	51,840	1,551*	56,180

*1951–54 average. †1947–50 average. ‡1950. §1951–53 average. ‖1914.

Market Gardening.—Market gardening is extensively practised in France, particularly in areas where a large urban population offers a good market. Moreover, the development of communications encouraged the growth of the more perishable fruits and flowers in the Midi. In some districts market gardening has replaced vine growing. Vegetables flourish in the sheltered areas of Brittany, Poitou and the Rhône valley and find a market in Paris, the industrial northeast and England. Fruit is grown extensively and in wide variety, and commercial production has been developed in many districts; for example, as well as canning, there is crystallizing in Gascony, bottling and sugaring in the RhBne valley. The cultivation of flowers, both for the cut-flower trade and for perfume, is a speciality of the Côte d'Azur.

Livestock.—Stock raising is carried on by itself or in conjunction with arable farming. Natural types of pasture are upland, lowland (*bocage*) and small areas of coastal salt marsh. The upland pastures include the *alpages* or *estibes* (between the permanent snow line and the tree line), whither stock is driven to graze from early summer until autumn under the system of transhumance (the migration of cattle from the artificial pastures to the higher natural ones), and the heath pasture of the 'Massif Central and its plateaus. The *bocage* type is found particularly in Normandy, Brittany and parts of La Vendée. Salt-marsh pasture occurs chiefly in the Crau and Camargue districts of the Rhône delta and along the Breton and Vendée coasts. In most other agricultural districts mixed farming is practised, with an emphasis upon dairy stock. In the number of stock to the hectare France is well below that of smaller countries such as Belgium and the Netherlands.

After the middle of the 19th century the number of cattle rose slowly because of their better economic value, and even in such poorer pasture areas as the Alps cattle tended to replace sheep and goats.

TABLE X.—*Livestock*
(in ooo head)

Type	1852	1913	1938	1947	1953	1954	1955
Cattle. . . .	11,911	14,788	15,622	15,125	16,281	16,889	17,322
Sheep . . .	33,282	16,131	9,872	7,406	7,675	7,826	8,013
Horses. . . .	...	3,222	2,692	2,407	2,333	2,777	2,215
Mules. . . .	...	188	135	84	88	86	85
Asses	...	356	185	105	100	102	95
Pigs	5,246	7,036	7,127	5,678	7,179	7,328	7,570
Goats. . . .	...	1,435	1,416	1,145	1,289	1,278	...
Hens	42,852*	..	145,000	75,000	75,000	75,000	...

*1862.

TABLE XI.—*Production of Foodstuffs*
(in ooo metric tons)

Item	1934–38 av.	1948–50 av.	1953	1954	1955
. . . .	885	943	1,160	1,388	1,410
. . . .	670	799	920	904	920
Mutton and lamb . .	105	97	110	111	115
Milk	14,900	13,633	17,500	19,500	...
Butter	225	198	275	305	...
Cheese	265*	242†	296	331‡	...
Sugar, raw value . .	971	1,092	1,637	1,686	1,620

*1937–38 average. †1948–52 average. ‡Including cheese from sheep and goat's milk.

In the mountainous districts the overriding problem is to secure enough winter fodder for stock. Indeed, areas that might support some type of grain were devoted to producing fodder, particularly since it had become easier to transport food for human consumption from the lowlands. Transhumance is nidely practised in the Alps and Pyrenees. The period spent in the mountains usually averages about three months but may, according to conditions, be as short as one or as long as five. Within the zone of high pastures the herds move from place to place accompanied by drovers and others who form a small colony, milking and making cheese in addition to guarding them. Most of the pastures are the collective property of rural communities. (*See* Tables X and XI.)

Forestry.—About 20% of France is forested. Woodland is distributed widely but in a varying degree; *e.g.*, 37% in the Vosges, 34% in the Jura and less than 5% in some of the northern *départements*. It may be divided into several types: temperate forests in the northern areas, chiefly composed of oak and beech; temperate forests interspersed with Mediterranean as in the southwestern plain; Mediterranean in the Midi (deciduous and coniferous), where, because of widespread deforestation, a secondary growth of stunted thickets and shrubs has vegetated (usually called *garrigue* west of the Rhône and *maquis* to the east); and the upland forests of beech and ash, fir and pine and, finally, dwarf trees, with a tree line around 4,000–5,000 ft. or even up to 8,000 ft. in the Pyrenees.

Control of forests began to be widely exercised after the 17th century and reafforestation in the latter part of the 19th, by which time it was apparent that clearing had progressed too far. Replanting was particularly carried out in the Alps, in the Cévennes, in Limousin, in the Landes, in the Sologne district and in the dry Champagne area.

The more primitive forest crafts declined considerably, particularly with the disappearance of charcoal as an industrial fuel and with the use of mechanical instruments for woodcutting. Cooperage and the making of sabots decreased, though in some districts smaller wooden articles are still made in domestic workshops. Economic exploitation is chiefly occupied with wood for pit props, railroad ties, paper, resin and cork.

Fisheries. — France possesses a coast line, deeply penetrated by bays and estuaries, of about 1,925 mi. and faces on the North sea, the Atlantic and the Mediterranean. Fisheries support around 300,000 persons, of whom approximately 65,000 are actually fishermen. Of these, 47% are from Brittany, 25% from Flanders, the Boulonnais and Normandy, 15% from the area between the Loire and the Adour and 13% from the Mediterranean coast. The chief fishing ports are Boulogne, Dieppe and Fécamp in the north, Lorient, Brest, La Rochelle and Bordeaux in the west and Marseilles on the Mediterranean.

Two-thirds of the French catch is made up of cod, herring, mackerel, tunny and sardine, which, except for the first named, are mostly fished in the relatively shallow waters of the continental shelf. Exploitation of the deeper waters of the northern Atlantic decreased from the end of the 18th century, but the fishing of west African waters increased. Lobster and oyster fishing ultimately became more important than miscellaneous coastal catches.

Table XII.—*Fisheries: Catch Landed**

Item	1912	1938	1947	1950	1951	1952	1953	1954
Value (000,000 fr.)	143	1,305	28,403†	...	33,808	...	...	...
Weight (000 m. tons)	...	530	441	454	528	488	520	500

*Including Algeria. †1948.

There is large-scale cultivation of oyster beds off southern Brittany and the coast of the Bay of Biscay. (See Table XII.)

INDUSTRY

The evolution of trades from small and often domestic and rural enterprises into larger and highly mechanized industries was far slower in France than in Great Britain or in Germany. Development in the 18th century (see History, above) took place largely in rural areas, where labour was cheap because of overpopulation and where restrictions applicable to the towns did not obtain. These restrictions were swept away at the fall of the ancien *régime,* after which industries became centred more and more in the localities which best supplied them with raw materials and power. Yet even in the first decades of the 19th century most textiles were made by hand in the home; charcoal was still commonly employed for blast furnaces; and the number of steam machines was around 600. By the middle of the 19th century the most common establishment was still the small workshop; only a few factories existed, each employing less than 100 workers. This slowness of evolution was partly the result of lack of fuel, partly of the large and cheap supply of labour and partly of the small employer's or individual craftsman's unwillingness to be absorbed within heavier or more highly organized trades. Thus the emphasis was placed on producing lighter machinery of specialized type, fine quality textiles and luxury goods.

The loss of the Lorraine iron fields and the textile industries of Alsace in 1871 proved a serious blow to the industrial production of France. During the next 40 years, however, some progress toward a more scientific industrialization took place, assisted by the development of inland communications. German occupation of the northeastern provinces in 1914 entailed widespread destruction of France's principal colliery and textile plant, and the opportunity for large-scale reconstruction on modem lines was not taken until after hostilities had ended. Moreover, the return of Alsace-Lorraine and the control (till 1935) of the Saar coal mines increased the industrial potentialities of the country enormously.

French industry proved at first less vulnerable to the economic crisis of the late 1920s and early 1930s than that of many other countries. The many small-scale industries surviving provided a more balanced and versatile economic structure that proved better capable of resisting the depression. Total production even increased until 1930, but by 1938 it had sunk by 25%.

In the first years of the German occupation during World War II an attempt was made by Germany to continue the activity of French manufactures and until 1941 about 60% of prewar production was maintained. But when raw materials became scarcer and French workers increasingly reluctant to collaborate, the country was despoiled on a large scale both of labour and of materials, and industry was concentrated on essential war equipment.

The promotion of industrial recovery was inaugurated after World War II by the Monnet plan (Premier plan de modernisation et *d'équipement,* named for Jean Monnet, adopted by the government Jan. 11, 1947) for modernizing equipment and increasing productivity, especially in the spheres of the coal, steel and textile industries and in transport and communications. Coal had been nationalized in 1944, gas, electricity and petroleum refining in 1946. Progress was, however, seriously handicapped, particularly in mining, by the strikes of the Communist trade unions in 1947 and 1948. Nevertheless. French industrial output tended to increase, despite rising costs and the traditional resistance of employers against the merging of smaller enterprises that was necessary for mass production. The "First Modernization plan" ended in Jan. 1954, and a second program was then begun. A peak of industrial production was reached early in 1952. After some setback late in 1953, production again began to rise, until in 1955 it reached a record figure.

Industrial Areas. — Two types of industrial area may be said, in general, to exist in France: the relatively extensive regions in the eastern half of the country; and the rather small and widely scattered pockets in the west. The development of these industrial areas was handicapped by the country's shortage of coal; but electrical power seemed likely to prove a factor of increasing importance.

The most important area is that of the northeast, chiefly composed of the two *départements* of Nord and Pas-de-Calais. There the dominating factor is the presence of France's largest coal field, which supports a large iron and steel industry. The fertile areas of Flanders and Artois also provide good soil for the cultivation of industrial crops such as flax and beets. An excellent system of communications by rail, road and waterway serves the locality. Within easy proximity are the ports of Dunkirk, Calais, Boulogne, Dieppe and Le Havre. A second well-developed area lies in the east, in Lorraine and Alsace. In Lorraine minette ores were exploited from the middle of the 19th century to form the basis of an important steel and iron industry. As supplies diminished, they were superseded by less rich ores. An extensive cotton industry flourished in the adjacent Vosges area and in the Alsace plain around Mulhouse. In Alsace itself occur two of the richest deposits of potash in Europe. A third area is composed of the Paris region, where various industries flourish, ranging from heavy engineering to luxury goods. A fourth area spreads on either side of the middle Rhône valley; it chiefly comprises metallurgical industries based on small coal fields to the east of the Massif Central and textile manufactures centred on Lyons but extending over a wide surrounding region.

Small industrial pockets occur principally in the north around Rouen and in the neighbouring valleys of the lower Seine (chiefly textiles) and in the Caen district of central Normandy (iron and steel); in the west centre around Mayenne, Le Mans and Angers (linen); and in the southwest, in the Garonne basin (metallurgy and chemicals). In addition certain towns form small local centres for a variety of trades; and over a large area of the country domestic cottage industries survive.

Fuel and Power. — Table XIII shows the development of French power resources.

Coal.—As stated above, France possesses one important coal field, comprising two adjacent basins, one in the Nord, the other in the Pas-de-Calais *département.* The whole coal field supplies about three-fifths of the country's output. It is a narrow belt,

TABLE XIII.—*Fuel and Power*
(in 000 metric tons; electricity in 000,000 kw.hr.; gas in 000,000 cu.m.)

Type	1913	1938	1947	1953	1954	1955
Coal	40,884	46,504	45,230	52,588	54,408	55,332
Lignite	793	1,058	2,093	1,956	1,908	2,052
Coke	...	7,636	6,003	8,631	8,723	10,079
Electricity	1,800*	20,800	25,941	41,300	45,524	49,560
Gas (mfd.)	...	1,622	2,466	2,590	2,589	2,497
Petroleum:						
Production	...	72	50	368	509	875
Treated in refineries	...	6,978	5,031	22,640	23,838	25,086

*Consumption. In 1923 production was 7,490,000,000 kw.hr.

about 51,000 ha. (125,970 ac.) in area, with deposits lying generally in deep-seated irregular strata as much as 13,000 m. below the surface, a fact which explains the slow and costly nature of production. Seams are often thin (only one metre in breadth) and of a variable quality, though each of the two basins has its own characteristics, that of the later-discovered Pas-de-Calais being the richer. Conversion into metallurgical coke and "patent fuels" is common. Serious exploitation of the basins began only with the 19th century. They then produced about one-third of the national output. This proportion rose first. to more than half (8,500,000 tons in 1880; 27,030,000 in 1913), then to two-thirds (28,000,000 in 1938). Production after World War II was again increased, chiefly through mechanization. By 1955 it had reached about 33,000,000 tons.

A small coal field in the east is that of the Moselle district, the principal centres of the industry being around Forbach and St. Avold. Many seams of coal are too deep for easy exploitation, but production rose steadily from 1,137,000 tons in 1900 to 6,737,000 in 1938 and to 12,000,000 in 1954; equipment there was up to date and output reached 2,000 kg. per man daily. In the Massif Central coal measures are often seamed along the folds of the valleys; for example, around St. Étienne in the upper Loire basin (3,951,000 tons in 1900 and 3,274,000 in 1938) and around Le Creusot, Blanzy and Épinac in the Burgundy-Nivernais basin (2,010,000 and 2,634,000). Coal is also mined around Alès (Gard) and Graissessac (Hérault) at the foot of the Cévennes; in the Creuse *département* on the north of the Massif; in the central Puy-de-Dôme area; and to the west in the valleys of the Tarn and Lot. Most of these fields support local metallurgical industries. By 1954, however, the basins of the centre and of the south, with their poor coal and bad position, were lagging behind in production (around 12,500,000 tons in all).

Total coal output showed a steady rise between 1820 and 1920 (except for war years), increasing from less than 2,000,000 tom to more than 40,000,000,but dropped in 192j to around 25,000,000 tons. After World War II modernization of equipment and technique made possible by investments under the Monnet plan and by aid from the United States brought production to a peak of 57,000,000 tons in 1952. The industry. however, suffered in the following year from the abolition of import quotas (under the European Coal and Steel Community) and from the competition of other types of energy. Production had to be curtailed. During the latter part of 1954 conditions began to improve, and the industry was reducing its financial deficit (9,000,000,000 fr. in 1954). Daily output at the coal face per man was around 1,515 kg. in 1954, a record. The number of miners was around 33,000 in 1850, 330,000 in 1927, 245,000 in 1937 and 238,800 in 1953. Of the last total, 157,400 were working at the coal face. A fair proportion of miners were foreigners, chiefly Poles. Exports of coal in 1954 came to 11,300,000 tons, chiefly to Great Britain, to the Benelux countries and to Germany.

Coke was produced mainly in the Pas-de-Calais section of the northern basin, in some districts of the central region (particularly at St. Étienne) and, increasingly, in the Moselle field. Output of all types of coke, a crucial problem for France, fell below national consumption and considerable quantities (4,843,516 tons in 195j) had to be imported.

The French coal industry was taken into the European Coal and Steel Community, under what is commonly known as the Schuman plan, in 1952.

Petroleum.—Though still insignificant and far short of the country's needs, the indigenous output of petroleum was considerably larger than it had been before World War II and steadily increasing by the latter 1950s. (*See* Table XIII.) Before the war it had been confined to deposits at Péchelbronn in Alsace, which produced 60,000 tons annually; but later more oil was struck in Alsace, and a fairly important field was discovered in 1939 near St. Marcet (Haute-Garonne), which produced 63,000 tons in 1950 and 263,000 tons in 1952. Oil deposits were found at Lacq (Basses-Pyrénées) in 1949 and at Parentis in the Landes early in 1954. Importation of crude petroleum, chiefly from Iraq, Kuwait and Saudi Arabia, reached 24,737,000 tons in 1955 and in 1954 was valued at 176,525,000,000 fr. Refined products in 1954 (plus imports, less exports) were approximately: gasoline, 4,090,800 tons; gas oil, 1,738,680 tons; fuel oil, 8,509,200 tons. Another source of energy is natural gas, found at St. Marcet, which supplied 240,500,000 cu.m. in 1953.

Electric Power.—The production of electricity developed considerably in France during the 20th century. At first the output of thermic energy surpassed that of hydraulic (4,085,000,000 kw.hr. against 3,405,000,000 in 1923); but later the utilization of the country's ample water power resulted in a preponderance of the latter. In 1955 about 55% of the country's electricity was generated in hydroelectric stations. The industry was nationalized in 1946.

Thermal generating stations were for the most part established in the coal fields or around the large towns and ports. The chief sources of hydraulic power are in the Alps (particularly the Isère, Doron, Arc and Drac rivers); in the Massif Central (the Dordogne, Truyère and Tarn rivers and their tributaries; and in the Pyrenees (the Garonne and Ariège rivers and their tributaries). There are important hydraulic installations on the Rhône at Génissiat and at Donzkre-Mondragon. Tidal energy was also being harnessed at La Rance on the Breton coast. The application of atomic energy to produce electricity was also being undertaken. Power has been distributed practically throughout the whole of France by the grid system.

Iron and Steel.—Iron ore is found in many parts of France, and in numerous localities iron was processed with the aid of charcoal in very early times. On the introduction of steam power the principal metallurgical areas became centred on the coal fields; but most native ores capable of treatment were becoming exhausted (except for a small but rich yield in Normandy). The abundant phosphoric deposits of the Lorraine area, however, provided a new source of exploitation after the invention of the Thomas process in 1878; the area's output of ore grew from 976,000 tons in 187j to 3,080,000 in 1895, to 19,920,000 in 1913 and to 55,700,000 in 1929; it fell to 11,600,000 in 1938 as foreign demand slackened; but rose again after World War II (33,000,000 in 1951).

Within the Lorraine area itself there are several metallurgical districts, principally around Nancy, between Metz and Thionville, around Briey and around Longwy. The iron content of the local ores is not very high, but it is easily extracted and reduced. Both pig iron and steel are produced, with an emphasis upon the former. Lorraine, however, has insufficient coal, the output of ore being far in excess of the local industry's demands. The chief metallurgical districts of the north, which get their ore both from Lorraine and from abroad, lie around Valenciennes, Douai and Lens on the coal field itself, in the Sambre valley to the southeast of it and around Lille, Isbergues, etc. In 1953 the northern coal field produced 21.5% of the national output of iron and steel. The chief types of steel produced are those made by the Thomas and the Martin processes; the Bessemer product is much rarer. The northern area in 1952 produced around 2,341,000 tons of steel.

A third and smaller area lies in the Ardennes *département* along the Meuse valley, with Mézières and Charleville as its centre. There a long-established iron industry, based on local ores, wood and water supplies, flourished. Supplies of ore or metal are now chiefly drawn from Lorraine, of coal from Belgium.

In and about the Massif Central there are further scattered metallurgical areas, which at first depended on local ore but later survived thanks to the easy availability of coal (though much has to be imported) or of hydroelectric power and, moreover, to their strategically less vulnerable position. Pig iron or iron ore is mostly obtained from Lorraine. The principal centres are at St. Étienne, producing steel and high-class alloys as well as iron, which supply an armament, aeroplane, locomotive and light engineering industry; and at Le Creusot, specializing in armaments and locomotives. More isolated centres, where local supplies are supplemented by imports, are Thiers and Clermont-Ferrand within the Massif and *Montluçon* and Commentry on its northern edge. Farther north, the ores of Berry were originally responsible for the metallurgical industries of the Nevers, Bourges and Vierzon districts, which now draw supplementary ores from Lorraine.

A small Norman iron industry, based on local ores of a rich content, is centred chiefly on Caen. In Brittany there are isolated iron and steel industries mostly confined to the ports or to their immediate district;

e.g., Nantes, St. Nazaire (with Trignac), Lorient and Brest. Small deposits of haematite ore are mined in the Pyrenees (Ariège and Haute-Garonne *départements*) and support an industry of electric steel at Pamiers and at Tarascon. Electric steel and ferroalloys are also produced in the Isère and Arc valleys of the Alps.

In the mid-1950s exports oi iron and steel were valued at 165,777,000,000 fr. and 126,400 people were employed in the industry at the beginning ot 1954.

Nonferrous Metals.— France is on the whole poor in nonferrous metals with the exception of bauxite; nor does it import very large quantities for industry purposes. After World War II, however, nonferrous resources were increasingly exploited. Bauxite is found particularly in the southeastern *département* of Var. It is converted into aluminum at plants in the Alpine and Pyrenean areas where hydroelectric power is readily available. Scattered deposits of zinc, Iead and copper occur in the mountainous areas, but their metal content is often very poor. (See Table XIV.)

TABLE XIV.—*Mining* and *Metallurgical Production*
(in ooo metric tons)

Metal	1913	1938	1947	1953	1954	1955
Iron ore*	21,918	33,062	18,691	42,372	43,824	50,321
Bauxite	...	649	676	1,165	1,275	1,497
Pig iron	5,207	6,012	4,886	8,700	8,842	10,959
Crude steel	4,680	6,221	5,732	10,000	10,627	12,348
Zinc	67.9	79.0	59.1	94.9	135.7	137.4
Aluminum	13.5	50.8	75.3	135.3	147.1	161.0
Copper	12.0	21.3	18.8	20.9	28.0	27.4
Tin	...	9.0	9.5	7.9	9.0	9.3
Magnesium	...	1.5	0.8	1.1	1.1	1.5

*35% metal content.

Chemicals.— The French chemical industry at mid-century (employing about 203,000 people) was based chiefly on the coal-producing regions, on coal-importing ports and on districts producing hydroelectric power. In the two former. waste products of the blast furnaces and coke ovens supplied gas, coal tar, ammonia and basic slag, to be turned into benzine, methyl and ethyl and resins. Dyestuffs were also manuiactured on the coal fields and near the textile areas as well as at Paris, Lyons and Rouen.

Chemical fertilizers were supplied by sulphate oi ammonia from the coal fields and basic slag both from there and from the smelters of Lorraine. Superphosphates were chiefly manuiactured at the ports from phosphates imported from North Africa. Sulphuric acid was derived from domestic copper pyrites or supplies from the Iberian peninsula. A fair proportion of potash, produced from deposits in Alsace, was exported, the rest chiefly turned into phosphatic fertilizers for the country's own agriculture. Common salt from rock salt, brine pumping or marine salt pans was produced in Lorraine, the Jura and the lagoons of the Mediterranean coast (2,639,000 tons in 1953; cf. 1,560,000 in 1938). Cheap hydroelectric power stimulated the growth of various electrochemical industries, producing calcium carbide, calcium cyanamide, synthetic nitrogen, etc. Works were oiten attached to the hydroelectric stations of the Alps and the Pyrenees. Vegetable oil was refined mostly at the ports (particularly Marseilles and Nantes) and in Paris and Lyons. From 9,878 tons in 1938, the production of plastics materials rose to 70,000 tons in 1954. Plastic manufactures were oiten the specialized occupation of craitsmen in hilly regions, such as the Jura. France ranked in 1954 fourth in the world as an exporter of chemicals.

Other minor industries included the making of artificial rubber (13,380 tons in 1954); the manufacture of synthetic perfumes; the distillation of alcohol irom beet root and potatoes; sugar refining in the northeast; and cement production, which was widespread because of the abundant distribution of limestone within the country.

Engineering.— By the middle of the 20th century, although supplies oi iron and electric energy were plentiful, France's coal and coke output had fallen short of the demand of the metallurgical and engineering industries. Moreover, except for aluminum, the nation relied mainly on imports for nonferrous metals. The engineering industry had been built up on a basis of supplying temporary demands, so that plants were neither large nor always up to date. Specialized equipment, metallurgical, electrical or agricultural, was mostly imported. ***(See*** Table XV.)

TABLE XV.—*Miscellaneous* Industrial Production
(in ooo metric tons)

Item	1938	1947	1953	**1954**	1955
Railway rolling stock	23,800	71,706	86,730	138,180	137,400
Agricultural machinery	163	118	124	...	...
Tractors (units)	1,750	4,203	28,246	39,444	64,224
Machinery (units)	433	3,964	5,902	6,936	11,424
Cement	4,129	4,467	9,227	9,554	10,764
Potash	3,274	4,168	6,068	6,739	7,703
Superphosphates	1,368	1,414	931	1,070	1,073
Sulphuric acid	1,272	1,069	1,180	1,379	1,472
Nitrogenousfertilizers	177	148	276	318	382
Rubber manufactures	162	168	290	331	356

The engineering industry, chiefly composed of small firms and employing in 1954 about 600,000 persons, nevertheless covered a wide variety of branches, particularly in the lighter sort of product. In 1950 its products represented about one-sixth of the total value of European output, and their domestic value in relation to the figure for 1938 had increased to 128%. Most of the heavy engineering firms were located on the northern, eastern and central coal basins. Locomotives and rolling stock were produced at Lille and Denain, electric rolling stock and coaches at Jeumont, Maubeuge and Douai. Paris specialized in light locomotives and various types of rolling stock.

The central region, because of its relatively protected situation, had most of the armament industry, particularly at Le Creusot and St. Étienne The most important exports were rolling stock and other railway equipment and textile machinery. The total value of exports in 1954 came to 84,000,000,000 ir. (cf. 106,000,000,000 fr. for imports). Electrical engineering, a new- and thriving industry, was chiefly concentrated in Paris and to a lesser extent around Lyons. It employed in 1954 more than 200,000 people and exported goods to the value of 48,600,000,000 fr. (cf. 20,900,000,000 fr. for imports). Similarly, the aircraft industry, largely nationalized after World War II, made up ground lost after 1940, producing particularly military aircraft.

Shipbuilding in France has always been on a small scale. Output reached a maximum in 1921 (210,000 tons or 5% of world output). In 1951, however, 36,000 tons of French shipping were completed, and substantial orders were being undertaken for abroad. The chief centres are St. Nazaire and Nantes on the Loire estuary and Le Havre, Harfleur, Le Trait and other places on the Seine; and there are lesser centres on the Gironde and at Marseilles. Marine engineering was not always closely related to the shipyards. Besides works at St. Nazaire and Nantes, engines were produced at Paris, Cherbourg and Dunkirk.

The motor industry was chiefly concentrated in a few large firms, mostly situated in the Paris area: Renault (state owned), Citroën-Panhard, Peugeot, Simca-Ford. A feature of the industry was the increased number of agricultural tractors produced. Roughly 25% of the production of private and commercial vehicles was exported, chiefly to French overseas territories. (See Table XVI.) The industry employed 260,000 workers.

TABLE XVI.—*Motor* Industry

Type	1929	1938	1947	1952	1954	1955
Passenger cars	211,000	182,400	66,277	369,960	437,196	553,344
Commercial vehicles	42,000	39,360	66,972	125,760	157,812	166,572
Exports:						
Passenger vehicles	...	19,302	57,212	82,218	100,896	132,840
Commercial vehicles	...	2,396	23,095	21,430	26,700	26,040
Chassis with motor	...	2.088	3,485	2,877	2,652	2,400

Textiles.— The French textile industry in the 1950s was still widely scattered throughout the country, but there were major concentrations in certain regions. These were: the northeast, particularly in and around Lille, producing chiefly cotton but also linen, woollen, rayon and mixed fabrics (in 1952 about 3,570 firms there employed 200,000 workers in all); Rouen and its district, chiefly cotton spinning; Alsace, producing cotton and calico; and the Lyons district producing silk and rayon. The industry as a whole tended to resist the integration of small units into larger concerns, and there was much local specialization in certain textiles. Whereas in 1840 French textile exports accounted ior 49.7% of the total value. in 1954 they constituted 15.8%. Import percentages were 24% (1840) and 15.2% (1954).

The woollen industry (with 99,883 employees in 1953), centred on Roubaix and Tourcoing near the Belgian frontier, began in the middle ages. In the early part of the 19th century the introduction oi steam power tended to throw an emphasis at first on the more easy production of cotton goods, but foreign competition led to a revival of the woollen industry. Roubaix specialized particularly in light cloths for women's wear, Tourcoing in carpets. In addition the district produced a variety of other woollen products and attracted certain allied industries. The woollen industry was also iound in Picardy, in Alsace (chiefly round Colmar and Mulhouse) and at Elbeui near Rouen. A number of towns also specialized in some class of woollens; *e.g.*, Reims and its district in flannels, Sedan in heavy cloth and Orleans in blankets. Supplies of wool were mostly obtained from the British commonwealth, from Argentina and from certain French overseas possessions. Barely one-tenth came irom domestic sources. Imports amounted to 89,127,000,000 fr. in 1954, with Australia the chief supplier.

The production of linen, once widespread in the north, largely withdrew into the valley of the Lys, around such centres as Lille and Armentières, which by the 1950s were producing more than 90% of French linen goods and giving employment to 10,000 workers. At first supplies of flax were drawn irom Flanders, but later there was a steady decline in this source. Manufactures ranged over a variety of products, with individual towns tending to specialize. The linen industry was also found in the Somme basin, Normandy and Brittany.

The cotton industry to a great extent supplanted the woollen and the linen and became by far the most important branch of textiles. It rapidly established itself at Rouen and in Flanders. Rouen became chiefly a spinning district and a producer of heavy cottons. Lille concentrated particularly on higher-quality products and also supplied adjacent towns with yarns. Cambrai, Tourcoing and Roubaix produced hosiery and knitwear, St. Omer, Cambrai and Valenciennes underwear, Armentieres coarser products. In the east, the cotton industry became localized in the Vosges valleys, in Alsace (particularly at Mulhouse and Colmar), in Lorraine (Epinal, St. Dié and Belfort). Cotton imports came to 96,251,000,000 fr. in 1954 with the U.S. and Egypt as chief suppliers.

Alsace tended to produce higher-quality piece goods such as zephyrs, twills and calicoes, the Vosges and Lorraine coarser goods. The industry was wholly dependent on imports of cotton, which came chiefly from the United States, India, Egypt and certain French possessions. It was largely composed of small undertakings, somewhat lacking in up-to-date machinery and producing a wide variety of goods within each area.

The silk industry was introduced into the lower Rhône valley by Italian immigrants during the 15th century. Thence sericulture rapidly spread as a cottage industry over Provence and Languedoc, while silk reeling and spinning became an occupation in the adjacent areas of Savoy and Auvergne and even extended farther into central France. From mid-19th century, however, the amount of cocoons greatly declined, despite state encouragement. Raw supplies were imported from Italy and China to make up the deficit. This was chiefly the result of competition from Italy and then from Japan and of the emergence of rayon as a substitute. By mid-20th century the manufacture of silk goods was largely concentrated in the Lyons and St. Étienne area, and the more elaborate articles were still produced by a cottage industry. Troyes also produced locally manufactured silk and spun silk for a considerable hosiery industry. Silk was also produced in the Vosges valleys, with Mulhouse and Barr as centres.

After World War I the rayon industry grew rapidly in France; by 1938 it was the sixth largest producer in the world, with 28,000 tons annually (*cf.* 4,000 in 1922). The industry is chiefly concentrated in the Lyons district, in Alsace and in the northeastern textile area, where the cotton and to a lesser extent the woollen industries became closely associated with it.

The jute industry was chiefly found in the northeast and in Alsace, where in many instances it was combined with the production of linen and hemp. Most of the raw jute was imported from India and used to make sacks, carpets and string.

Table XVII shows the state of the textile industry (which employed about 472,000 persons at the beginning of 1954) in France before and after World War II.

TABLE XVII.—*Textile Production*
(in ooo metric tonsj

Item	1938	1948	1950	1953	1954	1955
Cotton:						
Raw, imports	278	213	293	284	313	267
Yarn and thread	250	204	244	270	295	265
Fabrics	145	134	168	160	174	193
Wool:						
Raw,imports	117	92	107	109	97	119
Yarn and thread	118	116	127	120	128	129
Fabrics	80	72	80	68	72	70
Linen, yarn	24	18	23	28	30	28
Hemp, yarn	13	10	6	6	7	6
Jute:						
Raw, imports	82	59	74	101	85	97
Fabrics	60	47	62	69	73	79
Rayon:						
Yarn	28	44	45	47	53	55
Staple fibre	6	30	36	45	51	58

In late 1951 the industry encountered a severe crisis: the exports fell to less than half of the value that they had represented at the beginning of the year (10,000,000,000 fr. as against 21,500,000,000 fr. in February). The woollen trade, which normally exported 50% oi its output, suffered particularly severely. The setback was due to the rise of cost prices caused by wage increases, by expenses for social welfare and by the heavier charges for fuel and for transport and also to foreign competition and tariff discrimination, particularly on the part of Great Britain, Germany, Italy and South American countries. For 1954, however, the total value of the year's textile exports was 240,189,196,000 fr.; imports were valued at 232,762,632,000 fr.

COMMUNICATIONS

Posts, Telegraphs and Telephones.— In the later middle ages there were two postal services in France, that of the king and that of the University of Paris (used at first by students to communicate with their families and iriends, later by persons not connected with the university). Under Louis XI, Charles VIII and Francis I a system of relays was created on an international scale and some uniformity of postal tariffs was imposed. In 1j76 the royal post was placed at the service of the general public. Louvois established a *fermier des postes,* and in 1681 the private privileges of the university were abolished by decree, though its services continued until 1719, when they were fused with those of the royal post.

Under the Revolution, the *administration gdndrale des postes et messageries* was created. Use of stamps and unification of tariffs were introduced in 1848. The postal service incorporated the service of telegraphs in 1878 and that of telephones in 1889, and a special ministry was created.

The number of public telephone and telegraph posts in 1952 within the metropolitan area was around 1,496,000, with 947,000 supplementary posts. Private subscribers at the beginning of 1954 numbered 2,768,951. The volume of traffic represented a figure which existed in the U.S. in 1907 and in Great Britain in 1937.

Railways.— The first French railway for the transport of coal was opened in 1823 between St. Étienne and Andrézieux (13 mi.). Within the next two decades a few short stretches of industrial lines were opened; but with only 545 mi. of track in 1841, France was lagging behind the United States and Great Britain. A law of 1842 planned the construction of a series of railways radiating from Paris. The execution of the program was not achieved until 1870. The Paris-Rouen line was finished in 1843, the Paris-Strasbourg and the Paris-Bordeaux in 1853, the Paris-Lyons-Marseilles in 1856. By 1870 the network had reached a total of 10,830 mi. For a long time, however, the French system was lacking in international communications and in direct means of transit between provincial centres; and local lines, particularly in the more mountainous areas, did not exist.

By 1891 France had about 21,000 mi. of permanent way. Subsequently the rate of extension became slower, and in 1937 the total was only about 26,400 mi.; *i.e.,* 12 mi. to every 100 sq.mi. In 1938 the railways were nationalized and divided into five main regions. By 1954, when certain uneconomic lines had been abandoned, the total length of line amounted to about 25,600 mi. A major program of modernization was undertaken after World War II. This included technical developments for electrification of main lines and relaying tracks with rubber foundations. Staff was increasingly cut down (from 520,000 in 1938 to 380,000 in 1955). From June 3, 1956, the third class on French railways in Europe was abolished.

Electrification was begun on Paris suburban lines in 1901 and was extended to long-distance lines after 1945. By 1955 the total electrified distance was nearly 3,000 mi. In April 1955 trial runs on the electrified line between Bordeaux and Bayonne registered speeds of 205.6 m.p.h.

The railway system was increasingly integrated with state road transport, and many areas were supplied with motor transport, both long and short distance. By the middle of the 20th century railways were running about 320,000 motor vehicles for commercial and passenger transport.

Roads.—A road system existed in Gaul before the arrival of the Romans, who utilized, reorganized and extended it to link all the large centres together. Little further development took place until the 17th century, when the royal government attempted to strengthen the links connecting the provinces to Paris. Much of the work done in succeeding years was contributed by *corvée* (forced labour) of the peasantry.

By the time of the Revolution about 12,420 mi. of new roads had been added to the existing 18,375 mi, with towns such as Reims, Rouen, Lille, Lyons, Limogcs and Bordeaux as well as Paris serving as centres in the network. Napoleon devoted large sums to the upkeep of the system and extended it to cover the conquered countries of the empire; 229 imperial highways were enumerated in 1811. Local roads, however, were not very good until work to improve them and to build new ones was begun in 1836; by 1900 they had attained a length of more than 170,000 mi.

By 1950 the total length of French roads was 444,448 mi. of which 49,823 were *routes nationales,* 163,323 *routes départementales* or *communales,* 170,775 *chemins vicinaux* (local roads), the remainder comprising various minor sorts of thoroughfares.

Waterways.— The excellent river system of France was exploited by the Romans. Work for improving rivers as a means of communication was done in Flanders as early as the 11th century. Later the cutting of connecting canals was begun, and by the end of the 17th century the skeleton of a national system of linked waterways was created. By the early part of the 19th century an extensive network of about 2,900 mi, of canals alone had been constructed. Some destruction of waterways was incurred in World War I, and in later years reconstruction barely restored their former scope. In 1950 of a total length of 9,456 mi. (6,168 of rivers, 3,288 of canals) only 5,285 were in constant use. Traffic in 1954 comprised 52,740,000 metric tons of goods, of which 43,404,000 were loaded in France (including 36,996,000 in internal trade), and amounted to 8,270,400,000 ton-kilometres (cf. 8,256,000,000 in 1938).

Activity was most important on the Seine and in the Franco-Belgian and Franco-German areas; freight consisted chiefly of coal, coal products and petroleum.

Mercantile Marine.— The French merchant fleet increased from 662,000 tons in 1840 to 2,448,000 in 1914, to 3,000,000 in 1936 and to 3,571,967 at the beginning of 1955 when it comprised 89 passenger vessels (860,489 tons), 119 tankers (997,647) and 520 cargo ships (1,713,831). It could not, however, carry more than 50% of France's sea-borne trade. For goods traffic, Marseilles was the principal French port, followed by Le Havre, Rouen, Dunkirk, Bordeaux, Nantes and St. Nazaire, Caen, Sète, La Rochelle, Calais and Boulogne; for passenger traffic, Marseilles, Calais, Dieppe, Boulogne, Le Havre and Cherbourg. Shipping entered and cleared of all French ports came to 111,740,000 tons in 1937, to 68,500,000 in 1947 and to 83,317,000 in 1948.

Air Transport.— France's air communications, which serve particularly Europe, the widely dispersed overseas possessions and the new world, are chiefly in the hands of Air France, a state enterprise, though a certain number of private lines exist. On Dec. 31, 1954, Air France was operating with 83 four-engined and 51 twin-engined planes; the main private companies operating scheduled services possessed in July 1955 a total of 40 (chiefly twin-engined). The number of passenger-kilometres covered by Air France was 750,000,000 in 1947 and 2,043,600,000 in 1954; that by private lines, 170,000,000 and 667,100,000.

FOREIGN TRADE

At first, because of its largely self-sufficient agriculture and moderately developed industries, France did not need to import excessive quantities of raw materials. During the first half of the 19th century supplies for the textile industry accounted for nearly one-third of its imports and export trade consisted largely (50%) of textile manufactures, particularly silk. But later increasing industrialization, a falling-off in agricultural production and growth as a colonial power led France to take a greater share in world trade. By 1913 the increasing demands of a more varied industry were revealed by increasing imports of fuel, machinery, tools and metal goods. Exports had also become more diversified. Textiles had fallen to a sixth of the total value, while the products of heavy industries, iron, steel, machinery and chemicals, had become quite important.

After World War I the French export trade was helped by the modernization of the northern industrial area, by the recovery of Alsace-Lorraine and by the decline in the external value of the franc. Thus exports reached a value of 6,900,000,000 fr. in 1913 and of 8,800,000,000 fr. (in terms of 1913 gold value) in 1927; on the other hand there was no corresponding rise in the volume of imports. France particularly exploited its overseas possessions both as a source of raw materials and as a market for the metropolitan industries. An advantageous balance in total overseas trade was usually obtained before 1928. On the credit side also were considerable invisible assets such as tourist trade, foreign banking, insurance and other services. In later years any visible adverse trade balance was offset wholly or considerably by these invisible exports.

In the 1930s most classes of exports diminished, and imports of raw materials and manufactured goods also fell. One reason for the failure to sell was the high price of domestic goods, caused by the country's remaining on the gold standard while other countries devalued their currency, and by restrictions on the hours of labour and by increases in wages. On the other hand, the volume of imports was maintained—until it was reduced by a protectionist policy. In 1937, when world trade had revived considerably, the gold value of French exports was 29% of that of 1929. In 1938 there was some recovery, but French exports to foreign countries were paying only for about 66% of imports. Raw materials constituted the greatest proportion (in value) of imports; next came food and drink (chiefly cheaper wines); and finally, manufactured goods. The values of each category rose until 1930 and then began to diminish. In exports, manufactured goods, chiefly of a high quality, held the lead, followed by raw materials (largely iron ore, etc., from Lorraine) and finally food and drink.

Among imports of food and drink, cereals (chiefly maize and rice together with a small amount of wheat), fruit and coffee constituted the largest items. The raw materials imported were mainly higher-grade coal and other fuels, cotton and wool, etc., oilseeds and vegetable oils, nonferrous metals and special types of iron ore such as haematite. About half of the manufactured articles imported comprised machinery and metal goods, with chemical products forming another considerable item.

Among the exported foodstuffs, wines, spirits and liqueurs of a higher grade took prominent place. Refined sugar and sugar preparations had a good market; and various fruits, early vegetables and heavy produce were exported to the northern European countries. Raw materials sold were chiefly iron ore, iron, steel, bauxite and copper; and textile materials, of which carded wool, flax and rags were the most important. The chief class of exports comprised manufactured goods. Of these, textiles made up in value the greatest single group, chiefly yarns and tissues of various types. Highly fabricated metal articles and chemical products were also important; and miscellaneous smaller articles of a high grade or in the luxury class came to a considerable sum total.

After World War II France's trading position with foreign countries, particularly with the United States, was to its disadvantage. Former items of invisible trade were now seriously curtailed. On the other hand a continual surplus with the rest of the French union acted as a cushion to the deficits incurred. But the country's foreign trade showed an over-all deficit of 413,500,000,000 fr. in 1952; and the cumulative deficit of France with the European Payments union between July 1950 and June 1954 reached $312,000,000. A year later, however, this last figure had been reduced to $150,000,000, while measures taken against the trade deficit included the subsidizing of the export industries (10,000,000,000 fr. in 1952), the suspension of certain trade-liberalization measures, the encouragement of the tourist trade and more barter transactions. In 1954, then, the trade deficit had been greatly reduced. (*See* Table XVIII.)

The deficit with the dollar area amounted to 74,000,000,000 fr. and with the sterling area 199,500,000,000 fr. On the other hand there was a surplus of 120,400,000,000 fr. with members of the Organization for European Economic Cooperation outside the sterling area; 2,800,000,000 fr. with other countries and 134,800,000,000 fr. with the overseas territories of the French union. (*See* Tables XIX and XX.)

TABLE XIX.—*Percentage Distribution of Trade*

Area	1937		1952		1953		1954	
	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports
U.S. and Canada	11	7	12	4	10	5	10	4
Latin America	7	5	7	5	6	6	6	6
E.P.U.:								
Continental	25	36	23	29	23	33	23	34
Dependencies	24	28	24	43	26	37	28	36
United Kingdom	8	12	4	6	5	5	5	6
Other sterling area	11	1	19	4	21	4	18	4
Rest of world	14	10	10	9	9	10	10	10

TABLE XX.—*Principal Trading Partners*
(in 000,000,000 fr.)

Country	Imports from					Exports to				
	1938	1948	1952	1954	1955	1938	1948	1952	1954	1955
United States	5	119	161	113	162	2	16	55	54	71
Germany	3	36	115	120	151	2	23	79	123	176
Iraq	1	10	52	78	79	...	2	1	2	...
Belgium*	3	25	62	70	91	4	31	80	103	118
Australia	2	30	55	62	61	0.1	2	7	8	...
United Kingdom	3	19	60	57	74	4	32	85	85	124
Arabian states†	...	10	131	50‡	54‡	...	0.1	14	0.5‡	...
Brazil	0.7	7	29	36	...	0.3	5	25	28	25
Italy	0.6	11	34	28	36	0.5	5	38	58	65
Netherlands	1	16	33	34	48	1.3	18	28	37	51
Argentina	0.9	17	20	...	...	0.7	6	13	...	86
Switzerland	1	14	38	30	...	2	24	104	57	32
Sweden	0.6	10	37	...	34	0.5	13	22	...	...

*Including Luxembourg. †Saudi Arabia, Bahrein, Kuwait, etc. ‡Kuwait only.

Commercial Policy.—During the first half of the 19th century France was a strongly protectionist country. Under Napoleon III many duties on raw materials and foodstuffs were reduced despite the opposition of French industrialists. This policy of freer trade was, however, abandoned on the establishment of the third republic, and a somewhat high tariff was instituted behind which industry developed more rapidly. In 1892 a tariff imposing a general and a minimum duty was applied, the former directed against countries with whom France had no agreement. Within trade agreements, a most-favoured-nation clause was often inserted, by which France extended to the signatory any tariff reduction granted to a third country in return for a similar concession.

After World War I France endeavoured to free itself of the most-favoured-nation clause, denounced existing commercial treaties and raised its general tariff. This policy came to be based for a time on reciprocal advantages, and commercial relations were maintained by bargaining. But by 1927 France was obliged once more to accept the most-favoured-nation principle and a stabilized system of tariffs and to abandon reciprocity.

Following the world depression which began in 1929, existing stabilization agreements led to an increasing disequilibrium in the balance of payments. Then, in 1931, in order to protect its own agriculture and industry and to improve its balance of payments, France inaugurated a policy of quotas to reduce imports at prices which were falling, first as an emergency tariff measure to meet abnormally large imports and later as a permanent instrument. Though quotas did succeed in limiting imports, they failed to benefit French export trade though used as a bargaining weapon

TABLE XVIII.—*Foreign Trade*
(in 000,000 fr.)

Year	Imports				Exports			
	Total*	Food and drink	Raw materials	Mfd. goods	Total*	Food and drink	Raw materials	Mfd. goods
1909–13†	7,627	1,601	4,548	1,478	6,324	822	1,852	3,650
1922–26†	40,295	8,616	26,275	5,404	40,090	3,650	10,848	25,592
1928	53,644	12,612	33,101	7,931	52,104	6,318	13,102	32,684
1938	46,065	12,492	26,864	6,708	30,590	4,393	9,843	16,354
1946	264,737	82,346	117,782	64,609	101,388	19,777	16,290	65,320
1947	346,000	92,000	170,000	84,000	213,000	31,000	29,000	153,000
1950	1,072,209	297,549	511,948	262,244	1,062,688	161,276	173,070	694,829
1951	1,550,598	329,176	860,442	360,398	1,424,035	188,031	216,086	975,144
1952	1,513,492	384,669	775,926	352,210	1,339,768	163,226	229,848	893,158
1954	1,477,290	383,812	737,026	354,100	1,463,307	214,712	248,144	946,611
1955	1,656,415	378,470	794,506	467,212	1,695,828	261,385	287,362	1,076,788

*Including certain miscellaneous items not comprised in the major categories (except in 1922–26 and 1928). †Average.

to gain special concessions. Moreover, they tended to raise the cost of living and inspired retaliatory measures.

Nor did the devaluation of the franc in the autumn of 1936 have the desired effect of stimulating exports and restricting imports, because the social reforms of the popular front government raised production costs. In the year before the outbreak of World War II an attempt was made to restore freedom of trade. In the years between World Wars I and II, the unfavourable gap between exports and imports widened.

The contraction of its export markets inspired France to concentrate increasingly on developing trade with its overseas possessions, and a policy of commercial assimilation was followed with some colonies, and of preferential treatment with others.

From 1909 to 1913 trade with the overseas possessions constituted only about 10% of France's foreign trade. By 1938 the proportion had risen to 27%, with imports and exports roughly balanced. But the low economic level of overseas possessions, of which Algeria was by far the most important, limited their capacity either to absorb imports or to deliver exports. After World War II, however, their potentialities as an export market mere increasingly developed.

Before 1914 the largest invisible credit item in France's balance of current payments was the interest and dividends from investments abroad. In 1913 the yield on these was about one-third of the value of merchandise exports. During the period 1918–39 fresh investments were made to compensate for losses during the war years, and by 1939 their total income was around 4,000,000,000 fr. Tourist trade was also a considerable item in invisible revenue, but was subject to considerable fluctuation. In the best days before World War II this source contributed about 10,000,000,000 fr. to the national income. Shipping freight, insurance and transit trade also furnished a fair amount of income.

Between 1940 and 1944 French trade was controlled by Germany. Its volume with overseas countries dropped to a low level. By the end of World War II a large part of the traditional markets had been lost, the capacity of industry had been seriously affected and the value of invisible exports, particularly as regards freight revenue, considerably impaired.

Before 1939 invisible exports had usually been sufficient either to compensate an adverse trade balance or to provide a substantial cushion for it; but now, despite encouragement of the tourist trade and the reconstruction of the merchant navy, there was no such financial advantage. It was estimated that France needed to import about 45,000,000 tons of raw materials, semifinished and finished products and food annually; but between 1945 and 1949 the nation could import only a yearly average of 23,000,000 tons (10,000,000 in 1945, 46,000,000 in 1949).

Up to 1948 France, like most other European countries, tried to protect its production by a system of quotas rather than tariffs. After the formation of the Organization of European Economic Cooperation in 1948 this policy was progressively and partially superseded by one of liberalization of exchanges, with a lowering of customs tariffs. But French economists placed special emphasis upon the international organization of resources and trade before the abolition of protection. Thus, while the country sponsored such schemes as the Schuman plan for the integration of the western European coal and steel output and the Pflimlin plan for the pooling of agricultural resources, tariffs were used to afford a considerable measure of protection to the "franc zone" (*i.e.,* France and the countries of the French union), with which trade was being actively developed in the 1950s.

In 1954 it was noticeable that more raw materials, more chemicals and more semifinished goods and less foodstuffs, less energy and less equipment were being imported than in former years. *(See* Table XXI.)

TABLE XXI.—*Exports of Consumer Goods*
(in 000,000 fr.)

Consumer goods	1947		1954	
	Foreign	French union	Foreign	French union
Durable.	17,160	10,867		
Nondurable:				
Foodstuffs. . . .	16,155	15,936	115,822	76,339
Other.	31,375	31,189	93,991	160,450 88,663

NATIONAL FINANCE

National finance suffered not only from the effect of disastrous wars, but also from an inefficient fiscal system, from the ineffective application of tax regulations and from the reluctance of the nation to accept additional impositions. Thus, an increasing resort was made to balancing budgetary deficits by borrowing. In the later 1920s the resolute measures of the Poincaré administration restored to some extent the financial position of the country. New taxation was voted, considerable economies in the public services were introduced and a general tightening up of the fiscal system was carried out. Budgetary surpluses were 2,715,000,000 fr. in 1929 and 2,439,000,000 fr. in 1930.

With the resignation of the Poincaré government in 1929 the financial situation again deteriorated. There was a demand for the reduction of taxation; the civil services were given increased allowances; and various schemes of social insurance were subsidized. Considerable expenditure was also undertaken on rearmament. Budgetary deficits became, because of the deteriorating commercial and industrial situation, the rule. Deficits were provided for by extra budgets, which raised additional expenditure. (For public debt, *see* Table XXII.)

TABLE XXII.—*Public Debt*
(in 000,000,000 fr.)

Item	1927	1938	1947	1950	1951	1952	1953	1954
Internal . .	302.2	413.7	1,974.9	2,845.6	3,032.2	3,573.6	4,176.9	4,529.2
External . .		6.8	220.7	1,287.4	1,254.4	1,297.9	1,240.6	1,119.7

Ordinary state expenditure or revenue from 1913 to 1955 is shown in Table XXIII.

TABLE XXIII.—*Ordinary Budgets*
(in 000,000,000 fr.)

Item	1913	1939	1946	1952	1953	1954	1955*
Revenue . .	5.09	63.00	434.10	2,773.3	3,081.0	3,249.0	2,990.0
Expenditure .	5.07	98.56	351.76 †	3,381.0	3,401.0	3,535.0	3,550.0

*Revised estimate, July 1955. †Extraordinary expenditure was 169,443,000,000 fr.

Between 1946 and 1952 a budgetary deficit persisted and inflation increased. Attempts to solve these two problems comprised various measures whose effectiveness was only partial: economies in the national services; a more rigorous and better organized fiscal regime and additional taxation to balance the budget; and a policy of freezing available liquid assets, the raising of the bank rate, restrictions on credit facilities and the control of prices and wages to combat inflation. Nevertheless, prices continued to mount, accompanied by successful agitation by labour for increased wages. After 1950 financial recovery was further hampered by an increasing rearmament program and, till 1954, by the costly war in Indochina. Liberal contributions from the United States, both in the form of E.R.P. aid ($1,083,000,000 in 1948, $701,000,000 in 1949, $383,000,000 in 1950 and $327,000,000 in 1951) and as military subsidies did something to alleviate the position. But there was also a stubborn resistance within the country to increased taxation, to the freezing of credit and even to effective tax collection; and a chronic distrust of the franc continued.

Budgetary receipts for 1954 were 3,249,000,000 fr. and expenditure, 3,536,000,000 fr., of which 1,101,000,000 fr. were for defense. The resulting deficit was financed by net treasury borrowing of 580,000,000,000 fr. and by withdrawals from counterpart funds (representing United States grants and aid loans to provide foreign exchange resources) of 109,000,000,000 fr. This figure did not include exceptional grants to assist military operations in Indochina, amounting to 195,000,000,000 fr.

Banking and Currency.—The state bank is the Banque de France (*q.v.*), founded in 1800; it possesses the sole right to issue bank notes. Fiduciary money issued by the bank and script by various banking organizations came on Jan. 1955 to 5,239,000,000,000 fr. (*cf.* 2,678,000,000,000 fr. in Jan. 1950). In 1945 the Banque de France and four of the larger joint-stock banks, the Crédit Lyonnais, the Société Générale, the Comptoir National d'Escompte and Banque Nationale pour le Commerce et l'Industrie, were nationalized. The nominal capital of the metropolitan banks rose from 6,900,000,000 fr. in 1938 to 45,700,000,000 fr. in 1954. In addition to the national banks, there were still a number of independent deposit banks in the provinces.

Two national loan institutions continued to exist: the Crédit Foncier for making loans on urban and rural property, and an agricultural credit fund. Other types of banking institutions are the *banque d'affaires,* for providing credit on a large scale to industrial and commercial enterprises; and *banques populaires,* concerned with credit facilities for the smaller commercial businesses and tradesmen. Some degree of official control over all banks was established in 1945 by the appointment of the state *conseil national du crddit.*

The French currency unit is the franc (*q.v.*).

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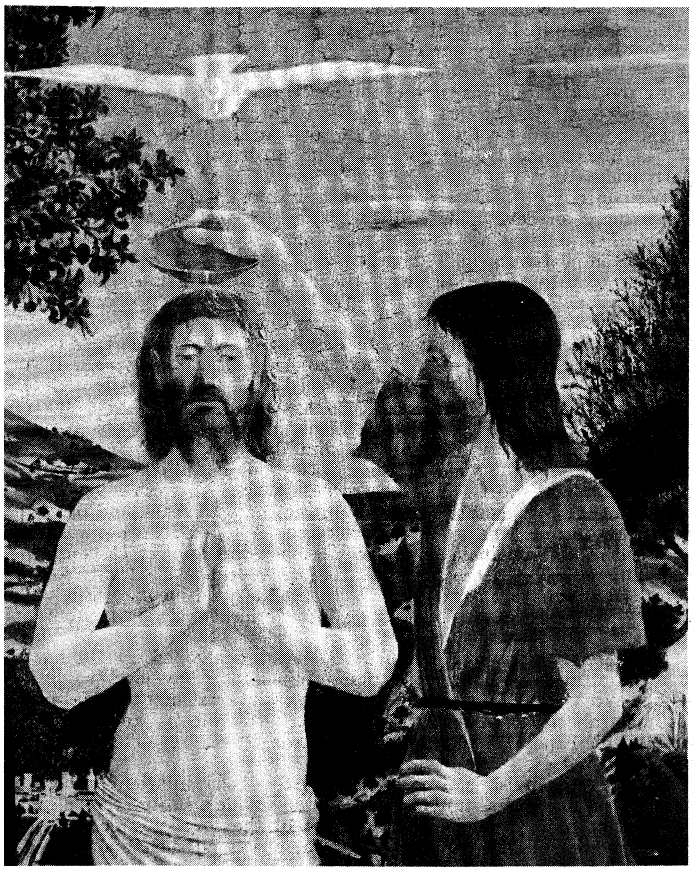
FRANCESCA, PIERO DELLA (PIERO DEI FRANCESCHI) (c. 1420–1492), Italian painter, one of the great masters of the Quattrocento. was born at Borgo San Sepolcro in Umbria between 1410 and 1420, probably nearer 1420. Throughout his life he retained a deep affection for his native place and spent much of his time there. although he worked in Florence, Arezzo, Ferrara. Rome and Urbino. The earliest record, Sept. 7, 1439, describes him as working in Florence with Domenico Veneziano—whether as pupil or partner is not clear—on frescoes in Sant' Egidio (Sta. Maria Nuova). These have almost entirely disappeared, so that nothing is known of the style of either at this date. During the 15th century Borgo San Sepolcro was dominated by Sienese art, and the "Baptism of Christ" (National gallery. London)—usually accepted as one of Piero's earliest works—shows marked affinities with Sienese painters like Stefano di Giovanni Sassetta. Probably his Florentine experience was decisive in the formation of Piero's style, for his strong mathematical bent enabled him to extend the researches into perspective of the Florentines Filippo Brunelleschi and Paolo Uccello. G. Vasari lays great stress on his mathematical abilities, and the intellectual climate of Florence in the first half of the 1 jth century was particularly favourable to a scientific and geometrical art. Kevertheless, Piero was back in Rorgo by 1442. On Jan. 11, 1445, the Company of the Misericordia of Borgo commissioned an altarpiece (now in the Pinacoteca there) to be completed within three years. In fact this work, in which his style is fully developed, may not have been finished before 1462. Certainly the polyptych contains a representation of San Bernardino, who was not canonized until 1450.

About 1449–50 Piero painted in Ferrara some frescoes, now lost. which contributed much to the development of the Ferrarese school, and in 1451 he signed and dated the fresco of "Sigismondo Malatesta before St. Sigismund" in S. Francesco at Rimini. This was formerly regarded as his earliest datable work but cleaning revealed a signature and the date 1450 on a "St. Jerome" in Berlin,



BY COURTESY OF THE NATIONAL GALLERY, LONDON

DETAIL FROM THE "BAPTISM OF CHRIST." ONE OF PIERO'S EARLIEST WORKS. IN THE NATIONAL GALLERY. LONDON

a crude work which is not an adequate prelude to the "Sigismondo" or to Piero's greatest achievement. the fresco cycle of the "Legend of the True Cross" in San Francesco at Arezzo, painted between 1452 and *c.* 1459 (certainly completed before 1466). These severely geometrical compositions show Piero at the height of his powers. Now among the most famous of 1 jth-century frescoes, they mere virtually unknown until late in the 19th century, when their pale colour and austere forms brought them back into favour among circles stressing the importance of aesthetic elements in wall decoration. It is precisely their inhuman calm, their lack of Florentine vigour. which led to four centuries of neglect but which is the essence of their attraction to modern sensibility. About this time Piero painted the "Resurrection" fresco in the Palazzo Comunale at Borgo. which combines these qualities with an awestruck dramatic sense. Critics as disparate as Vasari and Aldous Huxley have considered it his masterpiece.

Other works of this period of classical maturity include the diptych portraits of Federigo da Montefeltro. duke of Urbino, and Battista Sforza. his duchess (Uffizi. Florence). These are usually dated before 1466 on the inconclusive evidence of a poem by Ferabh of that year. but *c.* 1472 would seem to be more in accordance with the marked Flemish influence characteristic of Piero's later works. During 1459–60 he seems to have been working in Rome in the Vatican. but nothing survives, though a "St. Luke" in Sta. Maria Maggiore is not very convincingly ascribed to him. In the 1460s and 1470s Piero was frequently in Urbino and—perhaps partly on account of a lack of pictures ascribable to him—it has been suggested that he was in some way connected with the building of the palace there, perhaps the finest example of Italian architecture of its date. It is certainly imbued with the calm harmony of Piero's mathematical art. but the available evidence does not seem to justify more than a tentative connection. An altarpiece for Sant' Xpostino in Borgo San Sepolcro, commissioned in 1454, was apparently completed in 1469. This picture, dismembered and partly lost. was reconstructed by M. Meiss from extant parts in the

National gallery, London, the Frick collection, New York city, and the Poldi-Pezzoli museum, Milan; the subsequent rediscovery of a "St. Augustine" in Lisbon confirmed Meiss's original reconstruction. During the 1470s Piero probably had both Signorelli and Perugino as pupils and he painted the large "Madonna and Saints, with Federigo da Montefeltro" (Brera, Milan) and the "Senigallia Madonna" (Urbino). It has been suggested that the head and hands of Federigo in the "Brera Madonna" were added by the Spaniard Pedro Berruguete, but this is a very controversial point. The "Nativity" (National gallery, London) is probably Piero's last known work and his later years were taken up with mathematics. Of his two treatises, *De perspectiva pingendi*, on perspective, and *De quinque corporibus regularibus*, on the five regular bodies, the latter was written after 1482. There is a tradition that he was blind in his last years, but, even so, there is a long gap between the "Brera Madonna" of *c.* 1475 and the "Nativity," perhaps slightly later, and his death at Borgo on Oct. 12, 1492.

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FRANCESCHI, the name of three generals of brigade in the Napoleonic Wars.

1. JEAN BAPTISTE, BARON FRANCESCHI (1766–1813), was born at Bastia, Corsica, on Dec. 5, 1766. He served in Italy from 1795 to 1799, again as a general officer in the campaign of Marengo, in the Naples campaign of 1805–06 and in the Peninsular War from 1807 to 1809. He served also in the Russian war of 1812 and died at Danzig on March 19, 1813.

2. JEAN BAPTISTE MARIE FRANCESCHI-DELONNE (1767–1810) served throughout the revolutionary campaign on the Rhine, took part in the campaign of Zurich in 1799 and escaped from and returned to Genoa, when in 1800 Masséna was besieged there. In the Peninsular War he won distinction as a cavalry general. He died, a prisoner of the Spaniards, at Carthagena on Oct. 23, 1810.

3. FRANÇOIS FRANCESCHI-LOSIO (1770–1810), born at Milan, served through the Italian campaign of 1796–97 and subsequently, like Franceschi-Delonne, with Masséna at Ziirich and at Genoa and at the headquarters of King Joseph in Italy and Spain. He was killed in a duel by the Neapolitan captain Carlo Filangieri in 1810.

FRANCESCHINI, BALDASSARE (1611–1689), Italian painter of the Florentine school, called Il Volterrano from his native Volterra, was the son of a sculptor. At a very early age he started as an assistant to his father and then studied under the Florentine painter Matteo Rosselli. From 1652–60 he was employed on paintings in the cupola of the Niccolini chapel in S. Croce, Florence, which constitute his most noted performance. Among his best oil paintings of large scale is the "St. John the Evangelist" in the church of S. Chiara at Volterra. One of his last works was the fresco of the cupola of the Annunziata. Florence, which occupied him for two years around 1683. Franceschini died at Volterra on Jan. 6, 1689.

FRANCESCHINI, MARCANTONIO (1648–1729), Italian painter, a leading artist of the Bolognese school of his time, was born in Bologna on April 5, 1648. His masters were G. M. Galli da Bibiena and Carlo Cignani (*qq.v.*). He worked in Genoa, Modena and Rome as well as in Bologna. He was made director of the Accademia Clementina in Bologna in 1721. Franceschini was the last important representative of the tradition of the Carracci, the works of Lodovico Carracci and Francesco Albani being the main sources of his style. His figures, brushwork and colouring are unimaginative and unoriginal but he had a gift for skillfully arranging an elaborate composition and considerable talent as a decorator. His paintings in both oils and fresco are very numerous, though little known; the most famous, which were done for the church of Corpus Domini. Bologna (1687–94), were unfortunately destroyed during World War II. He died in Bologna on Dec. 24, 1729. (M. W. L. K.)

FRANCESCO DI GIORGIO (FRANCESCO MAURIZIO DI GIORGIO MARTINI [or DI MARTINO]) (1439–1501), a versatile Italian painter, sculptor and architect of the Sienese school, was baptized in Siena on Sept. 23, 1439. Early works were manuscript illuminations, furniture panels, and two monumental altarpieces in the Siena gallery. By 1477 he was in the service of Federigo da Montefeltro, duke of Urbino; there he produced a series of brilliant bronze reliefs, probably participated in the design and decoration of parts of the great palace of Urbino, and built 136 military fortresses. His architectural masterpiece is S. Maria del Calcinaio, Cortona (1484). Later masterpieces are four brilliant bronze figures for the high altar of Siena cathedral. He also probably returned to painting after many years. His book on architecture discusses city planning and military architecture, and anticipates some of the architectural theories of the high Renaissance. He was remarkably versatile, a kind of Sienese Leonardo da Vinci, who combined the bold investigation of the Renaissance with the conservative lyricism of the Sienese school.

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FRANCHE-COMTÉ, a region of eastern France, bounded on the east by Switzerland, on the south by Bresse and Bugey, on the north by Lorraine and on the west by Burgundy and Bassigny, and embracing the greater part of the Jura range and of the neighbouring low ground toward the Saône.

In antiquity, the region was occupied, from the 4th century B.C. onward, by the Celtic tribe of the Sequani, which built there several *oppida*, including Vesontio (Besanqon).

It became Roman in 52 B.C., after Julius Caesar's victory. From the invasion of the barbarians onward, the history of the region may be divided into four periods: from the 5th century A.D. to the end of the 13th it was first a part of independent kingdoms and then, when these disappeared in the 11th century, a territory more or less subject to the Holy Roman emperor; from the end of the 13th century to the end of the 15th its history was directly joined to that of the kingdom of France; at the end of the 15th century it passed to the house of Austria, within which it was assigned to the Spanish branch on Charles V's abdication; and finally it became French in 1678. (*See* also BURGUNDY.)

During the first period, what had been the territory of the Sequani was at first included in the original kingdom of Burgundy and was then joined, together with the latter, to the empire of Charlemagne, who divided it into the five countships of Ajoie, Portois, Varais, Amaons and Escuens, the archbishop of Besanqon having also his share in the administration. At the treaty of Verdun (843), these countships were included in Lothair's portion; and when this kingdom of Lotharingia broke up, a new kingdom of Burgundy was created, whose crown, at the end of the 9th century, passed to the German house of Welf.

Thus what was henceforth called *la comte'* (county; *comté* being then a feminine noun) of Burgundy was subject to this kingdom; but rivalries between the great families of the region disturbed it continually. The counts of the house of Salins, however, were powerful personages; and Guy (Guido), the brother of Raynald II, became pope as Calixtus II in 1119. In 1127 his nephew Raynald III refused to pay homage to the emperor. Lothair II (or III; of Supplinburg) had to fight for ten years before vanquishing his rival, Conrad of Zahringen. Thereafter he was the *franc-comte* ("free count"), whence the name of Franche-Comté de Bourgogne given to his territory. By marrying Raynald III's daughter Beatrix in 1156 the emperor Frederick I Barbarossa sought to secure the balance of power in his own country and to extend his influence. His successors, however, were unable to withstand the ventures of the kings of France in this area.

Finally, in 1295, the count Otto IV undertook to give his daughter Joan in marriage to Philip of Poitiers (later Philip V of France), the son of Philip the Fair, whom he left to govern the county and to collect its revenue. During all this period the country had not ceased to develop its potentialities. In the solitary recesses of the mountains Cluniac and then Cistercian monasteries sprang up; roads were put into repair, whereby northern Italy was connected with Champagne and Flanders; and towns expanded and attained their enfranchisements (Besanqon in 1184).

The first French period of the history of the Franche-Comté is far more simple (14th and 15th centuries). After a period of resistance to the king of France, who put it under the jurisdiction of a *bailli*, it was governed, as Philip V left no male heir, by his widow the sovereign countess Joan, whose elder daughter Joan of France married Odo (Eudes) IV, duke of Burgundy. Their grandson and heir Philip of Rouvre was thus both count and duke in succession to them (1350–61); but on his death without issue the county and the duchy were again separated, the county of Burgundy passing to the counts of Flanders.

On the death of Louis of Mâle (1384), however, Philip the Bold (*q.v.*) acquired the county by right of his marriage (1369) with Margaret, daughter and heiress of Louis and widow of Philip of Rouvre. Thereafter the county was under the dukes of Burgundy of the house of Valois. Through them the Franche-Comté (except Montbéliard, which belonged to the landgrave of Württemberg) was given its political organization; its capital was Dôle, the seat of a council, of a *parlement* and of estates (which were to meet 37 times from 1389 onward); and the province was divided into three military and judicial jurisdictions, the *bailliages* of Amont (Gray), of Aval (Salins) and of Dôle, which were themselves subdivided into several *chdtellenies.*

At the death of the duke Charles the Bold (1477), Louis XI of France took hold of the duchy of Burgundy and obtained that the dauphin Charles should receive the county and be betrothed to Charles the Bold's granddaughter Margaret of Austria, daughter of Maximilian I by his marriage with Mary of Burgundy. But, when Charles became king of France, as Charles VIII, he broke his engagement and married Anne of Brittany and consequently, at the treaty of Senlis (1493), had to surrender the Franche-Comté to the Habsburgs, under whom it was to remain for 185 years.

Margaret of Austria, now the widow of Philibert II the Fair of Savoy (for whose tomb she had the magnificent church of Brou erected at Bourg-en-Bresse), took over its administration, together with that of the Netherlands and Charolais, Malines included. Margaret proclaimed the neutrality of the Franche-Comté toward France in 1522, thanks to which the region remained apart from the political struggles between her nephew the emperor Charles V and the kings of France. Its towns were embellished by buildings in the contemporary Renaissance style, and their industries developed. In the reign of Philip II of Spain, under the administration of Antoine, cardinal de Granvella, and then of the archdukes, it even enjoyed a prosperity of which the neighbouring regions were jealous; this was especially true of Besançon, now the capital again and an imperial town. Only the wars of religion could disturb its tranquillity. The Huguenots from Switzerland did their utmost to gain adherents there and met with some success, particularly in the district of Montbéliard, but the main part of the people still clung to the Catholic faith. Again, with the struggles of Cardinal Richelieu and then of Louis XIV against the Habsburgs in the 17th century, the country had to suffer from war. Devastated in 1637 and in 1639 (during the Thirty Years' War) and conquered for the first time by the great Condé and his general the duc de Luxembourg in 1668, it was occupied anew by the French troops of Condé and annexed to France at the treaty of Nijmegen in 1678 (*see* DUTCH WARS).

Resistance to the French had been very strong. The feats of Lacuzon (Claude Prost, 1607–81) against them were outstanding. The region was peopled again quite rapidly by the influx of populations from neighbouring districts. Yet, for about half a century, all the Franc-Comtois remained faithful to the Spanish; only in the 18th century could they be considered as definitively assimilated to France. Louis XIV, at last, adopted measures to secure the country and to enable the people to live in peace. Besançon, formerly an imperial town, was the seat of a *parlement* and of a university; it was also the chief town of a commissariat and a *gouvernement militaire.* Vauban fortified the roads leading to the Swiss frontier. It was above all in the 18th century that the country assumed its present appearance. Whereas the old agricultural produce (especially the grape vines) prospered afresh, the exploitation of timber increased; metallurgical and textile industries settled in the north, and clock- and watchmaking appeared as a new craft. Thus, this region, one of the last to be included in the French patrimony, one of those whose history had been connected with that of Germany more closely than with that of France, one of the least favoured by its geography and climate, came eventually to hold a place of its own in the national life of France. After the Revolution, the *départements* of Jura, of Doubs and of Haute-Saône comprised, approximately, the old territory of the Franche-Comté.

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(M. PAC.)

FRANCHET D'ESPEREY, LOUIS-FÉLIX-MARIE-FRANÇOIS (1856–1942), French soldier, was born at Mostaganem in Algeria on May 25, 1856. Commissioned to the infantry in 1876, he saw active service in Tunisia, Tonkin and N. China. In 1908 he became general of brigade. In 1913, as general of division, he fought in Morocco, after which he was appointed to the I army corps at Lille. This corps he commanded during the battle of the Frontiers, Aug. 1914, and on the eve of the battle of the Marne he succeeded Gen. Lanrezac as commander of the V army. In March 1916 he was advanced to command the eastern group of armies, and later the northern group. On the recall of Guillaumat in June 1918, Franchet d'Esperey was sent out to replace him as commander in chief at Salonika. Adopting and developing his predecessor's plan for an offensive in the Balkans, he skilfully denuded the rest of the front to concentrate an overwhelming preponderance on the narrow Sokol-Dobropolye sector, west of the Vardar. With their reserves pinned down by vigorous pressure elsewhere the Bulgarians were unable to repair the breach, and as the Serbian spearhead drove in deeper, the whole Bulgarian front collapsed, and on Sept. 29 Bulgaria capitulated—the first defection among the Central Powers. He cleared Serbia of the Austrian troops and later, on Jan. 5, 1919, took prisoner the German Marshal von Mackensen, in Hungary. He commanded the Allied forces in Turkey until Nov. 1920, and was created a marshal of France on Feb. 21, 1921. He was elected to the French academy in 1934. Franchet d'Esperey died on July 8, 1942, near Albi, department of Tarn.

FRANCIA (FRANCESCO DI MARCO DI GIACOMO RAIBOLINI) (c. 1450–1517?), the major Bolognese painter of the late 15th century. He was born, according to G. Vasari, in Bologna in 1450 and died there on Jan. 5, 1517 (or perhaps 1518, as Vasari says). He was trained as a goldsmith and entered the goldsmiths' guild in Bologna in 1482; later he became famous as an engraver of dies and nielli and was master of the mint under the Bentivoglio and also under Pope Julius II after the expulsion of the Bentivoglio. As a painter he was much influenced by the Ferrarese (*e.g.*, Cossa and Ercole de' Roberti) and was closely associated with Lorenzo Costa, but his later works clearly show the influence of Perugino and Raphael. He seems to have begun painting by 1486, but the earliest dated work by him is the "Felicini Madonna" of 1494 in the Pinacoteca, Bologna. A Madonna in the National gallery in London, once thought to have been composed in 1490 or 1492, is now regarded as a forgery. There is also a certain amount of doubt about his exact relationship with Raphael. Formerly it was said that Raphael wrote to Francia on Sept. 5, 1508, in the most polite terms extolling the devotional quality of his madonnas; while Francia was said to have addressed an enthusiastic sonnet, beginning "Non son Zeusi, nè Apelle . . ." to Raphael. Both these documents appear for the first time in C. Malvasia's *Felsina pittrice,* a notoriously unreliable source; nor has anyone been able to discover the original documents. Vasari speaks of letters passing between the two, and it would have been easy to supply the want of them. It is, however, clear that Francia was acquainted with Raphael's works, and later opinion has not excluded the possibility that Malvasia was substantially correct. According to Vasari, Raphael was indirectly the cause of Francia's death, for the "St. Cecilia" so impressed him on its arrival in Bologna that he died of depression at his own inferiority.

An altarpiece from the church of S. Frediano, Lucca, now in London, is one of his last works and clearly shows the Perugino-

Raphael influence on his later style. There are many works by him (including two silver paxes) in the Pinacoteca. Bologna, and in the churches there and in many other European and American galleries.

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FRANCIA, JOSÉ GASPAR RODRÍGUEZ (*c.* 1766–1840), "El Supremo," dictator of Paraguay. was born in Asunción about 1766, probably the son of a Brazilian coffee grower. He studied at the university of Córdoba in Argentina and obtained there the degrees of master of philosophy and doctor of theology. Relinquishing his intention of taking holy orders, he studied law and practised in Asunción, where he acquired a reputation for ability, energy and integrity. Under the colonial government he filled several important posts, and when independence was declared in 1811, he became secretary to the national junta, exerting an influence far out of proportion to his position. In 1813, when a duumvirate replaced the national congress. Francia and Fulgencio Yegros, a gaucho, were chosen to fill the office. In 1814 he secured his election as dictator for three years, and in 1817 obtained the dictatorship for life. In his administration was found a strange mixture of farsighted statesmanship and petty despotism. Aware of his precarious position among powerful neighbours, he pursued a policy of strict isolation; realizing that he must make the country self-supporting, he carefully fostered internal industries. He banned foreign commerce; usurped the national revenues; organized and equipped an army; and introduced modern methods of agriculture. Imbued with the principles of the French Revolution, he abolished the Inquisition, suppressed the college of theology, swept away tithes and deprived the aristocracy of their social and political privileges. While practising republican simplicity in his private life, he exacted imperial deference wherever he went, isolated himself in the most stringent manner and punished with Draconian severity the slightest violation of his assumed prerogatives or hint of conspiracy against him. On Sept. 20, 1840, he was seized with a fit in Asunción, and died. Whatever may be the accusations brought against his rule, it is unlikely that except for him Paraguay could have escaped incorporation in either Argentina or Brazil. (W. B. P.)

FRANCIABIGIO (1482–152j), Florentine painter, best known for his portraiture, was probably born in Milan. His real name was Francesco di Cristofano. His father was a Milanese weaver, settled in Florence. According to Giorgio Vasari. Franciabigio when young worked in the company of Andrea del Sarto. He studied under Mariotto Albertinelli for a few months, and he was devoted to the study of perspective. One of his early works is the Madonna del Pozzo in the Uffizi gallery, Florence, which was for some time ascribed to Raphael. In the Atrium of the Annunziata in Florence he painted in 1513 the "Marriage of the Virgin," as a portion of a series wherein Andrea del Sarto was chiefly concerned. When the friars uncovered this work before it was quite finished, Franciabigio was so incensed that, seizing a mason's hammer, he struck at the head of the Virgin, and some other heads; and the fresco, which would otherwise be his masterpiece in that method, was mutilated.

At the Chiostro dello Scalzo, in another series of frescoes in which Andrea was likewise employed, he executed in 1518–19 the "Departure of John the Baptist for the Desert," and the "Meeting of the Baptist With Jesus"; and, at the Medici palace at Poggio a Caiano, in 1521, the "Triumph of Cicero."

Franciabigio was a first-rate portrait painter. The Dresden gallery contains one of his masterpieces, the "Bath of Bathsheba" (1523).

FRANCIS, SAINT, OF ASSISI (GIOVANNI FRANCESCO BERNARDONE) (1181/82–1226), founder of the Franciscans (*q.v.*) and principal patron of Italy (with St. Catherine of Siena), was born at Assisi in Umbria, the son of Pietro di Bernardone, cloth merchant, and the lady Pica, perhaps of noble lineage. Nothing certain is known of the family background. Francis learned to read and write Latin at the school near the church of St. George and later acquired some knowledge of the French language and literature, especially of the troubadours. His youth does not seem to have been marked by serious moral lapses but by a general spirit of worldliness which made him a recognized leader of the young men of the town.

In 1202 he took part in a war between Assisi and Perugia, was held prisoner for almost a year and on his release fell seriously ill. Setting out once more to join the forces of Walter of Brienne, he had a vision at Spoleto that bade him return to Assisi. He began to give himself to solitude and prayer.

Several other episodes make up what is called his conversion: a vision of Christ while he prayed in a grotto near Assisi; an experience of poverty during a pilgrimage to Rome, nhere. in rags, he mingled with the beggars before St. Peter's and begged alms; the incident where he not only gave alms to a leper (he had always felt a deep repugnance for lepers) but also kissed his hand. One day at the ruined chapel of S. Damiano outside the gate of Assisi, he heard the crucifix above the altar command him: "Go, Francis. and repair my house which, as you see, is well-nigh in ruins." Taking this literally, he hurried home. gathered much of the cloth in his father's shop and rode off to Foligno, where he sold both cloth and horse. He then tried to give the money to the priest at S. Damiano. Angered, his father first kept him at home and later cited him before the civil authorities. When Francis refused to answer the summons, his father called him before the bishop. Before any accusations mere made. Francis "without a word peeled off his garments even down to his breeches and restored them to his father." Covered only by a hair shirt, he said: "Until now I have called you my father on earth. But henceforth I can truly say: Our Father Who art in heaven." The astonished bishop gave him a cloak, and Francis went off to the woods of Mt. Subasio.

Francis had renounced material goods and family ties to embrace a life of poverty. He repaired the church of S. Damiano, restored a chapel dedicated to St. Peter the Apostle and then the now famous chapel of St. Mary of the Angels, the Porziuncola. on the plain below Assisi There on the feast of St. Mathias, Feb 24, 1208 (1209?), he heard at mass the mission of Christ to the apostles. "Do not possess gold. nor silver, nor money in your purses. Nor scrip for your journey, nor two coats, nor shoes. nor a staff; for the workman is worthy of his meat. And into whatsoever city or town you shall enter, inquire who in it is worthy, and there abide till you go thence" (Matt. x, 9–11). Although a layman, he began to preach to the tonnspeople. Disciples joined him, and for them he cornposed a simple rule of life. In 1209 (1210?). when the group numbered 12, they went to Rome and obtained the approval of Innocent III for the rule (*see* FRANCISCANS for further development of the order).

This early rule. which has not survived, set as the aim of the new life, "To follow the teachings of our Lord Jesus Christ and to nalk in his footsteps." Probably no one in history has ever set himself so seriously as did Francis to imitate the life of Christ and to carry out so literally Christ's work in Christ's own way. This is the key to the character and spirit of St. Francis. To neglect this point is to show an unbalanced portrait of the saint as a lover of nature, a social worker, an itinerant preacher, a lover of poverty. Certainly the love of poverty is part of his spirit, and his contemporaries celebrated the "holy nuptials of Francis with Lady Poverty"; *e.g.,* in the fresco of Giotto at Assisi and in the allegorical prose-poem, the *Sacrum commercium* (Eng. trans., *The Lady Poverty,* by Montgomery Carmichael [1901], or *The Converse of Francis and Hzs Sons With Holy Poverty,* by Canon Rawnsley [1904]). However, it was not mere external poverty he sought, but the total denial of self (as in Phil. ii, 7).

He considered all nature as the mirror of God and as so many steps to God. He called all creatures his "brothers" and "sisters," and in his "Canticle of Creatures" (less properly called the "Praises of Creatures." "Canticle of the Sun," etc.) he referred to "brother Sun" and "sister Moon," the wind and water and even "sister Death." His long and painful illnesses were nicknamed his sisters, and he begged pardon of "brother Ass the body" for having unduly burdened him with his penances. Above all, his deep sense of brotherhood under God embraced his fellow men, for "he considered himself no friend of Christ if he did not cherish those for whom Christ died."

The Franciscan order spread from Umbria through Tuscany, the Marches and other regions of Italy. In 1212 Francis began his second order for nuns, giving the habit to a noble lady of Assisi, later known as St. Clara (*q.v.*). For those who could not leave their families and homes he eventually (*c.* 1221) formed the Third Order of Brothers and Sisters of Penance, a lay fraternity which, without withdrawing from the world or taking religious vows, would carry out the principles of Franciscan life (see TERTIARIES).

As the friars became more numerous, the order extended outside Italy. In the late spring of 1212 Francis set out for the Holy Land but was shipwrecked on the east coast of the Adriatic and had to return. A year or two later sickness forced him to abandon a journey to the Moors in Spain. In 1217 he proposed to go to France, but Cardinal Ugolino (later Pope Gregory IX) advised that he was needed to direct the order in Italy. He did go to Egypt, where the crusaders were besieging Damietta, in 1219. With Brother Illuminato he went into the camp of the Saracens and preached to the sultan, who, impressed, gave him permission (it is said) to visit the holy places in Palestine.

News of disturbances among the friars in Italy forced Francis to return there. To remedy the situation he appointed Peter Catani as his vicar to handle practical affairs; after Peter's early death in 1221 he chose Elias of Cortona (*q.v.*). He asked Pope Honorius III for legislation introducing a year of probation (novitiate) for new friars, and set about amplifying and revising the rule. After the rule was approved by Honorius III in final form on Nov. 29, 1223, Francis tended to withdraw more and more from external affairs. In the summer of 1224 he went to the mountain retreat of La Verna to celebrate the feast of the Assumption of Our Lady (Aug. 15) and to prepare for St. Michael's day (Sept. 29) by a 40-day fast. There he prayed that he might know how best to please God; opening the Gospels for the answer, three times he came upon references to the Passion of Christ. As he prayed one morning, about the time of the feast of the Exaltation of the Cross (Sept. 14), suddenly he beheld a figure coming toward him from the heights of heaven.

St. Bonaventura wrote:

As it stood above him, he saw that it was a man and yet a Seraph with six wings; his arms were extended and his feet conjoined, and his body was fixed to a cross. Two wings were raised above his head, two were extended as in flight, and two covered the whole body. The face was beautiful beyond all earthly beauty, and it smiled gently upon Francis. Conflicting emotions filled his heart, for though the vision brought great joy, the sight of the suffering and crucified figure stirred him to deepest sorrow. Pondering what this vision might mean, he finally understood that by God's providence he would be made like to the crucified Christ not by a bodily martyrdom but by conformity in mind and heart. Then as the vision disappeared, it left not only a greater ardor of love in the inner man, but no less marvelously marked him outwardly with the Stigmata of the Crucified.

Francis took the greatest care to hide those wounds in his lifetime. After the death of Francis, Brother Elias announced the stigmata to the order by a circular letter. Later Brother Leo, confessor and intimate companion of the saint, who left a written testimony of the event, said that in death Francis seemed like one just taken down from the cross. (See also STIGMATIZATION.)

Francis lived two years longer, in constant pain and almost totally blind (he had contracted an eye disease in the east). Medical treatment at Rieti was unsuccessful, and after a stay at Siena he was brought back to Assisi, where he died at Porziuncola on Oct. 3, 1226. He was buried temporarily in the church of St. George at Assisi. Francis was canonized on July 16, 1228, by Gregory IX; his feast day is Oct. 4. In 1230 his body was transferred to the lower church of the basilica being erected by Elias at the west end of the city.

The works of St. Francis, consisting of the rule (in two redactions), his testament, spiritual admonitions, prayers and letters, were first edited by Luke Wadding (1623). There are critical editions by Leonard Lemmens (1904) and by H. Boehmer (1904); and English translations by Paschal Robinson (1906), Countess de Ware (1907), James Meyer (1952) and others.

BIBLIOGRAPHY.—The chief sources on the life of St. Francis and the beginnings of the order are (1) two *Lives* by Thomas of Celano, with his treatise on the miracles following Francis' death (1228, 1246, 1250, respectively), Eng. trans. by A. G. Ferrers Howell (1908) and critical Latin edition by the Quaracchi Franciscans, *Analecta Franciscana,* tome x (1926–41); and (2) the *Life* or "Legend" by St. Bonaventure (1260–62), written at the request of the general chapter of Narbonne to compress the tomes of Celano. The legend, the work of a theologian, interprets the life of St. Francis in terms of speculative and mystical theology (critical edition, *Analecta Franciscana,* x, pp. 557–652).

Other writings important for the spirit of St. Francis rather than for the facts of his life are the *Mirror of Perfection* and the so-called *Legend of the Three Companions*. The former is from the 14th century; the latter is a misnomer, and the text as published is something of a puzzle (Eng. trans. of both, 1904 *et seq.*).

The *Fioretti* or *Little Flowers of St. Francis* (some nine or ten English versions and innumerable editions) is a treasure of 14th-century popular literature. While it breathes the spirit of St. Francis, it must be used cautiously as a historical source (*see* the Italian edition of R. Pratesi, 1958; and the Eng. trans. with excellent notes of R. Brown, 1958). The interdependence of these and other sources and their historical value made up the so-called Franciscan Question, which went out of vogue somewhat after 1940. *Cf.* J. H. R. Moorman, *The Sources for the Life of St. Francis of Assisi* (1940); and the review of M. Bihl in *Archivum Franciscanum Historicum,* 39:3–37, 279–287 (1946).

See also biographies by J. Jørgensen (1907; Eng. trans. by T. O'Conor Sloane, 1912; 3rd ed., 1955); Fr. Cuthbert (1912; later ed., 1956); O. Englebert (Eng. ed. and trans. by E. Hutton, 1950); G. K. Chesterton (1924; later ed., 1957). (I. C. BY.)

FRANCIS, SAINT, OF PAOLA (1416–1507), founder of the Minim Friars and patron of Italian seamen, was born of humble parents in Paola, Italy, on March 27, 1416. Devoted to his saintly namesake of Assisi, to whom he ascribed his eye cure in infancy, Francis spent his 13th year with nearby Franciscan friars in San Marco. At the age of 14 he began a hermit's life of prayer and penance near Paola. Around 1435, like-minded men joined him to form his first friary of Hermits of St. Francis of Assisi, which he renamed in 1492 Ordo Minimorum (Order of the Least) in contrast to the Franciscans or Ordo Fratrum Minorum (Order of Lesser Brethren). Besides poverty, chastity and obedience, Minim Friars vowed to observe a perpetual fasting diet without meat, eggs or dairy products. After papal approval in 1474, they spread to other parts of Italy. By 1506, when Pope Julius II approved the definitive Minim rule, France, Spain, Germany and Bohemia had friaries, and Francis had established a second order for nuns and a third order for married people in the world. Hoping for a miraculous cure, Louis XI, king of France, induced Pope Sixtus IV to send Francis to him. Arriving in 1483, Francis instead persuaded Louis to make his peace with God. Successive monarchs built monasteries for the saint, keeping him in France until his death at Plessis-les-Tours, April 2, 1507. Famous for miracles and prophecy, Francis was canonized in 1519; his feast is April 2. His relics were disinterred and burned by Huguenots in 1562.

See H. Thurston and D. Attwater (eds.), *Butler's Lives of the Saints,* vol. ii, pp. 10–13 (1956); B. Bauer, *Saints of the Missal,* vol. i, pp. 153–156 (1958). (A. B. WR.)

FRANCIS, SAINT, OF SALES (FRANÇOIS DE SALES) (1567–1622), bishop of Geneva, refuted the error prevalent in his day that spiritual perfection was impossible for those living in the world. Born Aug. 21, 1567, in the castle of Sales at Thorens in Savoy, he was the eldest son of the Boisy family. His education began at La Roche and Annecy, continued at the Jesuit college of Clermont in Paris (1580–88) and was completed at Padua by theological study and the acquisition of the doctorate in law (1591). After a brief practice of law he turned to the ecclesiastical state and was ordained priest at Annecy (1593).

Missionary activity leading to the conversion of the Chablais from Calvinism to Roman Catholicism occupied the years from 1594 to 1598. Appointed coadjutor to the bishop of Geneva (1599) by Pope Clement VIII, Francis was consecrated bishop of that see on Dec. 8, 1602.

Diocesan organization and reform, plus continued efforts against Calvinism, marked Francis' episcopal administration. In teaching that perfection was easy and possible for all, he was especially effective as author, spiritual director and preacher. In 1610, through Jeanne Françoise Frémiot, the widowed baronne de Chantal, he founded a religious order for women, the Visitation of Holy Mary *(see* CHANTAL, SAINT JANE FRANCES). Francis died at Lyons on Dec. 28, 1622. His beatification (1661) and canonization (1665) took place under Pope Alexander VII. The title of doctor of the church was conferred on him by Pius IX (1877), and he was named the heavenly patron of all writers by Pius XI (1923). His feast day is Jan. 29.

Various religious congregations, both of men and women, taking him as their patron have followed his principles of spirituality.

St. Francis' writings—which include controversies against the Calvinists, works on spirituality, letters, sermons and documents on diocesan administration — resulted in most part from his activity in the ministry. A 26-volume critical edition was issued under the auspices of the Sisters of the Visitation of Annecy (1892–1932). The folloning have been translated into English: *The Controversies; The Treatise on the Lone of God; Spiritual Conferences;* selections from the letters, by H. B. Mackey; and, in several versions. *The Introduction of a Devout Life,* which is recognized as a classic on spirituality.

BIBLIOGRAPHY —*See* the biographies in English by H. Burton (1926) and E Sanders (1928). V Brassio, E. Morganti and M St Durica list other works from 1623 to 195j in *Opere e scritti riguardanti San Francesco Di Sales* (19j6). (E. J. CY.)

FRANCIS I. (1708–1765), Roman emperor and grand duke of Tuscany, second son of Leopold Joseph, duke of Lorraine, was born on Dec. 8, 1708. He married in 1736 Maria Theresa (*q.v.*), daughter of the emperor Charles VI. He succeeded his father as duke of Lorraine in 1729, but the emperar, at the end of the Polish War of Succession, desiring to compensate Stanislaus Leszczynski for the loss of his crown in 1735, persuaded Francis to exchange Lorraine for the reversion of the grand duchy of Tuscany. His wife secured his election to the Empire on Sept. 13, 1745, in succession to Charles VII., and she made him co-regent of her hereditary dominions. Francis was well content to leave the reality of power to his able wife. He died at Innsbruck on Aug. 18, 1765. *See* MARIA THERESA.

FRANCIS II. (1768–1835), the last Roman emperor, and, as Francis I., first emperor of Austria, was the son of Leopold II., grand-duke of Tuscany, afterwards emperor, and of his wife Maria Louisa, daughter of Charles III. of Spain. He was born at Florence on Feb. 12, 1768. In 1784 he was brought to Vienna to complete his education under the eye of his uncle the emperor Joseph II. Joseph is said to have treated his nephew with an impatient contempt which confirmed his natural timidity; but after the marriage of Francis to Elizabeth of Wiirttemberg (1788) their relations improved. The death of his wife in childbirth on Feb. 18, 1790 was followed by the death of his uncle on the 20th; and Francis acted as regent with Prince Kaunitz until his father came from Florence. On Sept. 19, he married his first cousin Maria Theresa, daughter of Ferdinand, king of Naples, by whom he was the father of his successor Ferdinand I., of Maria Louisa, wife of Napoleon, and of the archduke Francis, father of the emperor Francis Joseph. After her death (1807) he married Maria Ludovica Beatrix of Este (1808), and when she died he made a fourth marriage with Carolina Augusta of Bavaria (1816)

He succeeded in his twenty-fifth year to the Austrian dominions and the empire on the death of his father on March 1, 1792. The dominions of the house of Austria, widely scattered in the Low Countries, Germany and Italy, were exposed to the attacks of the French revolutionary governments and of Napoleon. He was dragged into all the coalitions against France, and in the early days of his reign he had to guard against the ambition of Prussia, and the aggressions of Russia in Poland and Turkey. For long he had no adviser save such diplomatists as Prince Kaunitz and Thugut, who had been trained in the Old Austrian diplomacy. His own best quality was an invincible patience supported by reliance on the loyalty of his subjects, and a sense of his duty to the State. (For the general events of this reign till 1815 *see* AUSTRIA, EMPIRE OF; EUROPE; FRENCH REVOLUTIONARY WARS; NAPOLEON I; etc.) Seeing that the Empire was in the last stage of dissolution, and that, even were it to survive, it would pass from the house of Habsburg to that of Bonaparte, he in 1804 assumed the title of hereditary emperor of Austria, thus giving some semblance of unity to his complex dominions in Germany, Bohemia, Hungary and Italy, by providing a common title for the supreme ruler. His action was justified when, in 1806, the establishment of the Confederation of the Rhine forced him to abdicate the empty title of Holy Roman emperor.

In 1805 he changed the basis of his administration. He had hitherto been assisted by a cabinet minister who was in direct relation with all the "chanceries" and boards which formed the executive government, and who acted as the channel of communication between them and the emperor and was in fact a prime minister. In 1805 Napoleon insisted on the removal of Count Colloredo, who held the post. From that time forward the emperor Francis acted as his own prime minister, superintending every detail of his administration. In foreign affairs after 1809 he reposed full confidence in Prince hfetternich. But Metternich himself declared at the close of his life that he had sometimes held Europe in the palm of his hand, but never Austria. Francis was sole master, and the history of the Austrian empire under his rule and after his death bears testimony to both his merits and his limitations. His indomitable patience and loyalty to his inherited task enable him to triumph over Napoleon. By consenting to the marriage of his daughter, Marie Louise, to Napoleon in 1810, he gained a respite which he turned to good account. By following the guidance of Metternich in foreign affairs he was able to intervene with decisive effect in 1813. The settlement of Europe in 1815 left Austria stronger and more compact than she had been in 1792, and that this was the case was largely due to the emperor.

During the 20 years which preceded his death in 1835, Francis was wholly in sympathy with the policy of "repression" which came, in popular view, to be identified with the Holy Alliance; and though Metternich was primarily responsible for the part played by Austria in the "policing" of Europe, Francis cannot but be held personally responsible for the cruel and impolitic severities, associated especially with the sinister name of the fortress prison of the Spielberg, which made so many martyrs to freedom. He was denounced by Liberals throughout Europe as a tyrant and an obscurantist. Nevertheless he was always popular among the mass of his subjects, who called him "our good Kaiser Franz." His capital error as a ruler of Austria was that he persisted in a system of administration which depended upon the indefatigable industry of a single man. Government in Austria broke down under a successor who had not his capacity for work. Francis died on March 2, 183j.

See Wolfsgruber, *Franz I. Kaiser von Osterreich* (a vols., 1899). Ample bibliographies will be found in Krones von Marchland's *Grundriss der osterreichischen Geschichte* (Berlin, 1882). *See* also HABSBURG.

FRANCIS I. (1494–1547), king of France, son of Charles of Valois, count of Angoulême, and Louise of Savoy, was born at Cognac on Sept. 12, 1494. On the accession of Louis XII. in 1498, Francis became heir-presumptive. Louis invested him with the duchy of Valois, and gave him as tutor Marshal de Gié, and, after Gié's disgrace in 1503, the sieur de Boisy, Artus Gouffier. François de Rochefort, abbot of St. Mesmin, instructed Francis and his sister Marguerite in Latin and history; Louise herself taught them Italian and Spanish.

The Knight.—Francis showed a great love for violent exercises, such as hunting, which was his ruling passion, and tennis, and for tournaments, masquerades and amusements of all kinds. His earliest gallantries are described by his sister in the 25th and 42nd stories of the *Heptameron.* He married Claude, daughter of Louis XII., on May 18, 1514, and succeeded to the throne on Jan. 1, 1515. In the early years of his reign the government was chiefly in the hands of Louise of Savoy, Chancellor Antoine Duprat, Secretary Florimond Robertet, and the two Gouffiers, Boisy and Bonnivet. The royal favour then elevated Anne de Montmorency and Philippe de Chabot, and in the last years of the reign Marshal d'Annebaud and Cardinal de Tournon. Women had a great influence over Francis—his sister, Marguerite d'Angoulême, and his mistresses. Whatever the number of these, he had only two titular mistresses—at the beginning of the reign Françoise de Chbteaubriant, and from about 1526 to his death Anne de Pisseleu, whom he created duchesse d'Etampes and who entirely dominated him. It has not been proved that he was the lover of Diane de Poitiers, nor does the story of "La belle Ferronnière" appear to rest on any historical foundation. *(See* Paulin Paris, *Études sur le règne de François Ier*.)

The Statesman.—Circumstances alone gave a homogeneous character to the foreign policy of Francis. The struggle against the emperor Charles V. filled the greater part of the reign. In reality, the policy of Francis, save for some flashes of sagacity, was irresolute and vacillating. Attracted at first by Italy, he led the triumphal Marignano expedition (1515), which gained him reputation as a knightly king and as the most powerful prince in Europe. In 1519, in spite of wise counsels, he stood as candidate for the imperial crown. The election of Charles V. caused an inevitable rivalry between the two monarchs which accentuated the light and chivalrous temper of the king and the cold and politic character of the emperor. Francis's personal intervention in this struggle was seldom happy. He did not succeed in gaining the support of Henry VIII. of England in 1520; his want of tact goaded the Constable de Bourbon to extreme measures in 1522–1523; and in the Italian campaign of 1525 he proved himself a vacillating and foolhardy leader, and by his blundering led the army to the disaster of Pavia (Feb. 25, 1525), where, however, he fought with great bravery *(see* ITALY: *History)*. "Of all things," he wrote to his mother after the defeat, "nothing remains to me but honour and life, which is safe"—the authentic version of the legendary phrase "All is lost save honour." He strove to play the part of royal captive heroically, but the prison life galled him. He fell ill at Madrid and was on the point of death. For a moment he thought of abdicating rather than of ceding Burgundy. But this was too great a demand upon his fortitude, and he yielded and signed the treaty of Madrid (1526). After Madrid he wavered unceasingly between two courses: that of continuing hostilities, and the policy favoured by Montmorency of peace-and understanding with the emperor. At times he had the sagacity to recognize the utility of alliances, as was shown by those he concluded with the Porte and with the Protestant princes of Germany. But he could never pledge himself frankly in one sense or the other, and this vacillation prevented him from attaining any decisive results. At his death, however, France was in possession of Savoy and Piedmont.

Religion.—In his religious policy Francis showed the same instability. Drawn between various influences, that of Marguerite d'Angoulême, the du Bellays, and the duchesse d'Etampes, who was in favour of the Reformation or at least of toleration, and the contrary influence of the uncompromising Catholics, Duprat, and then Montmorency and de Tournon, he gave pledges successively to both parties. In the first years of the reign, following the counsels of Marguerite, he protected Jacques Lefèvre of Etaples and Louis de Berquin, and showed some favour to the new doctrines. But the violence of the Reformers threw him into the arms of the opposite party. The affair of the Placards in 1534 determined him to adopt a policy of severity. From that time, in spite of occasional indulgences shown to the Reformers, due to his desire to conciliate the Protestant powers, Francis gave a free hand to the party of repression, of which the most active and most pitiless member was Cardinal de Tournon; and the end of the reign was sullied by the massacre of the Waldenses (1545).

The Ruler.—Francis introduced new methods into government. In his reign the monarchical authority became more imperious and more absolute. His was the government *"du bon plaisir."* By the unusual development he gave to the court he converted the nobility into a brilliant household of dependents. The Concordat brought the clergy into subjection, and enabled him to distribute benefices at his pleasure among the most docile of his courtiers. He governed in the midst of a group of favourites, who formed the *conseil des affaires*. The states-general did not meet, and the remonstrances of the *parlement* were scarcely tolerated. By centralizing the financial administration by the creation of the *Trésor de l'Épargne*, and by developing the military establishments, Francis still further strengthened the royal power. His government had the vices of his foreign policy. It was uncertain, irregular and disorderly. The finances were squandered in gratifying the king's unbridled prodigality, and the treasury was drained by his luxurious habits, by the innumerable gifts and pensions he distributed among his mistresses and courtiers, by his war expenses and by his magnificent buildings. His government, too, weighed heavily upon the people, and he was less popular than is sometimes imagined.

Francis owes the greater measure of his glory to the artists and men of letters who vied in celebrating his praises. He was pre-eminently the king of the Renaissance. Of a quick and cultivated intelligence, he had a sincere love of letters and art. He holds a high place in the history of humanism by the foundation of the Collège de France; he did not found an actual college, but after much hesitation instituted in 1530, at the instance of Guillaume Budé (Budaeus), *Lecteurs royaux*, who in spite of the opposition of the Sorbonne were granted full liberty to teach Hebrew, Greek, Latin, mathematics, etc. The humanists Budé, Jacques Colin and Pierre Duchbtel were the king's intimates, and Clément Marot was his favourite poet. Francis sent to Italy for artists and for works of art, but he protected his own countrymen also. Here, too, he showed his customary indecision, wavering between the two schools. At his court he installed Benvenuto Cellini, Francesco Primaticcio and Rosso del Rosso, but in the buildings at Chambord, St. Germain, Villers-Cotterets and Fontainebleau the French tradition triumphed over the Italian.

Francis died on March 31, 1547. By his first wife Claude (d. 1524) he had three sons and four daughters: Louise, who died in infancy; Charlotte, who died at the age of eight; Francis (d. 1536); Henry, who came to the throne as Henry II.; Madeleine, who became queen of Scotland; Charles (d. 1545); and Margaret, duchess of Savoy. In 1530 he married Eleanor, the sister of the emperor Charles V.

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(J. I.; X.)

FRANCIS II. (1544–1560), king of France, eldest son of Henry II. and of Catherine de' Medici, was born at Fontainebleau on Jan. 19, 1544. He married Mary Stuart *(see* MARY, QUEEN OF SCOTS), daughter of James V. of Scotland, on Aug. 25, 1558, and ascended the French throne on July 10, 1559. During his short reign the young king, a sickly youth and of feeble understanding, was the mere tool of his uncles Francis, duke of Guise, and Charles, cardinal of Lorraine, into whose hands he virtually delivered the reins of government. After the failure of the conspiracy of Amboise, directed against the Guises the duke of Guise became lieutenant-general of the kingdom, but his Catholic leanings were somewhat held in check by the chancellor Michel de l'Hôpital *(q.v.)*. Francis II. died on December 5, 1560.

See Ernest Lavisse, *Histoire de France* (vol. vi. *by* J. H. Mariéjol, 1904), which contains a bibliography.

FRANCIS I. (1777–1830), king of the Two Sicilies, was the son of Ferdinand IV. (I.) and Maria Carolina of Austria He married Clementina, daughter of the emperor Leopold II. of Austria, in 1796, and at her death Isabella daughter of Charles IV. of Spain. Francis was appointed regent in Sicily in 1812. On the fa11 of Napoleon his father returned to Saples and suppressed the Sicilian constitution and autonomy. incorporating his two kingdoms into that of the Two Sicilies (1816); Francis then assumed the revived title of duke of Calabria On succeeding to the throne in 1825 he showed himself as reactionary as his father. He left the government in the hands of favourites and police officials, and lived with his mistresses, surrounded by soldiers ever in dread of assassination During his reign the only revolutionary movement was the outbreak on the Cilento (1828), savagely repressed by the marquis Delcarretto, an ex-Liberal turned reactionary.

FRANCIS II (1836–1894), king of the Two Sicilies, son of Ferdinand II and Maria Cristina of Savoy, was the last of the Bourbon kings of Naples. He ascended the throne on May 22, 1859. He at once appointed Carlo Filangieri (*q v*), as prime minister but did not take his sensible advice. and Filangieri soon resigned. On June 7 a part of the Swiss Guard mutinied. and while the king mollified them by promising to redress their grievances. General Nunziante collected other troops, who surrounded the mutineers and shot them down. Cavour repeated an earlier proposal for an alliance to divide the papal states betneen Piedmont and Naples, the province of Rome excepted, but Francis rejected an idea which to him savoured of sacrilege. Meanwhile the revolutionary parties were conspiring for the overthrow of the Bourbons in Calabria and Sicily. and Garibaldi was preparing for the conquest of Sicily (*see* GARIBALDI. GIUSEPPE). These events at last frightened Francis into granting a constitution, but its promulgation was followed by disorders in h'aples and the resignation of ministers, and Liborio Romano became head of the government. Garibaldi. who had crossed the straits of Messina. was advancing northwards Francis. after long hesitations and even an appeal to Garibaldi himself, left Naples (Sept. 6) with his wife Maria Sophia, the court, the diplomatic corps (the French and English ministers excepted), and went by sea to Gaeta, where a large part of the army was concentrated. The next day Garibaldi entered Naples, was enthusiastically welcomed, and formed a provisional government. Garibaldi's troops defeated the Neapolitan royalists on the Volturno (Oct. 1–2), while the Piedmontese under Victor Emmanuel captured Capua. The siege of Gaeta by the Piedmontese began on Nov 6, 1860. The fortress capitulated on Feb. 12, 1861, and Francis was driven from his kingdom. He died on Dec. 27, 1894 at Arco in Tirol.

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FRANCIS OF MEYRONNES (Lat. FRANCISCUS DE MAYRONIS) (d. *c.* 1328). Provençal Franciscan philosopher, known to the scholastics as *doctor illuminatus* or *acutus,* was a pupil of Duns Scotus, whose doctrine of *fortnalitates* he applied even to the Trinity. According to Francis, ideas belong to God's substance; variations in the intensity of qualities, rather than qualities themselves, mark off individuals. The new kinetic theory of *vis impressa* and that of the revolution of the earth are mentioned in his works. He advocated a universal temporal monarchy headed by the pope; and upheld the doctrine of the Immaculate Conception. As well as theological and political treatises, he wrote commentaries on Porphyry's *Isagoge,* Aristotle's *Categories* and *Physics* and Peter Lombard's *Sentences.* (L. M.-Po.)

FRANCIS, JAMES BICHENO (1815–1892), U.S. civil engineer best known for his development of the mixed-flow or Francis turbine, was born in Southleigh, Eng., May 18, 1815. He left school at the age of 14 to assist his father on hydraulic works connected with a small railway in Wales. In 1833 Francis moved to the United States where he was employed in construction of the Stonington (Conn.) railway under the supervision of G. W. Whistler. Francis later followed Whistler when the latter joined a group known as "Proprietors of the Locks and Canals on the Merrimack River" at Lonell, Mass. At the age of 22 Francis became chief engineer of the company, engaged first in locomotive design, then in the erection of cotton mills, and finally in management of water power facilities at Lowell. For 40 years he looked after the company's water power interests and acted as consulting engineer to factories using the power; he contributed greatly to the rise of Lowell as an industrial city.

Among technical matters to nhich Francis gave his attention were timber preservation, the testing and design of cast-iron girders and the design of fire protection systems. In addition to his development of the Francis turbine, he is probably best known for his formulas for the flow of water over weirs and his many other hydraulic studies. He was widely consulted on engineering projects; one of them took him as far as Minnesota. An original member and one-time president of both the Boston and American societies of civil engineers, he wrote more than 200 technical papers and, although unschooled, became known as one of the most scientific in outlook of the civil engineers of his day. He died at Lowell on Sept. 18. 1892. (W. E. HD.)

FRANCIS, SIR PHILIP (1740–1818), English politician and pamphleteer, the supposed author of the *Letters* of *Junius,* and the chief antagonist of Warren Hastings, was born in Dublin on Oct. 22, 1740. He was educated at a Dublin free school, privately. and at St. Paul's school, London. In 1756, immediately on his leaving school, he was appointed to a junior clerkship in the secretary of State's office by Henry Fox (afterwards Lord Holland), and this post he retained under the succeeding administration. In 1758 he was employed as secretary to Gen. Bligh in the expedition against Cherbourg; and in the same capacity he accompanied the earl of Kinnoul on his special embassy to the court of Portugal in 1760.

In 1762 he was appointed to a principal clerkship in the War Office. where he formed an intimate friendship with Christopher D'Oyly, the secretary of State's deputy, whose dismissal from office in 1772 was hotly resented by "Junius"; and in the same year he married Miss Macrabie, the daughter of a retired London merchant. In 1763 the great constitutional questions arising out of the arrest of Wilkes began to be sharply canvassed. It was natural that Francis, who from a very early age had been in the habit of writing occasionally to the newspapers, should be eager to take an active part in the discussion. though his position as a Government official made it necessary that his intervention should be carefully disguised. He is known to have written to the *Public Ledger* and *Public Advertiser,* as an advocate of the popular cause, on many occasions about and after the year 1763. His chief title to fame as a writer, however, is his supposed authorship of the *Letters* of *Junius,* of which the first appeared in Jan. 1769, and the series was continued till Jan. 21, 1772 (*see* JUNIUS).

In March 1772 Francis finally left the War Office, and in the following July started a continental tour which lasted until Dec. 1772. In June 1773 Lord North appointed him a member of the newly constituted supreme council of Bengal at a salary of £10,000 per annum. Along with his colleagues Monson and Clavering he reached Calcutta in Oct. 1774, and a long struggle with Warren Hastings, the governor-general, immediately began. These three formed a majority of the council in opposition to the governor-general's policy, accusing him of corruption, mainly on the evidence of Suncomar. The death of Monson (1776) and of Clavering (1777) made Hastings again supreme in the council, and a dispute with Francis, led in Aug. 1780 to a minute being delivered to the council board by Hastings, in which he stated that "he judged of the public conduct of Mr. Francis by his experience of his private, which he had found to be void of truth and honour." A duel was the consequence, in which Francis received a dangerous wound (*see* HASTINGS, WARREN). His recovery was rapid and complete and he left for England where, on his arrival in Oct. 1781, he was received with little favour.

In 1784 Francis was returned by the borough of Yarmouth, Isle of Wight; and on the return of Hastings in 1785, did all in his power to bring forward and support the charges which ultimately led to the impeachment resolutions of 1787. He sympathized warmly with the French revolutionary doctrines, in 1793 supported Grey's motion for a return to the old constitutional system of representation, and was one of the founders of the "Society of the Friends of the People." The acquittal of Hastings in April 1795 disappointed Francis of the governor-generalship, and in 1798 he had to submit to the additional mortification of a defeat in the general election. He was once more successful, however, in 1802, when he sat for Appleby, but was not offered the governor-generalship on the Whig success in 1806, though he accepted a K C B. He was not re-elected for Appleby in 1807 and the remainder of his life was spent in comparative privacy.

Among the later productions of his pen were, besides the *Plan of a Reform in the Election of the House of Commons,* pamphlets entitled *Proceedings in the House of Commons on the Slave Trade* (1796), *Reflections on the Abundance of Paper in Circulation and the Scarcity of Specie* (1810), *Historical Questions Exhibited* (1818), and a *Letter to Earl Grey on the Policy of Great Britain and the Allies towards Norway* (1814). His first wife, by whom he had six children, died in 1806, and in 1814 he married his second wife, Emma Watkins, who long survived him, and who left voluminous manuscripts relating to his biography. Francis died on Dec. 23, 1818.

BIBLIOGRAPHY.—For the evidence identifying Francis with Junius *see* the article JUNIUS, and the authorities there cited. *See* also *Memoirs of Sir Philip Francis, with Correspondence and Journals,* by Joseph Parkes and Herman Merivale (2 vol., 1867).

FRANCISCANS (FRIARS MINOR; ORDO FRATRUM MINORUM; O.F.M.; in England called GREY FRIARS), an order of mendicant friars founded by St. Francis (*q.v.*) of Assisi. Francis heard the call to a life of poverty and preaching of penance (1209), and soon was joined by his first followers. He gave them a short and simple rule of evangelical maxims (the so-called "primitive rule") and in 1210 went with them, 11 others besides himself, to Rome, where he received verbal authorization from Innocent III. The brethren, who had no possessions of any kind and whose only centre was the little church, the Porziuncola, at Assisi, preached and worked at first in Umbria and then, as numbers grew, in the rest of Italy and abroad.

The character and message of Francis precipitated, so to say, a form of life that was already in the air in northern and central Italy, and recruits came in great numbers. For a time there were no fixed residences, but the brotherhood met each year in chapter at Assisi. In 1219, as a result of appeals and controversies, "ministers" for different regions were appointed and certain canonical ordinances were imposed by the pope. Francis himself renounced the official headship in 1220, but at the request of the general chapter composed a rule (the "second rule") which was found too strict and never applied. Unwillingly, with the aid of Cesarius of Speyer, he composed a third version (the "approved rule" or *Regula bullata),* which received papal confirmation when Honorius III gave formal approval of the order on Nov. 29, 1223. Finally, in 1226, Francis wrote his testament, in which he reaffirmed his deepest convictions as to poverty, the renunciation of all papal privileges and the sacrosanctity of the rule. understood literally. Francis, it seems clear, had originally no intention of founding an order. He had heard the call to follow Christ in evangelical poverty and simplicity, and he accepted this life as one to be shared with all—with his followers, with St. Clare and her sisters, and with all men and women of good will. He explicitly asserted the novelty of his brotherhood and his unwillingness to follow monastic precedent. When followers came in hundreds, neither he nor they could bring themselves either to insist fully upon or to renounce absolutely the primitive idea with Francis as its only accredited exponent. This inner conflict between the spiritual intuition of a saint, and the practical necessities of a large and miscellaneous body of men, remained unresolved for the first four centuries of the order's history and remains a problem of religious history.

Constitution. — When Francis died in 1226 the number of his friars was already great, but the rule gave no more than the skeleton of an organization, in which Francis and his vicar-general, Elias (*q.v.*) of Cortona, had had an almost monarchic position. In the years that followed there was a double tension: that of transforming a brotherhood of spiritual endeavour into a fully articulated and disciplined religious order, and that of translating the soaring vision of St. Francis into a body of doctrine that could be preached to and practised by a multitude of ordinary mortals. It was indeed the basic problem of Christianity focused upon a small body of medieval men.

The former process was at first delayed and later hastened by the autocratic and in some ways retrograde behaviour of Elias, who was himself neither learned nor in orders. Subsequently, under the generalate (1240–44) of Haymo of Faversham, an Englishman, the general chapter was used as a legislative body to sanction an elaborate constitution, based in part upon that of the Dominicans (Friars Preachers). The convents. each under a guardian, were grouped in regional provinces under ministers provincial, and the provinces under a minister general. Provincial and general chapters (the latter no longer an assembly of all the friars) were held triennially, and a system of education similar to that of the Dominicans was introduced. Friars not in orders were excluded from holding office, and gradually came to form a separate class. Meanwhile the pull of circumstances and the entry into the order of university masters and their pupils assisted in transforming a brotherhood of unlettered preachers of the Christian message into an order of highly trained clerical theologians. In two respects, however, the Friars Minor stood apart from the Friars Preachers: they remained nearer in heart and spirit to the common people, and the order was governed by its superiors rather than by elected committees *(see* also DOMINICANS: *History).*

The second of the two processes alluded to above was a longer and more difficult one, in which the victories of moderate men and practical statesmen were often counterbalanced by a lowering of ideals and by the harsh treatment meted out to those who might well seem to have preserved more faithfully the purity of their founder's ideal. In the process of change the papacy played a leading part; the friars were a valuable militia for the church; and the Curia, if appealed to on a question of law, could answer only in legal terms. The testament of Francis was soon (1230) declared to have no canonical force, and a succession of bulls reduced Francis' vision of poverty into a legal status in which the exigencies of the rule were preserved in word, but eluded, partly by the use of a third party to stand between the benefactor and these who in fact enjoyed the benefaction, and partly by the legal fiction of vesting the ownership of all property in the Holy See.

These decisions were not unchallenged, and a division showed itself between those who were familiar with the life and teaching of the founder and those, especially from countries beyond the Alps, who wished to see the order attain a maximum of freedom to pursue its work of learning and teaching. Something of an equilibrium was reached in the generalate (1257–74) of St. Bonaventura, who has sometimes been called the second founder of the order. By his life of St. Francis, his commentary on the rule and the constitutions promulgated under him at Narbonne (1260), as well as by his firm government and saintly personality, Bonaventura provided the framework and the inspiration for an interpretation of the message of St. Francis and a version of the Franciscan life that has remained ever since official and central in the order.

Meanwhile the friars had spread far and wide in Europe, while bands of missionaries had penetrated Syria and Africa. Simultaneously, the friars' houses in university towns such as Paris and Oxford were transformed into schools of theology which rapidly became the most celebrated in Europe, and both attracted and produced many of the greatest masters of the golden age of scholasticism. At Paris Alexander of Hales, Bonaventura, John Pecham and Matthew of Aquasparta, and at Oxford Adam Marsh, Thomas of York. Duns Scotus and William of Ockham, maintained the succession of genius for a century. After 50 years the contemporary controversies over Aristotelian philosophy brought the Dominicans and Franciscans into collision, and thenceforward the two orders were consistently and often bitterly opposed on all matters that were not part of the traditional faith.

Reform Movements.—Spirituals and *Conventuals*.—With the death of Bonaventura the internal dissensions of the order flamed up anew. The mantle of the first companions of Francis and the *zelanti* (zealots) was assumed by a school that gradually acquired the name of Spirituals, standing for the literal observance of the rule and testament, and the renunciation of papal dispensations. Opposed to them were the Conventuals, who stood for a less austere community life adapted to the exigencies of study and preaching. Among the 13th and 14th-century leaders of the Spirituals were Pietro Giovanni Olivi, Angelo of Clareno and Ubertino of Casale, and among their followers were those who formed for future generations in literature and in art—in the Fioretti ("Little Flowers"), the *Speculum* perfectionis ("Mirror of Perfection") and the poems of Jacopone da Todi—the romantic image of Francis and his first friars that has become part of the medieval legacy of beauty.

Yet the victory in law and practice was ensured to the Conventuals by the climate of the age, the fortunes of the other orders of friars, the needs of the faithful and the patronage of the papacy. Their advantages were increased by the extreme and ultimately rebellious and heretical opinions and conduct of many of the Spirituals. For a long time, however, the moral and what may be called the aesthetic superiority lay with the Spirituals, and their ultimate catastrophe is one of the tragedies of medieval history. After many vicissitudes. the controversy on poverty within the order, as also the claim of the Spirituals to form communities following their conception of the Franciscan life, was settled in 1322–23 in favour of the Conventuals by John XXII. His harsh treatment of dissidents led to a temporary schism in the order and the departure into rebellion and heresy of the extremists known as the Fraticelli Within a few decades, however, calamities of another sort had changed the face of the church. Both discipline and observance had suffered in the Conventual party during the strife, and the Minors felt also the disastrous effects of the great plague and the great schism, not to mention the nominalist movement in the schools, which had issued from their midst.

In the latter part of the 14th century the friars, and in particular the Franciscans, who were ubiquitous because of their great numbers and their active mendicancy, lost much of the esteem and popularity of earlier times. They became the target of satirists and reformers in every country, as readers of Boccaccio, Langland and Chaucer well know. Their theologians, already adepts in the subtleties of Scotus, were deeply infected with Nominalism (q v.) and as "Duns' men" (whence "dunces") they were regarded in the 16th century with distaste and hostility by Erasmus and the humanists in general.

Observants.—Throughout the 14th century a series of zealous reformers, the direct spiritual successors of Angelo and Ubertino, had initiated groups of friars of austere life existing apart from the main body of Conventuals. At last a clear separation was effected. A group of French and Burgundian friaries, vowed to the literal observance of the rule. were put by the Council of Constance in 1415 under a vicar-general mho owed obedience to the minister general alone. These mere known as Observants. Though several attempts were made by the papacy to align the whole order under the Observants' standard, the outcome was in fact a complete separation in 1517, when they became a separate religious order. Before that, the Observants under the leadership of St. Bernardino of Siena, St. John of Capistrano and St. James of the March had spread far and wide over Europe. They were introduced into England in 1482, and gained a name for strict discipline. The leading spirit of the Observants in early days was St. John (*q.v.*) of Capistrano, a preacher and wonder-worker of unparalleled genius and zeal, who died shortly after the victory over the Turks at Belgrade which was largely due to his inspiration. In Spain the great reforming statesman Cardinal Jimenez was an Observant. The English Observants as a body opposed both the royal divorce and the royal supremacy of Henry VIII, and were driven to death, prison and exile.

Between the Observants and the Conventuals a number of splinter groups came into existence, of which the "half-reform," a compromise sponsored (1430) by Martin V, was the most notable. Finally, in 1517 Leo X erected the Observants into an autonomous order, to which for a short time the Conventuals were subordinated. They spread widely and themselves gave birth to stricter groups, notably that of the Alcantarines or Discalced Friars Minor in Spain and Portugal, the work of St. Peter of Alcantara, remarkable for their extreme austerity.

Capuchins.—Meanwhile another important movement of reform had taken place that added an eremitical element to the literal interpretation of the rule. These friars. knoan as Capuchins (from their pointed cowl, *capuche*), were founded by Matteo da Bascio in 1525 and received papal confirmation and separate government under a vicar-general in 1535. Their constitutions prescribed absolute poverty, both corporate and personal, and great austerity of life. The Capuchins had a rough passage through the 16th century. They were harassed by the Conventuals and forbidden by the papacy to extend outside Italy. The defection (1542) to Protestantism of their second general, Bernardino Ochino, all but ruined them, and their leaders were not men of great ability. Nevertheless they increased rapidly, and by 1571 counted 17,000 brothers in Italy alone. In the following centuries, when allowed to expand freely, they reached a maximum of 33,000 in 1750. They played almost as important a part as the Jesuits in the later stages of the Counter-Reformation, appealing to the lower orders and to the country people as well as to courts and castles. Among notable Capuchins were St. Lawrence of Brindisi, a papal diplomatist; Ange de Joyeuse, a leader in the wars of religion: Père Joseph du Tremblay. the "gray eminence"; Benet Canfield, the English mystical writer; St. Fidelis of Sigmaringen; and Marco Cristofori of Aviana, who played a part in the victory over the Turks in 1683–88 similar to that of St, John of Capistrano two centuries earlier. In England a group staffed the chapels for the Catholic queens Henrietta Maria and Catherine of Braganza. They were active in missionary and social work all over the world, notably in America and Ireland.

After the French Revolution.—The Franciscans suffered, though not so severely as the endoned orders, in the French Revolution and the subsequent liberal and secularizing epoch; they have always been most numerous in the Latin lands, and on the missions they were never reduced to nonentity. They revived with the religious revival of the early 19th century and again spread widely; during the mid-19th century years they developed their activities in every missionary field of the old and new worlds. Since the 16th century the order had consisted of three main branches, but whereas the Capuchins were undivided, and the Conventual~had absorbed their largest offshoot (the so-called "improved Conventuals") in the 17th century, the Observants had consisted from early days of the Observants proper, the Reformed Observants. the Recollects, the Discalced and other smaller splinters. These were all united by Leo XIII in 1897 with new constitutions under a single minister general.

The Franciscans therefore form not one but three orders: the Conventuals (O.F.M. Conv.), the smallest group; the Observants (O.F.M.), the largest by far; and the Capuchins (O.F.M. Cap.). In 1960 the Observants had 37 provinces, including 5 in the United States, nith many friars of German origin; the Conventuals 21 provinces, including 3 in the United States; the Capuchins 45 provinces and other lesser groups, of which half are in Italy.

Five popes have been Franciscans: Nicholas IV; Sixtus IV; the two intensely dynamic 16th-century popes Julius II and Sixtus V; and Clement XIV, who suppressed the Jesuits. There have been numerous historians of the order since the Reformation, including the Irish friar Luke Wadding (1588–1657). In modern times the foundation (1879) of the College of St. Bonaventura at Quarrachi near Florence led to the establishment of a school of editors of the works of Bonaventura, Peter Lombard, Alexander of Hales, etc. A number of learned periodicals also have appeared, such as the *Analecta Franciscana,* the *Achivium Franciscanum historicum,* the *Antonianum* and the *Franziskanische Studien,* to say nothing of more popular productions in all languages.

Among Franciscan scholars may be mentioned P. M. Oliger, the historian of St. Francis, and A. Gemelli (d. 1959), founder and rector of the University of the Sacred Heart at Milan, both Observants. Among social workers may be mentioned Theobald Mathew (d. 1856), the Irish "apostle of temperance," and his contemporary Theodosius Florentini (d. 1865), the great Swiss philanthropist. In theology, the Franciscans have always taken St. Bonaventura and Duns Scotus as guides, and from the latter they received the legacy of propagating the doctrine of the Immaculate Conception. In the middle ages they introduced the Christmas crib, and since the 17th century they have popularized the devotion of the Way of the Cross, the indulgences of which they still distribute. In the 14th century the Franciscans were the first to establish charitable funds, *montes pietatis,* to grant interest-free loans to the poor.

The Observant habit is a dark brown tunic with rope girdle and round hood and sandals over bare feet; they wear a large tonsure. Conventuals wear a black tunic with white cord; a large, double, pointed hood; biretta, and shoes. The Capuchin habit is a coarse brown tunic with cord, pointed cowl, sandals and beard.

The Franciscan Aim.—The widespread modern predilection for St. Francis, the intensive work done by historians of every tongue on Franciscan origins, and the selection of the saint and his first followers as figures of ideal beauty and simplicity, heralds of the modern love of nature and of animals, have perhaps led many writers to a certain neglect of perspective. They have examined the original documents, have traced what seemed to them to be a decline from the original ideal, and have noted the lamentable divisions in the order in the late 13th century. As a consequence, those unfamiliar with the history of the church throughout the centuries have perhaps failed to appreciate the immense scope and the beneficent achievement of the Franciscans among the poor, the unfortunate and the heathen throughout the world from the time of St. Francis onward. They have been for centuries, and still are, by far the most numerous body of religious in the Roman Catholic Church, and in part at least their absence from the forefront of the world's stage is due to their fidelity to the message of simplicity and poverty which they have received from their founder.

Second Order.—The Second Order of St. Francis, known also as the Poor Ladies, Clarisses or Poor Clares, was founded at Assisi by St. Clare (*q.v.*), a daughter of a noble family of the town. She took the veil at the hands of St. Francis in the Porziuncola on March 18, 1212, and together with her sister Agnes and others was lodged by him in the church of San Damiano, where she was joined by relatives and friends and became abbess in 1216. Francis gave her only verbal counsel and a short "way of life," and the first rule, an austere monastic directory, was imposed by Cardinal Ugolino (later Gregory IX) in 1218–19. This was later modified to the second rule by Innocent IV in 1247. But Clare fought hard for union with the Friars Minor and the observance of full Franciscan poverty, and a third rule, largely that of St. Francis and embodying her wishes, was approved by Pope Innocent IV only two days before her death; the papal letter was found when her tomb was opened in 1893. Long before this papal act the Poor Ladies had founded convents in north Italy and beyond the Alps, and they continued to be very numerous until the Reformation, despite the severity of their rule.

The Second Order did not escape its share in the tribulations of the friars. Convents existed following each of the three rules, and a fourth became current in France. In 1263 Urban IV at the instigation of St. Bonaventura united all the Clares under the slightly mitigated (second) rule of 1247, but several reforms in the direction of primitive austerity took place. The Colettines, named after their founder, St. Colette (*q.v.*) of Corbie, represented one such (1417), the Conceptionists in Spain another (1489). In 1538 the Clare-Capuchinesses were founded in Italy; and finally the Clares of Strict Observance (Alcantarines) also in Italy, originated in 1630. The first and third of these multiplied greatly, particularly in France and Spain, respectively. All save the last-named still exist.

The Poor Clares have always ranked among the most austere and penitential of the religious orders, and in the 20th century they share with the Carmelites (*q.v.*) a reputation for the strict observance of a dedicated contemplative life. Despite (or perhaps because of) the severity of its rule, the order has always counted among its members. especially in France and Germany, many women of royal, noble and gentle families, and has never decayed. It remains flourishing in the mid-20th century, with more than 650 convents, chiefly in Spain and Italy but also throughout the world. including North and South America. Among the many saints, besides the foundress, her sister Agnes and St. Colette, may be mentioned St. Catherine of Bologna.

The Poor Clares' habit is brown, with cord girdle and black veil, and they go barefoot except for wearing sandals out of doors,

Third Order.—The Third Order of St. Francis, for men and women living in the world, was no more than a formalization of the message of St. Francis, who himself wrote a letter "to all Christians." Perhaps as early as 1221 brethren and sisters "of penance" (*i.e.,* pledged to a devout life) were in existence; certainly the Third Order was known as such in 1230. It met a need in the growing urban population of Europe that had hitherto been satisfied by semiorthodox associations and sects. Its members were distinguished by an exact observance of all the fasts and other precepts of the church, by a refusal to bear arms or to take oaths save in specified circumstances. Christopher Columbus and Isabella I were members of this order. The constitutions of the order for those in the world were revised and mitigated by Leo XIII in 1883, and by the 1960s there were more than 4,000,000 Franciscan "Tertiaries," both men and women, many of them given to works of charity and social service.

Early in Franciscan history there arose a "regular" Third Order of communities under vow. The male branch was all but extinguished at the Reformation and later during the French Revolution, but witnessed a revival after the mid-19th century, with numerous congregations, particularly in Holland and German-speaking countries, with derivatives in North America. Congregations of Franciscan women Tertiaries are numerous all over the Catholic world. Both men and women are devoted to teaching, nursing and the auxiliary missionary activities. A revised rule and constitutions were given them by Pius XI in 1927.

Minims.—The Minims (*Ordo Minimorum*) were founded by St. Francis (*q.v.*) of Paola in southern Italy about 1435, at first as a group of hermits. They were neither a reform of nor a revolt from the Franciscans, with whom they have never had organic connection. They were a separate institute, deriving their inspiration from St. Francis of Assisi, particularly in his encouragement of simplicity and the eremitical life. Their name, intended to set them below the Friars Minor, was a token of humility, and they received from their founder a life of the most austere penance, with emphasis on silence and on abstinence from all foodstuffs save bread, vegetables. fruit and oil. The order received papal approval in 1474 and spread rapidly in the 16th century, particularly in Italy, France, Spain and the New World, and has survived to the present day in Italy. The habit of the Minims is a wide-sleeved black or natural wool tunic, with cord girdle, and a cape with hood. The order is governed by a corrector general. *See* MONASTICISM; ORDERS AND CONGREGATIONS, RELIGIOUS; *see* also references under "Franciscans" in the Index volume.

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FRANCISCO MORAZÁN, department in highlands of central Honduras. Area 3,068 sq.mi., pop. (1961) 283,607. About half of the inhabitants live in the *districto central,* which includes Tegucigalpa (*q.v.*) the national and departmental capital. The many fertile highland valleys and basins are important agriculturally producing poultry, corn, beans, potatoes, cotton, harvested forage grasses, cattle and swine. Mountain forests cover about 34% of the department. Gold and silver are mined. Industries include foodstuffs, beverages, textiles, cigarettes. soap, glass, china and other clay products, matches, shoes and other leather goods, and furniture. The department was called Tegucigalpa until 1943 when it was renamed in honour of the president of the Central American federation (1830–40). (C. F. J.)

FRANCIS FERDINAND (1863–1914), Austrian archduke whose assassination was the immediate cause of World War I, was born in Graz on Dec. 18 1863, the eldest son of the archduke Charles Louis, brother of Francis Joseph.

The death of the heir apparent, the archduke Rudolf. on Jan. 30, 1889, made Francis Ferdinand next in succession to the throne after his father. who died in 1896 To enlarge his knowledge he embarked in 1892 on a one-year cruise round the world. A severe lung complaint forced him, beginning in 1895, to spend several years in the south under medical supervision. During this period his younger brother Otto (father of the future emperor Charles I) was regarded as likely to succeed to the throne. This made Francis Ferdinand a deeply embittered man, full of contempt for the high society of Vienna. Through his desire to marry Sophie, Gräfin Chotek (1868–1914), a lady in waiting, he came into sharp conflict with the emperor and with the court. Only after he had renounced his future children's rights to the throne was the morganatic marriage allowed (July 1, 1900).

Francis Ferdinand's military interests centred chiefly on the navy In foreign affairs he considered the estrangement from Russia to be disastrous and tried. without endangering the alliance with Germany, to restore Austro-Russian understanding At home he had a clear eye for the difficulties that were bound to develop through the reckless policy of magyarization pursued by the Hungarians against the Slavs in their half of the dual monarchy. At first he thought of a "triadic" reorganization of the monarchy, with the Slavs as the third force beside the Germans and the Hungarians. Later, however, he formed the plan of enforcing universal suffrage in Hungary before eventually receiving the crown of that kingdom, so as to secure the rights of the southern Slavs. These plans were based not on any preference for the Slavs but rather on the realization that any nationalistic policy pursued by one section of the population would endanger the multinational state of Austria. His relationship with Francis Joseph I was exacerbated by his continuous pressure on the emperor, who more and more left things to take care of themselves but sharply resented any interference with his prerogative.

From 1906 onward Francis Ferdinand's influence in military matters grew (*see* CONRAD VON HÖTZENDORF, FRANZ), and in 1913 he became inspector general of the army. Though he thought out his plans carefully it is doubtful whether the irascible, temperamental prince. whose harshness roused fear rather than affection, could have mastered the problems that he would have had to face as emperor. On a visit to Bosnia-Hercegovina, he and his wife were assassinated by the Serbian student Gavrilo Princip on June 28, 1914, at Sarajevo.

See R. Kiszling, *Erzherzog Franz Ferdinand von Österreich-Este* (1953). (K. O. v. A)

FRANCIS JOSEPH I. (1830–1916), emperor of Austria and king of Hungary, was born on Aug. 18, 1830, eldest son of the archduke Francis Charles. second son of the reigning emperor Francis I., and Sophia, daughter of Maximilian I, king of Bavaria. Francis Joseph was educated in a severe and clerical atmosphere, his preceptors including Mrtternich himself. On the outbreak of the revolution of 1848 he served in Italy, under Radetzky; and when the revolution was crushed, as the leaders of the reaction, Schwarzenberg and Windischgratz, wished to start afresh with a monarch not compromised by any concessions or promises to the revolutionaries, Ferdinand was persuaded to abdicate in favour of his nephew (Dec. 2, 1848). During the first years of his reign (*sue* AUSTRIA, EMPIRE OF) Francis Joseph was nholly under the influence of Schwarzenberg, his mother, and his tutor, Cardinal Rauscher. His rule began unauspiciously with the suppression of liberty in Germany, in Italy and in Hungary, where Russian help was called in to crush the Magyars. Even in Austria, the parliament of Kremsier was suppressed, and on Dec. 31, 1851, the young sovereign revoked the constitution which he himself had enacted two years previously to establish a centralist absolutism in which the monarch assumed the entire weight and responsibility of government. After Schwarzenberg's death (April 1852), Francis Joseph appointed no successor, but acted as his own Minister President. His conscientious diligence was untiring, and this period of his reign, for all its lack of liberty, did not lack wise administrative reforms. Unfortunately, in his youth even more than his age, Francis Joseph was convinced both of the impossibility and the impiety of constitutional methods. While leaving his bureaucracy to control a docile people, he embarked himself on an ambitious foreign policy. The army was increased; and his natural piety heightened by his escape from an assassin's knife in 1853, and combined with visions of a revival of the old Holy Roman Empire, found vent in the conclusion of the Concordat of 1855. Francis Joseph dreamed of a brilliant autocracy, resting on the church and the sword; but the foreign ventures of his early years was as unlucky as they were ambitious. His vacillating policy in the Crimean War left Austria isolated, and earned him the personal antagonism of the Tsar; the war of 1859 ended ill; his most brilliant plan of all, the convocation of a *Fürstentag* in Frankfurt, under his own presidency, to discuss German affairs, was frustrated by the shrewdness of Bismarck in preventing the king of Prussia from attending. The hegemony in Germany passed definitively to Prussia at the end of the Seven Weeks War of 1866.

These 18 Years of misfortune constitute the first period of Francis Joseph's career—the period of hope, ambition and self-confidence at home and abroad. During this period he might have justly been called a militarist; acts of repression and severity amounting to cruelty were perpetrated in his name, and the responsibility for them must lie with him, since he claimed the right to autocracy. Hitherto, also, he had believed in his ability (he always believed in his right) to enforce an absolute system, and to be sole judge of his peoples' welfare. But the consistent failure of his ambitions, involving Austria, as it did, in a disastrous financial crisis, compelled him to come to terms with his subjects, first and foremost the Magyars, but also the Poles, Czechs and Germans. With the plainest reluctance and opposition, he was forced step by step into the path of constitutionalism. Francis Joseph's inner resistance to this necessity was manifested in the impatience and instability of his decisions. He was still far from the idea of letting the *people* govern; the idea of sharing responsibility with the centralizing German bureaucracy alternated in his mind with that of concessions to the politically less desirable, but socially intelligible Magyar magnates As each in turn disappointed him, and seemed intolerably distasteful. he flew to the extreme of the other; so that all the period 1859–67 was marked by extraordinary vacillations which revealed another of the Emperor's weaknesses; he never trusted his ministers fully or for long, and looking on the most faithful of them only as servants and instruments, he threw them aside without a second thought when he was done with them.

The years 1866–67 formed the turning-point in Francis Joseph's life. He had been forced to accept the constitutional principle, had come to terms with the Magyars, in token of which he was at last crowned king in Hungary, and to admit definitively a constitutional regime in Austria. The period of adventure was over at home, and to a large extent abroad, for if up to 1870 he dreamed of revenge on Prussia, the decisive step was never taken, and after the foundation of the German Empire, Francis Joseph accommodated himself—joylessly but without resistance—to his diminished rôle in the west. In his private life, too, a period was closed. His marriage (April 24, 1854) with the beautiful Elizabeth of Wittelsbach had been a true love-match; but the couple soon became estranged, partly owing to the Emperor's fault, and partly to his mother's intrigues. His brother Maximilian perished in Mexico in 1867; his only son Rudolph was no joy to him.

His word once pledged to Constitutionalism, Francis Joseph stood by it. In his heart he probably always looked on the Magyars as rebels; but he was socially sympathetic to their magnates, and held loyally by the compromise of 1867; the prolonged crisis of 1903 on was caused by Magyar endeavours to alter the basis of the compromise, particularly of that prerogative to which Francis Joseph held above all others—his undisputed control over the army. His natural sympathies were for the German race; but the leading German party was that of the Liberals—middle-class, anti-clerical and opposed to military expenditure — while the Slav districts were the stronghold of the feudal magnates. So Francis Joseph stood above party, at heart unsympathetic to all, and playing off one against the other with a sole eye to the integrity of the monarchy. So far did his indifference to parliamentarism go, that he was actually largely instrumental in the introduction of general suffrage into Austria, as a last attempt to play off a new factor against all the unsatisfactory parties alike.

His foreign policy became increasingly pacific. He did, indeed, seek some compensation for his early losses in the occupation, and later annexation, of Bosnia and the Hercegovina; but these measures, especially the latter, were far more defensive than is generally admitted. His personal influence was always on the side of peace, and although deeply shocked by the murder of the Archduke, he would probably have found some means of averting war with Serbia in 1914, had the conduct of foreign policy not slipped from his hands with advancing age. War once declared, he remained wholly loyal to his German ally, although he would gladly have seen peace restored. For his illusions regarding successful war were gone; and he declared now that Austria "would be lucky if she got off with a black eye."

His disillusionment was due in part to the unceasing bickering of his subjects, in part to the increasing loneliness of his private life; for his wife was assassinated in 1897, his son Rudolph (*q.v.*) committed suicide in 1889, his nephew and heir, Francis Ferdinand (*q.v.*), was unsympathetic to him. In his old age he consorted with few persons except his lifelong friend, Katharine Schratt, and his young grandchildren. The hostility between him and his subjects (to whose welfare he was always devoted) had vanished; but their reverence for him was too remote to become active affection.

Francis Joseph's invariable reserve, due partly to his consciousness of his exalted position, was such that character-sketches or even anecdotes of him are rare. In his old age his character softened; and he was always courteous, conscientious, industrious, and above all dignified. He had a prodigious memory and experience, but an intellect not above the average, and a cold and somewhat ungenial nature, with no taste for the arts. His only passion was the chase. His great failing as a rule was his distrust of ability. Two of his phrases are illuminating: to the citizens of Frankfurt, in 1866, he said: "I have an unlucky hand"; and to the Field Marshal Conrad, at the end of his life: "Believe me, this realm cannot be ruled constitutionally." He died peacefully on Nov. 21, 1916. (C. A. M.)

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FRANCIUM, the heaviest of the alkali elements, is highly unstable, existing only in short-lived radioactive forms. Francium (symbol Fr, atomic number 87) occurs in uranium ores as actinium K, one of the decay products of uranium 235. As early as 1914, S. Meyer, V. F. Hess and F. Paneth observed that actinium 227, which disintegrates chiefly by emission of beta particles (electrons), sometimes emits an alpha particle (helium nucleus) instead. The emission of the alpha particle must produce atoms of element 87 with mass number 223.

In 1939 Marguerite Perey, of the Curie laboratory in Paris, isolated the daughter product, actinium K (francium) and studied its properties. She is credited with the discovery of the element, which she named francium in honour of France. Actinium K (symbol AcK) has a half life of only 21 min. for the emission of beta particles. It is produced from actinium in only 1.2% of the disintegrations of the parent element. AcK in turn exhibits branching decay since in about one disintegration in 10,000 it decays by alpha particle emission.

Several isotopes of francium have been produced artificially. Fr^{221} is a member of the U^{233} disintegration series. Isotopes with mass numbers 212 and 217 through 222 have been identified among the radioactive products observed when targets of thorium or uranium are bombarded in high-energy cyclotrons. All of these isotopes are more unstable than AcK. Francium cannot be isolated in visible or weighable amounts.

The chemistry of francium can be studied only by tracer methods. In all respects its behaviour is that to be expected of an alkali element filling a place just below cesium in the periodic chart of the elements. It can be coprecipitated with alkali perchlorates, chloroplatinates or silicotungstates. It is not coprecipitated with insoluble hydroxides, carbonates. sulfides or fluoride precipitates. Adsorption on cation exchange resin is a useful method of isolation.

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FRANCK, CÉSAR (1822–1890), French musical composer, a Belgian by birth who came of German stock, was born at Liége on Dec. 10, 1822. After some studies at Liége he went to Paris in 1837 and entered the conservatoire. His early compositions date from this period and include four trios for piano and strings, besides several piano pieces. *Ruth,* a biblical cantata, was produced with success at the conservatoire in 1846. An opera entitled *Le Valet de ferme* was written about this time but has never been performed. For many years Franck led a retired life, devoting himself to teaching and to his duties as organist, first at Saint-Jean-Saint-François, then at Ste. Clotilde, where he acquired a great reputation as an improvisor. He also wrote a mass, heard in 1861, and a quantity of motets, organ pieces and other works of a religious character.

Franck was appointed professor of the organ at the Paris conservatoire in succession to François Benoist, his old master, in 1872, and the next year he was naturalized a Frenchman. A revival of his early oratorio, *Ruth,* had brought his name again before the public, and this was followed by the production of *Rédemption,* a work for solo, chorus and orchestra, given under the direction of M. Colonne on April 10, 1873. The unconventionality of the music rather disconcerted the general public, but the work nevertheless made its mark. The following is a list of his subsequent compositions: *Rebecca* (1881), a biblical idyll for solo, chorus and orchestra; *Les Béatitudes,* an oratorio composed between 1870 and 1880, perhaps his greatest work; the symphonic poems *Les Éolides* (1876), *Le Chasseur maudit* (1883), *Les Djinns* (1884) for piano and orchestra, *Psyche* (1888) for orchestra and chorus; symphonic variations for piano and orchestra (1885); symphony in D (1889); quintet for piano and strings (1880); sonata for piano and violin (1886); string quartet (1889); prelude, choral and fugue for piano (1884); prelude, aria and finale for piano (1889); various songs, notably "La Procession" and "Les Cloches du soir." Franck also composed two four-act operas, *Hulda* and *Ghiselle,* both of which were produced at Monte Carlo after his death, which took place in Paris on Nov. 8, 1890. The second of these was left by the master in an unfinished state, and the instrumentation was completed by several of his pupils.

César Franck's influence on his younger contemporaries was great. An inspiring teacher, who by the simplicity and beauty of his own nature won the love and devotion of all who came in contact with him, he numbered among his own actual pupils Vincent d'Indy, Henri Duparc, Ernest Chausson, J. G. Ropartz, Gabriel Pierné, Pierre de Bréville, Charles Bordes and Guillaume Lekeu. A more sincere, modest, self-respecting composer probably never existed. In the centre of the brilliant French capital he was able to lead a laborious existence consecrated to his threefold career of organist, teacher and composer. He never sought to gain the suffrages of the public by unworthy concessions but kept straight on his path, ever mindful of an ideal to be reached and never swerving therefrom. A statue was erected to his memory in Paris on Oct. 22, 1904, the occasion producing a panegyric from Alfred Bruneau, in which he spoke of the composer's works as "cathedrals in sound"

See H. Imbert, *Portraits et Etudes, César Franck,* etc. (1896); G. Derepas, *Cdsar Franck* (1897); *V.* d'Indy, *Cdsar Franck* (1906, Eng trans, 1910).

FRANCK, JAMES (1882–), German-born physicist who received the Nobel prize for physics in 1925 with Gustav Hertz, was born in Hamburg on Aug. 26, 1882. He studied in the universities of Heidelberg and Berlin and became head of a department in the Kaiser Wilhelm Institute of Physical Chemistry at Berlin-Dahlem and later (1920) professor of physics at Göttingen. In 1935 he was appointed professor in Johns Hopkins university, Baltimore, and in 1938 professor of physical chemistry at The University of Chicago, eventually becoming a citizen of the United States. His researches lay in the fields of photochemistry and atomic physics and include determinations from molecular band spectra of the energy levels of the dissociation of molecules. He was awarded the Nobel prize for researches on the changes of energy occurring on the collision of atoms with electrons, from which it appeared that an electron must have a certain minimum energy (measured in volts as ionization potential) in order to ionize an atom and that this potential varied for the different gases. This result gave experimental proof to the fundamental assumptions of Niels Bohr's theory of the atom, namely, that an atom can take up internal energy only in such discrete amounts as transform it from one stationary state to another stationary state. (D. McK.)

FRANCK or **FRANK** (latinized FRANCUS), **SEBASTIAN** (*c.* 1499–*c.* 1543), German freethinker, was born about 1499 at Donauworth, whence he styled himself Franck von Word. He entered the university of Ingoldstadt (1515) and proceeded thence to the Dominican College, incorporated with the university, at Heidelberg. Having taken priest's orders, he held in 1524 a cure in the neighhourhood of Augsburg, but in 1525 went over to the Reformed party at Nuremberg and became preacher at Gustenfelden. His first work was a German translation with additions (1528) of the first part of the *Diallage*, or *Conciliatio locorum Scripturae*, directed against Sacramentarians and Anabaptists by Andrew Althamer, then deacon of St. Sebald's at Nuremberg. On March 17, 1528, he married Ottilie Beham, whose brothers, pupils of Albrecht Durer, had got into trouble through Anabaptist leanings. In 1529 he produced a free version *(Klagbrief der armen Dürftigen in England)* of the famous *Supplycacyon of the Beggers,* of Simon Fish. In the autumn of 1529 he went to Strasbourg, and there began his intimacy with Caspar Schwenkfeld. There, too, he published his most important work, the *Chronica, Zeitbuch und Geschichtsbibel* (1531), largely a compilation on the basis of the Nuremberg Chronicle (1493). It is too much to call him "the first of German historians"; he is a forerunner of Gottfried Arnold, with more vigour and directness of purpose. Driven from Strasbourg by the authorities, after a short imprisonment in 1531, he tried to make a living as a soapboiler at Esslingen, moving in 1533 for a better market to Ulm, where (1534) he was admitted as a burgess.

His *Weltbuch,* a supplement to his *Chronica,* was printed at Tiibingen in 1334; the publication, in the same year, of his *Paradoxa* at Ulm brought him into trouble with the authorities, and after the publication of his *Guldin Arch* (with pagan parallels to Christian sentiments) (Augsburg 1338) and *Germaniae chronicon* (Frankfort 1538) he had to leave Ulm (1539). At Basel he found work as a printer, and there, probably, he died in the winter of 1542–43. He had published in 1539 *Kriegbiichlein des Friedens* (pseudonymous), *Schriftliche und ganz gründliche Auslegung des 64 Psalms,* and *Das verbütschierte mit sieben Siegeln verschlossene Buch* (a biblical index, exhibiting the dissonance of Scripture); in 1541 his *Spruchwörter* (a collection of proverbs, several times reprinted with variations); in 1542 a new edition of his *Paradoxa;* and some smaller works.

Franck combined the humanist's passion for freedom with the mystic's devotion to the religion of the spirit. His breadth of human sympathy led him to positions which the comparative study of religions has made familiar, but for which his age was unprepared. Luther contemptuously dismissed him as a "devil's mouth." Pastor Frecht of Nuremberg pursued him with bitter zeal. In his last year, in a public Latin letter, he exhorted his friend John Campanus to maintain freedom of thought in face of the charge of heresy.

See Hegler, in Hauck's *Realencyklopädie* (1899); C. A. Hase, *Sebastian Franck von Word* (1869); J. F. Smith, in *Theological Review* (April 1874); E. Tausch, *Sebastian Franck von Donauwörth und seine Lehrer* (1893); Prenzel, *Kritische Untersuchung und Würdigung von Sebastian Francks "Chronicon Germaniae"* (1908); R. Jones. *Spiritual Reformers* (1914); A. Reimann, *Sebastian Franck als Geschichtsphilosoph* (1921).

FRANCKE, AUGUST HERMANN (1663–1727), German Protestant divine, was born on March 22, 1663. at Liibeck. He studied at Erfurt and at Kiel, where he came under the influence of the pietist Christian Kortholt (1633–94), then at Leipzig where he graduated and where, in 1685 he became a Privatdocent. A year later, by the help of his friend P. Anton, and with the approval and encouragement of P. J. Spener, he founded the Collegium Philobiblicum for the systematic study of the Bible, philologically and practically. Interdicted from preaching at Erfurt and Dresden, he found a place in the new university of Halle. first as professor of Greek and oriental languages, and then as professor of theology. There he continued to teach and preach for the next 36 years, until his death on June 8, 1727, and Halle became a centre of pietism.

At Halle in 1695 he instituted what is often called a "ragged school," supported by public charity. In 1698 there were roo orphans under his charge to be clothed and fed, besides 500 children who were taught as day scholars. The schools grew in importance and are still known as the *Francke'sche Stiftungen.*

See H. E. F. Guericke, *A. H. Francke* (1827 Eng. tr., 1837); A. Stein, *A. H. Francke* (3rd ed., 1894); Herzog-Hauck's *Realencyklopädie* (ed., 1899); Knuth, *Die Francke'schen Stiftungen* (2nd ed., 1903).

FRANCKE, MEISTER, German painter of altarpieces, was active in Hamburg during the first half of the 15th century. His name occurs in a contract with the travelers to England, dated 1424, in which the artist undertakes to paint an altarpiece for a chapel in the church of St. John at Hamburg. Nine separate portions of this work are now in the museum at Hamburg. Two represent scenes from the life of Thomas of Canterbury, and seven scenes from the life of Christ, including a fragment of "The Crucifixion." Besides these, few pictures can be ascribed to him with certainty. One of these is the "Christ as the Man of Sorrows" in the museum at Leipzig, an early work, and another is a later representation of the same subject in the museum at Hamburg. Meister Francke's style, though doubtlessly the product of the art of his time, is that of a strong personality, and all attempts to relate it to other schools have failed. With feeling for the decorative value of colour and for two-dimensional design, he combined a realistic rendering of detail and a somewhat exaggerated expression of emotions. To judge from numerous altarpieces in the north of Germany, which recall his style, his influence must have been widespread.

FRANCKEN. A number of Flemish painters of this name cultivated their art in Antwerp, Belg., during the 16th and 17th centuries. Several of them were related and some bore the same Christian name in succession. Hence, there is unavoidable confusion in the subsequent classification of paintings not widely differing in style or execution. Frans Francken the first, finding a rival in Frans Francken the second, described himself as "the elder," in contradistinction to his son, who signed himself "the younger." But when Frans the second was threatened with competition from Frans the third, he called himself "the elder," while Frans the third called himself "the younger." It is possible, though not by any means easy, to sift the works of these artists. The family stems from NICHOLAS OF HERENTHALS (*c.* 1535–1596), an artist, none of whose works has survived.

HIERONYMUS (JEROM) FRANCKEN (1542–1610), the eldest son of Nicholas, studied under Frans Floris. In 1566 Hieronymus was one of the masters employed to decorate the palace of Fontainebleau, and in 1574 he obtained the appointment of court painter from Henry III. In 1603, when Karel van Mander wrote his biography of Flemish artists. Hieronymus was still in Paris. Among his earliest works was a "Nativity" in the Dresden museum. executed in co-operation with Floris. Another of his important works is the "Abdication of Charles V" in the Amsterdam museum. Equally interesting is a "Portrait of a Falconer," dated 1558, in the Brunswick gallery, Germany.

FRANS FRANCKEN the first (c. 1542–1616), was the second son of Nicholas of Herenthals. He matriculated at Antwerp in 1567, and died in that city in 1616. He, too, studied under Floris. Several of his pictures are in the museum of Antwerp; another, dated 1597, in the Dresden museum represents "Christ on the Road to Golgotha."

AMBROSIUS FRANCKEN (1544–1618), the third son of Nicholas of Herenthals, left more specimens of his skill than Hieronymus or Frans the first. He started as a partner of Hieronymus at Fontainebleau, then returned to Antwerp, where he passed for his guild in 1573. He died at Antwerp on Oct. 16. 1618. His best works are the "Miracle of the Loaves and Fishes" and the "Martyrdom of St. Crispin," both in the Antwerp museum.

Frans Francken the first trained three sons to his profession, the eldest of whom, though he practised as a master of guild at Antwerp from 1600 to 1610, he left no trace of his labours.

HIERONYMUS (JEROM) FRANCKEN (1578–1623), the second son of Frans the first, took service with his uncle Ambrosius. He was born in Antwerp on Sept. 12, 1578, passed for his guild in 1607, and in 1620 produced a curious picture of "Horatius Cocles Defending the Sublician Bridge," which is in the Antwerp museum.

FRANS FRANCKEN the second (1581–1642), the third son of Frans the first, signed his pictures until his father's death in 1616 "the younger" and after 1630 "the elder." He was born on May 6, 1581 in Antwerp. In 1605 he entered the guild, of which he subsequently became president. He died in Antwerp on May 6. 1642. His earliest composition is the "Crucifixion," in the Belvedere at Vienna, dated 1606. His compositions include "Adoration of the Virgin" (1616) in the gallery of Amsterdam, "Woman Taken in Adultery" (1628) in Dresden, "Seven Works of Charity" (1630) at Munich, "Prodigal Son" (1633) at the Louvre.

FRANS FRANCKEN the third (1607–1667), the son of Frans the second, passed in the Xntwerp guild in 1639 and died at Antwerp on Aug. 21. 1667. His practice was chiefly confined to adding figures to the architectural landscapes pieces of other artists. He often introduced the figures into the works of Pieter Neefs the younger.

FRANCO, an expression in foreign commerce, meaning that a price quoted includes not only the cost of the goods, but all the costs entailed in delivering them to the purchaser's address; *i.e.,* cost, insurance. shipping freight, the import duty levied by the importing country, foreign carriage, etc. In U.S. practice the term "landed cost" comprises everything included in this term except land transportation charges from foreign customs to consignee's warehouse.

FRANCO BAHAMONDE, FRANCISCO (1892–), Spanish soldier and statesman. was born Dec. 4, 1892. at El Ferrol, Galicia. In 1907 he entered the military academy of Toledo, and in 1910 volunteered for military service in Morocco. By 1920 he was second in command of the Spanish foreign legion, and under Primo de Rivera was director of the General Military academy at Saragossa. Under the 1931 republic he was transferred to the Balearic Islands and later returned to Morocco. In 1936 he was sent to the Canary Islands.

On the outbreak of the civil war in July 1936 he flew to Tetuan, Spanish Morocco, and there organized the transport of troops to the Spanish mainland, where he soon followed. Upon the death of Gen. José Sanjurjo, General Franco became leader of the insurgents. (See SPAIN.) At the outbreak of World War II Franco issued a declaration of "strictest neutrality" in Sept. 1939, and again in May 1940, but on Italy's entry into the war he decided upon "nonbelligerency." On Oct. 23, 1940, he met Adolf Hitler and thereafter left no doubt of his proaxis sympathies. From June 1941 he sent "volunteers" to fight with Germany against the U.S.S.R., declaring that the Allies had lost the war already. But, as it became clear that they were winning, he changed his front, proclaiming himself in Oct. 1943 a "strict neutral" again, and, under pressure, expelling Germans from Tangier, cutting wolfram supplies to Germany and withdrawing his "volunteers" from the U.S.S.R. His pleas for a negotiated peace were ignored by the United Nations, as were his claims that Spain should have a place at the peace conierence. Internally, his chief concern was to check the growing power of the Falange and to restore traditional forms, such as the *Cortes* (July 1942). He also frequently hinted at a restoration of the monarchy. In April 1945 General Franco broke off relations with Japan. The 1947 Succession act confirmed him as head of the state for life and gave him the right to name his successor.

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FRANCO-GERMAN WAR (1870–1871). The victories of Prussia in 1866 over the Austrians and their German allies (see SEVEN WEEKS' WAR) rendered it evident to the statesmen and soldiers of France that a struggle between the two nations could only be a question of time. Belated measures were initiated in France to place the armament and equipment of the troops on a level with the requirements of the times. The chassepot, a new breech-loading rifle, immensely superior to the Prussian needle-gun, was issued; the artillery trains were overhauled, and a new machine gun, the *mitrailleuse,* from which much was expected, introduced. Wide schemes of reorganization (due mainly to Marshal Niel) were formulated, but little was done to put them into effect. The emperor Napoleon III also nourished illusory hopes of an alliance with Austria and Italy. In the first week of June 1870, General Lebrun, as his confidential agent, was sent to Vienna to try to concert a plan of joint operations with Austria against Prussia. Italy was also to be included.

What grounds there were for Napoleon's trust in the project remains uncertain, but in any case they were discounted by the fact that Moltke's plans were based on an accurate estimate of the time it would take Austria to mobilize and on the effect of a series of victories on French soil. In strong contrast to the French, plans for the strategic deployment of the Prussian army were prepared by the general staff and kept up to date year by year as fresh circumstances (*e.g.,* the co-operation of the minor German armies) arose and new means of communication came into existence. The campaign was actually opened on a revise of 1868–69, to which was added on May 6, 1870 a secret memorandum for the general staff.

Strategic Deployment of German Armies.—Under the German organization then existing the preliminary to all active operations was of necessity full and complete mobilization Then followed transport by road and rail to the line selected for the "strategic deployment," and it was essential that no part of these operations should be disturbed by action on the part of the enemy. But no such delay imposed itself of necessity upon the French, and a vigorous offensive was so much in harmony with their traditions that the German plan had to be framed so as to meet such emergencies. On the whole, Moltke concluded that the enemy could not undertake this offensive before the eighth day after mobilization. At that date about five French army corps (150,000 men) could be collected near Metz. and two corps (70,000) near Strasbourg; and as it was six days' march from Metz to the Rhine, no serious attack could be delivered before the 14th day, by which day it could be met by superior forces near Kirchheimbolanden. As, however, the transport of the bulk of the Prussian forces could not begin till the ninth day, their ultimate line of detrainment need not be fixed until the French plans were disclosed, and, as it was important to strike at the earliest moment possible, the deployment was provisionally fixed to be beyond the Rhine on the line Wittlich-Neunkirchen-Landau. Of the 13 north German corps three had to be left behind to guard the eastern frontier and the coast, one other, the VIII, was practically on the ground already and could concentrate by road, and the remaining nine were distributed to the IX through railway lines available. These ten corps were grouped in three armies, and as the French might violate Belgian neutrality or endeavour to break into southern Germany, two corps (Prussian Guard and Saxon XII corps) were temporarily held back at a central position around Mainz. whence they could move rapidly up or down the Rhine valley. If Belgian neutrality remained unmolested, the reserve would join the III army on the left wing, giving it a two to one superiority over its adversary; all three armies would then wheel to the right and combine in an effort to force the French army into a decisive battle on the Saar on or about the 23rd day. As in this uheel the army on the right formed the pivot and was required only to stand fast, two corps only were allotted to it; two corps for the present formed the III army, and the remaining five were assigned to the II army in the centre.

When (July 16–17) the south German states decided to throw in their lot with the rest, their three corps were allotted to the III army, the guards and Saxons to the II army, while the three corps originally left behind were finally distributed one to each of the three German armies.

Positions of the French Forces.—On the French side no such plan of operations was in existence when on the night of July 15 Kriegs mobil was telegraphed all over Prussia. An outline scheme had indeed been prepared as a basis for agreement with Austria and Italy, but practically no details were fixed, and the troops were without transport and supplies. Nevertheless, as speed was the essence of the contract, the troops were hurried up without waiting for their reserves—whose mobilization was then a slow and complicated system—and the Prussian Intelligence Department was able to inform Moltke on the 22nd of July (seventh day of mobilization) that the French stood from right to left in the following order, on or near the frontier:

I. Corps	Marshal MacMahon, duke of Magenta (Strasbourg)
V. „	General de Failly (Saargemund and Bitche)
II. „	General Frossard (St. Avold)
IV. „	General de Ladmirault (Thionville)
With, behind them:	
III. „	Marshal Bazaine (Metz)
Guard	General Bourbaki (Nancy)
VI. Corps	Marshal Canrobert (Châlons)
VII. „	General Félix Douay (Belfort)

If therefore they began a forward movement on the 23rd (eighth day) the case foreseen by Moltke had arisen, and it became necessary to detrain the II. army upon the Rhine. Without waiting for further confirmation of this intelligence, Moltke, with the consent of the king, altered the arrangements accordingly, a decision which, though foreseen, exercised the gravest influence on the course of events. As it happened this decision was premature, for the French could not yet move. The French rear services were chaotic. Supply trains had to be organized by requisition from the inhabitants, and even arms and ammunition procured for such reserves as had succeeded in joining. Nevertheless, by almost superhuman exertions on the part of the railways and administrative services, all essential deficiencies were made good, and by July 28 (13th day) the troops had received all that was absolutely indispensable and might well have been led against the enemy, who, thanks to Moltke's premature action, were for the moment at a very serious disadvantage. But the French generals did not utilise this opportunity to concentrate upon the heads of the Prussian columns as they struggled through the defiles of the Hardt.

To meet the possible danger, which came to his knowledge during the course of the 29th, Moltke sent a confidential staff officer, Colonel v. Verdy du Vernois, to the III. army to impress upon the crown prince the necessity of an immediate advance to distract the enemy's attention from the I. and II. armies; but, like the French generals, the crown prince pleaded that he could not move until his trains were complete. Fortunately for the Germans, the French intelligence service not only failed to inform the staff of this opportunity, but it allowed itself to be hypnotized by rumours. In imagination they saw oncoming men behind every forest, and, to guard against these dangers, the French troops were marched and counter-marched along the frontiers in the vain hope of discovering an ideal defensive position which should afford full scope to the power of their new weapons.

As these delays were exerting a most unfavourable effect on public opinion not only in France but throughout Europe, the emperor decided on Aug. 1 to initiate a movement towards the Saar, for its moral effect.

On this day the French corps held the following positions from right to left:

I. Corps.	Hagenau
11 „	Forbach
111 ,	St. Avold
IV. ..	Bouzonville
V. ,	Bitche
1 ,	Châlons
1 ,	Belfort and Colmar
Guard	nearllietz

Saarbrücken.—The French II. corps was directed to advance on the following morning direct on Saarbriicken, supported on the flanks by two divisions from the V. and III. corps. The order was duly carried out, and the Prussians (one battalion, two squadrons and a battery), seeing the overwhelming numbers opposed to them, fell back fighting and vanished to the northward, having given a very excellent example of steadiness and discipline to their enemy. The latter contented themselves by occupying Saarbriicken and its suburb St. Johann, and here, as far as the troops were concerned, the incident closed. Its effect, however, proved far-reaching. The Prussian staff could not conceive that nothing lay behind this display of five whole divisions. and immediately took steps to meet the expected danger. In their excitement, although they had announced the beginning of the action to the king's headquarters at Mainz, they forgot to notify the close and its results, so that Moltke was not in possession of the facts till noon on the 3rd of August. Meanwhile, Steinmetz, left without instructions and fearing for the safety of the II. army, the heads of whose columns were still in the defiles of the Hardt, moved the I. army from the neighbourhood of Merzig obliquely to his left front, so as to strike the flank of the French army if it continued its march towards Kaiserslautern, in which direction it appeared to be heading.

Whilst this order was in process of execution, Moltke, aware that the II. army was behind time in its march, issued instructions to Steinmetz for Aug. 4, which entailed a withdrawal to the rear, the idea being that both armies should, if the French advanced, fight a defensive battle in a selected position farther back. Steinmetz obeyed, though bitterly resenting the idea of retreat. This movement, iurther, drew his left across the roads reserved for the right column of the II. army, and on receipt of a peremptory order from Prince Frederick Charles to evacuate the road, Steinmetz telegraphed for instructions direct to the king, over Moltke's head. In reply he received a telegram from Moltke, ordering him to clear the road at once, and couched in terms which he considered as a severe reprimand. An explanatory letter, meant to soften the rebuke, was delayed in transmission and did not reach him till too late to modify the orders he had already issued It must be remembered that Steinmetz at the front was in a better position to judge the apparent siiuation than was Moltke at Mainz, and that all through the day of Aug. j he had received intelligence indicating a change of attitude in the French army.

Battle of **Spicheren.**—The news of the German victory at Weissenburg on the 4th (see below) had in fact completely paralysed the French headquarters, and orders were issued by them during the course of the 5th to concentrate the whole army of the Rhine on the selected position of Cadenbronn. As a preliminary, Frossard's corps withdrew from Saarbriicken and began to entrench a position on the Spicheren heights, 3,000 yd. to the southward. Steinmetz, therefore, being quite unaware of the scheme for a great battle on the Saar about Aug. 9, felt that the situation would best be met, and the letter of his instructions strictly obeyed, by moving his whole command forward to the line of the Saar, and orders to this effect were issued on the evening of the 5th. In pursuance of these orders, the advance guard of the 14th division (Lieutenant General von Kameke) reached Saarbriicken about g A.M. on the 6th, where the Germans found to their amazement that the bridges were intact. To secure this advantage was the obvious duty of the commander on the spot, and he at once ordered his troops to occupy a line of low heights beyond the town to serve as a bridge-head. As the leading troops deployed on the heights Frossard's guns on the Spicheren Plateau opened fire, and the advanced guard battery replied. The sound of these guns unchained the whole fighting instinct carefully developed by a long course of Prussian manoeuvre training. Everywhere, generals and troops hurried towards the cannon thunder. Kameke, even more in the dark than Steinmetz as to Moltke's intentions and the strength of his adversaries, attacked at once, precisely as he would have done at manoeuvres, and in half an hour his men were committed beyond recall. As each fresh unit reached the field it was hurried into action where its services were most needed, and each fresh general as he arrived took a new view of the combat and issued new orders. On the other side, Frossard, knowing the strength of his position, called on his neighbours for support. and determined to hold his ground. Victory seemed certain. There were sufficient troops within easy reach to have ensured a crushing numerical superiority. But the other generals had not been trained to mutual support, and thought only of their own immediate security, and their staffs were too inexperienced to act upon even good intentions; and, finding himself in the course of the afternoon left to his own devices, Frossard began gradually to withdraw, even before the pressure of the 13th German division on his left flank (about 8 P.M.) compelled his retirement. When darkness ended the battle the Prussians were scarcely aware of their victory. Steinmetz: who had reached the field about 6 P.M., rode back to his headquarters without issuing any orders, while the troops bivouacked where they stood, the units of three army corps being mixed up in almost inextricable confusion. But whereas out of 42,900 Prussians with 120 guns, who in the morning lay within striking distance of the enemy, no fewer than 27,000, with 78 guns were actually engaged; of the French. out of 64,000 with 210 guns only 24.000 with 90 guns took part in the action.

Action of Weissenburg.—Meanwhile on the German left wing the III. army had begun its advance. Early on Aug. 4 it crossed the frontier and fell upon a French detachment under Abel Douay, which had been placed near Weissenburg, partly to cover the Pigeonnier pass, but principally to consume the supplies accumulated in the little dismantled fortress, as these could not easily be moved. Against this force of under 4,000 men of all arms, the Germans brought into action successively portions of three corps, in all over 25,000 men with 90 guns. After six hours' fighting, in which the Germans lost some 1,500 men, the gallant remnant of the French withdrew deliberately and in good order, notwithstanding the death of their leader at the critical moment. The Germans were so elated by their victory over the enemy, whose strength they naturally overestimated, that they forgot to send cavalry in pursuit, and thus entirely lost touch with the enemy.

Next day the advance mas resumed, the two Bavarian corps moving via Mattstall through the foothills of the Vosges, the V. corps on their left towards Preuschdorf, and the XI. farther to the left again, through the wooded plain of the Rhine valley. The 4th cavalry division scouted in advance, and army headquarters moved to Sulz. About noon the advanced patrols discovered MacMahon's corps in position on the left bank of the Sauer (see WÖRTH). As his army was dispersed over a wide area, the crown prince determined to devote the 6th to concentrating the troops, and. probably to avoid alarming the enemy, ordered the cavalry to stand fast.

At night the outposts of the I. Bavarians and V. corps on the Sauer saw the fires of the French encampment and heard the noise of railway traffic, and rightly conjectured the approach of reinforcements. MacMahon had in fact determined to stand in the very formidable position he had selected, and he counted on receiving support both from the VII. corps (two divisions of which were being railed up from Colmar) and from the V. corps, which lay around Bitche.

Battle of Worth.—At dawn on Aug. 6 the commander of the V. corps outposts noticed certain movements in the French lines, and to clear up the situation brought his guns into action. As at Spicheren, the sound of the guns set the whole machinery of battle in motion. The French artillery immediately accepted the Prussian challenge. The I. Bavarians, having been ordered to be ready to move if they heard artillery fire, immediately advanced against the French left, encountering presently such a stubborn resistance that parts of their line began to give way. The Prussians of the V. corps felt that they could not abandon their allies, and Kirchbach, calling on the XI. corps for support, attacked with the troops at hand. When the crown prince tried to break off the fight it was too late. Both sides we're feeding troops into the firing line, as and where they could lay hands on them. Up to 2 P.M. the French fairly held their own, but shortly afterwards their right yielded to the overwhelming pressure of the XI. corps, and by 3.30 it was in full retreat. The centre held on for another hour, but in its turn was compelled to yield, and by 4.30 all organized resistance was at an end. The débris of the French army was hotly pursued by the German divisional squadrons towards Reichshofen, where serious panic showed itself. When at this stage the tardy supports sent by de Failly from Bitche came on the ground they saw the hopelessness of intervention, and retired whence they had come. Fortunately for the French, the German 4th cavalry division, on which the pursuit should have devolved. had been forgotten by the German staff, and did not reach the front before darkness fell. Out of a total of 82,000 within reach of the battlefield, the Germans succeeded in bringing into action 77,500. The French, who might have had 50,000 on the field, deployed only 37,000, and these suffered a collective loss of no less than 20.100; some regiments losing up to 90% and still retaining some semblance of discipline and order.

Under cover of darkness the remnants of the French army escaped. When at length the 4th cavalry division had succeeded in forcing a way through the confusion of the battlefield, all touch with the enemy had been lost, and being without firearms the troopers were checked by the French stragglers in the woods and the villages, and thus failed to establish the true line of retreat of the French. Ultimately the latter, having gained the railway near Lunéville, disappeared from the German front altogether, and all trace of them was lost until they were discovered, about Aug. 26, forming part of the army of Châlons, whither they had been conveyed by rail via Paris. This is a remarkable example of the strategical value of railways to an army operating in its own country.

In the absence of all resistance, the III. army now proceeded to carry out the original programme of marches laid down in Moltke's memorandum of May 6, events having nullified the plan for a battle on the Saar, and marching on a broad front through a fertile district it reached the line of the Moselle in excellent order about Aug. 17, where it halted to await the result of the great battle of Gravelotte-St. Privat.

Movements on the **Saar.**—We return now to the I. army at Saarbrucken. Its position on the morning of Aug. 7 gave cause for the gravest anxiety. At daylight a dense fog lay over the country, and through the mist sounds of heavy firing came from the direction of Forbach, where French stragglers had rallied during the night. The confusion on the battlefield was appalling, and the troops in no condition to go forward. Except the 3rd, 5th and 6th cavalry divisions no closed troops were within a day's march; hence Steinmetz decided to spend the day in reorganizing his infantry, under cover of his available cavalry. But the German cavalry and staff were unequal to their task. The 6th cavalry division, which had bivouacked on the battlefield, sent on only one brigade towards Forbach, retaining the remainder in reserve. The 5th, thinking that the 6th had already undertaken all that was necessary, withdrew behind the Saar, and the 3rd, also behind the Saar, reported that the country in its front was unsuited to cavalry movements, and only sent out a few officers' patrols. These were well led, but were too few in number, and their reports were consequently unconvincing.

In the course of the day Steinmetz became very uneasy, and ultimately he decided to concentrate his army by retiring the VII. and VIII. corps behind the river on to the I. (which had arrived near Saarlouis), thus clearing the Saarbrucken-Metz road for the use of the II. army. But at this moment Prince Frederick Charles suddenly modified his views. During the 6th of August his scouts had reported considerable French forces near Bitche (these were the V., de Failly's corps), and early in the morning of the 7th he received a telegram from Moltke informing him that MacMahon's beaten army was retreating on the same place (the troops observed were in fact those which had marched to MacMahon's assistance). The prince forthwith deflected the march of the Guards, IV. and X. corps, towards Rohrbach, whilst the IX. and XII. closed up to supporting distance behind them. Thus, as Steinmetz moved away to the west and north, Frederick Charles was diverging to the south and east, and a great gap was opening in the very centre of the German front. This was closed only by the III. corps, still on the battlefield, and by portions of the X. near Saargemund, whilst within striking distance lay 130,000 French troops, prevented only by the incapacity of their chiefs from a decisive counter-stroke.

Fortunately for the Prussians, Moltke at Mainz took a different view. Receiving absolutely no intelligence from the front during the 7th, he telegraphed orders to the I. and II. armies (10.25 P.M.) to halt on the 8th, and impressed on Steinmetz the necessity of employing his cavalry to clear up the situation. The I. army had already begun the marches ordered by Steinmetz. It was now led back practically to its old bivouacs amongst the unburied dead. Prince Frederick Charles only conformed to Moltke's order with the III. and X. corps; the remainder executed their concentration towards the south and east.

During the night of Aug. 7 Moltke decided that the French army must be in retreat towards the Moselle and forthwith busied himself with the preparation of fresh tables of march for the two armies, his object being to swing up the left wing to outflank the enemy from the south. This work, and the transfer of headquarters to Homburg, needed time, hence no fresh orders were issued to either army, and neither commander would incur the responsibility of moving without any. The I. army therefore spent a fourth night in bivouac on the battle-field. But Constantin von Alvensleben, commanding the III. corps, a man of very different stamp from his colleagues, hearing at first hand that the French had evacuated St. Avold, set his corps in motion early in the morning of Aug. 10 down the St. Avold-Metz road, reached St. Avold and obtained conclusive evidence that the French were retreating.

Advance to the Moselle.—During the 9th after 48 wasted hours the orders for the advance to the Moselle were issued. These were based, not on an exact knowledge of where the French army actually stood, but on the opinion Moltke had formed as to where it ought to have been on military grounds solely.

Actually on Aug. 7 the emperor had decided to attack the Germans on the 8th with the whole Rhine Army, but this decision was upset by alarmist reports from the beaten army of MacMahon. He then decided to retreat to the Moselle, as Moltke had calculated, and there to draw to himself the remnants of MacMahon's army (now near Lunéville). At the same time he assigned the strictly executive command of the Rhine Army to Marshal Bazaine. This retreat was begun during the course of Aug. 8 and 9; but on the night of the 9th urgent telegrams from Paris induced the emperor to suspend the movement, and during the 10th the whole army took up a strong position on the French Nied.

Meanwhile the II. German army had received its orders to march in a line of army corps on a broad front in the general direction of Pont-8-Mousson, well to the south of Metz. The I army was to follow by short marches in échelon on the right; only the III corps was directed on Falkenberg, a day's march farther towards Metz along the St. Avold-Metz road. The movement was begun on the 10th, and towards evening the French army was located on the right front of the III. corps. This entirely upset Moltke's hypothesis, and called for a complete modification of his plans, as the III. corps alone could not be expected to resist the impact of Bazaine's five corps. The III. corps therefore received orders to stand fast for the moment, and the remainder of the II. army was instructed to wheel to the right and concentrate for a great battle to the east of Metz on the 16th or 17th. Before, however, these orders had been received the sudden retreat of the French completely changed the situation. The Germans therefore continued their movement towards the Moselle. On the 12th Bazaine had been definitely invested with the command-in-chief of the Army of the Rhine and next day the French took up a fresh position 5 m. to the east of Metz, where they were located by the cavalry and the advanced guards of the German I. army.

Battle of **Colombey-Borny.**—Again Moltke ordered the I. army to observe and hold the enemy, whilst the II. was to swing round to the north. The cavalry was to scout beyond the Moselle and intercept all communication with the heart of France (see METZ). By this time the whole German army had imbibed the idea that the French were in full retreat and endeavouring to evade a decisive struggle. When therefore during the 14th their outposts observed signs of retreat in the French position, their impatience could no longer be restrained; as at Wörth and Spicheren, an outpost commander brought up his guns, and at the sound of their fire, every unit within reach spontaneously got under arms (battle of Colombey-Borny), In a short time, with or without orders, the I., VII., VIII. and IX. corps were in full march to the battle-field. But the French, too, turned back to fight, and an obstinate engagement ensued, at the close of which the Germans barely held the ground and the French withdrew during the night under cover of the Metz forts.

Still, though the fighting had been indecisive, the conviction of victory remained with the Germans, and the idea of a French retreat became an obsession. To this idea Moltke gave expression in his orders issued early on the 15th, in which he laid down that the "fruits of the victory" of the previous evening could only be reaped by a vigorous pursuit towards the passages of the Meuse, where it was hoped the French might yet be overtaken. This order, however, did not allow for the hopeless inability of the French staff to regulate the movement of congested masses of men, horses and vehicles, such as were now accumulated in the streets and environs of Metz. Whilst Bazaine had come to no definite decision whether to stand and fight or continue to retreat, and was merely drifting under the impressions of the moment, the Prussian leaders, in particular Prince Frederick Charles, saw in imagination the French columns in rapid orderly movement towards the west, and calculated that at best they could not be overtaken short of Verdun.

In this order of ideas the whole of the II. army, followed on its right rear by two-thirds of the I. army (the I. corps being detached to observe the eastern side of the fortress), were pushed on towards the Moselle, the cavalry far in advance towards the Meuse, whilst only the 5th cavalry division was ordered to scout towards the Metz-Verdun road, and even that was disseminated over far too wide an area.

Later in the day (15th) Frederick Charles sent orders to the III. corps, which was on the right flank of his long line of columns and approaching the Moselle at Corny and Novéant, to march via Gorze to Mars-la-Tour on the Metz-Verdun road; to the X corps, strung out along the road from Thiaucourt to Pont-à-Mousson, to move to Jarny; and for the remsinder to push on westward to seize the Meuse crossings. No definite information as to the French army reached him in time to modify these instructions.

Meanwhile the 5th (Rheinbaben's) cavalry division, at about three in the afternoon, had come into contact with the French cavalry in the vicinity of Mars-la-Tour, and gleaned intelligence enough to show that no French infantry had as yet reached Rezonville. The commander of the X. corps at Thiaucourt, informed of this, became anxious for the security of his flank during the next day's march and decided to push out a strong flanking detachment under Caprivi, to support Rheinbaben and maintain touch with the III. corps marching on his right rear.

Battle of Vionville-Mars-la-Tour.—Alvensleben, to whom the 6th cavalry division had meanwhile been assigned, seems to have received no local intelligence whatsoever; and at daybreak on the 16th he began his march in two columns, the 6th division on Mars-la-Tour, the 5th towards the Rezonville-Vionville plateau. And shortly after 9.15 A.M. he suddenly discovered the truth. The entire French army lay on his right flank, and his nearest supports were almost a day's march distant. In this crisis he made up his mind at once to attack with every available man, and to continue to attack, in the conviction that his audacity would serve to conceal his weakness. All day long, therefore, the Brandenburgers of the III. corps, supported ultimately by the X corps and part of the IX., attacked again and again, despite repulse. The enemy was thrice their strength, but very differently led, and made no adequate use of his superiority (battle of Vionville-Mars-la-Tour).

Meanwhile Prince Frederick Charles, at Pont-à-Mousson, was still confident in the French retreat to the Meuse, and had even issued orders for the 17th on that assumption. Firing had been heard since 9.15 A.M., and about noon Alvensleben's first report had reached him, but it was not till after 2 that he realized the situation. Then, mounting his horse, he covered the 15 m. to Flavigny over crowded and difficult roads within the hour, and on his arrival abundantly atoned for his strategic errors by his unconquerable determination and tactical skill. When darkness put a stop to the fighting, he considered the position. Cancelling all previous orders, he called all troops within reach to the battlefield and resigned himself to wait for them. The situation was indeed critical. The whole French army of five corps, only half of which had been engaged, lay in front of him. His own army lay scattered over an area of 30 m. by 20, and only some 20,000 fresh troops—of the IX. corps—could reach the field during the forenoon of the 17th. He did not then know that Moltke had already intervened and had ordered the VII., VIII. and II corps[1] to his assistance. Daylight revealed the extreme exhaustion of both men and horses. The men lay around in hopeless confusion amongst the killed and wounded, each where sleep had overtaken him, and thus the extent of the actual losses, heavy enough, could not be estimated. Across the valley, bugle sounds revealed the French already alert, and presently a long line of skirmishers approached the Prussian position. But they halted just beyond rifle range, and it was soon evident that they were only intended to cover a further withdrawal. Presently came the welcome intelligence that the reinforcements were well on their way.

About noon the king and Moltke drove up to the ground, and there was an animated discussion as to what the French would do next. Aware of their withdrawal from his immediate front, Prince Frederick Charles reverted to his previous idea and insisted that they were in full retreat towards the north, and that their entrenchments near Point du Jour and St. Hubert (see map in article METZ) were at most a rearguard position. Moltke was inclined to the same view, but considered the alternative possibility of a withdrawal towards Metz, and about 2 P.M. orders were issued to meet these divergent opinions. The whole army was to be drawn up at 6 A.M. on the 18th in an échelon facing north, so as to be ready for action in either direction. The king and Moltke then drove to Pont-à-Mousson, ana the troops bivouacked in a state of readiness. The rest of the 17th was spent in restoring order in the shattered III. and X. corps, and by nightfall both corps were reported fit for action. Strangely enough, there were no organized cavalry reconnaissances, and no intelligence of importance was collected during the night of the 17th–18th.

Battle of Gravelotte-Saint **Privat.**—Early on the 18th the troops began to move into position in the following order from left to right: XII (Saxons), Guards, IX., VIII. and VII. The X. and III. were retained in reserve.

The idea of the French retreat was still uppermost in the prince's mind, and the whole army therefore moved north. But between 10 and 11 AM. part of the truth—viz., that the French had their backs to Metz and stood in battle order from St. Hubert northwards—become evident. and the II. army, pivoting on the I., wheeled to the right and moved eastward. Suddenly the IX. corps fell right on the centre of the French line at Amanvillers, where it had been imagined that the French flank rested, and a most desperate encounter began, superior control, as before, ceasing after the guns had opened fire. Prince Frederick Charles, however, a little farther north, again asserted his tactical ability, and about 7 P.M. he brought into position three fresh army corps for the final attack. The sudden collapse of French resistance, due to the frontal attack of the Guards (St. Privat) and the turning movement of the Saxons (Roncourt), rendered the use of this mass unnecessary, but the resolution to use it was there. On the German right (I. army), about Gravelotte, all superior leading ceased quite early in the afternoon, and at night the French still showed an unbroken front. Until midnight, when the prince's victory was reported, the suspense at headquarters was terrible. The I. army was exhausted, no steps had been taken to ensure support from the III. army, and the IV. corps (II. army) lay inactive 30 m. away.

Having let slip the great opportunity of August 16 and 17 which fortune had flung into his hands, Bazaine had now allowed himself to be driven back into Metz, where he was content to stay. His motives and the question of his conduct are discussed under BAZAINE.

[1]Of the I. army the I. corps was retained on the east side of Metz. The II. corps belonged to the II. army, but had not yet reached the front.

On the German side the victory at St. Privat was at once followed up by the headquarters. Early on the 19th the investment of Bazaine's army in Metz was commenced. A new army, the Army of the Meuse (often called the IV.), was as soon as possible formed of all troops not required for the maintenance of the investment, and, under the command of the crown prince of Saxony, marched on towards Châlons, where MacMahon was known to be reorganizing the remainder of the French field army. The III. army also continued its assigned course in the direction of Paris.

Campaign **of** Sedan.—The operations which led to the capture of MacMahon's army in Sedan call for little explanation. Given seven corps, each capable of averaging 15 m. a day for a week in succession, opposed to four corps only, shaken by defeat and unable as a whole to cover more than 5 m. a day, the result could hardly be doubtful. But Moltke's method of conducting operations left his opponent many openings which could only be closed by excessive demands on the marching power of the men. Trusting only to his cavalry screen to secure information, he was always without any definite fixed point about which to manoeuvre, for whilst the reports of the screen and orders based thereon were being transmitted, the enemy was free to move, and Moltke based his calculations of such movements on strictly military grounds.

Thus whilst the German army, on a front of nearly 50 m., was marching due west on Paris, MacMahon, under political pressure, was moving parallel to them, but on a northerly route, to attempt the relief of Metz.

So unexpected was this move and so uncertain the information which called attention to it, that Moltke did not venture to change at once the direction of march of the whole army, but he directed the Army of the Meuse northward on Damvillers and ordered Prince Frederick Charles to detach two corps from the forces investing Metz to reinforce it. For the moment, therefore, MacMahon's move had succeeded, and the opportunity existed for Bazaine to break out. But at the critical moment the hopeless want of real efficiency in MacMahon's army compelled the latter so to delay his advance that it became evident to the Germans that there was no longer any necessity for the III. army to maintain the direction towards Paris, and that the probable point of contact between the Meuse army and the French lay nearer to the right wing of the III. army than to Prince Frederick Charles's investing force before Metz.

The detachment from the II. army was therefore countermanded, and the whole III. army changed front to the north while the Meuse army headed the French off from the east. The latter came into contact with the head of the French columns, during the 29th, about Nouart, and on the 30th at Buzancy (battle of Beaumont); and the French, yielding to the force of numbers combined with superior morale, were driven northwestward upon Sedan (*q.v.*), right across the front of the III. army, which was now rapidly coming up from the south.

The morning of Sept. 1 found the French crowded around the little fortress of Sedan, with only one line of retreat to the northwest still open. By 11 A.M. the XI. corps (III. army) had already closed that line. and about noon the Saxons (Army of the Meuse) moving round between the town and the Belgian frontier joined hands with the XI., and the circle of investment was complete. The battle of Sedan was closed about 4.15 P.M. by the hoisting of the white flag. Terms were agreed upon during the night, and the whole French army, with the emperor, passed into captivity.

(F. N. M.)

Later Operations.—Thus in five weeks one of the French field armies was imprisoned in Metz, the other destroyed, and the Germans were free to march upon Paris. This seemed easy. There could be no organized opposition to their progress,[1] and Paris, if not so defenceless as in 1814, was more populous. Starvation was the best method of attacking an over-crowded fortress, and the Parisians were not thought to be proof against the deprivation of

[1]The XIII. corps (Vinoy), which had followed MacMahon's army at some distance, was not involved in the catastrophe of Sedan, and by good luck as well as good management evaded the German pursuit and returned safely to Paris.

their accustomed luxuries. Even Moltke hoped that by the end of October he would be "shooting hares at Creisau," and with this confidence the German III. and IV. armies left the vicinity of Sedan on the 4th of September. The march called for no more than good staff arrangements, and the two armies arrived before Paris a fortnight later and gradually encircled the place—the III. army on the south, the IV. on the north side—in the last days of September. Headquarters were established at Versailles. Meanwhile the Third Empire had fallen, giving place on Sept. 4 to a republican Government of National Defence, which made its appeal to, and evoked, the spirit of 1792. Henceforward the French nation, which had left the conduct of the war to the regular army and had been little more than an excited spectator, took the burden upon itself.

Although of the regular army units only six regiments of infantry and ten of cavalry were left—outside Metz and other beleaguered garrisons—a great number of regular recruits'and reservists were available. From these the government organized 280 battalions of infantry, or 280,000 men, 31 regiments of the Garde Mobile, framed by Marshal Niel in 1868, totalling 110,000 men, and 80,000 formed in battalions of the Garde Nationale, called into existence on Sept. 1 j, and including all able-bodied men of from 31 to 60 years of age. With cavalry regiments and corps of francs-tireurs the total was 583,000, and this initial figure was far exceeded before the war finished. The German staff had of course to reckon on the Garde Mobile, and did so beforehand, but they wholly underestimated both its effective members and its willingness, while, possessing themselves a system in which all the military elements of the German nation stood close behind the troops of the active army, they ignored the potentialities of the Garde Nationale.

Meanwhile, both as a contrast to the events that centered on Paris and because in point of time they were decided for the most part in the weeks immediately following Sedan, we must briefly allude to the sieges conducted by the Germans—Paris (*see* FRANCE: The Third *Repubuc*), Metz (*q.v.*) and Belfort (*q.v.*) excepted. Old and ruined as many of them were, the French fortresses possessed considerable importance in the eyes of the Germans. Strassburg, in particular, the key of Alsace. the standing menace to South Germany and the most conspicuous of the spoils of Louis XIV's Raubkrzege, was an obvious target. Operations were begun on Aug. 9, three days after Worth, Werder's corps (Baden troops and Prussian Landwehr) making the siege. The French commandant, Uhrich, surrendered after a stubborn resistance on Sept. 28. Of the smaller fortresses many, being practically unarmed and without garrisons, capitulated at once. Toul, defended by Major Huck with 2,000 mobiles, resisted for forty days, and drew upon itself the efforts of 13,000 men and 100 guns. Verdun, commanded by Guérin de Waldersbach, held out till after the fall of Metz. Some of the fortresses lying to the north of the Prussian line of advance on Paris, *e.g.*, Mézières, resisted up to January 1871, though of course this was very largely due to the diminution of pressure caused by the appearance of new French field armies in October. On Sept. 9 a strange incident took place at the surrender of Laon. A powder magazine was blown up by the soldiers in charge and 300 French and a few German soldiers were killed by the explosion. But as the Germans advanced, their lines of communication were thoroughly organized, and the belt of country between Paris and the Prussian frontier subdued and garrisoned. Most of these fortresses were small town enceintes, dating from Vauban's time, and open, under the new conditions of warfare, to concentric bombardment from positions formerly out of range, upon which the besieger could place as many guns as he chose to employ. In addition they were usually deficient in armament and stores and garrisoned by newly-raised troops. Belfort, where the defenders strained every nerve to keep the besiegers out of bombarding range, and Paris formed the only exceptions to this general rule.

The "Defense Nationale."—The policy of the new French government was defined by Jules Favre on the 6th of September. "It is for the king of Prussia, who has declared that he is making war on the Empire and not on France, to stay his hand; we shall not cede an inch of our territory or a stone of our fortresses." These proud words, so often ridiculed as empty bombast, were the prelude of a national effort which re-established France in the eyes of Europe as a great power, even though provinces and fortresses were ceded in the peace that that effort proved unable to avert. They were translated into action by Léon Gambetta, who escaped from Paris in a balloon on Oct. 7, and established the headquarters of the defence at Tours, where already the "Delegation" of the central government—which had decided to remain in Paris—had concentrated the machinery of government. Thenceforward Gambetta and his principal assistant de Freycinet directed the whole war in the open country, co-ordinating it, as best they could with the precarious means of communication at their disposal, with Trochu's military operations in and round the capital. His critics—Gambetta's personality was such as to ensure him numerous enemies among the higher civil and military officials, over whom, in the interests of La *Patrie,* he rode rough-shod—have acknowledged the fact, which is patent enough in any case, that nothing but Gambetta's driving energy enabled France in a few weeks to create and to equip twelve army corps, representing thirty-six divisions (600,000 rifles and 1,400 guns), after all her organized regular field troops had been destroyed or neutralized. It is claimed that by undue interference with the generals at the front, by presuming to dictate their plans of campaign, and by forcing them to act when the troops were unready, Gambetta and de Freycinet nullified the efforts of themselves and the rest of the nation and subjected France to a humiliating treaty of peace. But even the brief narrative given below must at least suggest to the reader the existence amongst the generals and higher officials of a dead weight of passive resistance to the Delegation's orders, of unnecessary distrust of the qualities of the improvised troops, and above all of the utter fear of responsibility that twenty years of literal obedience had bred. The closest study of the war cannot lead to any other conclusion than this, that whether or not Gambetta as a strategist took the right course in general or in particular cases, no one else would have taken any course whatever.

On the approach of the enemy Paris hastened its preparations for defence to the utmost, while in the provinces, out of reach of the German cavalry, new army corps were rapidly organized out of the few constituted regular units not involved in the previous catastrophes, the depot troops and the mobile national guard. The first-fruits of these efforts were seen in Beauce, where early in October important masses of French troops prepared not only to bar the further progress of the invader but actually to relieve Paris. The so-called "fog of war"—the armed inhabitants, francs-tireurs, sedentary national guard and volunteers—prevented the German cavalry from venturing far out from the infantry camps around Paris, and behind this screen the new XV. army corps assembled on the Loire. But an untimely demonstration of force alarmed the Germans, all of whom, from Moltke downwards, had hitherto disbelieved in the existence of the French new formations, and the still unready XV. corps found itself the target of an expedition of the I. Bavarian corps, which drove the defenders out of Orleans after a sharp struggle, while at the same time another expedition swept the western part of Beauce, sacked Châteaudun as a punishment for its brave defence, and returned via Chartres, which was occupied.

After these events the French forces disappeared from German eyes for some weeks. D'Aurelle de Paladines, the commander of the "Army of the Loire" (XV. and XVI. corps), improvised a camp of instruction at Salbris in Sologne, several marches out of reach. and subjected his raw troops to a stern régime of drill and discipline. At the same time an "Army of the West" began to gather on the side of Le Mans. This army was almost imaginary, yet rumours of its existence and numbers led the German commanders into the gravest errors, for they soon came to suspect that the main army lay on that side and not on the Loire, and this mistaken impression governed the German dispositions up to the very eve of the decisive events around Orleans in December. Thus when at last D'Aurelle took the offensive from Tours (whither he had transported his forces, now 100,000 strong) against the position of the I. Bavarian corps near Orleans, he found his task easy. The Bavarians, outnumbered and unsupported, were defeated with heavy losses in the battle of Coulmiers (November 9), and, had it not been for the inexperience, want of combination, and other technical weaknesses of the French, they would have been annihilated. What the results of such a victory as Coulmiers might have been, had it been won by a fully organized, smoothly working army of the same strength, it is difficult to overestimate. As it was, the retirement of the Bavarians rang the alarm bell all along the line of the German positions, and that was all.

Then once again, instead of following up its success, the French army disappeared from view. The victory had emboldened the "fog of war" to make renewed efforts, and resistance to the pressure of the German cavalry grew day by day. The Bavarians were reinforced by two Prussian divisions and by all available cavalry commands, and constituted as an "army detachment" under the grand-duke Friedrich Franz of Mecklenburg-Schwerin to deal with the Army of the Loire, the strength of which was far from being accurately known. Meantime the capitulation of Metz on Oct. 28 had set free the veterans of Prince Frederick Charles, the best troops in the German army, for field operations. The latter were at first misdirected to the upper Seine, and yet another opportunity arose for the French to raise the siege of Paris. But D'Aurelle utilized the time he had gained in strengthening the army and in imparting drill and discipline to the new units which gathered round the original nucleus of the XV. and XVI. corps. All this was, however, unknown and even unsuspected at the German headquarters, and the invaders, feeling the approaching crisis, became more than uneasy as to their prospects of maintaining the siege of Paris.

The Orleans Campaign. — At this moment, in the middle of November, the general situation was as follows: the German III. and Meuse armies, investing Paris, had had to throw off important detachments to protect the enterprise, which they had undertaken on the assumption that no further field armies of the enemy were to be encountered. The maintenance of their communications with Germany, relatively unimportant when the struggle took place in the circumstances of field warfare, had become supremely necessary, now that the army had come to a standstill and undertaken a great siege, which required heavy guns and constant replenishment of ammunition and stores. The rapidity of the German invasion had left no time for the proper organization and full garrisoning of these communications, which were now threatened, not merely by the Army of the Loire, but by other forces assembling on the area protected by Langres and Belfort. The latter, under General Cambriels, were held in check and no more by the Baden troops and reserve units (XIV. German corps) under Werder, and eventually without arousing attention they were able to send 40,000 men to the Army of the Loire. This army, still around Orleans, thus came to number perhaps 150,000 men, and opposed to it, about Nov. 14 the Germans had only the Army Detachment of about 40.000, the II. army being still distant. It was under these conditions that the famous Orleans campaign took place. After many vicissitudes of fortune, and with many misunderstandings between Prince Frederick Charles, Moltke and the grand-duke, the Germans were ultimately victorious, thanks principally to the brilliant fighting of the X. corps at Beaune-la-Rolande (Nov. 28), which was followed by the battle of Loigny-Poupry on Dec. 2 and the second capture of Orleans after heavy fighting on Dec. 4.

The result of the capture of Orleans was the severance of the two wings of the French army, henceforward commanded respectively by Chanzy and Bourbaki. The latter fell back at once and hastily, though not closely pursued, to Bourges. But Chanzy, opposing the detachment between Beaugency and the Forest of Marchenoir, was of sterner metal, and in the five days' general engagement around Beaugency (December 7–11) the Germans gained little or no real advantage. Indeed their solitary material success, the capture of Beaugency, was due chiefly to the fact that the French there were subjected to conflicting orders from the military and the governmental authorities. Chanzy then abandoned little but the field of battle, and on the grand-duke's representations Prince Frederick Charles, leaving a mere screen to impose upon Bourbaki (who allowed himself to be deceived and remained inactive), hurried thither with the II. army. After that Chanzy was rapidly driven north-westward, though always presenting a stubborn front. The Delegation left Tours and betook itself to Bordeaux, whence it directed the government for the rest of the war. But all this continuous marching and fighting, and the growing severity of the weather, compelled Prince Frederick Charles to call a halt for a few days. About Dec. 19, therefore, the Germans (II. army and Detachment) were closed up in the region of Chartres, Orleans, Auxerre and Fontainebleau, Chanzy along the river Sarthe about Le Mans and Bourbaki still passive towards Bourges.

During this, as during other halts, the French government and its generals occupied themselves with fresh plans of campaign, the former with an eager desire for results, the latter (Chanzy excepted) with many misgivings. Ultimately, and fatally, it was decided that Bourbaki, whom nothing could move towards Orleans, should depart for the south-east, with a view to relieving Belfort and striking perpendicularly against the long line of the Germans' communications. This movement, bold to the point of rashness with such raw troops, seems to have been suggested by de Freycinet. As the execution of it fell actually into incapable hands, it is difficult to judge what would have been the result had a Chanzy or a Faidherbe been in command of the French. At any rate it was vicious in so far as immediate advantages were sacrificed to hopes of ultimate success which Gambetta and de Freycinet did wrong to base on Bourbaki's powers of generalship. Late in December, for good or evil, Bourbaki marched off into Franche-Comté and ceased to be a factor in the Loire campaign. A mere calculation of time and space sufficed to show the German headquarters that the moment had arrived to demolish the stubborn Chanzy.

Le Mans. — Prince Frederick Charles resumed the interrupted offensive, pushing westward with four corps and four cavalry divisions which converged on Le Mans. There on Jan. 10, 11, and 12, 1871, a stubbornly contested battle, in which the Germans engaged 75,000 against 90,000 French "improvised" troops, ended with the retreat of the French, who owed their defeat solely to the misbehaviour of the Breton mobiles. These, after deserting their post on the battlefield at a mere threat of the enemy's infantry, fled in disorder and infected with their terrors the men in the reserve camps of instruction, which broke up in turn. But Chanzy. resolute as ever, drew off his field army intact towards Laval, where a freshly raised corps joined him. The prince's army was far too exhausted to deliver another effective blow, and the main body of it gradually drew back into better quarters, while the grand duke departed for the north to aid in opposing Faidherbe. Some idea of the strain to which the invaders had been subjected may be gathered from the fact that army corps, originally 30,000 strong, were in some cases reduced to 10,000 and even fewer bayonets. And at this moment Bourbaki was at the head of 120,000 men! Indeed, so threatening seemed the situation on the Loire, though the French south of that river between Gien and Blois were mere isolated brigades, that the prince hurried back from Le Mans to Orleans to take personal command. A fresh French corps, bearing the number XXV., and being the twenty-first actually raised during the war, appeared in the field towards Blois. Chanzy was again at the head of 156,000 men He was about to take the offensive against the 40,000 Germans left near Le Mans when to his bitter disappointment he received the news of the armistice. "We have still France," he had said to his staff. undeterred by the news of the capitulation of Paris, but now he had to submit, for even if his improvised army was still cheerful, there were many significant tokens that the people at large had sunk into apathy and hoped to avoid worse terms of peace by discontinuing the contest at once.

So ended the critical period of the "*Défense nationale.*" It may be taken to have lasted from the day of Coulmiers to the last day of Le Mans, and its central point was the battle of Beaune-la-Rolande. Its characteristics were, on the German side, inadequacy of the system of strategy practised, which became palpable as soon as the organs of reconnaissance met with serious resistance, misjudgment of and indeed contempt for the fighting powers of "new formations," and the rise of a spirit of ferocity in the man in the ranks, born of his resentment at the continuance oi the war and the ceaseless sniping of the franc-tireur's rifle and the peasant's shot-gun. On the French side the continual efforts of the statesmen to stimulate the generals to decisive efforts, coupled with actual suggestions as to the plans of the campaign to be followed (in default, be it said, of the generals themselves producing such plans), and the professional soldiers' distrust of half-trained troops, acted and reacted upon one another in such a way as to neutralize the powerful, if disconnected and erratic, forces that the war and the Republic had unchained. As for the soldiers themselves, their most conspicuous qualities were their uncomplaining endurance of fatigues and wet bivouacs during an unusually bitter winter, and in action their capacity for a single great effort and no more. But they were unreliable in the hands of the veteran regular general, because they were heterogeneous in recruiting, and unequal in experience and military qualities, and the French staff was wholly incapable of moving masses of troops with the rapidity demanded by the enemy's methods of war, so that on the whole it is difficult to know whether to wonder more at their missing success or at their so nearly achieving it.

Faidherbe's Campaign. — The decision, as we have said, was fought out on the Loire and the Sarthe. Nevertheless the glorious story of the *"Défense nationale"* includes two other important campaigns — that of Faidherbe in the north and that of Bourbaki in the east.

In the north the organization of the new formations was begun by Dr. Testelin and General Farre. Bourbaki held the command for a short time in November before proceeding to Tours, but the active command in field operations came into the hands of Faidherbe, a general whose natural powers, so far from being cramped by years of peace routine and court repression, had been developed by a career of pioneer warfare and colonial administration. General Farre was his capable chief of staff. Troops were raised from fugitives from Metz and Sedan. as well as from depot troops and the Garde Mobile, and several minor successes were won by the national troops in the Seine valley, for here, as on the side of the Loire. mere detachments of the investing army round Paris were almost powerless. But the capitulation of Metz came too soon for the full development of these sources of military strength, and the German I. army under hlanteuffel, released from duty at Metz, marched north-eastward, capturing the minor fortresses on its way. Before Faidherbe assumed command, Farre had fought several severe actions near Xmiens, but, greatly outnumbered. had been defeated and forced to retire behind the Somme. Another French general, Friand, had also engaged the enemy without success near Rouen. Faidherbe assumed the command on Dec. 3, and promptly moved forward A general engagement on the little river Hallue (Dec. 23), east-north-east of Amiens. was fought with no decisive results, but Faidherbe, feeling that his troops were only capable of winning victories in the first rush, drew them off on the 24th. His next effort, at Bapaûme (Jan. 2–3, 1871), was more successfu!, but its effects were counterbalanced by the surrender of the fortress of Péronne (Jan. 9) and the consequent establishment of the Germans on the line of the Somme. Meanwhile the Rouen troops had been contained by a strong German detachment, and there was no further chance of succouring Paris from the north. But Faidherbe, like Chanzy, was far from despair, and in spite of the deficiencies of his troops in equipment (50,000 pairs of shoes, supplied by English contractors, proved to have paper soles). he risked a third great battle at St. Quentin (Jan. 19). This time he was severely defeated, though his loss in killed and wounded was about equal to that of the Germans, who mere commanded by Goeben. Still the attempt of the Germans to surround him failed and he drew off his forces with his artillery and trains unharmed. The Germans, who had been greatly impressed by the solidity of his army, did not pursue him far. and Faidherbe was preparing for a fresh effort when he received orders to suspend hostilities.

The last episode is Bourbaki's campaign in the east, with its mournful close at Pontarlier. Before the crisis of the last week of November, the French forces under General Crémer, Cambriels' successor, had been so far successful in minor enterprises that, as mentioned above, the right wing of the Loire army, severed from the left by the battle of Orleans and subsequently held inactive at Bourges and Nevers, was ordered to Franche Comté to take the offensive against the XIV. corps and other German troops there, to relieve Belfort and to strike a blow across the invaders' line of communications. But there were many delays in execution. The staff work, which was at no time satisfactory in the French armies of 1870, was complicated by the snow, the bad state of the roads, and the mountainous nature of the country, and Bourbaki, a brave general of division in action, but irresolute and pretentious as a commander-in-chief, was not the man to cope with the situation. Only the furious courage and patient endurance of hardships of the rank and file, and the good qualities of some of the generals, such as Clinchant, Crémer and Billot, and junior staff officers such as Major Brugère (afterwards generalissimo of the French army), secured what success was attained.

The Campaign in the **East.**—Werder, the German commander, warned of the imposing concentration of the French, evacuated Dijon and Dôle just in time to avoid the blow and rapidly drew together his forces behind the Ognon above Vesoul. A furious attack on one of his divisions at Villersexel (Jan. 9) cost him 2,000 prisoners as well as his killed and wounded, and Bourbaki, heading for Belfort, was actually nearer to the fortress than the Germans. But at the crisis more time was wasted, Werder (who had almost lost hope of maintaining himself and had received both encouragement and stringent instructions to do so) slipped in front of the French, and took up a long weak line of defense on the river Lisaine, almost within cannon shot of Belfort. The cumbrous French army moved up and attacked him there with 150,000 against 60,000 (Jan. 15–17, 1871). It was at last repulsed, thanks chiefly to Bourbaki's inability to handle his forces, and, to the bitter disappointment of officers and men alike, he ordered a retreat, leaving Belfort to its fate.

Ere this, so urgent was the necessity of assisting Werder, Manteuffel had been placed at the head of a new Army of the South. Bringing two corps from the I. army opposing Faidherbe and calling up a third from the armies around Paris, and a fourth from the II. army, Manteuffel hurried southward by Langres to the Saône. Then, hearing of Werder's victory on the Lisaine, he deflected the march so as to cut off Bourbaki's retreat, drawing off the left flank guard of the latter (commanded with much *éclat* and little real effect by Garibaldi) by a sharp feint attack on Dijon. The pressure of Werder in front and Manteuffel in flank gradually forced the now thoroughly disheartened French forces towards the Swiss frontier, and Bourbaki, realizing at once the ruin of his army and his own incapacity to re-establish its efficiency, shot himself, though not fatally, on Jan. 26. Clinchant, his successor, acted promptly enough to remove the immediate danger, but on the 29th he mas informed of the armistice without at the same time being told that Belfort and the eastern theatre of war had been on Jules Favre's demand expressly excepted from its operation. Jules Favre, it appears, neglected to inform Gambetta of the exception. Thus the French, the leaders distracted by doubts and the worn-out soldiers fully aware that the war was practicaliy over, stood still, while Manteuffel completed his preparations for hemming them in. On Feb. 1 General Clinchant led his troops into Switzerland, where they were disarmed, interned and well cared for by the authorities of the neutral state. The rearguard fought a last action with the advancing Germans before passing the frontier. On the 16th, by order of the French government, Belfort capitulated, but it was not until the 11th of March that the Germans took possession of Bitche, the little fortress on the Vosges, where in the early days of the war de Failly had illustrated so signally the want of concerted action and the neglect of opportunities which had throughout proved the bane of the French armies.

The losses of the Germans during the whole war were 28.000 dead and 101.000 wounded and disabled, those of the French, 156,000 dead (17,000 of whom died of sickness and wounds, as prisoners in German hands) and 143,000 wounded and disabled. 720,000 men surrendered to the Germans or to the authorities of neutral states, and at the close of the war there were still 250,000 troops on foot, with further resources not immediately available to the number of 280,000 more. In this connection, and as evidence of the respective numerical yields of the German system working normally and of the French improvised for the emergency, we quote from Berndt *(Zahl im Kriege)* the following comparative figures:—

End of July .	French 250,000,	Germans 384,000 under arms.		
Middle of November	„ 500,000,	„ 425,000	„	„
After the surrender of Paris and the disarmament of Bourbaki's army .	„ 534,000,	„ 835,000	„	„

The date of the armistice was Jan. 28, and that of the ratification of the treaty of Frankfurt May 23, 1871.

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The most useful bibliography is that of General Palat ("P. Lehautcourt"). (C. F. A.)

FRANÇOIS, JEAN CHARLES (1717–1769), French etcher and engraver, one of the inventors of the crayon method in engraving, was born at Nancy. He studied art under Claude Charles at Nancy. He experimented in copper engraving, worked at Dijon and Lyons, where he published in 1740 the *Principes de dessein faciles,* with descriptions of a new process imitating the effect of crayon drawings in engraving. He later perfected this process and in 1758 he received a pension from the king. His most important work is the series of portraits for Saverien's *Histoire des Philosophes modernes* (1761–69). François' work is not artistic. Its importance is due to his claim of having introduced the crayon method. He stated in a letter addressed to Saverien (1760) that he made experiments in the method in 1740; and the fact that he attained recognition from the French Royal Academy in 1757 seems to substantiate his statement. Two other engravers claimed the honour of the discovery, Gilles Demarteau and L. M. Bonnet. *See* also STIPPLE AND CRAYON ENGRAVING.

FRANÇOIS DE NEUFCHÂTEAU, NICOLAS LOUIS, COUNT (1750–1828), French statesman and poet, was born at Saffais, Lorraine, on April 17, 1750, the son of a school-teacher. He studied at the Jesuit college of Neufchâteau in the Vosges, and at 14 published verses which were praised by Rousseau and Voltaire. Neufchâteau conferred on him its name, and he was elected member of some of the principal academies of France. From 1783 to 1789 he was *procureur-général* to the council of Santo Domingo. After the Revolution he was elected deputy *suppléant* to the National Assembly, organized the Department of the Vosges, and was elected later to the Legislative Assembly, as secretary and then president. In 1793 he was imprisoned for his drama *Pamela ou la vertu récompensée* (Théâtre de la Nation, Aug. 1, 1793), but was freed afterward at the revolution of the 9th Thermidor. In 1797 he became minister of the interior; he developed inland navigation; inaugurated the museum of the Louvre, and was one of the promoters of the first universal exhibition of industrial products. From 1804 to 1806 he was president of the Senate; in 1808 he was made count. He died Jan. 10, 1828. François de Neufchâteau edited the *Lettres Provinciales* and *Pensées* of Pascal (1822–26) and *Gil Blas* (1820). His principal poetical works are *Poésies diverses* (1765); *Ode sur les parlements* (1771); *Nouveaux Contes moraux* (1781); *Les Vosges* (1796); *Fables et contes* (1814); and *Les Tropes, ou les figures de mots* (1817).

FRANCOLIN, any of numerous partridges abundant in Africa and southern Asia, particularly the genus *Francolinus* with some 30 species and many races over Africa south of the Sahara and in western Morocco, and five in southeastern and southern Asia, including the black partridge (*F. francolinus*)—from the dark plumage of the male—which ranges west to Cyprus. It is about 13 in. long. The browner female lays 6 to 10 eggs in a well-concealed nest on the ground. The double-spurred francolin (*F. bicalcaratus*) is well known, as are *F. africanus, F. shelleyi, F. coqui* and *F. squamatus,* all widely distributed in Africa. The bare-throated partridge or red-necked francolin (*Pternistes afer*) and three allied species are common over Africa. *Anurophasis monorthonyx* of alpine grasslands high on the Oranje mountains of New Guinea, is closely related. (G. F. Ss.)

FRANCONIA, one of the stem-duchies of mediaeval Germany. It stretched along the valley of the Main from the Rhine to Bohemia, and was bounded on the north by Saxony and Thuringia, and on the south by Suabia and Bavaria. It also included a district around Mainz, Spires and Worms, on the left bank of the Rhine.

This territory, occupied by the most easterly portion of the Frankish people, formed part of the kingdom of Austrasia. After the treaty of Verdun in 843 it became the centre of the East Frankish or German kingdom, and remained for a time the most important of the duchies which arose on the ruins of the Carolingian empire. Its influence began to decline under the kings of the Saxon house *(see* GERMANY). It lacked political unity, had no opportunities for extension, and soon became divided into Rhenish Franconia and Eastern Franconia. The most influential family in Rhenish Franconia was that of the Salians, the head of which early in the 10th century was Conrad the Red, duke of Lorraine and son-in-law of Otto the Great. In 1024 his great-grandson Conrad, duke of Franconia, was elected German king as Conrad II. and founded the line of Franconian or Salian emperors. Rhenish Franconia gradually became a land of free towns and lesser nobles, and under the earlier Franconian emperors considerable portions passed to the count palatine of the Rhine, the archbishop of Mainz and the bishops of Worms and Spires, and the name Franconia was confined to the eastern portion of the duchy. Clerical authority was becoming predominant in this region. A series of charters dating from 822 to 1025 had granted considerable powers to the bishops of Wiirzburg, who, by the time of the emperor Henry II., possessed judicial authority over the whole of Eastern Franconia. The duchy was nominally retained by the emperors in their own hands until 1115, when the emperor Henry V., wishing to curb the episcopal influence in this neighbourhood, appointed his nephew Conrad of Hohenstaufen as duke of Franconia. Conrad's son Frederick took the title of duke of Rothenburg. instead of duke of Franconia, but in 1196, on the death of Conrad of Hohenstaufen, son of the emperor Frederick I, the title fell into disuse. Meanwhile the bishop of Würzburg had regained his formal power in the duchy. and this was confirmed in 1168 by the emperor Frederick I.

The title was assumed by John II, bishop of Wurzburg early in the 15th century, and retained by his successors until the bishopric was secularized in 1802. The name Franconia was revived in 1837, when Louis I, king of Bavaria, gave to three northern portions of his kingdom the names of Upper. Middle and Lower Franconia. When Germany was divided into circles by the emperor Maximilian I in 1500, the name Franconia was given to that circle which included the eastern part of the old duchy. The lands formerly comprised in the duchy of Franconia are now divided among Bavaria. Wurttemberg, Baden, Hesse and the Prussian province of Hesse-Nassau.

FRANCS-ARCHERS. The institution of the *francs-archers* was the first attempt at the formation of regular infantry in France. They were created by the ordinance of Montils-les-Tours on Aug. 28. 1448, which prescribed that in each parish an archer should be chosen from among the most apt in the use of arms; this archer to be exempt from the *taille* and certain obligations, to practise shooting with the bow on Sundays and feast days and to hold himself ready to march fully equipped at the first signal. Under Charles VII the francs-archers, numbering about 8,000, never gave complete satisfaction. During the succeeding reigns the institution languished. It finally disappeared in the middle of the 16th century. The francs-archers were also called *francs-taupins.*

FRANCS-TIREURS, irregular troops, almost exclusively infantry ("free-shooters"), employed by the French in the war of 1870–71. They were originally rifle clubs or unofficial military societies formed in the east of France at the time of the Luxembourg crisis of 1867. The members were chiefly concerned with the practice of rifle shooting, and were expected in war to act as light troops. While the existing system of conscription let the greater part of the nation's military energy run to waste, the francs-tireurs were not only popular but also efficient workers in their sphere of action. As they wore no uniforms, were armed with the best rifles and elected their own officers, the government made repeated attempts to bring the societies, which were at once a valuable asset to the armed strength of France and a possible menace to internal order, under military discipline. This was strenuously resisted by the societies, to their sorrow as it turned out, for the Germans treated captured francs-tireurs as irresponsible noncombatants found with arms in their hands and usually exacted the death penalty. In July 1870, at the outbreak of the war, the societies were brought under the control of the minister of war and organized for field service, but it a-as not until November—by which time the *levée en masse* was in force—that they were placed under the orders of the generals in the field. After that they were sometimes organized in large bodies and incorporated in the mass of the armies, but more usually they continued to work in small bands. blowing up culverts on the invaders' lines of communication, cutting off small reconnoitring parties, surprising small posts, etc. Their most celebrated feats were the blowing up of the Moselle railway bridge at Fontenoy on Jan. 22, 1871 and the heroic defense of Chbteaudun by Lipowski's Paris corps and the francs-tireurs of Cannes and Nantes (Oct. 18, 1870). Although the original members of the rifle clubs were joined by many bad characters, the patriotism of the majority was unquestionable. The severity of the German reprisals is itself the best testimony to their service.

FRANK, FRANZ HERMANN REINHOLD VON (1827–1894), German Lutheran theologian, was born on March 2j, 1827, at Altenburg. and educated at Leipzig university. After teaching at Ratzeburg and Altenburg, in 1857 he was appointed professor of theology at Erlangen. where he died on Feb. 7, 1894.

Frank's chief works are: *System der christlichen Gewissheit* (1870–73; 2nd ed.. 1881–83; Eng. trans., 1886), in which he discusses the basis of belief; *System der christlichen Wahrheit* (1878–80; 3rd ed.. 1893–94); *System der christlichen Sittlichkeit* (1884–87; Eng. trans., 1886); *Zur Theologie A. Ritschls* (3rd ed.. 1891), in which he attacks Albrecht Ritschls' theology; and *Gesch. und Kritik der neueren Theologie* (1894; 3rd ed., 1898).

FRANK, ILYA MIKHAILOVICH (1908–), Russian physicist awarded the 1958 Nobel prize for physics jointly with P. A. Cerenkov and I. E. Tamm. "for the discovery and interpretation of. the Cerenkov effect." was born in 1908. Cerenkov's discovery, made in 1934, was concerned with the light emitted by charged particles traveling at very high speed. Study of this effect resulted in the discovery of methods for detecting and measuring the velocity of high-speed particles. Frank, together with the noted Russian physicist Tamm, provided a theoretical interpretation of the Cerenkov effect in 1937. This work is of the greatest importance for research in nuclear physics and for the study of cosmic rays. Frank's work includes collaboration with Cerenkov and Tamm in research on electron radiation, for which all were awarded the Stalin prize in 1946. Frank also specialized in the study of gamma ray quanta and the problem of neutron fluxes. He was made a member of the Academy of Sciences of the U.S.S.R. (W. J. Bp.)

FRANK, JAKOB (1726–1791), a Jewish theologian, founded in Poland a sect which emanated from Judaism but ended by merging with Christianity. The sect, the outcome of the Messianic mysticism of Sabbetai Zebi, was an antinomian movement in which the authority of the Jewish law was held to be superseded by personal freedom. It posed as an anti-Talmudic protest in behalf of a spiritual religion. The Frankists in 1759 were baptized *en masse,* amid much pomp, but the church soon became convinced that Frank was not a genuine convert. He was imprisoned on a charge of heresy, but on his release in 1763 the empress Maria Theresa patronized him, regarding him as a propagandist of Christianity among the Jews. He thenceforth lived in state as baron of Offenbach. and on his death his daughter Eva succeeded him as head of the sect.

FRANK, JOHANN PETER (1745–1821), German physician, was born on March 19. 1745, at Rodalben, Bavaria, and studied at Heidelberg and Strasbourg. He became court and garrison physician in Rastadt (1769), professor in Göttingen (1784), in Pavia (1785), director of sanitation in Lombardy (1786). and in 1795 sanitary officer to the Vienna hospitals. In 1804, after a short time in St. Petersburg as ordinary physician and counsellor of state, he returned to practise in Vienna, where he died on April 24, 1821. Frank's fame rests on his *System einer Vollstandigen medicinischen Polizey* (1779), which covers the hygiene of all the stages of a man's life.

His autobiography was published in Vienna (1802). *See* Leona Baumgartner and Elizabeth Mapelsden Ramsey, "Yohann Peter Frank and his *System einer Vollstandigen Medicinischen Polizey,*" *Annals of Medical History (N.S.),* vol. v, p. 525 (1933).

FRANK, LEONHARD (1882–1961), German novelist and dramatist, mas born in Würzburg on Sept. 4. 1882, the son of a carpenter. He belongs to the German Expressionist movement in his criticism of middle-class society, his pacifism and his faith in a better future for mankind. This reputation, however, depends less on his zeal for reform than on his skill in depicting human emotions. His early novels. *Die Räuberbande* (1914; Eng. trans., *The Robber Band,* 1928) and *Die Crsache* (1916; Eng. trans., *The Cause of Crime,* 1928) caused a sensation by their revolutionary tendencies. He followed these with other books which present aspects of his political and social ideals, but add little to his reputation: *Der Mensch ist gut* (1918), *Der Biirger* (1924; Eng. trans., *The Middleclass Man,* 1930), a novel on the classless society. Later works include *Deutsche Novelle* (1951), *Michaels Rückkehr* (1950) and *Links wo das Herz ist* (1952; Eng. trans., *Heart on the Left,* 1954). a thinly disguised autobiography. Frank received a number of literary awards and was elected to the German Academy of Letters in 1927. He lived as an independent writer until 1933. After 1933 he lived in exile, mainly in the United States. until 1950 when he returned to Germany. Frank died in Munich on Xug. 18, 1961. (W. I. L.)

FRANK-ALMOIGN, in the English law of real property, a species of spiritual tenure, whereby a religious corporation, aggregate or sole, holds lands of the donor to them and their successors for ever. It was a tenure dating from Saxon times, held not on the ordinary feudal conditions, but discharged of all services except the *trinoda necessitas*. But "they which hold in frankalmoign are bound of right before God to make orisons, prayers, masses and other divine services for the souls of their grantor or feoffor, and for the souls of their heirs which are dead, and for the prosperity and good life and good health of their heirs which are alive. And therefore they shall do no fealty to their lord, because that this divine service is better for them before God than any doing of fealty" (Litt. s. 135).

It was the tenure by which the greater number of the monasteries and religious houses held their lands; it was expressly exempted from the statute 12 Car. II. c. 24 (1660), by which the other ancient tenures were abolished, and it is the tenure by which the parochial clergy and many ecclesiastical and eleemosynary foundations hold their lands at the present day. As a form of donation, however, it came to an end by the passing of the statute *Quia Emptores,* for by that statute no new tenure of frank-almoign could be created, except by the crown.

See Sir Frederick Pollock and F. W. Maitland, *History of English Law,* vol. i, 218–30.

FRANMEL, ZACHARIAS (1801–1875), German rabbi, scholar and theologian, was born in Prague on Sept. 30. 1801. He received a thorough Talmudic training, as well as an intensive classical education at the University of Budapest. After serving as rabbi in several German communities, he was called in 1854 to the presidency of the newly organized Jewish Theological seminary at Breslau, which became the most important modern institution for the training of rabbis in Europe and lasted until the Nazi persecutions nearly a century later.

Frankel's theology was known as positive-historical Judaism. This school of thought differed from Orthodoxy in its acceptance of the results of historical research and from Reform Judaism in its maintenance of the pattern of Jewish traditional ritual and its adherence to the national aspects of Judaism. Through the faculty and students of the Breslau seminary, Frankel's viewpoint became highly influential in central Europe. In the 20th century it found congenial soil in the United States, where, under the name of Conservative Judaism, it attained its greatest growth. Frankel died at Breslau on Feb. 13, 187j.

Frankel's scholarly works on the historical development of Talmudic literature and the influence of rabbinic thought on the Septuagint are of classic importance. They include: *Die Eidesleistung der Juden* (1840), a study of the oath in Jewish law; *Vorstudien zur Septuaginta* (1841); *Introduction to the Mishnah* (in Hebrew, 1859); and *Introduction to the Palestinian Talnzud* (in Hebrew, 1870); as well as other books and many articles.

(RT. GS.)

FRANKENTHAL, a town of Germany, in the Rhineland Palatinate, on the Isenach, connected with the Rhine by a canal 3 mi. in length, 6 mi. N.W. from Mannheim. Pop. (1925) 24,647; (1950) 25,417.

Frankenthal (Franconodal) is mentioned as a village in the 8th century. A house of Augustinian canons established there in 1119 was suppressed in 1562 by the elector palatine, who gave its possessions to Protestant refugees from the Netherlands. In 1577 this colony received town rights from the elector John Casimir, whose successor fortified the place, and under the elector Charles Theodore it became the capital of the Palatinate. It has a medieval town hall, two interesting old gates and remains of its former environing walls. Its industries include the manufacture of machinery, casks, corks, soap, dolls and furniture, iron founding and bell founding — the famous "Kaiserglocke" of the Cologne cathedral was cast there.

Frankenthal was formerly famous for its porcelain factory, making figures and groups, established there in 1755. In 1795 the factory was removed to Griinstadt.

FRANKENWALD, a mountainous district of southern Germany, connecting geologically the Fichtelgebirge and the Thuringian forest. It is a broad well-wooded plateau, about 30 mi. long, descending gently on the north and east sides toward the Saale, but more precipitously to the Bavarian plain in the west. Its highest point is the Dobraberg near Steinheid (2,608 ft.). Along the centre lies the watershed between the basins of the Main and the Saale, of the Rhine and Elbe systems, respectively. The principal tributaries of the Main from the Frankenwald are the Rodach and Hasslach; of the Saale, the Selbitz.

FRANKFORT, HENRI (1897–1954). Dutch archaeologist, pioneered in developing near eastern archaeology from a technique for the excavation and classification of material remains to a discipline reconstructing the significant aspects of ancient Egyptian and western Asian civilizations. Born Feb 24, 1897, in Amsterdam, Frankfort presaged in his formative years the breadth of his later interests. Study of history at the University of Amsterdam, Egyptian with Sethe at Berlin. and archaeology under Petrie at the University of London (M.A., London, 1924; Ph D., Leiden, 1927) was balanced by excavation in Egypt with Brunton (1922) and travel in the Balkans and near east (1922, 1924–25). This period culminated in *Studies in Early Pottery of the Near East,* 2 vol., (1924–27).

As director of the excavations of the Egypt Exploration society at Abydos, Tell el-Amarna and Armant (1925–29) and of the expedition of the Oriental Institute of The University of Chicago in Iraq (1929–37), Frankfort made discoveries and interpretations that filled major gaps in knowledge. Publications of those years ranged from Egyptian funerary texts and architecture to thoroughly documented reconstructions of Mesopotamian culture and art.

The appearance of *Cylinder Seals: a Documentary Essay on the Art and Religion of the Ancient Near East* (1939) marked the transition to the final phase of Frankfort's nork (1938–54), spent as professor at The University of Chicago and the University of London, where he headed the Warburg institute. No longer absorbed by the contingencies of excavation, Frankfort brought his far-reaching humanistic interests to bear on comparative studies between the two countries where he had worked. Egypt and Mesopotamia. He approached archaeological materials with keen regard for anthropological, aesthetic and philosophical problems and with rare understanding of religious phenomena. This gave added depth to the syntheses of religion and art which were the product of Frankfort's later years (*e.g., Kingship and the Gods: a Study of Ancient Near Eastern Religion as the Integration of Society and Nature* [1948]; *Ancient Egyptian Religion: an Interpretation* [1948]; *The Art and Architecture of the Ancient Orient* [1954]). He died in London on July 16, 1954.

See P. Delougaz and T. Jacobsen, "Henri Frankfort," and J. Vindenas, "Bibliography of Henri Frankfort," *Journal of Near Eastern Studies,* vol. xiv, pp. 1–13 (1955). (H. J. KA.)

FRANKFORT, capital city of Kentucky, U.S., and seat of Franklin county, on the Kentucky river, 52 mi. E. of Louisville, is in the Bluegrass region and surrounded by hills on both sides of the river. The city is a trading centre for the rich surrounding country, which produces tobacco and raises thoroughbred trotting horses. Natural gas and hydroelectric power are available. The manufactures include bourbon whisky, candy! furniture, electronic parts, shoes, clothing, rolled metal parts, ornamental iron rails and columns, store fixtures and cooperage products.

Frankfort was founded in 1786 by Gen. James Wilkinson and was chosen capital of the state in 1792 (when its population was less than 500) because of its central location. It was chartered as a city in 1839. Twice during Frankfort's early history the capitol burned, and both times the larger cities of Louisville and Lexington attempted to become the state capital but Frankfort was retained.

During the Civil War it was occupied for a short time (1862) by Gen. Braxton Bragg (Confederate), who was driven out by Gen. Don Carlos Buell.

In 1900 there was a bitter contest for the governorship, in connection with which the Democratic claimant. William Goebel, was assassinated. Daniel Boone and other national heroes are buried in the Frankfort cemetery. Frankfort was inundated during the Ohio river flood of 1937. Property damage was extensive, and the losses were estimated in millions of dollars.

The state capitol (built in 1905–09 at a cost of $2,000,000) is of granite and white limestone, 400 ft. long by 18j ft. wide, finished on the interior entirely in white marble. The old capitol

(1829) is occupied by the Kentucky Historical society. The state arsenal, the state board of health, Kentucky State college (established in 1886 for Negroes) and the Kentucky Training Home for feeble-minded persons are also there.

The Orlando Brown house and Liberty hall are noted examples of the many fine homes in the city's environs. The name Frankfort is a corruption of "Frank's Ford," which was in turn named for an early settler, Stephen Frank. For comparative population figures see table in KENTUCKY: Population. (J. W. CL.)

FRANKFURT AM MAIN (FRANKFURT-ON-MAIN), a town in the *Land* of Hesse, Germany, lies on both sides of the Main, about 22 mi. above its confluence with the Rhine at Mainz. Frankfurt, birthplace of the poet Goethe, was famous from the 9th to the 18th century as the town where the German kings were elected, and from the 13th century as a centre for trade and communications. It is one of Germany's leading industrial cities. Pop. (1950) 532,037, (1958 est.) 613,100.

The Town.—The stages of the city's development can still be seen in its general plan. The old fortified town grew up in the 12th century round the imperial castle of Pfalz, which was built on the cathedral mound. The limits of the old town are marked by the Main on the south and by street names ending in -graben (moat) from Hirschgraben on the west to Wollgraben on the east. (Sachsenhausen, the district south of the river, was also fortified, however.) The new town arose when the town boundaries were extended after 1333. Also fortified, its wails were demolished after 1806 and replaced by promenades, the Anlagen. The only surviving fortifications are the round tower of the Eschenheimer Tor, 155 ft. high (1426–28), the Rententurm (1455–56) on the bank of the Main and the Kuhhirtenturm (1490) in Sachsenhausen. After 1866 Frankfurt expanded and its area increased to nearly three times its original size. Air raids in 1943–45 largely destroyed the old town. The new town has been rebuilt in modern style.

BY COURTESY OF GERMAN TOURIST INFORMATION OFFICE

THE ESCHENHEIMER TOR, FRANKFURT AM MAIN. ONE OF THE LAST REMAINING LANDMARKS OF THE OLD MEDIEVAL CITY, STANDING IN MARKED CONTRAST TO THE MODERN POST OFFICE IN THE BACKGROUND

The cathedral, dedicated to St. Bartholomew, is of red sandstone and has a 300-ft. tower. It dates from about 1215, but stands on the site of an earlier church, the Salvatorkirche, built in 852 by Louis the German. The present church was originally a Romanesque basilica, but this was replaced by an early Gothic building in 1235–39 and was again reconstructed from 1315–1500, when the Pfarrturm was temporarily completed by a cupola. The building, including the tower, was only finished after a fire in 1867.

The Roman Catholic St. Leonhardskirche was built after 1219 on a site presented to the town by the emperor Frederick II. Also originally a basilica, it was reconstructed in the 15th and 16th centuries as a Gothic building of the hall type. Two Romanesque towers and two beautiful Romanesque portals still remain, however.

The Nikolaikirche, on the south side of the Romerberg square, dates from the 13th century. It served as church to the town council in the 15th century. Some time after the Reformation it was secularized but in 1847 was once more established as a Protestant church. The Katharinenkirche, in the town centre, was the first Protestant church to be built (1678–81). It stands on the site of a 14th-century church where the first Protestant sermon was preached in Frankfurt in 1522.

Other notable churches are the Roman Catholic Liebfrauenkirche, founded in the 14th century and reconstructed in the 15th and 16th centuries as a Gothic hall-type church; the Deutschordenskirche in Sachsenhausen, a Gothic building (1309), converted to the Baroque style (1747–51); the 9th-century Justinuskirche. which is the oldest remaining church; and the 18th-century Paulskirche. The last was the meeting-place of the 1848–49 German parliament and since the 1957 reconstruction has served as a hall for festive civic occasions. All these churches were damaged in World War II and have been restored. The Westend synagogue is once more open for worship.

In the heart of the town lies the Romerberg, a square once surrounded by picturesque old houses. Those on the north and southeast mere destroyed in 1944 and are to be rebuilt in modern style.

The patrician residence, Zum Romer, which gave the square its name, lies on the northwestern side. In 1405 it was bought by the town and converted into a town hall. Later the neighbouring houses were also acquired, and the five-gabled Gothic facade became famous. The exterior of the Romer and the two adjacent houses have been restored since 1944. Inside the Romer, however, the only room to be restored is the Kaisersaal, or royal hall, where the coronation banquet of the Holy Roman emperors was held, following their election and coronation in the city. The Fernmelde-Hochhaus, belonging to the post office and the most important news centre in western Germany, has replaced the palace of the princes of Thurn and Taxis (1731–36) which was destroyed in 1944. In this palace the German parliament met from 1816–66. Only the palace doorway and entrance pavilion now remain.

On the bank of the Main a 13th-century Romanesque chapel remains of the Saalhof, the castle built by the Hohenstaufen kings in about 1150. A new building replaced the castle in the 14th century and was given an imposing Renaissance façade in 1715. Rebuilt after World War II, it contains the town's historical museum; it was planned to rebuild the Leinwandhaus (linen-drapers' hall, 1396), near the cathedral, and to use it for the town archives. The house in the Grossen Hirschgraben where Goethe was born and spent his youth was burned to the ground in 1944. It has been faithfully restored and contains the original interior fittings, which had been saved. With the adjoining Goethe museum and library it is one of the town's chief attractions.

Notable modern buildings include the late 19th-century exchange, the Frankfurter Hof hotel and main station, the festival hall in the exhibition grounds (1907–08), the wholesale market hall (1927–28) and the former offices of I. G. Farben's chemical works (1928–30). After 1950 a series of skyscrapers was built, among them the offices of the electricity company AEG on the south bank of the Main.

Among the treasures saved after World War II from the municipal and university libraries are a 9th-century ivory diptych, a Gutenberg Bible, the Schopenhauer records and Gustav Freytag's collection of pamphlets.

The most famous of Frankfurt's museums is the Senckenberg museum which has one of the most important natural history collections in Germany. Its history began in 1763 when Johann Christian Senckenberg, the physician, bequeathed his large fortune to the citizens of Frankfurt for the endowment of a hospital, a botanical institute, chemistry and anatomy laboratories. At Goethe's instigation the Senckenbergische Society for Scientific Research was founded in his memory in 1817; this society set up the museum which since 1907 has possessed its own building near the university. The Städel art institute, Frankfurt's fine picture gallery on the south bank of the Main, was endowed in 1816 by one of the town's citizens; it contains Italian, German, French, Spanish and Dutch paintings from the 15th to the 18th centuries, as well as modern and contemporary works. The town's collection of sculpture, containing among many masterpieces the Myron Athena, is housed in the adjoining Liebieghaus. The idyllic moated castle (1727) of the von Holzhausen family contains Roman antiquities found in the Frankfurt area. The opera house (1875–80) stood in ruins after World War II, while the former Schauspielhaus (playhouse) was rebuilt to serve all kinds of theatrical performances, including opera.

The Johann Wolfgang Goethe university is one of the largest in Germany. It was founded in 1914 by an amalgamation of the existing institutions, including the Paul Ehrlich institute for serum research and the Senckenberg Society for Scientific Research. There are also colleges of art and music, and many learned institutions, among which is the Leo Frobenius institute for ethnography with its great library. The Palmengarten (palm garden), founded in 1868, is known throughout Germany for its large collections of flowers from all parts of the world.

Trade and Communications. — By the 14th century Frankfurt was already a great trading town. The half yearly fairs, before Easter and at the beginning of September, were frequented by merchants from all over Europe. As well as dealing in goods, therefore, Frankfurt also became a banking centre of the first importance, and it was there that the Rothschild (*q.v.*) family started business.

Besides the two international fairs there are now many specialized fairs (tobacco, clocks, jewelry, chemical apparatus) and among the exhibitions are the book fair, which takes place annually in September, and the international motor show. Up to the middle of the 19th century Frankfurt was a purely commercial town; it was only after 1866 that it became industrialized. Today Frankfurt with its suburbs (Hochst, Bockenheim, Fechenheim, etc.) has large chemical and pharmaceutical concerns, printing works and electrical and metal industries (machine construction, optical instruments, etc.), and it also manufactures leather goods, foodstuffs and drinks. It is the headquarters of many professional associations (motor industry, engineering, book trade, etc.).

Frankfurt's importance as a centre of communications has grown steadily since the 13th century. Up to 1844 there was only one bridge over the Main, and that had existed in 1222. Between 1844 and 1878 three road, one foot and two railway bridges were built. All these were destroyed in 1945. Of the new bridges the most important is the Friedensbriicke. By the construction of a large inland harbour in 1907–12 Frankfurt became a key point for inland shipping. It is the point of intersection of two autobahnen — from Berlin and the north to Munich and Salzburg, and from Cologne to Nuremberg. Similarly, after the opening of the first railway to Kastel in 1840, Frankfurt has been at the centre of west German rail communications. The Rhine-Main airport, 6 mi. from the city centre, is one of the focal points of world air transport.

History. — Excavations in the area of the former old town have produced evidence that there was already a Roman settlement in Frankfurt in the first century A.D. Where the suburbs of Heddernheim and Praunheim now stand was the great Roman camp Nida, the administrative centre for the hinterland (civitas *Praunensium*) of the Roman frontier wall, the Limes.

The name Frankfurt probably arose about A.D. 500 when the Franks drove the Alemanni south. The first written mention of it occurs in 793, when Einhard, Charlemagne's biographer, states that he spent the winter in the villa Frankonovurd.

In 794 Charlemagne held a western synod in the castle at Frankfurt; in the 9th century the east Frankish Carolingian kings chose the place as their residence. It was only in the 12th century, however, that the castle settlement developed into a town through the favour of the Hohenstaufens. Henry, the son of Conrad III, was elected German king in Frankfurt in 1147, but he died before his father and it was not until 1152, when Frederick Barbarossa was elected, that the first reigning king was elected in Frankfurt.

Between the end of the 12th and the beginning of the 14th century the city's constitution developed into the form which remained effective until 1806. A royal bailiff or magistrate replaced the governor of the castle as head of the town soon after 1200. Gradually a council grew up composed of junior magistrates, counselors and members of the guilds. In 1311 two mayors, annually elected, replaced the royal bailiff as head of the council and in 1372 the town became in fact a free imperial city.

The 14th century saw a remarkable advance in all spheres of Frankfurt's life. In the Golden Bull (*q.v.*) of 1356 Charles IV named Frankfurt as the town where the German kings were to be elected. The copy of the bull made specially for Frankfurt in the imperial chancellery is one of the town's treasures. From 1562–1792 the kings elected in Frankfurt were also crowned there.

During the Reformation, Frankfurt accepted the Reformed church and remained Lutheran, although the Catholics kept the cathedral and some other churches. In 1554 Frankfurt became the home of many Protestant refugees from England and the Netherlands. The English under John Knox, however, left Frankfurt after the Marian persecution in England ceased, but the Netherlanders remained in Frankfurt.

In the 17th century the autocratic rule of the council, whose members came from a small group of aristocratic families, led to a revolutionary movement among the citizens. An agreed constitution was reached under the leadership of Vincenz Fettmilch in 1612. But the revolution went further and was eventually put down in 1614 by imperial commissioners and in 1616 its leaders were put to death. The situation, however, did not improve. Only in 1705–32, following another popular uprising, was a case (Frankfurt v. Frankfurt) brought by the emperor in Vienna and judgment given for the citizens of the town. From that time the constitution of 1612, with a measure of popular representation, was in force.

When the empire broke up in 1806 Frankfurt lost its free status. It became the seat of government for the prince primate of the Confederation of the Rhine. In 1815, however, under the new order for Germany made by the congress of Vienna, it became once more a free city, and a sovereign member of the German Confederation. As the meeting place of the Bundestag, it was the real capital of Germany and so remained for over 50 years.

A commercial and maritime treaty was concluded with Great Britain in 1832. In 1848 the first German national assembly was held in the Paulskirche. After the war of 1866 Frankfurt was occupied by Prussian troops and forcibly incorporated into Prussia. It was only after this annexation that it developed into a big industrial city, its population rising from 91,000 in 1871 to 550,000 in 1939. At the end of World War II the town had to be almost rebuilt. Its face was much altered in the process but some striking monuments still bear witness to the inheritance of earlier generations. (H. MT.)

FRANKFURT AN DER ODER (FRANKFURT-ON-ODER), a town of Germany, in the district of Frankfurt, 50 mi. S.E. from Berlin by rail. Pop. (1950) 52,822; (1956 est.) 56,938. It owes its origin and name to a settlement of Franconian merchants, in the 13th century, on land conquered from the Lubuszanie, a Polish tribe.

In 1253 it was made a town by the margrave John I and borrowed from Berlin the Magdeburg civic constitution. In 1379 it received the right to free navigation of the Oder; it belonged (1368–*c.* 1450) to the Hanseatic League.

The university, opened in 1506, was moved in 1516 to Cottbus and restored again to Frankfurt in 1539. It was dispersed during the Thirty Years' War and again restored by the Great Elector, but finally transferred to Breslau (Wroclaw) in 1811.

In the 15th century Frankfurt successfully withstood sieges by the Hussites (1429 and 1432), by the Poles (1450) and by the duke of Sagan (1477). Also in the Thirty Years' War and the Seven Years' War (city's capture by the Russians on July 23, 1759) and Napoleonic Wars it suffered much.

The Evangelical Marienkirche (Oberkirche), a brick edifice of the 13th century with five aisles, and the Rathhaus dating from 1607, and bearing the device of a member of the Hanseatic League, are notable. Frankfurt an der Oder was long the seat of the court of appeal for the province, but of this it was deprived in 1879.

Its industries include the manufacture of machinery, metalware, chemicals, paper, leather and soap. It has an extensive system of water communication by means of the Oder and its canals to the Vistula and the Elbe. Trade in corn, cattle and wine was fostered by its three annual fairs, held respectively at Reminiscere (the second Sunday in Lent), St. Margaret's day and at Martinmas.

In 1945 Frankfurt an der Oder was captured by Russian troops during the Soviet advance to Berlin.

The town proper lies on the left bank of the Oder and was connected by a stone bridge goo ft. long with the former suburb of Damm-Vorstadt (after World War II a town of western Poland named Sluhice [pop., 1946, 1,689] in Zielona Gora province).

FRANKINCENSE or OLIBANUM, a gum resin obtained from certain species of trees of the genus *Boswellia* and natural order Burseraceae. Five species of *Boswellia* have been distinguished: one, indigenous to the mountainous tracts of central India and the Coromandel coast, and another, found in Ethiopia, though both thuriferous, are not known to yield any of the olibanum of commerce. B. Frereana, B. *bhua-dajiana* and B. carterii of the Somali country in east Africa, the last species including a variety found in Hadramaut, Arabia, are the sources of true frankincense or olibanum.

To obtain the frankincense a deep incision is made in the trunk of the tree, and below it a narrow strip of bark five inches in length is peeled off. When the milklike juice (called *spuma pinguis* by Pliny) which exudes has hardened by exposure to the air, the incision is deepened. In about three months the resin has attained the required degree of consistency. The season for gathering lasts from May until the first rains in September. The large clear globules are scraped off into baskets. and the inferior quality that has run down the tree is collected separately. Packed in sheep- and goatskins. in quantities of 20 to 40 lb., it is carried on camels to Berbera, for shipment either to Aden, Makalla or other Arabian ports, or directly to Bombay. At Bombay it is assorted, and is then packed for export to Europe, China and elsewhere. Olibanum is a reputed natural product of China.

Frankincense or olibanum occurs in commerce in semiopaque, round, ovate or oblong tears or irregular lumps, which are covered externally with a white dust, the result of their friction against one another. It has an amorphous internal structure and a dull fracture; is of a yellow to yellowish-brown hue, the purer varieties being almost colourless, or possessing a greenish tinge; and has a somewhat bitter aromatic taste and a balsamic odour, which is developed by heating. Immersed in alcohol it becomes opaque, and with water it yields an emulsion. It contains about 72% of resin soluble in alcohol; a large proportion of gum soluble in water, and apparently identical with gum arabic; and a small quantity of a colourless inflammable essential oil, one of the constituents of which is the body oliben. Frankincense burns with a bright white flame, leaving an ash consisting mainly of calcium carbonate, the remainder being calcium phosphate and the sulfate, chloride and carbonate of potassium. Good frankincense, according to Pliny, is recognized by its whiteness, size, brittleness and ready inflammability. That which occurs in globular drops, he says, is termed male frankincense; the most esteemed is in breast-shaped drops, formed each by the union of two tears. The best frankincense, Arrian wrote, was formerly exported from the neighbourhood of Cape Elephant in Africa (the modern Ras Fiel); and A. von Kremer, in his description of the commerce of the Red sea (1863), observed that the African frankincense, called by the Arabs *asli*, is of twice the value of the Arabian luban.

Frankincense was used by the ancient Egyptians in their religious rites. but not in embalming. It constituted a fourth part of the Jenish incense of the sanctuary and is frequently mentioned in the Pentateuch As a medicine it was in former times in high repute. Pliny mentions it as an antidote to hemlock. and Avicenna recommends it for tumours, ulcers of the head and ears, affections of the breast, vomiting, dysentery and fevers. In the east frankincense is used as an external application on carbuncles, blind boils and gangrenous sores, and it is given internally in the treatment of gonorrhea. In China it was an old internal remedy for leprosy and struma, and is accredited with stimulant, tonic, sedative, astringent and vulnerary properties. It is not used in modern medicine. being destitute of any special virtues.

Common frankincense (thus or abietis *resina*) is a term applied to a resin which exudes from fissures in the bark of the Norway spruce fir, Abies *excelsa;* when melted in hot water and strained it constitutes Burgundy pitch.

FRANKING. A term used for the right of sending letters or postal packages free (Fr. franc) of charge. The privilege was claimed by the English house of commons in 1660 in "a Bill for erecting and establishing a Post Office," their demand being that all letters addressed to or sent by members during the session should be carried free. The clause embodying this claim was struck out by the lords, but with the proviso in the act as passed for the free carriage of all letters to and from the sovereign and the great officers of state, and also the single inland letters of the members of that present parliament during that session only. The practice, however, apparently mas tolerated until 1764, nhen, by an act dealing with postage, it was legalized. every peer and each member of the house of commons being allowed to send free 10 letters a day, not exceeding an ounce in weight, to any part of the United Kingdom, and to receive 15. The act did not restrict the privilege to letters either actually written by or to the member, and thus the right was very easily abused, members sending and receiving letters for friends, all that was necessary being the signature of the peer or M.P. in the corner of the envelope. Wholesale franking grew usual. and M.P.'s supplied their friends with envelopes already signed to be used at any time On Jan. 10, 1840. parliamentary franking was abolished on the introduction of the uniform penny rate.

In the United States the franking privilege was first granted in Jan. 1776 to the soldiers engaged in the American War of Independence. The right was gradually extended till it included nearly all officials and members of the public service. By special acts the privilege was bestoaed on presidents and their widows. The vice-president, members of the house and senate and delegates, the clerk of the house and the secretary of the senate were given the privilege of sending and receiving free through the mail all public documents printed by order of congress, the written name of the official user, or a facsimile, and designation of the office appearing on the envelope or parcel. this privilege continuing until the 30th day of June following the expiration of their respective terms of office. The Congressional Record or any part thereof could, under the frank of a member or delegate to be written by himself, be carried free under regulations of the postmaster general. Seeds transmitted by the secretary of agriculture or by any member or delegate receiving seeds from the department for transmission could be sent free in the mails under frank, this privilege applying to former members and former delegates for a period of nine months after the expiration of their terms. The vice-president, members, members elect. delegates and delegates elect could send free through the mails. under their franks, any mail matter to any government official or to any person, correspondence not exceeding four ounces in weight, upon official or departmental business.

United States government agencies are entitled to use the so-called "penalty" statement ("penalty for private use to avoid payment of postage $300") in lieu of postage stamps. The equivalent legend in Great Britain is "O.H.M.S." ("on her majesty's service").

(G. B. GY.)

FRANKL, LUDWIG AUGUST, RITTER VON HOCHWART (1810–1894), Austrian poet, was born at Chrast, Bohemia. on Feb. 3, 1810. In 1838 he became secretary of the Jewish community in Vienna. In the revolutionary year of 1848 his poem, *Die Universitiit*, had an enormous circulation. He wrote lyrics, epic and many excellent critical works on his contemporaries. He is perhaps best remembered for his services to Jewish education. He established the first Jewish school in Jerusalem, and wrote an account of his eastern travels, *Nach Jerusalem* (2 vol., 1858).

See his *Briefwechsel* (1907), edited by Bruno Frankl; his *Erinnerungen* (1910), edited by St. Hock.

FRANKLAND, SIR EDWARD (1825–1899), English chemist and pioneer in the field of structural chemistry. was born at Churchtown, near Lancaster, on Jan. 18, 1825. He wished to enter the medical profession and so was apprenticed to a druggist. During this period of six years he became interested in chemistry and taught himself to make experiments and even to carry out rough analyses of water. In 1845 he entered Lyon Playfair's laboratory in London, subsequently working under R. W. Bunsen at Marburg for three months, and again in 1848. In 1847 he was appointed science master at Queenwood school, Hampshire, where he met John Tyndall. He received his Ph.D. at Marburg in 1849. In 1851 Frankland became the first professor of chemistry at Owens college, Manchester. He worked at Giessen, Ger., under Justus von Liebig for a time. Returning to London, he became lecturer in chemistry at St. Bartholomew's hospital, and in 1863 professor of chemistry at the Royal institution as successor to Michael Faraday. In 1865 he succeeded August Wilhelm von Hofmann at the School of Mines, where he remained for 20 years. In 1894 he received the Copley medal, the highest honour of the Royal society. He was made a knight commander of the Bath in 1897 and died while on holiday at Golaa, Nor., on Aug. 9. 1899.

Analytical problems, such as the isolation of certain organic radicals. attracted his attention to begin with, but he soon turned to synthetical studies. He was only about 25 years of age when he discovered the organometallic compounds. A consideration of these and other substances led Frankland, in 1852, to the conception that the atoms of each elementary substance can combine only with a certain limited number of the atoms of other elements. The theory of valency thus founded dominated the subsequent development of chemical doctrine, and formed the basis of modern structural chemistry.

In applied chemistry Frankland's great work was in connection with water supply. He was appointed a member of the second royal commission on the pollution of rivers in 1868, and in the course of six years he brought to light an enormous amount of valuable information respecting the contamination of rivers by sewage, trade refuse, etc., and the purification of water for domestic use. He also showed that the luminosity of a flame was not only connected with the presence of solid particles, but also with the pressure of the burning gas or vapour; even hydrogen at a pressure of 10 to 20 atm. burns with a luminous flame. Further. he showed that the spectrum of a dense ignited gas resembles that of an incandescent liquid or solid, and he traced a gradual change in the spectrum of an incandescent gas under increasing pressure.

An application of these results to solar physics in conjunction with Sir Norman Lockyer led to the view that at least the external layers of the sun cannot consist of matter in the liquid or solid forms, but must be composed of gases or vapours. Frankland and Lockyer were also the first to realize the existence of helium (*q.v.*).

See memorial lecture delivered by H. E. Armstrong before the London Chemical Society on Oct. 31, 1901; also H. McLeod, *Journal of the Chemical Society* (1905); *Autobiographical Sketches* (1902); W. A. Tilden, *Famous Chemists* (1902); J. Wislicenus, *Berichte der deutschen chemischen Gesellschaft* (1900). His original papers, down to 1877, were collected and published as *Experimental Researches in Pure, Applied and Physical Chemistry.*

FRANKLAND, PERCY FARADAY (1858–1946), British chemist, second son of Sir Edward Frankland. was born in London, Oct. 3, 1858. He was professor of chemistry at Dundee 1888–94; at Mason college. Birmingham. 1894–1900; and at the Imperial College of Science and Technology, South Kensington, 1900–18. His work in pure chemistry was concerned chiefly with optical activity and stereochemistry. He died Oct. 28, 1946.

FRANKLIN, BENJAMIN (1706–1790), American printer, author, publisher. inventor, scientist. public servant and diplomat, has been called "the first civilized American," "the apostle of modern times" and even "the immortal mentor. or, man's unerring guide to a healthy. wealthy, and happy life." Beyond question he was one of the best known and most admired men in the world during the latter half of the 18th century, and he has remained a prominent and symbolic figure in the American gallery of heroes. His life and his thought, however, were so complex and so marked by apparent contradictions that he has puzzled some of his most sensitive interpreters.

His contemporaries knew him as natural philosopher, moralist and diplomat, renowned for his identification of lightning with electricity, for his widely translated and reprinted *Way to Wealth* (the collected sayings of his fictional almanac maker, "Poor Richard" Saunders) and for his skillful furtherance of the welfare of the British colonies nhich became the United States of America. All educated Europeans knew the epigram of Turgot, the French economist — "He snatched the lightning from the skies and the sceptre from tyrants" — and a great many agreed.

Later generations, however. have known Franklin most directly through his posthumously published *Autobiography*. It is an account of his life to 1757, written at nide intervals between 1771 and 1788 and often inaccurate in details. Addressed to his natural son William. it preaches the gospel of getting ahead in the world by thrift, industry and shrewd use of the lessons of experience. Franklin displayed a keen eye for the main chance. and his book is a classic American example of the rags-to-riches story. To the officers of savings banks and other practical men Franklin has seemed the summation of good sense and morality. To others, those who rate caution below warm human sympathies and reverence for the mysteries of the human spirit, he has often appeared to be only a colourless and materialistic opportunist.

"God helps those who help themselves." one of Poor Richard's maxims, is doubtless typical of one facet of Franklin. Yet he was not an ungenerous, timid or self-centred man. He was often passionate and extravagant; he enjoyed whimsy and hoaxes; he looked at the world with a mixture of hope and cynicism. He loved men and women and thought highly of their potentialities, recognizing at the same time the credulity and inadequacy of mankind in the mass. Much of his political and scientific work was controlled by the world view expressed in a letter of 1780 to Joseph Priestley, the discoverer of oxygen. "The rapid progress true science now makes." Franklin wrote, "occasions my regretting sometimes that I was born too soon. It is impossible to imagine the height to nhich may be carried. in a thousand years. the power of man over matter. We map perhaps learn to deprive large masses of their gravity. and give them absolute levity. for the sake of easy transport. Agriculture may diminish its labour and double its produce; all diseases may by sure means be prevented or cured not excepting even that of old age, and our lives lengthened at pleasure even beyond the antediluvian standard. O that moral science were in as fair a way of improvement, that men would cease to be wolves to one another, and that human beings would at length learn what they now improperly call humanity!"

Birth and Ancestry. — Franklin was born in Milk street, Boston, Mass., on Jan. 17, 1706 (new style; Jan. 6, old style). His father, Josiah, a maker of soap and candles, had emigrated from Banbury Oxfordshire, Eng in 1683, aged 25. taking with him a wife. Anne, and three children. Before Anne died in 1689 she had four more children, tuo of them short lived. Josiah quickly remarried, his second wife being Abiah, daughter of Peter Folger, a Nantucket individualist aho had attacked in verse (*A Looking-Glass for the Times*, 1677) the persecutors of Quakers and Baptists Benjamin was the 8th of Abiah's 10 children, the 15th (and the 10th son) of Josiah's 17.

The *Autobiography* begins nith some genealogy. Franklin had learned from an uncle's notes that his father's family had lived for more than 300 years on a 30-ac. farm with a blacksmith's forge at Ecton in Northamptonshire. This parish lies about 70 mi. N.N.W. of London, in central England. Franklin, visiting Ecton in 1758, found parish records beginning in 1555 and learned that *he was the youngest son of the youngest son for five generations. The Franklins had been Anglicans from the time of Henry VIII, but Josiah became a Congregationalist.*

Early Boyhood *(1706–18)—Josiah's fondness for music, his handiness with tools and his good judgment are noted in the memoirs. Benjamin obviously respected his father, who presumably taught him to read, so early that he could not remember learning. An uncle, also named Benjamin, was a member of the household for some time after 1715; he and Josiah, both middle aged, gave much thought to this tenth son's future. For a time they dreamed of making him a clergyman, a tithe to the church, and he had a year in grammar school before Josiah decided he could not afford the cost of a college and theological education. Then George Brownell, a private teacher of such practical arts as writing. bookkeeping and navigation, took Benjamin on. "Under him I acquired fair Writing pretty soon, but I fail'd in the Arithmetic, & made no Progress in it. At Ten Years old I was taken home to assist my Father in his Business." (Franklin's Memoirs, ed. by Max Farrand, p. 20, University of California Press, Berkeley, 1949.)*

The boy's distaste for cutting wicks led Josiah, one of whose sons had already run off to sea, to walk Benjamin around Boston, observing the craftsmen at work and looking for a congenial trade. One cousin was a cutler, and that occupation was seriously considered. Then, on the ground of his fondness for books, Benjamin was persuaded to sign indentures with his elder brother James, who in 1717 had returned to Boston from London with a printing press.

Apprentice and Author (1718–23). *—Benjamin soon learned his trade; he also found time for self-education. He had already read Bunyan's Pilgrim's Progress (which has been compared with the Autobiography), some other religious and theological works owned by his father, Plutarch's Lives and two books which may have contributed to his penchant for social improvement: Defoe's Essay on Projects and Cotton Mather's Essays To Do Good. Now he took a fancy to poetry, and late in 1718 wrote two occasional ballads. One, "The Lighthouse Tragedy," was a popular success, but Josiah's ridicule discouraged further versifying. Friendships developed with other booklovers: Matthew Adams, a tradesman with a "pretty Collection" to lend (Farrand, p. 32), and John Collins. a youngster his own age with a fondness for argument. About 1719 he read some of the Boyle lectures directed against deism (probably William Derham's Physico-Theology, 1712), liked the refutations less than the views abhorred, and "soon became a thorough Deist" (Farrand, p. 146). Franklin years later regretted that his religious skepticism "perverted" others, among them Collins.*

Two books, however, provided experiences he never regretted. A volume of the Spectator was read repeatedly and the essays rewritten from memory, so that he might improve his style and increase his vocabulary. Thomas Tryon's Way to Health led him to a vegetarian diet—and to a bargain with James to feed himself for half the money paid for his board. Half of that Benjamin saved. and he could both buy books and get more time to read. He taught himself some of the mathematics he had missed and, exploring the art of logic, was "charm'd" by the Socratic method into dropping his habits of contradiction to become the "humble Enquirer & Doubter" (Farrand, p. 40), entangling others by hesitance and insidious question.

In 1721 James Franklin founded the New-England Courant, a newspaper remarkable both for its criticism of civic and religious leaders. then unaccustomed to such treatment. and for its literary content. Original essays were welcomed. among them Benjamin's first published prose, the "Silence Dogood" series of 1722, slipped surreptitiously under the officedoor. They intimated, among other things, that money was more valued in Harvard college than intelligence, that New England funeral elegies were hackneyed and ridiculous, and that the euphemisms of drunkards were weird and wonderful. Obviously imitative of the Spectator, they are still readable; clearly Benjamin Franklin was to be more than an ordinarily literate printer.

When James remarked late in 1722 that Massachusetts officials were slow in doing something about piracy he landed in jail for a month. Benjamin carried on the Courant. A few months later James was forbidden to print or publish the paper and Benjamin, his old indentures discharged, became the nominal publisher. The new indentures which he signed secretly he disregarded after quarrels with his brother. sure that James would not dare to produce them, even though his apprenticeship had nearly two years to run. "It was not fair in me," he was to recall years later, "to take this Advantage, and this I therefore reckon one of the first Errata [mistakes. in printing lingo] of my Life." (Farrand, p. 50.) James blocked employment elsewhere in Boston, so Benjamin persuaded a ship captain to give him passage to New York, hinting he "had got a naughty Girl with Child" (Farrand, p. 52)—a fabrication of no little irony. in the light of later events.

Hard-Earned Lessons (1723–26).—*At 17 Franklin had a trade, but he still had much to learn about men and women. He found no work in New York. but heard there might be some in Philadelphia. It took him a stormy 30 hours to get across Lower New York bay, three days and 50 mi. of walking to cross New Jersey, and he still had a cold, sleepless night lost along the Delaware river before he arrived on the Market street wharf. tired. hungry and all but penniless. A vivid passage in the Autobiography describes his walk that Sunday morning, a large puffy roll of bread under each arm and another being munched on, with Deborah Read, eventually to become his wife, watching with amusement from her doorway. A few weeks later he was solvent, employed in Samuel Keimer's printing shop and rooming at the Reads'. Within months, as the result of a chance remark by a brother-in-law. he was sought out by the provincial governor, Sir William Keith, who urged him to enter business for himself and sent him back to Boston with a flattering letter to his father. Josiah thought his son too young for such a venture and refused immediate support.*

On his second trip to Philadelphia Franklin picked up a companion, his old friend John Collins. Now a drinker and wastrel as well as an unbeliever, Collins borrowed money which Franklin was holding but which was not his own, and after some disagreeable scenes left for Barbados without returning it. Even more disillusioning was Sir William's cruelty. Refusing to accept Josiah's judgment, he offered to provide letters of credit and introduction if Franklin would go to England to purchase the equipment needed. He repeatedly postponed handing over the promised letters, finally saying they would be on the ship. Bidding Deborah farewell, probably with some promises. Franklin sailed, to find on his arrival that he had no letters and Sir William no friends. It was left to a shipboard acquaintance, Thomas Denham, a Quaker merchant, to explain that the governor was unreliable. Employment was no problem—Franklin was soon at work in a large printing house—but James Ralph was. He had left a wife and child to accompany Franklin to London and become a poet. Ralph borrowed about £27 before (he being away) Franklin "attempted Familiarities (another Erratum)" (Farrand, p. 112) with a pleasant milliner who had become Ralph's mistress. Another debt was unpaid and another friendship ended.

Franklin's temperance did not endear him to the beer-drinking workmen at the shop, but he showed some of them that it saved money and he was eventually accepted. Helping to set in type the second edition of William Wollaston's Religion of Nature, he was moved to write a deistical pamphlet. A Dissertation on Liberty and Necessity, Pleasure and Pain (1725). His argument that since man has no real freedom of choice he is not morally responsible for his actions later seemed still another erratum, but it brought him the acquaintance of a Dr. Lyons, who introduced him to Henry Pemberton, early popularizer of Newton's philosophy, and Bernard Mandeville, author of the Fable of the Bees. He also met Sir Hans Sloane, from whose collections grew the British museum, selling him a purse made of asbestos from Pennsylvania.

Franklin's most impressive talent at this time was swimming (he once swam the Thames from Chelsea to Blackfriars, about three miles). and he was considering starting a swimming school when his friend Denham urged him to return to Philadelphia. offering employment in his store. They sailed in July 1726. Franklin was not happy about facing Deborah, to whom he had written only once. On the voyage he kept a journal which shows an awakening interest in science and which originally contained a plan for his future conduct. This plan is not certainly extant. One would expect that it contained some resolutions about lending money to friends, accepting the word of would-be benefactors and making advances to women.

Achievement of Security (1726–48).—Franklin worked for Denham about four months before his employer died unexpectedly. He then returned to Keimer's printing shop, and was soon "quite a Factotum" (Farrand, p. 130), casting type, engraving and making ink, as well as helping train the apprentices. To Hugh Meredith, near the end of his term, he was particularly close, and early in 1728 the two set up in business for themselves. In July 1730 Franklin bought out his partner with borrowed money. At this point his private life was extremely complicated. Deborah Read had understandably not waited for him, but the man she married had deserted her and disappeared. Franklin's demand of a marriage settlement to pay off his business debt ended one matchmaking venture. A strong sexual drive, "that hard-to-be governed Passion of Youth" (Farrand, p. 178), as Franklin described it, was sending him to "low Women," and in the winter of 1730–31 he had a son, William, whose mother has never been identified. Franklin must have known that a baby was on the way when, his affection for Deborah having "revived," he "took her to Wife" (Farrand, p. 180) on Sept. 1, 1730. Their common-law marriage lasted until Dehorah's death in 1774. They had two children, a son who died at four and a daughter, Sarah, later Mrs. Richard Bache, who survived them both. The illegitimate William was brought up in the household.

As his own master and the head of a family, Franklin proceeded to make himself financially secure. He was able to retire from business in 1748, although he seems to have retained some hand in the almanacs published by Franklin and Hall, the firm nhich between 1748 and 1766 gave him an average annual income of almost £500. His retirement was the result of hard work, clever salesmanship and some good fortune. His shop dispensed not only printing, but also books, stationery, soap and occasionally fish. cheese, spices and other commodities; he bought rags for papermakers; he even dealt in slaves and the unexpired contracts of indentured servants.

Government printing was a major source of profit to the trade. Franklin and Meredith's first success was securing the job of printing paper currency for Pennsylvania. Characteristically, Franklin helped get this business by writing in favour of paper money; his *Modest Enquiry Into the Nature and Necessity of a Paper Currency* (1729) was his first venture into economic theory. For years thereafter Franklin was public printer not only of Pennsylvania, but also of New Jersey, Delanare and Maryland Another money-making venture was the *Pennsylvania Gazette,* a newspaper purchased from Keimer in 1729. It soon surpassed its competitors in liveliness and in advertising. Franklin was a skillful editor and publisher. Another success was the series of *Poor Richard* almanacs, published annually between 1732 and 1757 in issues as large as 10,000. The famous maxims, pillaged from the collections of proverbs and epigrams of the old world, but often Americanized by Franklin's hand, helped make Franklin known far beyond his town and province. Failures, of course, were inevitable for a publisher: a German-language newspaper collapsed in 1732 before it had really started, and in 1741 a monthly magazine lasted only six months. Franklin was generally prosperous, however; he made enough to invest capital in real estate and in partnerships or working arrangements with printers in the Carolinas, New York and the British West Indies.

His energy was not exhausted by business. More than ordinarily gregarious, and with a remarkable social conscience, he mas involved in numerous projects for social improvement by collective efforts The first of these was the Junto, or Leather Apron club, organized in 1727 to debate questions of morals, politics and natural philosophy, and to exchange knowledge of business affairs nhich might be valuable to the more enterprising members. More than one historian has noted the similarity of the Junto to the so-called "service" clubs of the 20th century, of which Rotary International is the prototype. Franklin worked through the Junto in many ways. The need of its members for easier access to books led in 1731 to the organization of the Library Company of Philadelphia, earliest of the many American subscription libraries. By his own account Franklin spent an hour or two there each day, mastering foreign languages and filling in the gaps in his general education. Through the Junto he proposed a paid city watch or police force, a suggestion eventually but not immediately followed; a paper read to the same group resulted in the organization of a volunteer fire company. In 1743 he called for a "constant correspondence" of virtuosos (men of scientific interests) throughout the colonies, and in the following year the American Philosophical society was modestly functioning. It is often described as an outgrowth of the Junto.

Franklin became, in short, a successful promoter. He noted that Pennsylvania had neither a college nor a militia. An academy was in his mind as early as 1743, but not until 1749 did he find the time ripe for his *Proposals Relating to the Education of Youth in Pennsylvania,* instrumental in founding the Academy of Philadelphia in 1751 and the best-known early American argument for advanced training in the useful arts and sciences. Although his ideas were not wholly followed, the institution which grew out of the academy — the University of Pennsylvania — made notable contributions to professional education. Another pamphlet, *Plain Truth; or, Serious Considerations on the Present State of the City of Phzladelphia and Province of Pennsylvania* (1747), written after French and Spanish privateers had invaded the Delaware river, helped enroll a volunteer militia of 10,000 men, despite the Quaker coolness toward armed defense. Eventually he became almost indispensable to those who had good works in mind. helping to raise money for church buildings and, in 1751, for Thomas Bond's project, the Pennsylvania hospital, a pioneer institution important to medical education in America.

Franklin's belief in association for useful ends made natural his joining St. John's lodge in 1731. It claims to be the first Masonic lodge in America. Franklin's loyalty to Freemasonry helped him years later with some of the anticlerical intellectuals in the court of Louis XVI. In 1782 he uas elected venerable master of La Loge des Neuf Soeurs, which has been called with some justice the UNESCO of the 18th century.

Before his retirement. moreover. Franklin also began his work as a servant of the public. Appointed clerk of the Pennsylvania assembly (legislature) in 1736, he retained that post until 1751, when he was elected a member. In 1737 he was appointed postmaster of Philadelphia. an unusually valuable office for a newspaper publisher; he held it until he became one of the two deputy postmasters general for the colonies in 1753.

Electrical Science (1748–52).—Franklin's curiosity about natural phenomena can be traced to his boyhood, but not until 1740 did it become more than desultory. In that year he invented the Pennsylvania fireplace, better known as the Franklin stove, a new kind of heating unit. This invention characteristically combined theoretical knowledge and practical advantages. He wrote a pamphlet about this stove in 1744, for his friend Robert Grace, who was manufacturing it, but refused to take out a patent because "as we enjoy great Advantages from the Inventions of others. we should be glad of an Opportunity to serve others by any Invention of ours" (Farrand, p. 794). By this time he was reading all the scientific literature he could find and had some contact with lecturers on natural philosophy *(cf.* I. Bernard Cohen's edition of *Benjamin Franklin's Experiments,* 1941, and the same scholar's *Franklin and Newton,* 1956). He certainly read with care the articles on electricity, at that moment the most novel subject in European science, by William Watson, published in the *Philosophical Tvansactions* of the Royal Society of London in 1745. Franklin and three friends — Thomas Hopkinson, Philip Syng and Ebenezer Kinnersley — acquired simple apparatus and, in the winter of 1746–47, began an exploration of electrical phenomena. The Philadelphia climate and apparatus makers, combined with Franklin's ingenuity, produced remarkable discoveries. reported by Franklin in a series of letters to a London friend, Peter Collinson. Many of the letters were read before the Royal society and some were printed in the *Gentleman's Magazine.* In April 1751 a collection was printed as *Experiments and Observations on Electricity.* This book, of 80-odd pages, made Franklin famous, first in France, where a translation appeared in 1752, and later throughout Europe. The experiment which Franklin suggested to prove the identity of lightning and electricity was first carried out in France. before Franklin is supposed to have tried the simpler expedient of flying a kite in a thunderstorm. His book stands first among the scientific contributions of 18th-century Americans. It appeared in four later English editions before 1769, usually with additional letters and papers by Franklin and others; there were two additional French editions; and it was also translated into German (1758) and Italian (1774).

Franklin's study of electricity has two noteworthy aspects. First, his "one fluid" theory or hypothesis accounted for more of the observable phenomena than did any previous hypothesis. Second, his suggestion that buildings might be protected from lightning by erecting pointed iron rods seemed both practical and highly dramatic. On the whole his originality was not as great as many of his admirers have thought (Cohen has shown that it decreased as he came into closer touch with his fellow experimenters in Europe). but he invented many of the terms which are still used in discussing electricity (positive, negative, battery, conductor, etc.) and he described his experiments with a clarity that commands respect from all orderly minds.

By 1752 he had made his most important contributions to science, including, outside of electricity, his observation (1743) that storms which apparently came from the northeast actually moved from the southwest. For the rest of his life he occasionally conducted experiments or theorized with his innumerable correspondents. Heat, light, sound and magnetism interested him, as did hydrodynamics. hydrostatics, chemistry, geology, physiology, psychology and oceanography.

Science gave him handsome rewards. In 1753 he received the Copley medal from the Royal society and honorary M.A. degrees from Harvard and Yale. William and Mary gave him an M.A. degree in 1756, Edinburgh an LL.D. in 1759 and Oxford the degree of doctor of civil law in 1762. He was an active, corresponding or honorary member of scientific societies in London, Edinburgh, Paris, Orléans, Rotterdam, Gottingen. Padua, Milan and St. Petersburg.

He has some interest as a social scientist as well (*cf.* L. J. Carey, *Franklin's Economic Views,* 1928). "Observations Concerning the Increase of Mankind, Peopling of Countries, etc." (1755, but written in 1751) speculated on the relation between population and the means of subsistence and states a belief in free trade. Later papers. notably "Positions to Be Examined, Concerning National Wealth" (1769), show a distrust of commerce and manufactures which he may have acquired from his friends among the French economists.

Public Servant (1753–85).—Politics encroached more upon his retirement than did science. From 1753, when he took charge of the mails in all the northern colonies, he tended to think in terms of the bonds of common interest which tied the separate commonwealths together. although it mas to be long before the average man in America thought of himself as an American first and a Virginian or Pennsylvanian second. For 20 years Franklin was America's chief spokesman, so far as there was an America to speak for. His base of operations for 16 years mas London, where he was thoroughly at home and might easily have settled except for his sense of responsibility. He became an American and a revolutionary almost in spite of himself, working until the last possible moment to reconcile conflicting interests, to interpret America to Englishmen and British politics to Americans. At one time or another he was *persona non grata* to extremists on both sides of the debate. Like most politicians he made mistakes and suffered for them, but he also had some triumphs.

The first of the latter was the adoption of his "Plan of Union" by the Albany congress. assembled in 1754 to make common cause against the French and Indians. It proposed a general council, with representatives from the several colonies, having the power to tax, organize the common defense and supervise Indian relations and new settlements. A president, appointed by the king. was to have the veto power, as was the king himself if he exercised it within three years, Neither the colonial legislatures nor the king's advisers found this scheme acceptable, each fearing some loss of power. The rejection of his scheme was his first lesson in a conflict between reason and justice on the one hand and the factor of power on the other, an antagonism which was probably the central feature of his political career (*cf.* Gerald Stourzh, *Benjamin Franklin and American Foreign Policy,* 1954). Noteworthy, too, was his assertion of the time-honoured principle that taxation should be the prerogative of representatives of the people—soon to become one of the major issues in the American Revolution.

The realities of political action nearly ruined Franklin in 1755, when he promised Pennsylvania farmers to stand good for any losses they might sustain if they used their horses and wagons to supply Gen. Edward Braddock's army in its expedition against Ft. Duquesne. For more than two months it appeared that he might have to pay almost £20,000 out of his own pocket. The government eventually paid, but Franklin was thereafter more cautious about his commitments.

The need of money for defense led the Pennsylvania legislature to seek to tax the lands of the Penn family, proprietors under the charter of the colony. Either their consent or a change in the form of government was required. Chosen to represent the assembly on this matter, Franklin was in London most of the time between July 1757 and Aug. 1762. With the help of a legal adviser, the "all-knowing" Richard Jackson, he eventually effected a compromise, by which the proprietors' improved lands could be taxed, but not those unsurveyed. This was not enough for Franklin, who detested Thomas Penn and wanted to oust the proprietary government altogether. His first mission was nevertheless remarkable for his continued use of his talent as an author to further his cause. and for his establishment of many close friendships. His most significant writing in London was *The Interest of Great Britain Considered With Regard to Her Colonies, and the Acquisitions of Canada and Guadaloupe* (1760), believed to have influenced the makers of the treaty of Paris (1763), which gave Canada to Great Britain as Franklin had hoped.

By then he was back in Philadelphia. where the conflict between legislature and proprietors continued. A petition to make Pennsylvania a crown colony was agreed on and by Dec. 1764 Franklin was again in London, just in time to testify that the proposed Stamp act was the wrong way to raise additional tax money in America. Nonetheless the act was passed. Franklin so greatly underestimated the probable opposition that he nearly ended his political usefulness. Determined to make the best of a bad situation, he meekly ordered stamps for the use of Franklin and Hall and nominated a friend for the post of stamp officer in Philadelphia. The feeling against him was so strong that his wife Deborah brought guns and male relatives into the house to defend it. Shocked by the violence reported from America. Franklin devoted himself to the campaign for repeal and regained his prestige by answering 174 questions before the house of commons in mid-Feb. 1766. The examination. during nhich he clearly and briefly answered both friends and enemies. gave Britons some understanding of how Americans ielt. Immediately published from a stenographic transcript his remarks made him the hero of the repeal. His real mission, the negotiation of a new charter. was unsuccessful, but the failure was forgotten in the excitement.

Pennsylvania kept him on as agent, and he was employed by three other colonies—Georgia (1768). New Jersey (1769) and Massachusetts (1770). With this support and that of the British Whigs, he rode through the succession of crises ending with the armed clashes at Lexington and Concord. Gradually he was forced to realize that there could be no reconciliation and that his dream of a British empire of self-governing nations would not come true. He did his best to present the American view to his friends and, through newspaper articles (126 between 1765 and 1775), to the British public. At the end he was bitter, in "Rules by Which a Great Empire May be Reduced to a Small One" and "An Edict by the King of Prussia," both first printed in the *Public Advertiser* in 1773. Taken together they are a capsule history of the long-drawn-out contest. In Jan. 1774, because of his writing and his share in the publication of the letters of Thomas Hutchinson, governor of Massachusetts, to his British superiors, Franklin was dismissed from the post office. In March 1775, aware that there might be war, he left England, three days before his friend Edmund Burke delivered his eloquent but futile speech to the commons on conciliation with America. A day after his arrival in Philadelphia he was a delegate to the second Continental Congress. There he served on committees for the organization of a postal system and for the drafting of the Declaration of Independence, and on a commission which vainly attempted to bring Canada into the war as an ally. He also found time to be presiding officer of the constitutional convention of Pennsylvania.

In Sept. 1776 Congress agreed to send a commission to France, hoping to secure economic and military assistance. Its members were Silas Deane, already in Paris, Arthur Lee (as a substitute for Thomas Jefferson, kept home by his wife's illness) and Franklin. He arrived in Paris just before Christmas; before the end of the year he and his colleagues were engaged in secret negotiations with the comte de Vergennes, minister of foreign affairs and. fortunately for the Americans, an enemy of Britain. These negotiations were enormously complicated by cloak-and-dagger intrigue, with spies and informers everyahere. As a diplomat, Franklin had the great advantages of French friends and disciples, a skin ailment which made it reasonable for him to wear a fur hat, and no shyness about his need for spectacles through ahich to see the world. Before long he mas the hero of France, the personification of the unsophisticated nobility of the new world, leading his people to freedom from the feudal past. His portrait was everywhere, on *objets d'art* from snuffboxes to chamber pots, his society sought after by diplomats, scientists, Freemasons, fashionable ladies. There was indeed a Franklin cult, not without its ridiculous side. Franklin rose to the occasion magnificently, however, displaying such wit and social grace as to endear him to the French for generations.

The sought-for treaties mere signed in Feb. 1778, after General Burgoyne and 6,000 men had surrendered at Saratoga and it was clear that Britain was not going to crush the rebellion easily. Very considerable loans were obtained for the United States, and without French military and naval aid the final victory at Yorktown in 1781 might not have been achieved. The marquis de Lafayette. the comte de Rochambeau and Admiral de Grasse are the best known of an estimated 12.000 soldiers and 32.000 sailors. including officers, who left France to support Washington in America. Despite the strong bonds thus established (and recalled by General Pershing's "Lafayette. we are here" in 1917), the peace was difficult. Spain had entered the war in 1779, hoping to recover Gibraltar but, aware of the conflict of interests in Florida and Louisiana, refused to recognize American independence. France had guaranteed that there would be no separate peace. Franklin worked with Vergennes until his fellow commissioners. John Adams and John Jay. overruled him on procedure, signing preliminary agreements with Britain late in 1781 without prior consultation with France. The formal treaty was signed Sept. 3, 1783.

Before the end of the year Franklin asked congress to be replaced. but he was retained for two more years to help make trade treaties. His popularity unabated, he occupied himself by observing the first balloon ascension and serving on a committee appointed by Louis XVI to report on the claims of a new marvel, "animal magnetism." which Franz Anton Mesmer thought would cure many if not all diseases.

The **Last Years (1785–90)**.—Franklin was 79 when he began his last journey home. He had a large stone in his bladder, which made carriage travel an agony. and other ailments of old age. Carried to Le Havre in one of Marie Antoinette's litters, he was comfortable enough on the voyage to write two scientific papers. "Maritime Observations" and "The Causes and Cure of Smoky Chimneys." In Philadelphia he was elected to the executive council of the state and a few days later chosen president, serving for three years. He lived as quietly as possible. interested himself in improving his property, but was still active in the American Philosophical society and in the new Society for Political Enquiries (1787). of which he was first president. A member of the Constitutional Convention of 1787. he was not able to convince his associates that the American government should have an executive committee at its head rather than a president. nor that there should be a single-chamber legislature. He spoke when the time came for compromise between the large states and the small ones. and his speech on the last day. read for him by James Wilson, was a plea that the objections, his own among them, be forgotten, and that the delegates unanimously support the instrument they had framed. This government, Franklin wrote, "is likely to be well administered for a course of years, and can only end in despotism, as other forms have done before, when the people shall become so corrupted as to need despotic government, being incapable of any other." His motion for adoption by unanimous consent was promptly carried. In the fight for ratification he took no active part. Except for supporting an effort to have the first congress of the United States consider the abolition of Negro slavery, he took no further part in public life.

For the last year he was bedridden, escaping severe pain only by the use of opium. He died on April 17, 1790, aged 84. Philadelphia gave him the most impressive funeral that city had ever seen. and in France. uhere Louis XVI was imprisoned in the Tuileries eulogy after eulogy poured forth to the man who to the French was the symbol of enlightenment and freedom.

Private Life.—Franklin, for all his fame, had many personal misfortunes. His son William, who became royal governor of New Jersey in 1763, chose to take his stand with the loyalists in the Revolution; he and his father were never fully reconciled thereafter. William Temple Franklin, William's natural son. was his grandfather's secretary in France and. after long delay. the first editor of the memoirs; he shoved no special talent for either task. Deborah Franklin, although a good manager of her husband's affairs and devoted to her family, nas far from his equal in intelligence or adaptability to social situations. Jane Mecom, the sister nith whom he was most in touch. norried him with a succession of family troubles grave enough to embitter any ordinary man. Franklin did a great deal for his relatives—and was criticized for it—but he had far from an ideal family life.

His most satisfying emotional connections may have come from outside his immediate family, with girls and women younger than he. The first such friendship (at first, perhaps, a flirtation) was nith Catharine Ray (later Mrs. William Greene), whom he met in 1754, when she was 23 and he 48. They corresponded for 35 years and met seven times. In 1757, rooming in Craven street, London, Franklin formed a similar attachment to Mary (Polly) Stevenson (later Mrs. William Hewson). They were close for more than 30 years, exchanging many letters, and during the last four years of Franklin's life. Mrs. Hewson was in Philadelphia, where she read to him on his deathbed. In Paris, after Deborah's death in 1774, Franklin was more or less seriously in love with Mme. Brillon de Jouy. the youthful wife of a public official. and with Mme. Helvétius, a widow to whom he proposed marriage. Much of his most polished nriting is to be found in the letters written to these women or in pieces written for their entertainment or instruction.

Modernity.—The most remarkable aspect of Franklin is perhaps the variety of ways in which he has remained interesting to his successors. In 1956. for example, the Franklin Institute of Philadelphia, with the co-operation of about 500 other societies and institutions. organized an international celebration of the 250th anniversary of Franklin's birth. Ten areas wherein Franklin's work or thought was believed relevant to the 20th century were defined. (1) education and the natural sciences; (2) international relations and the public service; (3) publishing, broadcasting and communications; (4) science and engineering; (5) medicine and the public health; (6) printing, advertising and the graphic arts; (7) finance. insurance, private enterprise; (8) religion, fraternal organizations and the humanities; (9) agriculture, horticulture and botany; and (10) music, entertainment and special events. The connections in some instances, such as the last two, are rather tenuous, but few other men of the 18th or any other century can even tenuously be related to so many fields. Of ail the founding fathers of the United States, Franklin, were there such a thing as reincarnation, would adapt himself most readily to the complexities of the latter half of the 20th century. His modernity is nothing less than astonishing.

BIBLIOGRAPHY.—A. H. Smyth's edition of Franklin's writings, 10 vol. (1907–10), has long been the best available. In 1954 the American Philosophical Society and Yale University announced their joint sponsorship of an edition of Franklin's papers, to include between 25,000 and 30,000 documents.

The fullest biography is Carl Van Doren, *Benjamin Franklin* (1938), the best brief one Verner W. Crane. *Benjamin Franklin and a Rising People* (1954). Both have useful bibliographies. Generally admired, also, is Carl Becker's article in the *Dictionary of American Biography* (1931), separately reprinted in 1946. The *Autobiography,* to be used, as has been suggested, with caution, presents an exceedingly complicated textual problem; see *Benjamin Franklin's Memoirs,* Parallel Text Edition, ed. by Max Farrand (1949), for its explanation.

A number of the numerous special studies have been cited in the present article. For a survey of Franklin scholarship, *see* Richard D. Miles, "The American Image of Benjamin Franklin," *American Quarterly* (summer 1957). (*T.* HR.)

FRANKLIN, EDWARD CURTIS (1862–1937), pioneer with H. P. Cady and C. A. Kraus in the field of chemistry of liquid ammonia solutions, was born on March 1, 1862, at Geary City, Kan. He was educated at the University of Kansas, Lawrence (B.S., 1888; M.S., 1890), and Johns Hopkins university, Baltimore, Md. (Ph.D., 1894). He was assistant in chemistry at the University of Kansas, 1888–93; associate professor, 1893–98; and professor. 1898–1903. In 1903 he became associate professor of organic chemistry at Stanford university, Calif., and in 1906 tvas made professor. He retired as emeritus professor in 1929. He served on the U.S. assay commission in 1906, in 1911–13 was professor of chemistry and chief of the division of chemistry at the Hygienic laboratory of the U.S. public health and marine hospital service. In 1918 he was a physical chemist at the bureau of standards. His honours included membership in the National Academy of Sciences and election to the presidency of the American Chemical society (1923). The chief significance of his work was in extending the horizons of inorganic chemistry as a result of his researches on the ammonia system of compounds and the use of liquid ammonia as an electrolytic solvent. He was the author of the classic monograph "The Nitrogen System of Compounds." (JB. KG.)

FRANKLIN, SIR JOHN (1786–1847), English rear admiral and explorer who discovered the northwest passage, mas born at Spilsby, Lincolnshire, on April 16, 1786. He served at the battles of Copenhagen and Trafalgar. In 1818 he commanded the "Trent" in Capt. D. Buchan's arctic expedition. From 1819 to 1822 he led the arctic overland expedition from Hudson bay to the Arctic ocean and surveyed part of the coast to the east of the Coppermine river. From 1825 to 1827 he commanded a second overland expedition and traced the North American coast from the Mackenzie to 149° 37' W. long., while John Richardson's party explored the coast between the mouths of the Mackenzie and Coppermine. The two expeditions together had added 1,200 mi. of coast line to the knowledge of the American continent. He published two books giving an account of these journeys: *Narrative of a Journey to the Shores of the Polar Sea* (1823) and *Narrative of a Second Expedition to the Shores of the Polar Sea* (1828). In 1828 Franklin married Jane Griffin, his second wife. The following year he was knighted. From 1836 to 1843 he was governor of Van Diemen's land (Tasmania).

On his return to England, Franklin took command of an expedition for the discovery of the northwest passage. The "Erebus" and "Terror," with 129 officers and men, sailed on May 19, 1845. They were last seen at the entrance to Lancaster sound on July 25. It was 14 years before the mystery of their subsequent movements was solved. From 1848 onward a series of expeditions organized by the government or by private individuals searched for them and in 1859 Capt. Leopold McClintock, sent by Lady Franklin, finally disclosed the fate of the expedition. Besides skeletons and various articles in King William Island, and reports from an Eskimo in Boothia, a record was found telling the history of the expedition up to April 25, 1848. In 1845–46 they had wintered at Beechey Island, having ascended the Wellington channel to latitude 77°, and returned by the west side of Cornwallis Island. They had navigated Peel and Franklin straits but had been stopped by ice coming down McClintock channel (then unknown). An addendum dated April 25, 1848, signed by J. Fitzjames and F. R. M. Crozier, said that the ships were deserted on April 22, 1848, having been beset since Sept. 1546. Franklin died on June 11, 1847, and by then 24 officers and men had perished. The record stated that they would start the next day for Back river. Strength must have failed; an Eskimo woman said that they fell down and died as they walked. Franklin's expedition is credited with having discovered the northwest passage, as the point the ships reached was within a few miles of the known waters of America.

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FRANKLIN, WILLIAM BUEL (1823–1903), prominent Union general in the American Civil War, was born at York, Pa., on Feb. 27, 1823. He graduated with distinction from the G.S. Military academy, West Point, N.Y.; served in the Mexican War; and engaged thereafter in engineering work. After outbreak of the Civil War he was assigned to the army of the Potomac and served as brigadier-general in the campaign against Richmond in 1862. During the battle of Frayser's Farm he performed well in covering the retreat of Gen. George B. McClellan (*q.v.*). As major-general at Antietam (*q.v.*) his apparently sound advice that his fresh troops renew the battle was not heeded. Though Franklin was criticized by Gen. A. E. Burnside (*q.v.*) for inefficiency at Fredericksburg (*q.v.*) and was blamed by the congressional committee on the conduct of the mar for the loss of the battle. it should be pointed out that Burnside's orders to his subordinate were somewhat confusing. Franklin resigned from the army in 1866 and served as vice-president and general manager of the Colt's Patent Fire Arms Manufacturing company in Hartford, Conn., until 1888. He died at Hartford on March 8, 1903.

See James *H.* England, "William Buel Franklin," *Professional Memoirs, Corps of Engineers, United States Army and Engineer Department at Large,* vol. x, pp. 485–489 (1918); Kenneth P. Williams, *Lincoln Finds a General: a Military Study of the Civil War,* vol. 1 and 2 (1957). (H. H. SI.)

FRANKLIN, one of the three divisions of the Northwest Territories, Canada, extending from the Arctic circle to the north pole and including Baffin land south of the Arctic circle. It was formed into an organized district by order in council in Oct. 1895 and its boundaries were finally adjusted by an order in council March 16, 1918, in force Jan. 1, 1920, and includes islands and peninsulas, such as Banks, Prince Albert, Victoria. Wollaston, King Edward and Baffin land, Melville, Bathurst, Prince of Wales and Cockburn islands. Of these, Baffin Iand alone extends south of the Arctic circle. Area, 549,253 sq.mi. Pop. (1956) 4,408. Except for the mounted police and officials, there are a few Indians, Eskimos and fur traders. There are musk oxen, polar bears, foxes and other fur-bearing animals. District named after Sir John Franklin.

FRANKLIN, a city of Pennsylvania, U.S., the seat of Venango county, is located 65 mi. N. of Pittsburgh at the junction of French creek and the Allegheny river. Because of its strategic location, Franklin was an important pawn in the English-French struggle for North America after 1750. In 1752 a French expedition under Chevalier Pierre Paul Marin established Ft. Machault at that point. In December of the next year George Washington stopped at the new fort while delivering Governor Dinwiddie's "get out" message to the French commander. The French destroyed the fort during their retreat of 1758 but the British raised a new fortification (Ft. Venango) at the site. This in turn was destroyed by Indians during the uprising of 1763. The town, which derives its present name from Ft. Franklin, erected by the Americans in 1787 and named in honour of Benjamin Franklin, was platted in 1795, incorporated as a borough in 1823 and incorporated as a city in 1866.

Franklin's later history is closely associated with the rise of the American oil industry. The first successful oil well in America (Colonel Drake's well) was drilled in 1859 by William A. Smith of Franklin on an island in Oil creek, near Titusville. Within two years the Franklin-Titusville-Oil creek area was transformed into the "Oil Regions" with an annual production in excess of 2,000,000 bbl. About 2,000 craft of all descriptions transported this harvest downstream. Franklin became a financial, transportation and refining hub of the new industry until development of the Texas-Oklahoma oil fields after 1900 shifted the oil production centre to the southwestern United States. John Wilkes Booth was the owner of one of the early Franklin wells; he left the town in early April 1865, to assassinate Pres. Abraham Lincoln. The frantic atmosphere of this boom period that spawned such diverse characters as "Coal Oil Johnny" and John D. Rockefeller has been captured by Hildegarde Dolson, a native of Franklin, in her colourful history, *The Great Oildorado* (1959).

Franklin continues to bear the imprint of the prosperous oil years; expansive lawns provide a setting for many well-kept, ostentatious houses of the Victorian era. Its population in the 20th century remained fairly stable; for comparative population figures *see* table in PENNSYLVANIA: *Population.* (R. L. LE.)

FRANKLIN INSTITUTE: *see* MUSEUMS AND GALLERIES: *Industry Museums.*

FRANKLINITE, a member of the spinel (*q.v.*) group of minerals, consisting of oxides of ferric and ferrous iron, manganese and zinc in varying proportions. It is found in considerable amount, associated with zinc and manganese minerals (zincite and willemite) in crystalline limestone, at Franklin, N.J., where it is mined as an ore of zinc (containing 5% to 20% of the metal); after the extraction of the zinc, the residue is used in the manufacture of an alloy of iron and manganese (spiegeleisen) used in making steel. Franklinite occurs as octahedral crystals. often with rounded edges, and as granular masses. The colour is iron-black and the lustre metallic; hardness 6, specific gravity 5.2. The formula is $(Fe,Zn,Mn)(Fe,Mn)_2O_4$. It resembles magnetite, but is readily distinguished by the fact that it is only slightly magnetic. *See* also ZINC.

FRANKPLEDGE. The frankpledge system provided that all men not in the household of some great man, who would be responsible for their good behaviour and appearance in court in case of necessity, should be in frankpledge or tithing. The frankpledge was an association of men, generally twelve in number, the members of which were mutually responsible for the production of any one of them in court. If a man fled rather than pay for his crime the frankpledge of which he was a member had to pay, This idea of keeping the peace by a system of mutual responsibility goes back to very remote times. In the 12th century the greater efficiency of the central administration enabled the system to be regularly enforced. Originally the frankpledge was confined to free men, the unfree were left to their lord. By the time records began to be kept the system embraced all but persons of established position. The word frankpledge was not used uniformly all over England to describe these associations. In some parts they were known as tithings or *decennœ*. The custom ruling the arrangements of the frankpledges and tithings, too, varied considerably. Sometimes the frankpledge was known by the name of the chief member, the chief pledge or the tithing man. Sometimes it was known by the name of the village or hamlet. It is possible that the density of population had much to do with deciding the local practice. The View of Frankpledge was a bi-annual enquiry as to the proper observance of the law with regard to frankpledges; an enquiry whether everyone was in frankpledge, whether the frankpledges were of an adequate size, and were performing their duty. Originally the sheriff held the view of frankpledge in the shire court twice a year. It is clear that he made the view an occasion for extortion and in the 1217 issue of Magna Carta the holding of this court is regulated. In the 13th century this franchise, the view of frankpledge, was often in private hands. This did not prevent the law with regard to frankpledges being enforced, since the franchise was a valuable one and it paid the lords of the courts to conduct the enquiry.

See W. A. Morris, *The Frankpledge System* (1910). (D. M. S.)

FRANKS, SIR AUGUSTUS WOLLASTON (1826–1897), English antiquary, was born on March 20, 1826, and was educated at Eton and at Trinity college, Cambridge. In 1851 he was appointed assistant in the antiquities department of the British Museum. Here, and as director of the Society of Antiquaries, an appointment he received in 1858, he made himself the first authority in England upon mediaeval antiquities of all descriptions, upon porcelain, glass, the manufactures of savage nations, and in general upon all Oriental curiosities and works of art later than the Classical period. In 1866 the British and mediaeval antiquities, with the ethnographical collections, were formed into a distinct department under his superintendence; and the Christy collection of ethnography in Victoria street, London, afterwards transferred to the British Museum was also under his care. He retired in 1896, and died on May 21, 1897. His fortune was largely devoted to the collection of ceramics and precious objects of mediaeval art, most of which became the property of the nation, either by donation in his lifetime or by bequest at his death. The most famous of the objects bequeathed by him to the British Museum is the carved bone casket, Northumbrian work of the 8th century, known as the "Franks Casket."

FRANKS. The earliest mention in history of the name Franks is an entry on the *Tabula Peutingeriana,* "Chamavi qui et Pranci." The earliest occurrence of the name in any author is in the *Vita Aureliani* of Vopiscus, referring to the year 241.

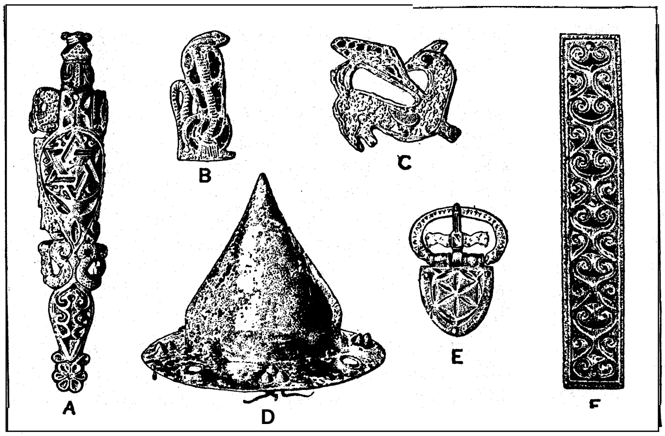
All the Germanic tribes, which were known from this time onwards by the generic name of Franks, doubtless spoke a similar dialect and were governed by customs which must scarcely have differed from one tribe to another—all they had in common. Each tribe was politically independent; they formed no confederations. Sometimes two or three tribes joined forces to wage a war; but, the struggle over, the bond was broken, and each tribe resumed its isolated life.

Of these tribes the Salians were to become most prominent. They are mentioned for the first time in 358, by Ammianus Marcellinus (xvii, 8, 3). At this time they occupied the region south of the Meuse, between that river and the Scheldt. The Caesar Julian defeated them completely, but allowed them to remain as *foederati* of the Romans. They perhaps paid tribute, and they certainly furnished Rome with soldiers; *Salii seniores* and *Salii juniores* are mentioned in the *Notitia dignitatum,* and Salii appear among the *auxilia palatina.*

At the beginning of the 5th century, when the Roman legions withdrew from the banks of the Rhine. the Salians installed themselves in the district as an independent people. The place-names became entirely Germanic; the Latin language disappeared; and the Christian religion suffered a check, for the Franks were to a man pagans. The Salians were subdivided into a certain number of tribes, each tribe placing at its head a king, distinguished by his long hair and chosen from the most noble family *(Historia Francorum,* ii. 9).

The most ancient of these kings, reigning over the principal tribe. who is known to us is Chlodio. Towards 431 he crossed the great Roman road from Bavay to Cologne, which was protected by numerous forts and had long arrested the invasions of the barbarians. He then invaded the territory of Arras, but was severely defeated at Hesdin-le-Vieux by Aetius, the commander of the Roman army in Gaul. Chlodio, however, soon took his revenge. He explored the region of Cambrai, seized that town and occupied all the country as far as the Somme. At this time Tournai became the capital of the Salian Franks.

After Chlodio a certain Meroveus was king of the Salian Franks. Perhaps the remarks of the Byzantine historian Priscus may refer to Meroveus. A king of the Franks having died, his two sons disputed the power. The elder journeyed into Pannonia to obtain support from Attila; the younger betook himself to the imperial court at Rome. "I have seen him," writes Priscus; "he was still very young, and we all remarked his fair hair which fell upon his shoulders." Aetius welcomed him warmly and sent him back a friend and *foederatus.* In any case, Franks fought (451) in the Roman ranks at the great battle of the Catalaunian fields,



FROM SEYMOUR DE RICCI, "THE J. P. MORGAN MEROVINGIAN COLLECTION"

FRANKISH METALWORK OF THE 4TH TO THE 8TH CENTURIES A.D.

A. Gilt silver plaque from spear with Seal of Solomon in centre; B. One of a pair of flat bronze sacred serpents (uraei) covered with red cloisonne paste; C. One of a pair of bird or dragon-shaped fibulae of bronze coated with gold; D. Iron umbo of a shield covered with gilt silver; E. Gilt silver belt buckle inlaid with niello; F. Gilt silver plaque from spear

which arrested the progress of Attila, and there is some evidence that Meroveus was among the combatants. Towards 457 Meroveus was succeeded by his son Childeric. At first Childeric was a faithful *foederatus* of the Romans, fighting for them against the Visigoths and the Saxons south of the Loire; but he soon sought to make himself independent and to extend his conquests. He died in 481 and was succeeded by his son Clovis, who conquered the whole of Gaul with the exception of the kingdom of Burgundy and Provence Clovis imposed his authority on the other Salian tribes, and put an end to the domination of the Ripuarian Franks.

These Ripuarians had settled in the 5th century on the left bank of the Rhine, but their progress was slow It was not until the middle of the century that they occupied Cologne, which was not permanently in their possession until 463. The Ripuarians subsequently occupied all the country from Cologne to Trier. Aix-la-Chapelle, Bonn and Zulpich were their principal centres, and they even advanced southward as far as Metz, which appears to hare resisted their attacks. The Roman civilization and the Latin language disappeared from the countries which they occupied; indeed it seems that the actual boundaries of the German and French languages nearly coincide with those of their dominion In their southward progress the Ripuarians encountered the Alamanni, who, already masters of Alsace, were endeavouring to extend their conquests in all directions The Ripuarians long remained allies of Clovis, the son of their king fighting under him at Vouillé in 507. Ultimately, however, Clovis destroyed the Ripuarian dynasty and was himself chosen as king of this people. Thus the Salian Franks united under their rule all the Franks on the left bank of the Rhine. During the reigns of Clovis' sons they again turned their eyes on Germany, and imposed their suzerainty upon the Franks on the right bank. This country, north of the Main and the first residence of the Franks, then received the name of *Francia Orientalis,* and became the origin of one of the duchies into which Germany was divided in the 10th century—the duchy of Franconia (Franken).

The Franks were redoubtable warriors, and were generally of great stature. Their fair or red hair was brought forward from the crown of the head towards the forehead, leaving the nape of the neck uncovered; they shaved the face except the upper lip. They wore fairly close breeches reaching to the knee and a tunic fastened by brooches Round the waist over the tunic was worn a leathern girdle having a broad iron buckle damascened with silver. From the girdle hung the single-edged missile axe or *francisca,* the *scramasax* or short knife, a poniard and such articles of toilet as scissors, a comb (of wood or bone), etc The Franks also used a weapon called the *framea* (an iron lance set firmly in a wooden shaft), and bows and arrows They protected themselves in battle with a large wooden or wicker shield, the centre of which was ornamented with an iron boss (*umbo*) Frankish arms and armour have been found in the cemeteries which abound throughout northern France, the warriors being buried fully armed.

See E. von Wietersheim, *Geschichte der Volkerwanderung,* 2nd ed., edit. by F. Dahn (Leipzig, 1880–81); R. Schroder, "Die Ausbreitung der salischen Franken," in *Forschungen zur deutschen Geschichte,* vol. xix.; K. Lamprecht, *Frankische Wanderungen und Ansiedelungen* (Aix-la-Chapelle, 1882); K. Miillenhoff, *Deutsche Altertumskunde* (1883–1900); Fustel de Coulanges, *Histoire des institutions politiques de l'ancienne France—l'invasion germanique* (1891); *W.* Schultz, *Deutsche Geschichte von der Urzeit bis zu den Karolingern,* vol. ii. (Stuttgart, 1896). Also the articles SALIC LAW and GERMANIC LAWS, EARLY. (C. PF.)

FRANZ, ROBERT (1815–1892), German composer of songs in the tradition of Schubert and Schumann. The son of Cristoph Franz Knauth (known as Cristoph Franz), he was born at Halle, June 28, 1815. He studied the organ under J. C. F. Schneider at Dessau (1835–37), and on return to Halle became a friend of Wilhelm Osterwald, manv of whose poems he later set to music. In 1841 he was appointed organist at the Ulrichskirsche at Halle and in 1842 became director of the Singakademie. In 1843 he published his "Twelve Songs." Opus 1, the intimate character of which was admired by Schumann and also by Liszt who later transcribed a series of Franz's songs for the piano. In the same vear his hearing became affected and he mas later afflicted with nervous disorders. Obliged to relinquish his post at the Singakademie in 1868, he was supported for the rest of his life by the singer, Arnold von Pilsach. Franz devoted his later years to arranging works by Bach, Handel, Mozart and Schubert. He died at Halle, Oct. 24, 1892.

Franz wrote about 350 songs, remarkable for their sensitive musical prosody. "My music does not pretend to be much in itself," he told Liszt, by which he meant not to undervalue his work, but to indicate the subservience of his settings to the poetic texts. Heine's poems form nearly a quarter of his texts. Most of his songs are in strophic form and were written for mezzo-soprano of limited range. Among his most expressive songs are "Gewitternach," "Die Heide ist braun" and "Es hat die Rose sich beklagt." He also wrote a series of choral and religious works.

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FRANZEN, FRANS MIKAEL (1772–1847), Finnish-Swedish poet, a forerunner of Swedish romanticism, was born on Feb. 9, 1772, at Uleåborg, Fin. He studied at Åbo, where, in 1798, he became professor of philosophy. After the annexation of Finland by Russia, Franzén went to Sweden (1811). In 1831 he was appointed bishop of Harnosand, where he died on Aug. 14. 1847. Franzén was a master of a new poetic style in Swedish literature. Shakespeare, Milton and Gray made a deep impression on him. His work consists chiefly of simple, idyllic lyrics, and his best poems embody the imaginative spirit of the romantic era. His images have the vividness of the bright, northern summer nights. His hymns breathe a quiet and cheerful confidence.

Franzén's collected poems were published in 7 vol. (1867–69). *See* also G. Castren, F. *M. Franzén in Finland* (1902); S. Ek, *Franzéns Abodiktning* (1916). *(S. E.)*

FRANZENSBAD (Czech FRANTIŠKOVY LÁZNĚ), a town in the Karlovy Vary region, Czechoslovakia. Situated about 1,500 ft. above sea level amid delightful mountain scenery, its springs have been known and used since the 16th century, though the modern town developed around the *Kurhaus,* built in the late 18th century. The springs, 18 in number, are rich in carbon dioxide, iron. Glauber's salt, lithium and radium, and are used for drinking and bathing cures; in addition there exist large quantities of ferruginous mineral mud in local peat swamps. The waters have an average temperature between 50.2° F. and 54.5° F. and are of healing value in the treatment of women's diseases. nervous disabilities, abdominal troubles and affections of the heart and blood.

Franzensbad rapidly developed importance as a principal centre of treatment and as a holiday resort for the population of nearby industrial areas. In 1938 the town came under German control as part of the Sudetenland. Pop. (1950) 2,945.

FRANZ JOSEF LAND, an arctic archipelago, belonging to the U.S.S.R., lying east of Spitsbergen and north of Novaya Zemlya. extending northward from about 80° to 82" N., and between 43° and 65" E. Area 7.313 sq.mi. The islands are all very similar in appearance and consist of platforms of fossiliferous clay, shales and sandstone rising to 400–600 ft. capped by 500–700 ft. of Tertiary basalt. Intrusive sills also occur. The basalts are related to those of Jan Mayen, Iceland. Greenland and west Scotland. The islands are clearly remains of a more extensive land surface that nas broken and partially submerged along lines of faults subsequent to the volcanic period. Raised beaches indicate recent elevations. The islands have caps of ice or névé and valley glaciers or sheer ice faces to the sea. vegetation is scanty and includes 14 flowering plants and some mosses and lichens. Pack-ice renders access difficult. but occasionally Norwegian trappers have nintered there. The bear and fox are the only land mammals; insects are rare; but the avifauna includes at least 22 species of which probably 15, including the ivory gull, nest there.

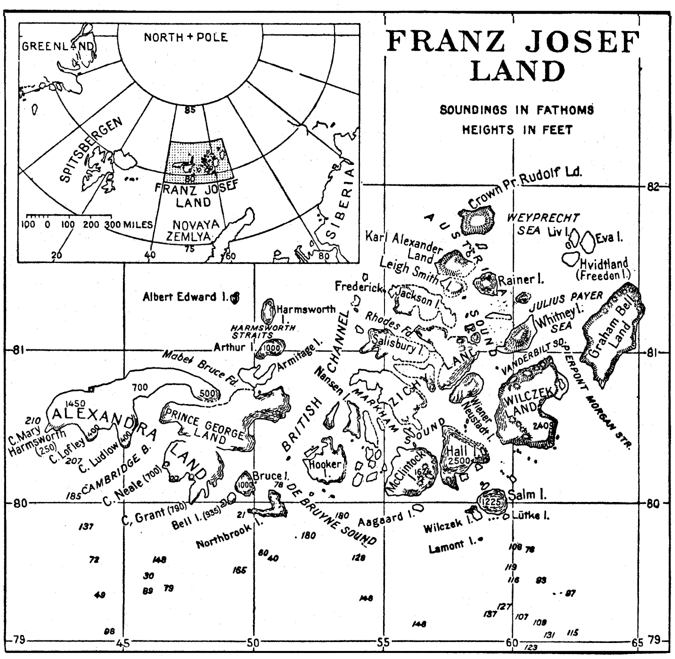
August Petermann expressed the opinion that Baffin may have sighted the west of Franz Josef Land in 1614, but the first actual discovery is due to Julius Payer. who was associated with Weyprecht in the Austrian polar expedition fitted out by Count Wilczek on the ship "Tegetthof" in 1872. On Aug. 31, 1873, the "Tegetthof" being then beset. high land was seen to the northwest. Later in the season. Payer led expeditions to Hochstetter and Wilczek islands. and after a second winter in the ice-bound ship, a difficult journey was made northward through Austria Sound, which was reported to separate two large masses of land, Wilczek Land on the east from Zichy Land on the west, to Cape Fligely, in 82° 5″ N. Cape Fligely was the highest latitude attained by Payer, and remained the highest attained in the Old World till 1895. Payer reported that from Cape Fligely land (Rudolf Land) stretched north-east to a cape (Cape Sherard Osborn), and mountain ranges were visible to the north, indicating lands beyond the 83rd parallel, to which the names King Oscar Land and Petermann Land were given.

In 1879 De Bruyne sighted high land in the Franz Josef Land region, but otherwise it remained untouched until B. Leigh Smith, in the yacht "Eira," explored the whole southern coast from 42° to 54° E. in 1881 and 1882. discovering many islands and sounds, and ascertaining that the coast of Alexandra Land, in the extreme nest, trended to north-west and north.

In 1894 Alfred Harmsnorth (afterwards Lord Northcliffe) fitted out an expedition in the "Windward," under F. G. Jackson, with the object of establishing a permanent base in Franz Josef Land, from which a journey should be made to the Pole. Jackson's base was at "Elmwood," near Cape Flora. at the western extremity of Northbrook Island. After a preliminary reconnaissance to the north, the summer of 189j was spent in extending discovery to the west. In 1896 the Jackson-Harmsworth expedition worked northwards and reached Cape Richthofen, whence an expanse of open water was seen to the north, which received the name of Queen Victoria sea. To the west of the British channel appeared glacier-covered land, and an island which was probably Payer's King Oscar Land lay to the northward. To north a water-sky appeared in the supposed position of Petermann Land. Thus Zichy Land itself was resolved into a group of islands, and the outlying land sighted by Payer was found to be islands also. Meanwhile Nansen, on his southward journey, had approached Franz Josef Land from the north-east, finding only sea at the north end of Wilczek Land. Nansen wintered near Cape Norway, Jackson Island, only a few miles from the spot reached by Jackson in 1895. He had finally proved that a deep oceanic basin lies to the north. On June 17, 1896, the dramatic meeting of Jackson and Nansen took place, and in the same year the "Windward" revisited "Elmwood" and brought Nansen home, the work of the Jackson-Harmsworth expedition being continued for another year. As the non-existence of land to the north had been proved. the attempt to penetrate northwards was abandoned. and the last season was devoted to a survey and scientific examination of the archipelago. especially to the west. by Jackson A. B. Armitage, R. Koettlitz, H. Fisher, W. S. Bruce and D. W. Wilton.

Further light was thrown on the relations of Franz Josef Land and Spitsbergen during 1897 by the discoveries of Captain Robertson of Dundee In August 1898 an expedition under Walter Wellman, an American, landed at Cape Tegetthof. The eastern limits of the archipelago were explored by E Baldwin and many new islands added to the map. Wellman reached 82° N. In June 1899 the duke of Xbruzzi in the "Stella Polare" succeeded in forcing his ship through the British channel to Rudolf Land, and wintered in Teplitz bay, in 81° 33' N. latitude. In March 1900, a sledge party of 13, under Captain Cagni. started northward. They found no trace of Petermann Land, but aith great difficulty crossed the ice to 86° 33' N. latitude. (See ARCTIC REGIONS.) Baldwin did some work again in 1901–02 and A. Fiala, in 1904, lost his ship in Teplitz bay. The Russian, G. L. Sedoff, used Hooker Island in 1913 as a base for a sledge journey to the Pole, but died near Rudolf Land.

See *Geographical Journal*, vol. xi, Feb. 1898; F. G. Jackson, *A Thousand Days in the Arctic* (1899) (with appendices on geology and botany); Duke of Abruzzi, *On the Polar Star* (1903), *The Ziegler Polar Expedition 1903–5, Scientific Res.*, ed. *A.* Fiala (1907); L. Breitfuss, *Irrfahrten im Lande des Weissen Todes* (193j).



FRASCATI, a town and episcopal see of Italy. province of Rome. 1j mi. S.E. of Rome by rail and also reached by electric tramway via Grottaferrata. Pop. (1951) 10.895. The town is situated 1.056 ft. above sea level, on the northern slopes of the outer crater ring of the Alban hills. and commands a very fine view of the Campagna and of Rome. The cathedral contains a memorial tablet to Charles Edward. the Young Pretender, whose body for some while rested there; his brother, Henry, Cardinal York, was long bishop of Frascati. The villas of the Roman nobility, nith their beautiful gardens and fountains. are the chief attractions of Frascati. The earliest in date is the Villa Falconieri, planned by Cardinal Rufini before 1550; the most important of the rest are the Villa Torlonia (formerly Conti), Lancelotti (formerly Piccolomini). Rufinella (now belonging to Prince Lancelloti), Aldobrandini. Borghese and Mondragone (now a Jesuit school). Frascati seems to have arisen on the site of a very large villa (probably that of Passienus Crispus, the second husband of Agrippina the younger. who compassed his death for the sake of his property, which thus passed into the possession of her son Nero and remained imperial) about the 9th century. The medieval stronghold of the counts of Tusculum (*q.v.*), which occupied the site of the ancient city, was dismantled by the Romans in 1191, and the inhabitants put to the sword or mutilated. Many of the fugitives naturally took refuge in Frascati. For the greater part of the middle ages Frascati belonged to the papacy.

See T. Ashby in *Papers* of *the British School at Rome*, v. (1910), 301 sqq.; F. Tomassetti, *Campagna Romana*, iv. (1926), 346 sqq. (T. A.)

FRASER, CLAUD LOVAT (1890–1921), British artist who exercised a rejuvenating influence on English stage designs, was born in London on May 15, 1890, and was educated at Charterhouse. He began to follow his father's profession as a solicitor in 1908, but abandoned this three years later for art. After working with Walter Sickert for a time, he exhibited in 1913, being responsible in the same year for the decoration of the *Flying Fame* chapbooks and broadsheets.

His gift for spirited design and lively colour, based to a great extent on 18th-century conventions, developed rapidly, and he not only successiully illustrated many books, but produced designs for *The Beggar's Opera* (1920), *As You Like It* (1920) and *If* (1921). A career of great promise was cut short by his death, June 18, 1921.

See J. Drinkwater and A. Rutherston, *Claud Lovat Fraser* (1923).

FRASER, JAMES BAILLIE (1783–1856), Scottish traveler and author who, on his journeys through Persia (Iran), took astronomical observations that were of great service to the cartography of Asia Minor, was born at Reelick. Inverness-shire, on June 11, 1783. He went to India early in life, and in 1815 made a tour of exploration in the Himalayas, subsequently beginning his Persian travels. His *Narrative of a Journey Into Khorasan in the Years 1821 and 1822* (2 vol., 1825) contains detailed calculations of the latitude and longitude of various Persian cities. His other works on Persia include fiction of no great merit. Fraser went on a diplomatic mission to Tehran in 1833–34, and in 1835 was made responsible for two Persian princes on a visit to England. Having retired to cultivate his estate at Reelick, Fraser died there in Jan. 1856.

FRASER, JAMES EARLE (1876–1953), U.S. sculptor, mas born at Winona, Minn., on Nov. 4, 1876. Growing up on the Dakota prairies, he found friends among the Indians, which influenced his later Indian subjects—"The End of the Trail." equestrian statue shown at the Panama-Pacific exposition (San Francisco, Calif.) in 1915 and subsequently placed in Waupun, Wis.; and the United States buffalo five-cent coin, 1913. In 1894 he studied at the Art Institute of Chicago and then was the pupil of J. A. J. Falguière in Paris. assistant to Augustus Saint-Gaudens, 1898–1902, and instructor at the Art Students' league. New York city, 1906–11. In 1913 he married a sculptress and former pupil, Laura Gardin.

Until 1932 Fraser's work showed the romanticism and animation of Falguière, and some of the refinement and dignity of Saint-Gaudens. He changed his style to a more heroic, monolithic massiveness. however, after he mas summoned to Washington, D.C., to create several works for the capital. He did the groups in the pediments of the Commerce Department building (1932), the figures in the huge pediment of the National Archives building and two heroic statues by the entrance steps (1935), as well as two other allegorical figures by the steps of the Supreme Court building. Most of his other works are in Washington and New York city. In Washington are a full-length bronze statue of Alexander Hamilton, Treasury building; "Journey Through Life." Keep monument, Rock Creek cemetery; Ericsson monument, Potomac park; etc. In New York city are a bust of Saint-Gaudens, Hall of Fame; sarcophagus of Bishop Potter. Cathedral of St. John the Divine; equestrian group of Theodore Roosevelt, Museum of Natural History. Fraser also designed many medals. He died in Restport, Conn.. on Oct. 11, 1953. (J. W. Le.; X.)

FRASER, PETER (1884–1950), New Zealand government official,was born at Fearn, Ross and Cromarty, Scot., on Aug. 28, 1884. On leaving school he became a local officer of the Liberal party in Scotland and in 1908 joined the Independent Labour party. He went to New Zealand two years later and was active in the labour movement.

He was elected to the house of representatives for Wellington Central in 1918, and in 1935 was appointed minister of education, health, marine and police, and in 1939 deputy prime minister. In his government's program of social services he was responsible for the national health plan.

On April 1, 1940, on the death of M. J. Savage, Eraser became prime minister. His party was defeated in the general election of Nov. 1949, and he resigned in December. From 1943 he had been also minister of external affairs and minister of island territories. and from Dec. 1946 native minister (renamed minister of Maori affairs in 1947). He also held the portfolio of employment during 1946.

During World War II he attended meetings of the war cabinet in London, and in 1944, 1948 and 1949 attended the London meetings of the British commonwealth prime ministers. In 1945 he attended the United Nations meetings at San Francisco, Calif., and in 1948 led the New Zealand delegation to the third UN general assembly in Paris.

Fraser died at Wellington, N.Z., on Dec. 12, 1950.

FRASERBURGH, a small burgh on the northeastern coast of the county of Aberdeen, Scot., close by the Kinnaird head lighthouse at the southern entrance of the Moray firth and 43 mi. N. of Aberdeen by road. Pop. (1951) 10,444. It is the main seat of the herring industry in Scotland. After World War II the whitefish industry grew considerably and in the mid-1950s vied with the herring landings in value and quantity. The harbour has more than $2\frac{1}{2}$ ac. of wharfage and can accommodate vessels of 4.000 tons. Besides having engineering, canning and deep-freeze plants, Fraserburgh is a holiday resort with a fine beach and a golf course. Included in the burgh is the village of Broadsea with its centuries-old fishermen's cottages.

The burgh was granted a charter by Mary, queen of Scots, in 1546. In the 17th century. as a result of an outbreak of plague in Aberdeen, a university was instituted in Fraserburgh, but it fell into disuse when Marischal and King's colleges grew up in the county capital. (J. M. Be.)

FRASER RIVER, chief river of British Columbia, Can., drains about 90,000 sq.mi. of the Interior plateau and its perimeter of rugged mountains. It was named for Simon Fraser who first descended it to the sea in 1808. The Cariboo gold rush, which began in 1858, took place in the Fraser river basin. Rising near Yellowhead pass on the British Columbia–Alberta border the Fraser flows 850 mi. to its mouth on Strait of Georgia. From its mountain source, the river's course is initially northwestward, descending by gentle gradients along the Rocky mountain trench. Near latitude 54° N. the river makes a great bend southward to traverse the Interior plateau and then the Coast mountains. Entrenchment and gradients increase progressively downstream, and through the Coast mountains the raging waters traverse a canyon about 5,000 ft. deep. Below this canyon the Fraser turns westward to flow placidly across an alluvial plain to its debouchment near Vancouver. The Thompson river which enters the Fraser about 145 mi. from its mouth is the most important of numerous tributaries, many of which rise in extensive mountain lakes. Hydroelectric developments on the tributaries have been carried on, and it is estimated that the Fraser river system has a total potential of about 13,000,000 h.p. The Fraser is also the largest salmon-producing river in North America. Navigation is important only in the tidal estuary where New Westminster serves deep-sea ships. (G. A. W.)

FRATERNAL ORGANIZATION, a voluntary association of persons having certain ethnic, social, religious or economic characteristics in common, formed primarily for social, benevolent or economic purposes. Despite the fact that social purposes had come to predominate by the middle of the 20th century, most fraternal organizations still exhibited the strong ties developed to solve common problems or to meet common needs, and a good many still utilized secrecy and rituals.

Fraternal associations may be divided into three categories according to their primary purpose: (1) benevolent or protective associations, ordinarily with marginal social activities permitted by their bylaws, termed the fraternal benefit societies; (2) mixed social organizations, many of which marginally may support benevolent programs, termed mixed fraternal associations; and (3) social fraternal associations, which offer neither protective nor benevolent programs.

Purely social organizations, to be classed as fraternal associations, ordinarily have a legal charter providing for a secret ritual and initiation ceremony and often establish membership criteria. Those organizations include collegiate social fraternities and such groups as the International Associations of Lions clubs. This article is not concerned with them but only with fraternal benefit associations. (See FRATERNITY AND SORORITY.)

Fraternal associations perform a number of functions. The secret fraternity enables a group of individuals with common interests to associate exclusively. That is particularly important to minority groups in whom such associations engender a sense of belonging, a feeling that is strengthened through the ritual which helps to create a personal bond. In addition. through use of eligibility criteria, election for membership usually is controlled to provide greater unity in the organization. Ethnic minority groups, as the central and eastern European immigrants during the period of rapid American population growth, found strength and purpose as well as social satisfaction in a new environment through such associations. which led them to assist each other to adapt more rapidly to their new homeland.

Education to perpetuate past traditions, in many cases ethnic or moral in character, is another major purpose of fraternal organizations. The training process is oriented largely toward the new member and is designed both to promote his integration into the group and to assure the continuance of his group's culture, though no longer in contact with the homeland. While social functions predominate. the oldest functions of fraternal organizations mere to provide group secuiity through benevolent and later protective activities. These activities were designed to aid members and their families in case of sickness or death. The earliest payment noted in the United States was to a widow who received a $5 per month benefit payment beginning in March 1857 from the Czecho Slovak Society of America. founded in 1854

Later, such activities assumed larger dimensions, going beyond the parochial limits of the membership. The earliest attempts to provide group security took the form of direct personal aid. Later the groups tended to centralize the function and to provide it on a more or less standard basis In that context, the Ancient Order United Workmen, founded in 1868, is generally credited with being the first U.S. fraternal insurance society.

In later years the beneficial activities mere supplemented through adoption of insurance techniques which, however, were not always correctly used. With that program the risks and benefits were considerably standardized, and the risks of the loss of income to the member and his family from sickness and death were shared. In that pattern the beneficiary status became a right rather than a privilege, and benefits were related to contributions rather than need alone.

Origins of Fraternalism in the United States. — History is replete with examples of fraternal activity. Mystical, ritualistic associations have been identified as early as the early Egyptian period. In modern times the first legislation covering their activities nas written in Great Britain in 1793 and nas entitled "An Act for the Encouragement and Relief of Friendly Societies." It was intended to govern some of the risk-sharing functions of the early friendly societies not covered by the Act of 1776.

Other groups had developed on the European continent, but the predominance of the British influence in colonial America tended to force the associations into a form more or less parallel to that of their British counterparts. Among the organizations imported were the Free and Accepted Masons; Independent Order of Odd Fellows; Ancient Order of Foresters; a number of ethnic orders, e g., the Ancient Order of Hibernians in America; and the United Ancient Order of the Druids. These early imported associations were mainly of the beneficial society and mixed society type. The first native fraternal association, Actors' Order of Friendship, was founded in 1849.

In the period following the American Civil War, as the characteristics of immigrants changed, so also did the fraternal organizations. Minority groups found that close association with their countrymen seemed to make their adjustment to a nen world easier. The organizations provided a common meeting place for social activities and a medium for transmitting their common heritage to new generations. The social function was soon supplemented aith benevolent or protective activities. The ethnic character demonstrated by the names of the organizations and the dates of their founding are closely correlated with the successive waves of immigrants by country of origin. These were typified by the Lithuanian Roman Catholic Alliance of America (1886); Croatian Fraternal Union of America (1894); and the Brith Sholom (1905).

Mutual aid in the solution of economic and related problems for individuals with common interests or employment served as the basis for other fraternal organizations, such as the fraternal orders of police, firemen and mechanics. In general, these groups engaged in many types of social and benevolent activities.

Political or patriotic bases exist for the formation of some fraternal organizations. such as those for veterans of military service. Their activities are largely devoted to the support of national traditions and the establishment of a centre for social activities. (See AMERICAN LEGION; VETERANS OF FOREIGN WARS.)

A religious origin or basis for solution of social and economic problems is evident in some fraternal organizations that provide for indigent members, their wives and orphaned children. This is typified by activities of the Lutheran Brotherhood, established in 1917 as a mutual benefit order. The Knights of Columbus (*q.v.*) and many others are of the same type.

Membership Requirements. — Qualifications for membership are largely set within the ethnic. religious, economic and political tenets of the associations. Age and sex also enter into consideration as qualifications in many cases. The ethnocentric associations usually require birth in a certain country or direct descent from immigrants from that country. The religious associations require public confession of belief in a particular faith. In some cases this statement of faith is broad enough to admit almost anyone, as, for example, in the case of the Masonic Order, which merely requires belief in the Almighty God. The Knights of Columbus, on the other hand, requires belief in a particular theology and performance of a ritual of worship.

Employment in a particular occupation often is required, as in the case of the Firemen's Mutual Aid and Benefit association, established in 1897. In the political or patriotic orders, prior military service or descent from a particular group (*e.g.,* a revolutionary soldier) is required. As to age, most organizations require majority; some have a junior status, with age of admission falling as low as 15. Usually these groups require that the initiate be the child of an adult member, as in the Order of DeMolay.

The majority of fraternal organizations are true fraternities in the sense that only men are admitted to active status. A few specialized organizations exist for women, such as the Catholic Women's Benevolent Legion. Many of the men's organizations have women's auxiliaries, such as the International Order of the Eastern Star, established in 1876.

The requirements for introduction into the beneficial and mixed fraternal associations indicated above differ significantly from those of the social fraternal organizations. In the social fraternal association some requirements tend to be more catholic in nature, in many cases cutting across ethnic, racial and religious lines. In other cases they tend to be even more selective as in the case of the educational, professional and honorary Greek letter fraternities.

Growth and Decline. — From the colonial period to the Civil War the development of the fraternal system of the United States was marked primarily by the establishment of imported orders. The English, German, Irish, Scotch-Irish and Welsh origins are particularly identifiable in these groups. In the years following the Civil War the purposes were modified and increasing numbers of associations were founded annually. This was true for each of the three categories of fraternal associations. The largest number of fraternal benefit orders for any decade was founded between 1890 and 1900 when more than 65 societies were established. During that period the patriotic orders also showed a rapid growth. In the second quarter of the 20th century there were fewer foundings than in any earlier period, the formation rate being about one every four years.

As the numbers of benefit associations increased, the insurance function of providing protection to members was developed and specific legal regulations governing it were adopted. A class of membership frequently was provided that did not require contributions or carry any protection rights. During the period from the Civil War to the 1960s the number of insurance policies in force increased rapidly and the average value of the policies also rose. Many forces contributed to this result: the ethnocentrism of the immigrants; their economic insecurity; the need for low premium insurance; insurance company failures; the lack of low cost group and industrial insurance; the relative inaccessibility of ordinary insurance to the subject groups; and the immigrants' frequent suspicion of financial institutions.

The subsequent decline of these fraternal benefit associations was the result of other forces. The gradual assimilation of immigrants into the social, political, economic and ethnic patterns of the United States probably has been the most significant of these forces. With the increase in the security, flexibility and availability of insurance following the turn of the century, the need for group provision of personal security of the type provided by the fraternal has gradually diminished. Although a large volume of new insurance is written each year by fraternal associations, the rate of growth in the net total in force has declined. However, in 1959 there was more than $12,000,000,000 of insurance in force in fraternal associations on 9,300,000 certificates.

The Social Fraternal Association. — Prominent among the fraternal organizations in which ethnocentrism is lacking are the following with nationwide membership: the Fraternal Order of Eagles (founded 1898) and the Benevolent and Protective Order of Elks (1868); and the Loyal Order of Moose (1888). All of these provide ritualistic orders for social activities only. Altogether there were several hundred organizations of this type in the United States, having a total membership in the early 1960s of about 90,000,000. Much of this membership must be discounted because of the multiple membership held by many persons. Of this total more than 10,000,000 persons were members of fraternal organizations that provide member protection through insurance. *See* also FRIENDLY *SOCIETY*.

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(J. F. A.; Jo. C. S.)

FRATERNITY AND SORORITY, social, professional or honorary organizations whose membership is drawn primarily from college or university students. Those for men are generally referred to as fraternities, while those exclusively for women are popularly called sororities. With few exceptions, fraternities and sororities use, combinations of letters of the Greek alphabet as names.

Social Fraternities. — The social fraternity is peculiar to America, although attempts have been made to compare it with student organizations in other areas of the world, such as the corps of German universities. Its function, although basically to serve as a collegiate "home" for its members, varies from school to school. At some universities fraternities are the nucleus of campus political and social life. and affiliation with a Greek-letter society is a prerequisite for positions of importance in student activities, while at other schools, where fraternities are barely tolerated, affiliation might be considered detrimental to anyone seeking class or campus office.

The college chapter, basic unit of a fraternity, consists of all its undergraduate members at a specific school. The chapter house is the centre of fraternity activity, serving as meeting place, dormitory and dining hall for members. Each chapter has its own alumni group and, in many metropolitan areas. there are organized alumni chapters whose members may come from different schools. Alumni chapters cannot elect new members, but serve as sponsors of collegiate chapters.

Members of social fraternities and sororities are usually, although not exclusively, chosen from first-year students by a system known as "rushing." This usually consists of the fraternity's inviting prospective members, or "rushees," to the chapter house for meals or special rushing parties. Each rushee who is acceptable to the fraternity members is then extended a bid, or invitation to join, which he may accept or decline.

The initial probationary membership, called "pledgeship," is followed by initiation into active membership. Eligibility for active membership is controlled jointly by the school and the fraternity. Active membership is held during the remaining college years, and upon leaving school or graduating the active member assumes alumni status. Membership is for life and initiation is considered a permanent bar to membership in any other social fraternity. Members are, however, eligible for membership in both professional and honorary fraternities.

Each national fraternity has a general headquarters, with governing and supervisory officers who assist collegiate chapters in their operation and in maintaining the ideals and standards of the fraternity and the college. There also are many fraternities and sororities with only one chapter, often organized for the purpose of later affiliation with one of the established national groups. Many of these locals. however, have deep-rooted traditions on a particular campus and do not wish to subordinate themselves by national affiliation.

Traditionally, each fraternity has characteristic insignia — a badge or pin, coat of arms. seal, flag, certain colours and a fraternity flower. The fraternity ritual, in most cases a secret document, is an exposition of the ideals and aims of the organization and contains an explanation of its symbolism. This may include a password, grip, motto and recognition sign. The ritual also contains formal ceremonies used on occasions such as pledging and initiation.

Criticism. — There have been charges that fraternities promote irresponsibility, pay too much attention to social life at the expense of scholarship and carry on dangerous hazing practices. The modern fraternity or sorority, however, if for no other reason than self-preservation, has had to stress high standards of scholarship; the development of leadership and loyalty; and participation in community and national service projects. In addition, universities have regulated hazing practices, and fraternities which violate hazing regulations are severely punished and even may be denied recognition by the school.

The rushing system, too, has often been denounced as undemocratic, since, in those fraternities using a blackball system, a minority of the members may prevent bidding someone of whom the majority approves. Other criticism has been directed against the restrictive nature of certain fraternities which automatically bar members of certain racial, religious, national or ethnic groups from consideration. In the second half of the 20th century, a number of universities ruled that fraternities with discriminatory policies could not operate on campus. This led many fraternities to drop restrictive clauses from their constitutions.

History of the Social Fraternity. — Social fraternities trace their origin to student clubs existing during colonial days. The most famous of these and the first to use Greek letters for its name was Phi Beta Kappa, organized on Dec. 5, 1776, at the College of William and Mary, Williamsburg, Va. Five students, meeting in the Apollo room of the Raleigh tavern, on that date formed a secret society, adopting as their insignia a square silver medal, bearing on one side the Greek letters Phi, Beta and Kappa; three stars; and an index. The stars represent the guiding principles of the society — friendship, morality and literature. On the reverse were the Roman letters *S* P., for *Societas Philosophiae.* In the course of time Phi Beta Kappa became an honour society rather than a social fraternity. Its secrets were revealed to the public following anti-Masonic agitation in the 1820s.

In 1812 four students at the University of North Carolina formed Kappa Alpha or Kuklos Adelphon. This group had over 15 chapters, but disintegrated prior to the American Civil War. In 1825 Kappa Alpha society the oldest social fraternity still in existence as such, was established at Union College, Schenectady, N.Y. Sigma Phi and Delta Phi were organized at Union in 1827. These three form the "Union Triad!'; also founded at Union were Psi Upsilon (1833), Chi Psi (1841) and Theta Delta Chi (1847). The fraternity idea spread to the midwest with the founding of Beta Theta Pi (1839), Phi Delta Theta (1848) and Sigma Chi (1855), at Miami university, Oxford, O. These constitute the "Miami Triad." After the Civil War, fraternities appeared on the west coast of the U.S. and in Canada when Zeta Psi, founded at New York university in 1847, established chapters at the University of California (1870) and at the University of Toronto (1879).

Although most fraternities are secret societies, in 1834 there was founded at Williams college, Williamstown, Mass., the Social fraternity, an antisecret group organized as a protest against the influence of the secret fraternities. Similar organizations were later formed at other colleges and in 1847 formed the Antisecret confederation. In 1864 the name was changed to Delta Upsilon and thereafter, except for its nonsecret nature, it functioned much like any other national fraternity.

The first women's fraternities. or sororities, were the Adelphean (1851), later Alpha Delta Pi; and the Philomathean (1852), later Phi Mu, established at Wesleyan college, Macon, Ga. These were followed by the I.C. Sorosis (1867), which became Pi Beta Phi; Kappa Kappa Gamma (1870) at Monmouth college. Monmouth, Ill.; and Kappa Alpha Theta (1870) at DePauw university, Greencastle, Ind. The expansion of the sorority system came at about the same time that women were accepted as students in state-supported universities. In some cases men's fraternities aided in the organization of early sororities. thus bringing about the official brother-sister relationship which exists between certain fraternities and sororities.

Professional Fraternities. — Professional fraternities are specialized organizations whose membership is limited to students and faculty members engaged in one field of educational specialization. These have broader membership qualifications than the social groups and emphasize activities designed to develop professional competency rather than social life.

Professional fraternities began at Transylvania college, Lexington, Ky., where medical students formed the Kappa Lambda Society of Aesculapius (1819). Phi Delta Phi (law) was organized in 1869; Nu Sigma Nu (medicine) and Delta Sigma Delta (dentistry) in 1882, all at the University of Michigan. Other professions represented include agriculture, commerce, education, engineering, pharmacy, foreign service, journalism, optometry, osteopathy, etc.

Honorary Fraternities. — Honorary fraternities recognize superior attainment in a given field of activity. There are three classes: (1) those with requirements for membership based upon scholastic excellence in all fields; (2) those recognizing outstanding achievements in both extracurricular activities and scholarship; (3) those recognizing excellence and achievement in a single field. All candidates for membership must be of exemplary character.

Honour societies include Phi Beta Kappa (general scholarship, 1776); Tau Beta Pi (engineering, 1885); Sigma Xi (scientific research, 1886); and Phi Kappa Phi (general scholarship, 1897). Other groups, of more recent origin, represent architecture, civil engineering, commerce, forensics, history, journalism, industrial engineering, leadership, music, medicine, pre-medicine, romance languages, etc.

Interfraternity **Relations.**—Although the first fraternity preceded the first sorority by 75 years, it was the women who first recognized the need for an organization in which Greek letter societies could exchange ideas and take united action on common problems. The first call for a meeting of women's groups in 1884 had no results, but discussions were held in 1891 and 1893. Nine years later, in 1902, representatives from seven sororities met in Chicago and the organization which became known as the National Panhellenic conference was born. Agitation for a men's interfraternity group began in 1907, and the first meeting, attended by representatives of 26 fraternities, was held in 1909. The following year a constitution and bylaws were adopted for the Interfraternity conference. The word National was added in 1931.

Among the problems with which the conferences concern themselves are rushing, pledge rules, fraternity-college and fraternity-community relations, hazing, scholarship. etc. In addition to these national groups, each campus has its own undergraduate Panhellenic and Interfraternity councils which exercise certain controls over the societies on that campus, and, in many cases, do liaison work between the college and the fraternities.

Professional and honorary fraternities and sororities have similar organizations which promote high standards and ethics within the individual organizations.

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FRATICELLI, the name given during the 13th, 14th and 15th centuries to a number of religious groups in Italy, differing widely from each other but all derived more or less directly from the Franciscan movement.

The word is a plural diminutive of the Ital. *frate* and denoted, not any particular sect, but members of orders formed on the fringe of the church.

It was first used of heretics by John XXII in 1317, to designate the group which held that he had fallen into heresy and had lost all spiritual power by his decretal on the poverty of Christ. This group of exalted and isolated ascetics soon began to regard itself as the sole legitimate order of the Minorites and then as the sole Catholic Church. For the most part they lived in hiding and wore a shorter and poorer kind of Franciscan habit. Because of the confusion caused by the absence of the popes from Italy during the Avignon period and the great western schism, they spread widely in Italy and Sicily and were not unknown in Bohemia, Catalonia, Greece and Persia. Consequently, for nearly a century the Fraticelli were able to carry on an active propaganda throughout Italy, until pope Martin V, in 1426, appointed two of the strict and orthodox section of the Franciscans known as Observants, with orders to make a special crusade against the heresy of the Fraticelli and to extirpate it. In 1449 Pope Nicholas V renewed the measures taken against them. The sect gradually died out after losing the protection of the common people, whose sympathy was now transferred to the austere Observants and their miracleworker, St. John of Capistrano.

Paul II also energetically repressed the Fraticelli who had appeared again in the March of Ancona, in the Romagna, the Campagna and even in Rome itself. After this repression (1466–67) the name disappears from history.

See F. Ehrle in *Archiv für Literatur- und Kirchengeschichte des Mittelalters*, iv, 64–190 (1888); L. Oliger, *Documenta Inedita* (Quaracchi, 1913), and in *Zeitschrift für Kirchengeschichte*, 45, 215–242 (1926); *Catholic Encyclopedia s.v.*, "Fraticelli"; L. von Pastor, *History of the Popes* (Eng. trans.), iv, 113 ff.; H. C. Lea, *History of the Inquisition of the Middle Ages*, iii, 129–180 (London, 1888).

FRAUD. Fraud, as a legal term, is a constituent of a number of statutory and common law offenses and is the basis of a number of civil actions. In civil law, fraud is actionable as the tort of deceit. Also it may vitiate a contract, if it is an ingredient, as would mere innocent misrepresentation, which is not a tort in itself. To sustain an action of deceit there must be proof of fraud and nothing short will suffice. Fraud is proved when it is shown that a false pretense has been made knowingly or without belief in its truth. or recklessly, careless whether it be true or false (*Derry* v. *Peek*, 14 app. cases 337).

It is probable that the action of deceit originated in England as a remedy for abuse of legal proceedings and is known to have existed as such in the 13th century. Early forms of tort depended upon an act with physical damage as a consequence, while the state of the wrongdoer's mind was practically disregarde . In the middle of the 14th century, it was developed by "an action on the case" so as to include a wider aspect of fraud; thus an action lay to a plaintiff who bought cattle from a man to whom they did not belong. So, by stages, it was developed until by modern times any false statement made wilfully so that the plaintiff acts to his detriment will probably be actionable (*Pasley v. Freeman*, 1789). The development of contractual liability was similar and was related to the economic development of the country. When property was retained by force, the remedy to fraud lay in the strength of the arm of the dispossessed person, but as trade developed it became essential that the standards of honesty which were required in business should be protected by the courts. In the 16th century there was a liability in contract if a warranty were included and that warranty were false, but in 1603 there was still some doubt as to whether a knowledge on the part of the defendent as to the veracity of the warranty was essential. By the 18th century, warranty was implied and thus there developed liability in contract for misrepresentation whether fraudulent or otherwise, but there was no corresponding extension in the action in tort of deceit. Even today the principle of *caveat emptor* (let the purchaser beware) applies in contract, so that every misrepresentation is not necessarily fraudulent but only if a warranty is implied.

In criminal law there is no such offense as fraud in itself, though it is an essential ingredient of many offenses. Of these the most important are: obtaining money by false pretenses (S. 32. Larceny act, 1916); fraudulent conversion (Ss. 20–21 Larceny act, 1916); obtaining credit by false pretenses or any other fraud (S. 13. Debtors act, 1869); and a number of offenses under the Companies act, 1948, and the Prevention of Fraud (Investments) act, 1939. In most of these cases, fraud or some similar expression is specifically an ingredient, but even in those offenses where no fraud is mentioned it is still to a lesser degree an ingredient, for with all criminal offenses there must be *mens rea*.

The history of criminal fraud is recent compared with that of offenses of violence which have always been crimes. The maintenance of public order free from violence was more important for the preservation of the king's peace than the fraudulent acquisition of private property. Hence to this day offenses entailing fraud are classified generally as misdemeanours, whereas larceny and crimes of violence are felonies. The distinction has in many ways lost its significance, but even today a man who has stolen sixpence may be arrested without a warrant whereas a man who has defrauded a large section of the community of thousands of pounds can only be arrested on the order of a magistrate.

Probably the first attempt to bring fraud within the criminal law was in the 16th century, when Britain's reputation in commerce was beginning to develop. Two statutes were passed in the reign of Elizabeth I dealing with conveyances in fraud of creditors and in fraud of purchasers which curtailed the current fraudulent practice of disposing of assets prior to bankruptcy.

An act had been passed earlier, in 1541, which made it an offense to issue a document in furtherance of fraud. This was later extended to any fraudulent writing; but a lie, however blatant, unless it was such as to affect the public at large, was not fraudulent. Thus, where a woman obtained money by stating that she had been sent by her mistress to obtain silks for the queen, and both statements were false, it was held that as no false document was given, no fraud was committed. This narrow interpretation of the law did not meet the needs of the developing community and, as a result, in 1757 it became an offense to obtain goods by false pretenses, and from this act (30. Geo. 2 C4) the present offenses of false pretenses have developed.

Ancient Frauds.—Frauds were common in remote antiquity. According to Herodotus, the mason who built the stone treasury of Rameses III contrived a secret entrance through which he passed nightly to steal a portion of the royal treasure. The Old Testament describes how Jacob defrauded his brother Esau of his birthright and how the Hebrews in bondage defrauded their Egyptian taskmasters of their jewels. Specimens of loaded dice have been found in Herculaneum.

Some Types of British Fraud.—The variations of fraud are as infinite as the ingenuity of the perpetrators, but some of the better known forms are "kite flying"; "teeming and lading"; "share pushing"; "bucket shops"; "long firm fraud"; and the "confidence trick."

"Kite flying" is the use, as credit, of the time taken in the course of banking machinery for a cheque to be cleared. Thus, if A pays a cheque drawn by B into A's account, it will be some days before it is debited against B's account. During these days it may be possible, under certain circumstances, to make use of the credit shown in A's bank account, by A's being allowed to draw on the "uncleared effects," namely B's cheque.

"Teeming and lading." which strictly means unloading and loading, is merely an accountants' term for the system of robbing Peter to pay Paul. Thus a cashier, having misappropriated part of one day's takings, appropriates part of the next day's takings to make up his deficiency, and so continues from day to day. He usually increases his appropriations until either the deficiency overtakes the total drawings of a day or, for some extraneous reason such as illness, his actions are discovered.

"Share pushing" is a colloquial expression for high-pressure salesmanship of shares in limited companies. It is probable that the provisions of the Prevention of Fraud (Investments) act. 1939, have curtailed this form of activity which was rife between World Wars I and II. The method was simple but the offense difficult to prove. Shares were bought at a low price in a company doing practically no business, then by balance sheets which failed to show the true position, eulogistic reports by experts on gold findings or other operations and careful circularization of potential speculators, the shares were run up to many times their original value. Having unloaded his supply of shares on the public. the fraudsman disappeared, probably to another continent. It became an offense under the 1939 act to circularize in this way, and dealing in shares generally was restricted. The offenses of publishing fraudulent balance sheets or prospectuses were so widened that a mere misleading statement or forecast might be an offense.

"Bucket shop" means the business of a sham share broker who gambles with his customers on the rise or fall in the prices of stock exchange securities without acquiring these securities at all. The origin of the name may well lie in the activities of small-time wheat dealers who dealt with odd lots which were described as "bucketsful." The expression is loosely used to describe any fraudulent financial firm but the true bucket shop is not necessarily fraudulent though its activities would probably be an offense under the Prevention of Fraud (Investments) act, 1939.

"Long firm fraud" is a term loosely used for any firm which fraudulently obtains goods on credit and sells these goods without attempting to pay for them. Strictly speaking, it is restricted to those cases where the person supplying credit is induced so to do by the production of false references. The goods are usually sold under cost to obtain a quick return and to enable the operator to make his money before the creditors and police become interested in his activities. Until 1948 the offense was usually dealt with as false pretenses, but, so far as companies are concerned, it is now more easily proved to be fraudulent trading under the Companies act.

The "confidence trick" is the cultivation of the confidence of the victim often by prompt repayment of small debts or by lavish entertainment until he is willing to part with a large sum.

Antiquarian Frauds.—Frauds for gain must be distinguished from those perpetrated for mischief. The catalogue of literary forgeries is long. The person who fabricated a grammar of the Formosan language in Samuel Johnson's time was a laborious practical joker. as were the joint authors of *Wanderings in New Guinea*, by "Capt. Lawson R.N." This book was accepted as authentic by all British learned societies except the Linnaean, because the wardroom officers of H.M.S. "Basilisk," who produced their book in advance of that projected by their unpopular admiral, knew less about insects than they did about fauna of fur and feathers. Thomas J. Wise (1859–1937) printed many supposedly first or private editions of Victorian writings which deceived collectors until the fraud was exposed by John Carter and Graham Pollard in 1934.

The ineptitude of some forgers is remarkable. Errors are made which, on examination, are obvious. A will purporting to be signed in 1862 was written on paper bearing an 1870 watermark. Envelopes addressed to celebrities in the 18th century have been offered for sale although envelopes were not made before 1842.

Red ink appears in documents of the 17th century though red ink was unknown before 1780. Stamps have been used on receipts and other documents purporting to be issued before the stamp was printed.

It was scarcely possible that the modern interest in archaeology should escape the attention of impostors. Scores of ancient documents alleged to have been found in tombs and in the sand of the Fayum are submitted to tourists year by year. Even Egyptian mummies have been fabricated with success. A Dresden doctor having purchased the corpse of a young woman, embalmed it and disposed of it as the mummy of the queen Nitocris for a considerable sum. Unfortunately his process was defective and when the mummy, which was supposed to have resisted the ravages of time for three millenniums, began to decompose, the fraud was discovered.

Like literary frauds, archaeological frauds are not always for pecuniary gain, as is exemplified by the Piltdown skull, which was classified as *Eoanthropus Dawsoni,* a remarkable aberrant type of early man. In 1912 a local archaeologist found part of a skull, a jaw, some animal remains, and other implements in a gravel pit at Piltdown in Sussex. The find was believed to be of great importance as it showed a variation of development of man which was out of line chronologically with other discoveries. The authenticity of the find was generally accepted though one or two eminent men of science were somewhat sceptical. The importance of the bones was such that no injury could be risked from experimental methods of investigation. and thus, for many years, the find had to be accepted as genuine; but gradually suspicion developed. principally because the cranium and the jaw seemed more and more irreconcilable. When safer methods of investigation were developed, the find was subjected to X-ray and radio-activity tests and it was found that the jaw almost certainly was that of a young orangutan. The canine tooth mas found to have been coloured with oil paint. Some bones were found to be genuine. but they had been "planted" at Piltdown from elsewhere. They were much younger than the gravel in which they were alleged to have been found. Thus a discovery which for about 40 years was an enigma was explained by the patient work of scientists from all branches.

The faking of works of art is almost as old as art itself and is recorded by Pliny. It has been stated that throughout the world there are 2.000 "Van Dykes." though Sir Anthony Van Dyke only painted 70 pictures Hans Van Meegeren was arrested in 1945 on a charge of collaborating with the Germans during the occupation and specifically for having sold a Vermeer painting to Hermann Goring. To save himself from such an accusation, Van Meegeren confessed that he had executed the painting himself, together with five others which had been sold for a total of about £700,000; all had been accepted as genuine by experts, including some at the leading museums. To prove his statement he painted a further picture under supervision but even then the forgeries were only conclusively proved by highly technical analysis of the paints, frames and canvasses. In 1947 he was sentenced to 12 months imprisonment. but died 19 days later. He stated that his only reason for executing the forgeries mas to avenge himself on various art critics by showing them that he was. in fact, a great painter

Fraudulent Claims. — Fraudulent claims to titles and estates have been common. In the early 17th century a Frenchwoman appeared in Limoges claiming to be Queen Henrietta Maria, the daughter of Louis XIII. uho at the moment was in London as consort of Charles I. Nevertheless, she played her part uith such distinction that she was widely accepted as a royal personage. A commission was sent down from Paris to examine her and she signed her interrogatory as Henriette de Bourbon. Nevertheless she was condemned to be whipped by the hangman and to be imprisoned till further orders. No fewer than seven pretenders claimed to be Louis XVII of France, though the death of the dauphin in the Temple on June 8, 1795, was testified to by responsible witnesses.

The impudent claim of Arthur Orton, a Wapping butcher, to the title and estates of Sir Roger Tichborne in May 1871 aroused greater public interest than any trial of this nature before or since. Sir Roger Tichborne was born in 1829 and educated at Stonyhurst. He was an officer in the carabineers for 33 years. He had become secretly engaged to his cousin. When this was discovered by her father, there was a stormy scene, and he sailed for South America in 1852. He was then presumptive heir to the baronetcy. On April 20, 1854, he sailed for Australia in the "Palma." A few days later wreckage from that vessel was picked up and none of the crew was ever heard of again. Roger Tichborne's will was proved and legal proof was given of his death. Meanwhile his mother, unwilling to believe in his death. had advertised a reward for his discovery. Thirteen years after the loss of the "Ralma" a solicitor in Wagga Wagga, N.S.W.. wrote to Lady Tichborne that her son was living in the town under the name of Castro. Funds having been provided for his journey, this man made a devious journey to Paris in the course of which he went to Wapping to inquire about the Orton family and to Tichborne where he was shown over the house as an ordinary visitor. Roger Tichborne had been a slight man: the claimant weighed nearly 20 stone (280 lb.). Nevertheless Lady Tichborne made an affidavit that she recognized her son and she allowed him £1,000 a year until the trial. She died before the claim came before the court. The trial took up the greater part of two years. England was divided between pro- and anti-claimants. But as the trial wore on and the claimant admitted that as far as he could remember Caesar and Virgil wrote in Greek, and went on to say that he had seduced the lady to whom Roger Tichborne had been engaged, there was a wave of sentiment against him. He lost his case and was sentenced to 14 years' penal servitude.

Company Frauds. — The list of company frauds is a very long one. The South Sea company was at first unwisely and aftenvard dishonestly managed. The South Sea bubble, as it was called, burst in 1720 ruining thousands of families. By fraudulent artifice the shares had been run up from £100 to £1,000. A parliamentary enquiry was held. and as a result John Aislabie, chancellor of the exchequer, and several members of parliament were expelled from the house (see SOUTH SEA BUBBLE). The crash had followed the collapse of John Law's (*q.v.*) bubble in France.

The London and Globe company frauds of the early 1890s were the work of Whitaker Wright, an Englishman who had spent many years as a mining engineer in Philadelphia. Pa. He returned to England in 1880 and began at once to float companies, concealing his frauds under a cloud of complicated details. The directors of the London and Globe company were puppets in his hands and believed everything that he told them. The crash came in 1903, when Wright was charged with issuing a fraudulent balance sheet. While the judge was passing sentence Wright swallowed cyanide of potassium.

A large fraud which occurred between 1919 and 1922 was the case in which Gerald Lee Bevan, a stock broker and director of the City Equitable Fire Insurance company, attempted to defraud the shareholders of that and subsidiary companies for several years by showing that the company nas in a sound financial position whereas it was hopelessly insolvent. He was charged with fraudulently converting more than £200,000 and. further, with obtaining sums on the false prospectuses which he issued.

Turf Frauds. — Conspicuous among the turf frauds was the case of Henry Benson. His father was a prosperous merchant, and he had an excellent education. Having already served a sentence for an impudent fraud in London, he advertised for employment as a linguist and was engaged by a certain William Kurr, who was concerned in dubious turf business. With the help of Benson's ingenuity and education, a criminal organization was built up. Kurr was under police suspicion, and therefore Benson set to work to suborn the police. He bought over three chief inspectors at Scotland Yard, all of whom were concerned in watching Benson's new activities in France. By means of a fabricated copy of a sporting paper. he induced French investors to trust him with their money. The French government pressed for the arrest of the snindlers. and the police warned Benson of his danger. It was too late; he. Kurr and his police confederates were arrested and sentenced. On release in 1887, Benson and Kurr crossed to America where they prospered as bogus company promoters. Subsequently Benson was found exploiting mines in Brussels, Belg., but, after a term in a Belgian prison, he went to Geneva as an American banker, So well did he play his part that he won the heart of the daughter of a retired Indian army officer whom he induced to part with all his capital in return for worthless scrip. He was arrested. but on his rélease he turned up in Mexico personating Madame Patti's agent and "netted" £5,000 in advance bookings. Arrested in New York city, he committed suicide. He was then still under 40.

An interesting example of this type of fraud was that attempted in July 1953 by a Maidenhead bookmaker with London offices, who with his three confederates endeavoured to scoop about £60.000 by substituting a tried sprinter for a mediocre racehorse in the Spa Selling Plate at Bath racecourse, a procedure called "ringing" in racing slang. Two horses similar in colour and size and unknown to English racegoers were purchased in France. The better horse. Santa Amaro. and the other horse, Francasal. a poor selling plater, were brought to England together; and, entered for the race in Francasal's name. Santa Amaro ran and won easily Starting price odds of 10 to 1 against were laid by the bookmakers because of Francasal's known poor form and because of the precautions taken by the "ringers" to conceal the large amount staked by spreading their bets over a great number of bookmakers off the racecourse. However. the severing of a main telephone cable just before the race (which prevented telephonic communication between bookmakers off and on the course that might have affected the starting price) aroused suspicion. and before the bets were settled the police began to make inquiries which led to the trial of the confederates at the Old Bailey in Jan. 1954. Their defense, that the switching of the horses was the mistake of a horse transporter, was not believed and they mere sentenced to varying terms of imprisonment.

Miscellaneous Frauds. — The Rev. William Dodd, a canon of Brecon and chaplain to George III. obtained funds from moneylenders by forging the signature of his former patron, Lord Chesterfield. Nothing might have been heard of the transaction had the document not been shown to Lord Chesterfield who denied its authenticity and allowed the forger to be arrested. In his extremity Dodd refunded the money. Nevertheless he was convicted. though with a strong recommendation to mercy. He was a fashionable clergyman of the day and a noted preacher and courtier. All London joined in a petition to the king, Dr. Johnson himself became his champion, but with King George III they cried to deaf ears. The poor chaplain was hanged at Newgate, pouring forth paeans of praise upon the king.

The Victory Bond scheme for which Horatio Bottomley was sentenced to a term of seven years' penal servitude in May 1922 was an ingenious method of exploiting patriotic enthusiasm and the gambling instinct at the same time. The Victory Bonds were issued by the government at £5: Bottomley invited subscribers at £1 or more, on the understanding that the interest should be drawn for as a lottery and the capital investment should remain intact. So strong was the bait that about 30.000 people trusted him with their money at the rate of £10,000 a day. He was forced to take action for criminal libel but on counsel's advice he offered no evidence at the trial. He was finally prosecuted for fraud and was found guilty on 23 out of 24 counts of the indictment for sums totalling £150,000, but he probably acquired a total of about £5,000,000 with the aid of his companies.

One of the most impudent frauds which amused the public considerably was that perpetrated under the pseudonym of D. S. Windell. In the autumn of 1908, 13 branches of one of the larger banks received an "advice transfer note" purporting to come from the Harlesden branch of the bank. This note advised each of the recipients that an account in the name of Davitt Stanley Windell was being transferred. The note was apparently genuine and was authenticated with a code number and suitable details. The following day, a smart young man called at 8 of the 13 branches, gave the name of D. S. Windell and drew cash It was only when the transfer failed to materialize that it was discovered that no such account existed at Harlesden and that the note mas a forgery. It mas realized that some party to the fraud must have an intimate knowledge of bank procedure and in due course a man was arrested who was in fact a cashier of another branch of the bank. He had considered that, in view of the poor pay which he alleged he received, he was entitled to obtain the money from his employers by any means.

Ivar Kreuger. the Swedish "match king." was responsible for fraud on an unprecedented scale. After World War I, when he was managing director of the Swedish Match company, he arranged loans, totalling more than £50,000,000, to many European states in exchange for match monopolies. To raise these loans, Kreuger resorted to bribery and downright forgery in order to make the bargains sufficiently attractive to his investors. At first his credit with the banks was excellent. but as he needed still more money and the banks needed greater security, Kreuger wrote up nonexistent assets and supported them by book transfers. He maintained dummy companies and even founded banks to deal with his transactions. He forged large quantities of scrip, but his most notorious forgery was of £28,500,000 Italian treasury bonds. Technically his forgeries were simple and of little interest. Kreuger was successful because no one doubted him. As his schemes grew greater, Kreuger became desperate for money. In 1932 the Swedish banks refused him further credit and Kreuger went to America in an attempt to raise £20,000,000. He failed, and in his absence the banks proposed a further credit on condition that they might investigate his affairs. Kreuger was finished and in March 1932 he shot himself, ruining thousands.

Possibly the largest single conspiracy in England was that brought to justice in the fire-raising trial in 1933. It was fraud in the grand style. More than 20 people were eventually convicted, 2 others committed suicide, and property worth hundreds of thousands of pounds was involved. The method was simple. One of the conspirators would acquire a business which was quickly stocked with goods, often of an inferior value. Insurance cover would be arranged, and in a short time the premises would be set on fire, and in due course an insurance claim followed. Salvaged stock would then be used at a new business where it was given the appropriate name of "old soldiers" because it had already been under fire. Again a fire would occur, and an insurance claim would follow, supported by fraudulent invoices so as to inflate the value of the stock held at the time of the fire. The conspiracy continued for several years, and investigation on behalf of the insurance companies was long and involved. The main trial of 17 conspirators lasted for 32 days, and the sentences ranged from 14 years' imprisonment downward.

Another famous fraud is that perpetrated in 1929 by a group of men led by an able financier who conducted a financial organization in the City of London which was approached by the councils of certain boroughs who wished to raise loans. The loans were raised by the group as required but, instead of restricting the issue of scrip to that covered by the loan, they issued duplicate certificates so that no less than £700,000 was acquired fraudulently.

Modern legislation tries hard to protect the fool from his folly; but it is always faced with the difficulty of doing so without interfering with legitimate trade. There is no protection from the wily fraudsman except an inquiring mind which demands confirmation of any story however plausible. New schemes for parting a man from his money are concocted every day, and though it might be thought that the story of a Spanish prisoner writing from a Spanish castle that he requires a little money to free a fortune had been sufficiently publicized in the press to prevent anyone believing such a story, in 1953 its modern version — of a chest of jewels behind the "iron curtain" — secured its victim.

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UNITED STATES

More damage is done to the U.S. pocket and purse by so-called white-collar racketeers in a single year than by all of the armed thugs in a lifetime of violence. Few people have gone through life anywhere in the United States without having been mulcted or defrauded more than once.

Dubious investments, products and services are apparently marketed in the U.S. more expeditiously than anywhere else in the world. Perhaps because U.S. history contains so many success stories of persons grown fabulously rich from humble beginnings, the U.S. investor has seemed always ready to take a chance on a new "get rich scheme" or to give credence to a "something for nothing" offer. His innate gullibility and his generally high standard of living have also helped to make the American an especially easy and lucrative mark for the professional swindler.

While the word fraud, in its legal sense, has a strictly limited meaning applicable only in cases where guilt has been established under rules of evidence and law, the word may also be applied in its looser sense to the many types of ventures which, while not provable violations of law, depend nevertheless on guile and deceit to part the investor and consumer from his earnings and savings. These schemes, operating cleverly on the borderline of illegality but only rarely overstepping the line, are by far the more numerous, effective and widespread. In the sections below, both types of frauds will be discussed and illustrated.

MERCHANDISE FRAUDS

Rackets and frauds always follow the trend of the times and capitalize on people's natural desires. In the generation following the stock market crash of 1929, the investment boom declined. As the country lifted itself out of the depression of the 1930s and the American people began once again to accumulate extra savings, their interest shifted to the newly developed products which were being produced by fast-growing industry. Instead of seeking to put their money into stocks, bonds and other financial investments. they turned to automobiles, washing machines, refrigerators and television receivers, and the adaptable professional swindler turned with them. For this reason, merchandise frauds, some of which are described below, have grown substantially in extent and importance.

"Bait and Switch."—This type of scheme constitutes one of the most subtle and widespread merchandise frauds in the U.S. The scheme consists of advertising a product at a ridiculously low price simply as a lure to gain entrance into the prospect's home or to entice him to the advertiser's place of business. When the prospect responds to the advertisement, the salesman disparages the advertised product and makes a high-pressure attempt to switch him to a much more expensive one which is frequently an unknown, inferior and overpriced brand. If the prospect insists on the advertised product. the salesman may refuse to take his order or, if he does, delivery is rarely made.

"Bait and switch" tactics are used in the sale of a variety of products but particularly in connection with certain household appliances, which are often sold through demonstration in the home. In the case of the low-priced special "bargain" it has been found that the demonstration model was deliberately tampered with to impair its efficiency. One company, for example, followed the practice of removing a vital part from its demonstrator model, resulting in a reduction of performance to $ of its normal capacity. This was deliberately done so that the prospect would find the advertised machine so completely unacceptable as to be readily switched to the high-priced machine which the salesman "just happened to have in his car."

Fake Contests.—These have been widely used for promoting the sale of inferior merchandise at high prices. Such contests take many forms but are characterized by the fact that every contestant wins the "prize" and the award is usually a credit voucher applicable to the purchase of some piece of merchandise. One common type is the so-called "mystery melody" contest. Melodies are played on the radio and listeners are told, for example, that the first 25 persons who send in the name of the melody will receive a $50 credit applicable to the purchase of certain merchandise. The melodies played are simple, familiar tunes which are known to almost every schoolchild.

As a further indication of the falsity of the contest, tests have shown that persons sending in incorrect answers also "win" the prize. There is, of course, no limit on the number of "winners." In all of these cases, the price has been marked up in advance so that the application of the $50 credit would result in a price which is no lower and often higher than the normal selling price for the merchandise.

Door-To-Door Selling.—While the honest door-to-door salesman plays an important part in the distribution of goods and usually represents highly respectable and reputable companies, this method of selling has been subject to many frauds and abuses. The young salesman who is "working his way through college" or, as he grows older, is "working his way through medical school" was, after the end of World War II, joined by the "wounded war veteran" who uses this fictitious appeal to gain the sympathy of his potential victims. As the market survey became an important technique of business research, many door-to-door salesmen also adopted the guise of the survey taker. After going through the motions of taking a survey by asking the housewife some questions about the soap powder she uses or the magazines she reads, for example, the "survey taker" offers her a "gift" for her cooperation—merchandise "valued at" $150 for only $50. The actual value, however, may be less than half of $50.

Another common fakester is the door-to-door house-improvement salesman who claims that the prospect's house is the first approached in the area and that, if he will agree to have his home repaired or improved at a special bargain price and permit it thereafter to be used as a model for others in the neighbourhood to view, the property owner will receive a $50 bonus for every additional job done in that area. Such promises are never included in the formal contract and are seldom fulfilled.

Fake Jewellery Salesmen.—These have used a reprehensible method to sell watches to illiterate industrial, restaurant and hotel workers. They approach their victims during their lunch hours at their places of employment or after work and show them gaudy watches at "bargain" prices. The salesman suggests to the victim that he wear the watch a day or two and show it to his friends and family before making up his mind. All that is required, says the salesman, is the signing of an overnight receipt so that he can account for the watch to his employer. If the victim is gullible enough to sign the "receipt," he subsequently finds that what he has actually signed is a firm contract for the purchase of the watch on instalment payments and that the agreement also gives the firm the right to attach his wages if he does not keep up his payments.

"Going-out-of-business" Sales.—An old and time-worn trick of unscrupulous merchants is the fake going-out-of-business sale, Such tricks are used particularly by certain merchants located in sections of large cities frequented by out-of-towners who have no way of knowing that the merchant is perpetually closing out his business.

In many U.S. communities, laws have teen enacted requiring the special licensing of all "going-out-of-business sales," their duration being strictly limited.

Certain types of merchandise frauds which formerly enjoyed widespread success but were largely eliminated through legislation and special precautionary measures are worth mentioning for their historical interest in famous frauds. Two of these are described below.

Stuffed Flats.—Dealers in furniture, furs, jewellery, etc., rent an apartment and pose as private parties obliged to sell their furnishings and belongings at great sacrifice. The apartments are actually furnished from the dealer's own stocks. The merchandise is grossly misrepresented, exhorbitant prices are charged, and the flats regularly "restuffed."

Suit Clubs.—Suit club swindles require the payment to the promoter of $1 or $2 per week for 25 weeks or more for the "chance" of winning a suit in one of the weekly lucky drawings. It is understood that those whose numbers are not drawn are to receive a suit anyway upon the completion of their payments. Actually, very few legitimate drawings are held. The suit which the member of the club gets at the completion of his payments is made of the shoddiest material and is worth far less than the total amount paid in. Operators of the clubs often abscond before the end of the payment period.

COMMERCIAL FRAUDS

"Clip-and-paste" Schemes.—While possessed of greater business judgment and acumen than the ordinary consumer, the businessman himself is the victim of a surprising number of frauds and rackets, usually the result of his own carelessness. One of the most common promotions by which businessmen are duped is the "clip-and-paste" directory. In this scheme, a promoter of an obscure trade directory with little or no circulation clips a company's advertisement or listing from a well-known and recognized directory and pastes it on an invoice form of his own. The form is cleverly prepared and worded, usually cluttered with print and marked "Rush" and "Final Proof" in bold letters. In most respects, the form looks like a renewal invoice from the directory in which the advertisement was originally published. The careless businessman approves the invoice and sends his remittance in the belief that he is simply renewing his previous advertisement.

Homework Schemes.—An advertisement appears offering earnings as high as $50 per week for addressing envelopes at home or for doing home embroidery work. Persons who respond are asked to send in from $2 to $5 as evidence of their "good faith," or to cover the cost of a "working kit," this cost to be reimbursed to the respondent out of future "earnings."

In actual fact. these homework offerings usually involve the addressing of envelopes by the respondent as part of a plan whereby he attempts to sell merchandise which he must purchase from the advertiser, or an attempt on the part of the promoter to sell kits and equipment to respondents.

"Death Vultures," also known as "hearse chasers," victimize recently bereaved families by attempting to collect payment for items which they falsely claim had been ordered or purchased by the deceased just before his demise. In their grief. the family frequently fails to check the claim and pays the bill. Other "hearse chasers" send C.O.D. packages addressed to the deceased. The family pays for the goods believing the deceased had ordered them before his death.

Gardening Rackets.—Spring is the time of the year for gardening frauds—quack tree surgeons, fake seed salesmen and illegitimate humus peddlers. Housewives are approached by truckmen with loads of "fine humus" for lawns. The truckman offers to spread the material on the lawn at a cost of 75 cents a basket. Scattering some sample baskets as a demonstration of how little is needed, the truckman receives permission to proceed. The housewife goes about her chores and when the job is done she is presented with a bill of $150. Although greatly chagrined. she usually feels she has no choice hut to pay. In many cases, laboratory analysis of the "fine humus" discloses it to be entirely worthless as a lawn invigorator.

Radio and Television Repair Schemes.—Advertisers of television and radio receiver repair service in the home at ridiculously low prices often follow the practice of removing the receiver to their shops even when the repair is a simple one which can easily be performed in the home. They finally return the set with a large bill for repairs for work never needed and never done. Some unscrupulous service companies of this nature have been trapped by the police by calling them in to repair sets which had previously been prepared by experts so that one small tube and nothing more required replacement. Identification marks were placed on each of the tubes and parts. Subsequently. when the crooked company rendered a bill for the replacement of parts which examination of the set showed were never replaced, criminal proceedings were instituted.

Child Model Schemes.—Agents approach mothers with the tale that their children had been observed at play and appeared, in the opinion of the agent, to be remarkably precocious and attractive. The agent paints a picture of a large unsatisfied demand for child models to pose for advertisements which could easily make the child the family breadninner. An additional inducement is the enticing suggestion that the child may even find his way to Hollywood to star in motion pictures. For a $50 listing fee, the child's photograph is included in a catalogue which, states the agent, is circulated to all of the "right people." While the catalogue is actually produced and distributed, it carries no weight and receives little attention from persons in a position to employ child models. In only the rarest case does a child earn any money as a result of inclusion in the catalogue and in practically no case do the earnings even repay the cost of inclusion in the catalogue.

Song Sharks.—These are "song publishing" companies which, for a fee. will accept for publication any song submitted by a hopeful but, regrettably, untalented songwriter. The song shark fulfills his contractual obligation by obtaining copyrights and by printing a handful of copies of the song. It has been estimated that approximately 1% of all songs copyrighted and published in the United States ever achieve success. Legitimate publishers do not require the payment of a publishing fee.

Charity Frauds.—In the 1950s it was estimated that Americans were unknowingly contributing approximately $100,000,000 a year to corrupt and fraudulent appeals made in the name of charity. Using the mails. personal canvass and "boiler rooms" (batteries of telephones at which professional solicitors make calls to persons listed on carefully prepared "sucker" lists) the charity fraud became one of the most lucrative fields of endeavour for the white-collar underworld. Many of the erstwhile operators of financial swindles, with their financial operations restricted by government legislation, turned to the greener pastures of charity solicitations.

Charity frauds may be divided into two categories: those appeals conducted by crooked promoters in behalf of a nonexistent charity in which they pocket all of the funds collected; and the more subtle and widespread procedure of obtaining permission of an established charity to use its name, thus giving the solicitation an aura of respectability and legitimacy, in which the promoter turns over a small part to the charity instead of keeping all for himself.

In 1953 a joint legislative committee of the New York state legislature conducted public hearings into charity rackets The report issued at the conclusion of its investigation exposed a large organization of wounded veterans as having collected more than $21,000,000 in a three-year period. Of this sum, the report showed. $14,000,000 was used to pay promoters and to cover other fund-raising expenses. This organization had been using the names of the president of the United States and a farmer president in its fund-raising campaigns. A national organization which based its appeal on rendering assistance to children raised almost $4,000,000, of which $3,250,000 was consumed in fund-raising expense. A cancer hospital which existed purely in the mind of the promoter was able to collect $630,000 in its nation-wide solicitations. Another prevalent solicitations racket exposed by the committee was the operation of a self-styled "bishop" who sent six "nuns" out into the streets every day to solicit funds. No church received any benefit. The "bishop" received $2.50 a day from the "nuns" in return for which he gave them a certificate as evidence that they were solicitating funds for his church. None of the paid solicitors were actually nuns. They would come to the church in the morning in their street clothing, change into a nun's habit and then go out with little metal trays to solicit funds. At the end of the day they would come back to the church, change their clothes and go home. All they collected over $2.50 was clear profit to themselves.

FINANCIAL FRAUDS

In the period between the end of World War I and the stock market crash of 1929, financial frauds reached a volume and a degree of success never equalled before or after in the U.S. According to Andrew Mellon, secretary of the treasury during most of this period, the annual American loss in financial ventures alone in those years was $1,700,000,000. One flourishing business in itself was the marketing of "sucker lists" of persons who had already been victimized, on the theory that these were the best potential subjects for future "fleecing." In the aftermath of the 1929 collapse, the United States congress enacted a series of laws designed to protect the public from fraudulent and speculative investments. A federal agency, the Securities and Exchange commission, was established to administer the laws and to require the registration of security offerings. Many states adopted similar local requirements. The result was that while investment frauds still continued to appear from time to time, most of the free and easy stock swindles of the 1920s became extinct. No record of the subject of frauds would be complete, however, without some reference to two of the more famous frauds of the roaring 1920s.

The Ponzi Scheme.—During its relatively short existence, the swindle operated by Charles Ponzi was one of the most remarkable individual operations in the history of fraud. Beginning in Dec. 1919 Ponzi, who had served a previous prison sentence for forgery, produced a scheme involving the purchase of International Postal Reply coupons in countries where the exchange was low, trading them in for postage stamps at their face value in a country where the rate was high, and then selling the stamps at a great profit. International Postal Reply coupons were an instrumentality or device of the international bureau of the Universal Postal union which stipulated that the coupons were to be sold at a price not less than 28 centimes gold. The slogan of the swindle was 40% in 90 days. In its first month of operation, there were only 15 customers whose investment totalled $870. In the third month, there were 17 people contributing $5,290. In the fourth month, 110 customers invested a total of $24.724. In the sixth and last month the swindle reached its final fantastic proportions—20,000 individuals invested nearly $10,000,000. In fact Ponzi could not have done what he was promising to do even if he had bought the coupons. Actually, however, Ponzi made no purchases whatever of International Postal Reply coupons. When the bubble finally burst, the investors had lost all the money they had entrusted to Ponzi, and he himself was sentenced to a federal prison where he spent the next five years.

Tipster Sheets, of which there were at one time at least 50 in existence on the eastern seaboard alone, were publications put out by crooked stock promoters who pretended to furnish unbiased advice on investments. Almost everything in a tipster sheet was true and almost all of the advice obviously sound, thus creating an atmosphere of responsibility. The sole reason for publishing the sheet, however, was the advice it contained to buy a certain stock which the publisher was trying to unload. The most notorious and successful tipster sheet was the *Wall Street Iconoclast*, a biweekly publication of George Graham Rice, who subsequently served a term in a federal penitentiary in connection with one of the fraudulent stocks he successfully sold with the help of his tipster sheet. Among other things, the *Wall Street Iconoclast* attacked financial swindlers and warned its readers against them. So plausible were the writings contained therein that a professor in one university was found using it as a periodical for instruction in his classes on financial and economic subjects.

REAL ESTATE FRAUDS

The Free Lot Scheme.—In this scheme the victim is informed he has won a "free" lot, and he and his wife are taken by the salesman to see the new home site they have so luckily acquired. They find, however, that the lot they have "won" has a completely undesirable location. The salesman then persuades the victim to accept a $100 "allowance" on the "free" lot to be deducted from the sale price of a more desirable one. The price of the second lot is, of course, inflated to absorb the allowance and, frequently, much more.

Advance Fee Schemes.—Certain crooked real-estate firms demand a fee in advance to cover their "expenses" in selling their client's property. No real effort is made to sell the property, however, and the agent simply pockets the advance fee. This scheme has also had application in connection with attempts to locate living accommodations, especially in areas where housing is scarce. The applicant pays the "agent" a $50 advance fee for help in finding a suitable apartment or house. If the quest is successful, he is told, the $50 will be kept by the agent as his fee. If not, the applicant may at any time request the return of $40, the remaining $10 being retained by the agent for his troubles. The unscrupulous agent makes no bona fide effort to locate accommodations for his applicants, but nets the $10 "service" fees.

Development Frauds.—One of the most spectacular real estate frauds in history involved real estate at Muscle Shoals, Ala. During World War I a gigantic project to manufacture nitrates was started there by the government. together with the Wilson dam and its hydroelectric system. The project was not completed until the early 1920s—too late to be of any value in the war. Nevertheless, capitalizing on the publicity that accompanied the project, a group of promoters bought up surrounding farm land, divided it up into city lots, and proceeded to unload them on the public at prices far in excess of the actual value of the land. Thousands of unwary investors were victimized.

MIXED FRAUDS AND CONFIDENCE GAMES

The "Spanish Prisoner Fraud."—Many frauds. although exposed over and over again, continue to reappear, sometimes with slight variations. One which constantly recurs in different sections of the United States is the "Spanish prisoner" letter. This particular swindle is of historical interest as one of the oldest of international frauds and is said to have been started in 1588. The writer of the letter states he is a prisoner in Spain or Mexico and has $200,000 in cash which he will divide with the victim if he will advance the money necessary to purchase his release. Frequently, an alluring señorita is also a part of the bait.

Missing Heirs.—One of the most successful confidence swindles is based on a fortune allegedly left unclaimed at the time of the owner's death. The confidence man convinces his victim that he is the rightful heir to the estate and is usually able to extract substantial sums to cover the supposed expenses of establishing the rightful proprietorship. One of the best-known "missing heir" schemes revolved around Jacob Baker. For almost 100 years after his death, many persons named Baker were convinced by fakers that he had been the owner of most of the land on which Philadelphia was built and each of these Bakers was willing to pay to have their inheritance recovered. In 1937 a United States attorney established that Jacob Baker had died penniless. His alleged will. which fakers had used to dupe their victims, was proved a forgery.

Quack Doctors.—Fake medical men with counterfeit diplomas and quack cures are practitioners of one of the most dangerous of frauds, known to have produced the death of more than one gullible patient. What adds to the success of their masquerade is the willingness of their "patients" to speak of them in the most laudatory terms. Persons beyond middle age, for example, frequently develop harmless growths which are solemnly diagnosed by the quack as cancer. When simple caustics remove the growth, the patient goes home in fine health to serve henceforth as a living advertisement of an alleged cancer cure.

One of the most reprehensible frauds involving fake medical men is the "glimmer scheme" practised by quack eye doctors. The eye "doctor" and a confederate drive through rural areas and learn from talkative store keepers which farmers in the neighbourhood are having difficulty with their vision. The confederate, posing as a chauffeur, drives to the farmer's house and stops for water. Pretending to notice the farmer's eye condition he confides that he is driving a famous eye surgeon to a convention in a near-by city. The chauffeur persuades the "doctor" to examine the victim's eyes. The gullible victim is told he suffers from cataracts and his eyesight is in danger, but that this can be cured by a simple operation. The farmer pleads for the surgeon to save his sight. The surgeon agrees reluctantly, pointing out that he is not licensed in that state. The farmer, however, agrees to keep the operation a secret. A harmless fake operation is then performed and a piece of egg membrane displayed to the farmer as the removed cataract. Numerous persons have paid $100 to $2,500 for such "operations." (*See* also QUACKERY; SALE OF GOODS.)

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FRAUENFELD, the capital of the Swiss canton of Thurgau, 27 mi. N.E. of Ziirich by rail, on the Murg stream a little above its junction with the Thur. Pop. 11,114. It has iron manufactures. The old upper town centres around the castle, of which the tower dates from the 10th century, though the rest is later. Both stood on land belonging to the abbot of Reichenau, who, with the count of Kyburg, founded the town, first mentioned in 1255.

FRAUENLOB, the name by which HEINRICH VON MEISSEN, a German poet of the 13th century, is generally known. He seems to have acquired the sobriquet because in a famous *Liederstreit* with his rival Regenbogen he defended the use of the word *Frau* (i.e., *frouwe,* "lady") instead of *Weib* (*wîp,* "woman"). Frauenlob was born about 1250 of a humble burgher family, but he gradually acquired a reputation as a singer at the various courts of the German princes. In 1278 we find him with Rudolph I in the Marchfeld, in 1286 he was at Prague at the knighting of Wenceslaus (Wenzel) II, and in 1311 he was present at a knightly festival celebrated by Waldemar of Brandenburg before Rostock. After this he settled in Mainz, and there according to the popular account, founded the first school of Meistersingers (*q.v.*). He died on Nov. 29, 1318.

Frauenlob's poems make a great display of learning; he delights in far-fetched metaphors, and his versification abounds in tricks of form and rhyme. They were edited by L. Ettmüller in 1843; a selection will he found in K. Bartsch, *Deutsche Liederdichter des 12. bis 14. Jahrhunderts,* 3rd ed. (1893). An English translation of Frauenlob's *Cantica canticorum,* by A. E. Kroeger, with notes, appeared in 1877. *See* A. Boerkel, *Frauenlob,* 2nd ed. (1881); Pfannmuller, *Frauenlobs Marienleich* (1913).

FRAUNCE, ABRAHAM (*c.* 1558–1633), English poet whose critical textbook *Arcadian Rhetorike* (1588) is original in illustrating each precept by a quotation from a classical, continental or English author. The English quotations are mainly from works by Sir Philip Sidney and from Spenser's *The Faerie Queene,* then unprinted, and show that these two poets had achieved fame while their chief works were still in manuscript.

A native of Shropshire, Fraunce was born between 1558 and 1560, and was educated at Shrewsbury school and St. John's college, Cambridge. He was called to the bar at Gray's Inn in 1588, and apparently practised in the court of the Welsh marches. His works include *Victoria,* a Latin comedy, edited by G. C. Moore Smith (1906); *The Lawiers Logike* (1j88); and *The Countess of Pembroke's Emanuell* (1591).

FRAUNHOFER, JOSEPH VON (1787–1826), German physicist, is best known for his study of the dark lines in the sun's spectrum, known by his name. He was born at Straubing in Bavaria on March 6, 1787. He gained experience as an optician and obtained work at the Utzschneider optical institute at Benedictbeuern, near Munich, of which he became sole manager in 1818; the institute was in 1819 moved to Munich. Fraunhofer acquired great skill in the manufacture of achromatic lenses and various optical instruments.

While measuring the refractive index of glass of various kinds, he noticed and made use of the D lines in the sodium spectrum, and continued work led to observation of "Fraunhofer lines." His researches were published in the *Denkschriften der Münchener Akademie* for 1814–1j. These dark lines had been noted earlier by W. H. Wollaston (*Phil. Trans.,* 1802), but were for the first time carefully observed by Fraunhofer. He mapped j76 of these lines, the principal of which he denoted by the letters of the alphabet from A to G; and by ascertaining their refractive indices he determined that their relative positions are constant, whether in spectra produced by the direct rays of the sun, or by the reflected light of the moon and planets. The spectra of the stars he obtained by using, outside the object glass of his telescope, a large prism through which the light passed to be brought to a focus in front of the eyepiece.

In 1823 he was appointed conservator of the physical cabinet at Munich, where he died on June 7, 1826.

FRAY BENTOS, a port on the Uruguay river and capital of the department of Rio Negro in Uruguay, was founded as Independencia in 1859. Pop. (1954 est.) 15,000. It became important when the first industrialized meat-packing plant in Uruguay was established there by G. C. Giebert in 1861, using the meat-extracting method invented by Baron Justus von Liebig. The industry grew rapidly, and Fray Bentos has a significant share of the nation's meat-packing trade, exporting the produce of its stock-raising hinterland. Its modern port is the deepest on the Uruguayan side of the Uruguay river. It has rail, road and air connections with Montevideo. (M. I. V.)

FRAYSSINOUS, DENIS ANTOINE LUC, COMTE DE (1765–1841), French prelate and statesman, was born of humble parentage at Curihres on May 9, 1765. He owes his reputation mainly to the lectures on dogmatic theology delivered in the church of Saint Sulpice, Paris, from 1803 to 1809. As court preacher and almoner to Louis XVIII., he later exercised great public activity and influence. In connection with the controversy raised by the signing of the reactionary concordat of 1817, he published in 1818 his *Vrais Principes de l'église Gallicane sur la puissance ecclksiastique.* The consecration of Frayssinous as bishop of Hermopolis "in partibus," his election to the French Academy, and his appointment to the grand-mastership of the university, followed in rapid succession. In 1824, he became minister of public instruction and of ecclesiastical affairs under the administration of Villèle; and about the same time he was created a peer of France with the title of count. In 1828 he, along with his colleagues in the Villhle ministry, was compelled to resign office, and the subsequent revolution of July 1830 led to his retirement to Rome. He died at St. Géniez on Dec. 12. 1841. His lectures were published in 1825 as *Défense du Christianisme* (15th ed. 1843, Eng. trans. 1836).

See Bertrand, *Bibl. Sulpicienne,* t. ii, 135 *sq.;* iii, 253, for bibliography, and G. A. Henrion, *Vie de M. Frayssinous* (1844).

FRAZER, SIR JAMES GEORGE (1854–1941), British anthropologist and classical scholar who specialized in folklore and mythology, was born at Glasgow on Jan. 1, 1854, of a wealthy family. Educated at Helensburgh, Glasgow university and Trinity college, Cambridge, he was elected a fellow of Trinity in 1879 and in the same year was called to the bar, but never practised. In 1907 he became professor of anthropology at Liverpool university.

His fame as an author was established with the publication in 1890 of *The Golden Bough; A Study in Magic and Religion* (reissued in 12 vol., 1907–1j; abridged edition in one vol., 1922). This was a comparative study of myths and rituals that drew equally from ethnology, ancient history and European and oriental folklore. Frazer's data on ethnology were second hand and often inaccurate, but his theories on religion were stimulating and his work on folklore prodigious. He was knighted in 1914 and received many academic honours.

He died on May 7, 1941, in Cambridge.

Among his many other works were *Totemism* (1887); *Adonis, Attis, Osiris, Studies in the History of Oriental Religion* (1906. 3rd ed. 1914); *Totemism and Exogamy* (1910); *Aftermath, a Supplement to the Golden Bounh* (1936).

FRÉCHETTE, LOUIS HONORÉ (1839–1908), French-Canadian poet noted for his patriotic poems, was born at Lévis, across the St. Lawrence from Quebec city, on Nov. 16, 1839. He studied law at Laval university, Quebec, and was admitted to the bar in 1864. After a year spent at Lévis in radical journalism. he chose political "exile" from 1866 to 1871 in Chicago. where he edited *Amérique* for Franco-Americans. In *Mes Loisirs* (1863) he had exhibited the spell of the nationalist school of Quebec, led by Octave Crémazie (*q.v.*). Now he was inspired by Victor Hugo; in *La Voix d'un Exile'* (1866–1868) he attacked political and clerical dealings in Quebec in that period of Canadian confederation and voiced patriotism for France idealized as a republic. Returning to Lévis to enter politics, he suffered defeat in several elections but represented LCvis from 1874 to 1878 in the federal house of commons. From 1888 until his death on May 31, 1908, he lived in Montreal, traveling frequently to Quebec city to act as clerk of the provincial legislative council.

Meanwhile he had made literary history. *Les Fleurs Borkales et Les Oiseaux de Neige* (1879) were acclaimed in France and awarded the Prix Montyon in 1880—the first time the work of a Canadian had been crowned by the French Academy. Famous now, and representative of liberal nationalism, Fréchette wrote *La Le'gende d'un Peuple* (1887), conceived as the epic of French Canada in the manner of Hugo's *La Le'gende des Siècles*. Popular success drew criticism from his rivals, but left him with many honours and a secure place in French-Canadian letters. Some admirable, less pretentious poems may be found in the volumes mentioned and in *Pêle-Mêle* (1877), *Feuilles Volantes* (1891) and *Poésies Choisies* (1908). Fréchette's prose stories were published in *Originaux et Détraqués* (1892) and *La Noël au Canada* (1900; Eng. trans., *Christmas in French Canada*, 1899). He also wrote the polemical *Lettres à Basile* (1872) and the dramas *Félix Poutrk* (1871), *Papineau* (1880) and *Ve'ronica* (1908).

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(C. F. KK.)

FREDEGOND *(Fredigundis)* (d. 597), Frankish queen. Originally a serving-woman, she inspired the Frankish king, Chilperic I., with a violent passion. At her instigation he repudiated his first wife Audovera, and strangled his second, Galswintha, Queen Brunhilda's sister. A few days after this murder Chilperic married Fredegond (567). This woman exercised a most pernicious influence over him. She forced him into war against Austrasia, in the course of which she procured the assassination of the victorious king Sigebert (575); she carried on a malignant struggle against Chilperic's sons by his first wife, Theodebert, Merwich and Clovis, who all died tragic deaths; and she persistently endeavoured to secure the throne for her own children. Her first son Thierry, however, to whom Bishop Ragnemod of Paris stood godfather, died soon after birth, and Fredegond tortured a number of women whom she accused of having bewitched the child. Her second son also died in infancy. Finally, she gave birth to a child who afterwards became king as Clotaire II Shortly after the birth of this third son, Chilperic himself perished in mysterious circumstances (584). Fredegond has been accused of complicity in his murder, but with little show of probability, since in her husband she lost her principal supporter.

Henceforth Fredegond did all in her power to gain the kingdom for her child. Taking refuge at the church of Notre Dame at Paris, she appealed to King Guntram of Burgundy, who took Clotaire under his protection and defended him against his other nephew, Childebert II., king of Austrasia. From that time until her death Fredegond governed the western kingdom. She endeavoured to prevent the alliance between King Guntram and Childebert, which uas cemented by the pact of Andelot; and made several attempts to assassinate Childebert by sending against him hired bravoes armed with poisoned *scramasaxes* (heavy single-edged knives) After the death of Childebert in 595 she resolved to augment the kingdom of Neustria at the expense of Austrasia, and to this end seized some cities near Paris and defeated Theodebert at the battle of Laffaux, near Soissons. Her triumph, however, was short-lived, as she died quietly in her bed in 597 soon after her victory.

See V. N. Augustin Thierry, *Récits des temps mérovingiens* (Brussels, 1840), Ulysse Chevalier, *Bio-bibliographie* (2nd ed.), *s.v.* "Frédégonde."
(C. PF.)

FREDERIC, HAROLD (1856–1898), U.S. journalist and author, whose novel *The Damnation* of *Theron Ware* gained him his greatest fame, was born in Utica, N.Y., on Aug. 19, 1856. He received a respectable education by the standards of the time although he went to work at an early age. His first interests were photography and journalism, and by the age of 20 he was a reporter for the *Utica Observer;* by 1882 he was editor of the *Albany Evening Journal.* In 1884 he went to London as the correspondent for the *New York Times,* and remained there as an expatriate for the rest of his life. As a reporter. Frederic was able and courageous. In 1884 he made a hazardous tour investigating outbreaks of cholera in certain districts of southern France and Italy. In 1891 he visited Russia to investigate the persecution of the Jews. His novels fall into certain natural groupings because of their subject matter. *Seth's Brother's Wife* (1887) and *The Lawton Girl* (1890) draw upon his memories of upper New York state; *The Return of O'Mahoney* (1892), a fantasy, reflects Frederic's lifelong interest in the Irish; In *the Valley* (1890) is about the American Revolution; and *The Copperhead* (1893) and *Marsena and Other Stories* (1894) are concerned with the American Civil War. In 1896 he combined his memories of the Mohawk valley uith his interest in the meaning of American history to produce his best novel *The Damnation of Theron Ware* (published in England as *Illumination),* the story of the decline and fall of a young Methodist minister.

Frederic wrote three other novels (two of which were published posthumously) concerned with English life: *March Hares* (1896), *Gloria Mundi* (1898) and *The Market Place* (1899).
(J. H. RH.)

FREDERICIA (FRIEDERICIA), a seaport of Vejle, Denmark, near the southeast corner of Jutland, on the west shore of the Little Belt opposite the island of Fyn. Pop. (1955) 27,910. It has good railway communication, and a steam ferry connects with Middelfart, a seaside resort on Fyn. There is a considerable shipping trade. Industries comprise a railway works and the manufacture of tobacco, salt, chicory and cotton goods. A small fort was erected on the site of Fredericia by Christian IV of Denmark, and his successor, Frederick III determined about 1650 to make it a powerful fortress. The town first bore the name of Frederiksodde, and received its present designation in 1664. In 1657 it was taken by the Swedes and in 1659, after the fortress had been dismantled, it was occupied by Frederick William of Brandenburg. It was refortified in 1709–10. Monuments in the town and vicinity commemorate the fighting of 1849 with the Prussians. The fortress was strengthened again in 1864 and stood a short siege before the Austro-Prussian occupation of that year.

FREDERICK, "king or lord of peace" (Ger. *Friedrich:* Ital *Federigo;* Fr. *Frédéric* and *Fédéric*). A Christian name borne by many European sovereigns and princes.

FREDERICK I (c. 1123–1190), Holy Roman emperor, called "Barbarossa" or "Redbeard" by the Italians, was the son of Frederick II of Hohenstaufen, duke of Swabia, and Judith, daughter of the Welf Henry IX, duke of Bavaria. When his father died in 1147 Frederick became duke of Swabia, and immediately afterwards accompanied his uncle, the German king Conrad III, on his disastrous crusade, during which he won the complete confidence of the king. In 1152 the dying king advised the princes to choose Frederick as his successor to the exclusion of his own young son. Frederick was chosen German king at Frankfurt on March 5, 1152, and crowned at Aix-la-Chapelle on the 9th, owing his election partly to his personal qualities, and partly to the fact that he united in himself the blood of the rival families of Welf and Waiblingen.

The new king saw clearly that the restoration of order in Germany was a necessary preliminary to the enforcement of the imperial rights in Italy. Issuing a general order for peace, he was prodigal in his concessions to the nobles. Abroad Frederick decided a quarrel for the Danish throne in favour of Svend, or Peter as he is sometimes called, who did homage for his kingdom, and negotiations were begun with the East Roman emperor, Manuel Comnenus. About this time he obtained a divorce from his wife Adela, on the ground of consanguinity, and made a vain effort to obtain a bride from the court of Constantinople. On his accession Frederick had communicated the news of his election to Pope Eugenius III, but neglected to ask for the papal confirmation. But a treaty was concluded between king and pope at Constance in March 1153, by which Frederick promised in return for his coronation to make no peace with Roger II, king of Sicily, or with the rebellious Romans, without the consent of Eugenius, and generally to help and defend the papacy.

The journey to Italy made by the king in 1154 was the precursor of five other expeditions which engaged his main energies for 30 years, during which the subjugation of the peninsula was the central and abiding aim of his policy. He was crowned emperor at Rome on June 18, 1155. He left Italy in the autumn of 11jj to prepare for a new and more formidable campaign. Disorder was again rampant in Germany, especially in Bavaria, but general peace was restored by Frederick's vigorous measures. Bavaria was transferred from Henry II Jasomirgott, margrave of

Austria, to Henry the Lion, duke of Saxony; and the former was pacified by the erection of his margraviate into a duchy, while Frederick's step-brother Conrad was invested with the Palatinate of the Rhine. On June 9, 1156 the king was married at Wurzburg to Beatrix, daughter and heiress of the dead count of Upper Burgundy, Renaud III., when Upper Burgundy or Franche Comté, as it is sometimes called, was added to his possessions. An expedition into Poland reduced Duke Boleslaus IV. to submission, after which Frederick received the homage of the Burgundian nobles at Besançon in Oct. 1157.

In June 1158 Frederick set out upon his second Italian expedition, during which imperial officers called *podestas* in the cities of northern Italy, captured revolted Milan, and the long struggle began with pope Alexander III., who excommunicated the emperor on March 2, 1160. During this visit Frederick summoned the doctors of Bologna to Roncaglia in November 1158, and as a result of their inquiries into the rights belonging to the kingdom of Italy he obtained a large amount of wealth. Returning to Germany towards the close of 1162, Frederick prevented a conflict between Henry the Lion, duke of Saxony, and a number of neighbouring princes, and severely punished the citizens of Mainz for their rebellion against archbishop Arnold In 1163 his plans for the conquest of Sicily were checked by a powerful league against him provoked by the exactions of the *podestas* and the enforcement of the rights declared by the doctors of Bologna. Frederick had supported an anti-pope Victor IV. against Alexander, and on Victor's death in 1163 a new anti-pope called Paschal III. was chosen to succeed him. At a diet at Würzburg in May 1165 he took an oath, followed by many of the clergy and nobles, to remain true to Paschal and his successors. A temporary alliance with Henry II., king of England, the magnificent celebration of the canonization of Charlemagne at Xix-la-Chapelle, and the restoration of peace in the Rhineland, occupied Frederick's attention until Oct. 1166, when he made his fourth journey to Italy. Having captured Ancona, he marched to Rome, stormed the Leonine city. and procured the enthronement of Paschal, and the coronation of his wife Beatrix; but the sudden outbreak of a pestilence destroyed the German army and drove the emperor to Germany. During the next six years the imperial authority was asserted over Bohemia, Poland and Hungary. Friendly relations were entered into with the emperor Manuel, and a better understanding was sought with Henry II., king of England, and Louis VII., king of France.

In 1174, Frederick made his fifth expedition to Italy. The campaign was a complete failure. The refusal of Henry the Lion to bring help into Italy was followed by the defeat of the emperor at Legnano on May 29, 1176, when he was wounded and believed to be dead. He concluded with Alexander the treaty of Venice (Aug. 1177), and at the same time a truce with the Lombard league was arranged for six years. Frederick, loosed from the papal ban, recognized Alexander, and in July 1177 knelt before him and kissed his feet. The possession of the vast estates left by Matilda, marchioness of Tuscany, and claimed by both pope and emperor, was to be decided by arbitration, and in Oct. 1178 the emperor was again in Germany. Henry the Lion was deprived of his duchy, and sent into exile; a treaty was made with the Lombard league at Constance in June 1183; and Frederick's son Henry was betrothed in 1184 to Constance, daughter of Roger II., king of Sicily, and heiress of the reigning king. William II. This betrothal, which threatened to unite Sicily with the Empire, made it difficult for Frederick, when during his last Italian expedition in 1184 he met Pope Lucius III. at Verona, to establish friendly relations with the papacy. The question of Matilda's estates was left undecided; and Lucius had refused to crown Henry or to recognize the German clergy who had been ordained during the schism. Frederick then formed an alliance with Milan, where the emperor, who had been crowned king of Burgundy, or Arles, at Arles on July 30, 1178, had this ceremony r'epeated (Jan. 27, 1186); while his son Henry was crowned king of Italy and married to Constance, who was crowned queen of Germany.

The quarrel with the papacy was continued with the new pope Urban III., and open warfare was begun. But Frederick was recalled to Germany by the news of a revolt raised by Philip of Heinsberg, archbishop of Cologne, and instigated by the pope. Hostilities were checked by the death of Urban and the election of a new pope as Gregory VIII. In 1188 Philip submitted, and immediately afterwards Frederick joined the Third Crusade. He left Regensburg in May 1189 at the head of a splendid army, and having overcome the hostility of the Eastern Roman emperor Isaac Angelus, marched into Asia Minor. On June 10, 1190, Frederick was either bathing or crossing the river Calycadnus (Geuksu), near Seleucia (Selefke) in Cilicia, when he was drowned. The place of his burial is unknown, and the legend which says he still sits in a cavern in the Kyffhauser mountain in Thuringia waiting until the need of his country shall call him, is now thought to refer, at least in its earlier form, to his grandson, the emperor Frederick II. He left by his wife, Beatrix, five sons, of whom the eldest afterwards became emperor as Henry VI.

Frederick encouraged the growth of towns, easily suppressed the few risings against his authority, and took strong and successful measures to establish order in Germany. His power rested upon his earnest and commanding personality, and also upon the support which he received from the German church, the possession of a valuable private domain, and the care with which he exacted feudal dues from his dependents. Even in Italy, though his general course of action was warped by wrong prepossessions, he in many instances showed exceptional practical sagacity in dealing with immediate difficulties and emergencies. From the beginning, however, he treated the Italians, as indeed was only natural, less as rebellious subjects than as conquered aliens.

In appearance Frederick was a man of well-proportioned, medium stature, with flowing yellow hair and a reddish beard. He delighted in hunting and the reading of history, was zealous in his attention to public business, and his private life was unimpeachable. Carlyle called him "a terror to evil-doers and a praise to well-doers in this world, probably beyond what was ever seen since."

The principal contemporary authority for the earlier part of the reign of Frederick is the *Gesta Friderici imperatoris,* mainly the work of Otto, bishop of Freising. This is continued from 1156 to 1160 by Rahewin, a canon of Freising, and from 1160 to 1170 by an anonymous author. The various annals and chronicles of the period are to be found in the *Monumenta Germaniae historica. Scriptores* (Hanover and Berlin, 1826–92); many valuable documents are found in the *Monumenta Germaniae selecta,* vol. iv., edited by M. Doeberl (Munich, 1889–90).

See also, J. Jastrow, *Deutsche Geschichte im Zeitalter der Hohenstaufen* (1893); *W*. von Giesebrecht, *Geschichte der deutschen Kaiserzeit,* vol. iv. (Brunswick, 1877); H. von Biinau, *Leben und Thaten Friedrichs I.* (Leipzig, 1872); H. Prutz, *Kaiser Friedrich* I. (Dantzig, 1871–74); C. Peters, "Die Wahl Kaiser Friedrichs I." in the *Forschungen zur deutschen Geschichte,* vol. xx. (Gottingen, 1862–86); W. Gundlach, *Barbarossalieder* (Innsbruck, 1899). For a complete bibliography *see* Dahlmann-Waitz, *Quellenkunde der dezrtschen Geschichte* (Gottingen, 1894), and U. Chevalier, *Répertoire des sources historiques du moyen âge,* vol. iii. (1904). *See* further W. Stubbs, *Germany* in *the Early Middle Ages* (1908), and *Germany in the Later Middle Ages* (1908).

FREDERICK II. (1194–1250), Holy Roman emperor, king of Sicily and Jerusalem, was son of the emperor Henry VI. and Constance of Naples, daughter of Roger I., king of Sicily, and therefore grandson of the emperor Frederick I. Born at Jesi near Ancona on Dec. 26, 1194, and chosen German king at Frankfort in 1196, he was baptized Frederick Roger, and after his father's death crowned king of Sicily at Palermo on May 17, 1198. His mother, who assumed the government, died in November 1198, leaving Pope Innocent III. as regent of Sicily and guardian of her son. In 1208 he was declared of age, and in 1209 he married Constance, daughter of Alphonso II. king of Aragon, and widow of Emerich or Imre, king of Hungary. In September 1211, a number of influential German princes met at Nuremberg, declared Otto IV. deposed, and invited Frederick to come and occupy the vacant throne. He accepted the invitation; and having recognized the papal supremacy over Sicily, and procured the coronation of his son Henry as its king, he reached Germany in the autumn of 1212. Frederick was welcomed in Swabia, and the renown of the Hohenstaufen name and a liberal distribution of promises made his progress easy. He was chosen German king a second time at Frankfort on Dec. 5, 1212, and crowned Dec. 9, at Mainz. Anxious to retain the pope's support, Frederick promulgated a bull at Eger on July 12, 1213, by which he renounced all lands claimed by the pope since the death of the emperor Henry VI. in 1197, gave up the right of spoils and all interference in episcopal elections, and acknowledged the right of appeal to Rome. He again affirmed the papal supremacy over Sicily, and promised to root out heresy in Germany. He had allied himself with Philip Augustus of France against Otto, and the victory of his French allies at Bouvines on July 27, 1214 greatly strengthened his position. He was crowned the German king at Aix-la-Chapelle on July 25, 1215. In May 1218 the death of Otto left him undisputed ruler of Germany. His son Henry was brought to Germany and chosen by the princes German king at Frankfort in April 1220, though Frederick assured the new pope, Honorius III., that this step, which would involve the future union of Sicily with Germany, had been taken without his consent. In August 1220 Frederick set out for Italy, and was crowned emperor at Rome on Nov. 22, 1220; after which he repeated the undertaking he had entered into at Aix-la-Chapelle in 1215 to go on crusade, and made lavish promises to the Church. The clergy were freed from taxation and from lay jurisdiction, the ban of the Empire was to follow the ban of the Church, and heretics were to be severely punished.

But Frederick was occupied until 1225 in restoring order in Sicily. The island was seething with disorder, but by stern and sometimes cruel measures the emperor suppressed anarchy. Meanwhile the crusade was postponed again and again; until under a threat of excommunication, after the fall of Damietta in 1221, Frederick definitely undertook to set out in August 1227. On Nov. 9, 1225, he married his second wife Iolande (Yolande or Isabella), daughter of John, count of Brienne, titular king of Jerusalem. She died in 1227. Frederick then himself assumed the title of king of Jerusalem. He then summoned a diet at Cremona, but the cities, watchful and suspicious, renewed the Lombard league and took up a hostile attitude. Frederick's reply was to annul the treaty of Constance and place the cities under the imperial ban; but he was forced by lack of military strength to accept the mediation of Pope Honorius and the maintenance of the status *quo.*

After these events, which occurred early in 1227, preparations for the crusade were pressed on, and the emperor sailed from Brindisi on Sept. 8. A pestilence, however, which attacked his forces compelled him to land in Italy three days later, and on the 29th of the same month he was excommunicated by the new pope, Gregory IX. The greater part of the succeeding year was spent by pope and emperor in a violent quarrel. Alarmed at the increase in his opponent's power, Gregory denounced him in a public letter, to which Frederick replied in a clever document addressed to the princes of Europe. The reading of this manifesto, drawing attention to the absolute power claimed by the popes, was received in Rome with such evidences of approval that Gregory was compelled to fly to Viterbo. Frederick again set sail for Palestine, where he met with considerable success, the result of diplomatic rather than of military skill. By a treaty made in February 1229 he secured possession of Jerusalem, Bethlehem, Nazareth and the surrounding neighbourhood. Entering Jerusalem, he crowned himself king of that city on March 18, 1229. These successes had been won in spite of the hostility of Gregory, which deprived Frederick of the assistance of many members of the military orders and of the clergy of Palestine. But although the emperor's possessions on the Italian mainland had been attacked in his absence by the papal troops and their allies, Gregory's efforts had failed to arouse serious opposition in Germany and Sicily; so that when Frederick returned unexpectedly to Italy in June 1229 he had no difficulty in driving back his enemies, and compelling the pope to sue for peace. By the treaty of San Germano (July 1230), the emperor, loosed from the ban, promised to respect the papal territory, and to allow freedom of election and other privileges to the Sicilian clergy. Frederick then pacified Sicily. In 1231 a series of laws were published at Melfi which destroyed the ascendancy of the feudal nobles. Royal officials were appointed for administrative purposes, large estates were recovered for the crown, and fortresses were destroyed, while the church was placed under the royal jurisdiction and all gifts to it were prohibited. At the same time certain privileges of self-government were granted to the towns, representatives from which were summoned to sit in the diet. In short, by means of a centralized system of government, the king established an almost absolute monarchical power.

In Germany, an entirely different policy was pursued. The concessions granted by Frederick in 1220, together with the Privilege of Worms, dated May 1, 1231, made the German princes virtually independent. All jurisdiction over their lands was vested in them, no new mints or toll-centres were to be erected on their domains, and the imperial authority was restricted to a small and dwindling area. A fierce attack was made on the rights of the cities. Compelled to restore all their lands, their jurisdiction was bounded by their city-walls; they were forbidden to receive the dependents of the princes; all trade gilds were declared abolished; and all official appointments made without the consent of the archbishop or bishop were annulled. A further attack on the Lombard cities at the diet of Ravenna in 1231 was answered by a renewal of their league, and was soon connected with unrest in Germany. About 1231 a breach took place between Frederick and his elder son Henry, who appears to have opposed the Privilege of Worms and to have favoured the towns against the princes. After refusing to travel to Italy, Henry changed his mind and submitted to his father at Aquileia in 1232; and a temporary peace was made with the Lombard cities in June 1233. But on his return to Germany Henry again raised the standard of revolt, and made a league with the Lombards in December 1234. Frederick, meanwhile, having helped Pope Gregory against the rebellious Romans and having secured the friendship of France and England, appeared in Germany early in 1235 and put down this rising without difficulty. Henry was imprisoned, but his associates were treated leniently. In August 1235 a splendid diet was held at Mainz, during which the marriage of the emperor with Isabella (1214–1241), daughter of John, king of England, was celebrated. A general peace (*Landfrieden*), which became the basis of all such peaces in the future, was sworn to; a new office, that of imperial justiciar, was created, and a permanent judicial record was first instituted. Otto of Brunswick, grandson of Henry the Lion, duke of Saxony, was made duke of Brunswick-Lüneburg; and war was declared against the Lombards.

Frederick was now at the height of his power. His second son, Conrad, was invested with the duchy of Swabia, and the claim of Wenceslaus, king of Bohemia, to some lands which had belonged to the German king Philip was bought off. The attitude of Frederick II. (the Quarrelsome), duke of Austria, had been considered by the emperor so suspicious that during a visit paid by Frederick to Italy a war against him was begun. Compelled to return by the ill-fortune which attended this campaign, the emperor took command of his troops, seized Austria, Styria and Carinthia, and declared these territories to be immediately dependent on the Empire. In January 1237 he secured the election of his son Conrad as German king at Vienna; and in September went to Italy to prosecute the war which had broken out with the Lombards in the preceding year. Pope Gregory attempted to mediate, but the cities refused to accept the insulting terms offered by Frederick. The emperor gained a great victory over their forces at Cortenuova (Nov. 27, 1237); but his failure to take Brescia in October 1238, together with the changed attitude of Gregory, turned the fortune of war. The pope had become alarmed by the project of marriage between the heiress of Sardinia, Adelasia, and Frederick's natural son Enzio, who afterwards assumed the title of king of Sardinia. But as his warnings had been disregarded, he made an alliance with the Lombards, and excommunicated (Mar. 20, 1239), the emperor. A violent war of words ensued. Frederick, accused of heresy, blasphemy and other crimes, called upon all kings and princes to unite against the pope, who on his side used his emissaries, a crowd of wandering friars, to preach rebellion in Germany. It was, however, impossible to find an anti-king. In Italy, Spoleto and Ancona were declared part of the imperial dominions, and Rome itself was threatened. A number of ecclesiastics proceeding to a council called by Gregory were captured by Enzio at the sea-fight of Meloria, and the emperor was about to undertake the siege of Rome when the pope died (August 1241). Germany was at this time menaced by the Mongols; but Frederick contented himself with issuing directions for a campaign against them, until in 1242 he was able to pay a short visit to Germany, where he gained some support from the towns by grants of extensive privileges.

Gregory's immediate successor, Pope Celestine IX., died soon after his election; and after a delay of eighteen months, during which Frederick marched against Rome on two occasions and devastated the lands of his opponents, one of his partisans, Sinibaldo Fiesco, was chosen pope, and took the name of Innocent IV. Negotiations for peace were begun, but the relations of the Lombard cities to the Empire could not be adjusted, and when the emperor began again to ravage the papal territories Innocent fled to Lyons. Hither he summoned a general council, which met in June 1245; but although Frederick sent his justiciar, Thaddeus of Suessa, to represent him, and expressed his willingness to treat, sentence of excommunication and deposition was pronounced against him. Accused by Innocent of violating treaties, breaking oaths, persecuting the church and abetting heresy, Frederick replied by an open letter rebutting these charges, and denouncing the clergy and threatening the confiscation of their wealth. In vain the mediation of the saintly king of France, Louis IX., was invoked. Innocent declared Frederick deposed, and ordered the Germans to elect a new king. War soon became general in Germany and Italy. Henry Raspe, landgrave of Thuringia, was chosen German king in opposition to Frederick in May 1246, but neither he nor his successor, William II., count of Holland, could drive the Hohenstaufen from Germany. In Italy, during the emperor's absence, his cause had been upheld by Enzio and by the ferocious Eccelino da Romano In 1246 a formidable conspiracy of the discontented Apulian barons against the emperor was crushed with ruthless cruelty. Suddenly news reached Frederick that Parma, a stronghold of the imperial authority in the north, had been surprised, while the garrison was off its guard, by the Guelphs. He therefore concentrated his forces on the city, building over against it a wooden town which, in anticipation of the success that astrologers had predicted, he named Vittoria. The siege was protracted, and finally, in February 1248, during the absence of the emperor on a hunting expedition, was brought to an end by a sudden sortie of the men of Parma, who stormed the imperial camp. The emperor's forces were destroyed or scattered; the treasury, with the imperial insignia, together with Frederick's harem and some of the most trusted of his ministers, fell into the hands of the victors. Thaddeus of Suessa was hacked to pieces by the mob; the imperial crown was placed in mockery on the head of a hunch-backed beggar, who was carried back in triumph into the city.

Frederick's old confidence had left him; he had grown moody and suspicious, and his temper gave a ready handle to his enemies. Pier della Vigna, accused of treasonable designs, was disgraced; and the once all-powerful favourite and minister, blinded now and in rags, was dragged in the emperor's train, as a warning to traitors, till in despair he dashed out his brains. Then, in May 1248. the tidings of Enzio's capture by the Bolognese broke the emperor's spirit. He retired to southern Italy, and after a short illness died at Fiorentino on Dec. 13, 1250, after having been loosed from the ban by the archbishop of Palermo. He was buried in the cathedral of that city, where his splendid tomb may still be seen. By his will he appointed his son Conrad to succeed him in Germany and Sicily, and Henry, his son by Isabella of England, to be king of Jerusalem or Aries, neither of which kingdoms, however, he obtained. Frederick left several illegitimate children: Enzio has already been referred to; Frederick, who was made the imperial vicar in Tuscany; and Manfred, his son by the beloved Bianca Lancia or Lanzia, who was legitimatized just before his father's death, and was appointed by his will prince of Tarento and regent of Sicily.

The character of Frederick is one of extraordinary interest and versatility, and contemporary opinion is expressed in the words *stupor mundi et immutator mirabilis*. Licentious and luxurious in his manners, cultured and catholic in his tastes, he united in his person the most diverse qualities. His Sicilian court was a centre of intellectual activity. Michael Scot, the translator of some treatises of Aristotle and of the commentaries of Averroes, Leonard of Pisa, who introduced Arabic numerals and algebra to the West, and other scholars, Jewish and Mohammedan as well as Christian, were welcome at his court. Frederick himself had a knowledge of six languages, was acquainted with mathematics, philosophy and natural history, and took an interest in medicine and architecture. In 1224 he founded the university of Naples, and he was a liberal patron of the medical school at Salerno. He formed a menagerie of strange animals: and wrote a treatise on falconry (*De arte venandi cum avibus*) which is remarkable for its accurate observation of the habits of birds.[1] It was at his court, too, that—as Dante points out—Italian poetry had its birth. Pier della Vigna there wrote the first sonnet, and Italian lyrics by Frederick himself are preserved to us. His wives were kept secluded in oriental fashion; a harem was maintained at Lucera, and eunuchs were a prominent feature of his household. His religious ideas have been the subject of much controversy. Frederick's rule in Germany and Italy was a failure, but this fact may be accounted for by the conditions of the time and the inevitable conflict with the papacy. In Germany the enactments of 1220 and 1231 contributed to the disintegration of the Empire and the fall of the Hohenstaufen, while conflicting interests made the government of Italy a problem of exceptional difficulty. In Sicily Frederick was more successful. He quelled disorder, and under his rule the island was prosperous and contented. Hi's ideas of government were those of an absolute monarch, and he probably wished to surround himself with some of the pomp which had encircled the older emperors of Rome. His chief claim to fame, perhaps, is as a lawgiver. The code of laws which he gave to Sicily in 1231 bears the impress of his personality, and has been described as "the fullest and most adequate body of legislation promulgated by any western ruler since Charlemagne." Without being a great soldier, Frederick was not unskilful in warfare, but was better acquainted with the arts of diplomacy. In person he is said to have been "red, bald and short-sighted," but with good features and a pleasing countenance. It was believed in Germany for about a century after his death that Frederick was still alive, and many impostors attempted to personate him. A legend, afterwards transferred to Frederick Barbarossa, told how he sat in a cavern in the Kyffhäusser before a stone table through which his beard had grown, waiting for the time for him to awake and restore to the Empire the golden age of peace.

The contemporary documents relating to the reign of Frederick II. are very numerous. Many of the more important ones are given in the *Historia diplonzatica Friderici II.*, edited by M. Huillard-Bréholles (Paris, 1852–61); *Acta imperii selecta. Urkunden deutscher Könige und Kaiser*, edited by J. F. Bohmer and J. Ficker (Innsbruck, 1870); *Acta imperii inedita seculi XIII. Urkunden und Briefe zur Geschichte des Kaiserreichs und des Königreichs Sicilien*, edited by E. Winkelmann (Innsbruck, 1880); *Epistolae saeculi XIII. selecta e regestis pontificum Romanorum*, edited by C. Rodenberg, tome i. (Berlin, 1883); P. Pressutti, *Regrsta Hotzorii papae III.* (Rome, 1888); L. Auvray, *Les Registres de Grégoire IX.* (Paris, 1890).

The best modern authorities are M. Huillard-Bréholles, *Vie et corr. de Pierre de la Vigne* (1865); F. von Räumer, *Geschichte der Hohenstaufen* (vols. iii. & iv., 5th ed., 1878); C. Kohler, *Das Verhältnis Kaiser Friedrichs II. zu den Päpsten seiner Zeit* (Breslau, 1888); W. von Giesebrecht, *Gesch. der deut. Kaiserzeit*, vol. v. (Leipzig, 1888); G. Blondel, *Etude sur la politique de l'empereur Frédéric II. en Allemagne* (1892); K. Hampe, *Kaiser Friedrich II.* (Munich, 1899); A. Folz, *Kaiser Friedrich II. und Papst Innocenz IV. ihr Kampf 1244–45* (rqoj); W. Cohn, *Das Zeitalter der Hohenstaufen in Sizilien* (1925).

FREDERICK III. (1415–1493), Holy Roman emperor—as Frederick IV.. German king; as Frederick V., archduke of Austria,—son of Ernest of Habsburg, duke of Styria and Carinthia, was born at Innsbruck on Sept. 21, 1415. After his father's death in 1424 he lived at the court of his uncle and guardian, Frederick ISr., count of Tirol. In 1435, together with his brother, Albert the Prodigal, he undertook the government of Styria and Carinthia. but there were constant feuds between the brothers, which lasted until Albert's death in 1463. In 1439 the deaths of the German king Albert II. and of Frederick of Tirol left Frederick

[1]First printed at Augsburg in 1596; German edition by Schöpffer. (Berlin, 1896).

the senior member of the Habsburg family, and guardian of Sigismund, count of Tirol. In the following year he also became guardian of Ladislaus, the posthumous son of Albert II., and heir to Bohemia, Hungary and Austria. On Feb. 2, 1440 Frederick was chosen German king at Frankfort, but, owing to his absence from Germany, the coronation at Aix-la-Chapelle was delayed until June 17, 1442.

Disregarding the neutral attitude of the German electors towards the papal schism, and acting under the influence of Aeneas Sylvius Piccolomini, afterwards Pope Pius II., Frederick in 1445 made a secret treaty with Pope Eugenius IV. This developed into the Concordat of Vienna, signed in 1448 with the succeeding pope, Nicholas V., by which the king, in return for a sum of money and a promise of the imperial crown, pledged the obedience of the German people to Rome, and so checked for a time the rising tide of liberty in the German church. Taking up the quarrel between the Habsburgs and the Swiss cantons, Frederick invited the Armagnacs to attadk his enemies, but after meeting with a stubborn resistance at St. Jacob on Aug. 26, these allies proved faithless, and the king soon lost every vestige of authority in Switzerland. In 1451 Frederick, disregarding the revolts in Austria and Hungary, travelled to Rome where, on March 16, 1452, his marriage with Leonora of Portugal was celebrated, and three days later he was crowned emperor by pope Nicholas. He was the last emperor crowned in Rome. On his return he found Germany seething with indignation. His capitulation to the pope was not forgotten; his refusal to attend the diets, and his apathy in the face of Turkish aggressions, constituted a serious danger; and plans for his deposition failed only because the electors could not unite upon a rival king.

In 1457 Ladislaus, king of Hungary and Bohemia, and archduke of Austria, died; Frederick failed to secure either kingdom, but obtained lower Austria, from which houever. he was soon driven by his brother Albert, who occupied Vienna. On Albert's death in 1463 the emperor united upper and lower Austria under his rule, but these possessions were constantly ravaged by George Poděbrad, king of Bohemia, and by Matthias Corvinus, king of Hungary. A visit to Rome in 1468 to discuss measures against the Turks with Pope Paul II. had no result, and in 1470 Frederick began negotiations for a marriage between his son Maximilian and Mary, daughter and heiress of Charles the Bold, duke of Burgundy. The emperor met the duke at Treves in 1473, when Frederick, unwilling to bestow the title of king upon Charles, left the city secretly, but brought about the marriage after the duke's death in 1477. Again attacked by Matthias, the emperor was driven from Vienna (1490), and soon handed over the government of his lands to Maximilian, whose election as king of the Romans he vainly opposed in 1486. Frederick then retired to Linz, where he passed his time in the study of botany, alchemy and astronomy, until his death on dug. 19, 1493.

Frederick was a listless and incapable ruler, lacking alike the qualities of the soldier and of the diplomatist, but possessing a certain cleverness in evading difficulties. With a fine presence, he had many excellent personal qualities, is spoken of as mild and just, and had a real love of learning. He contributed to the aggrandisement of his family by the marriage of Maximilian with Mary of Burgundy, and delighted to inscribe his books and other articles of value with the letters A.E I.O U. (*Austriae es imperare orbi universo;* or in German, *Alles Erdreich ist Oesterreich unterthan*). His tomb, in red and white marble, is in the cathedral of St. Stephen at Vienna.

See Aeneas Sylvius Piccolomini, *De rebus et gestis Friderici III.* (trans. Th. Ilgen, Leipzig, 1889); J. Chmel, *Geschzchte Kaiser Friedrichs IV. und seines Sohnes Maximilians I.* (Hamburg, 1840); A. Bachmann, *Deutsche Reichsgeschzchte im Zeitalter Friedrichs III. und Maximilians I.* (Leipzig, 2 vols., 1884–94); A. Huber, *Geschichte Österreichs* (Gotha, 1885–92).

FREDERICK II. (1534–1588), king of Denmark and Norway, son of Christian III., was born at Hadersleben on July 1, 1534. His mother, Dorothea of Saxe-Lauenburg, was the elder sister of Catherine, the first wife of Gustavus Vasa and the mother of Eric XIV. The two little cousins, born the same year, were destined to be lifelong rivals. At the age of two Frederick was proclaimed successor to the throne at the *Rigsdag* of Copenhagen (Oct. 30, 1536), and homage was done to him at Oslo for Norway in 1548. He married his cousin, Sophia of Mecklenburg, on July 20, 1572.

The reign of Frederick II. falls into two well-defined periods, one of war, 1559–70; and the other of peace, 1570–88. The period of war began with the Ditmarsh expedition, when the independent peasant-republic of the Ditmarshers of West Holstein, which had stoutly maintained its independence for centuries against the counts of Holstein and the Danish kings, was subdued by a Dano-Holstein army of 20.000 men in 1559, Frederick and his .uncles John and Adolphus, dukes of Holstein, dividing the land between them. Frederick was also victorious in the Scandinavian Seven Years' War. There were many causes of quarrel between Denmark and Sweden, but the detention at Copenhagen in 1563 of an embassy on its way to Germany, to negotiate a match between Eric XIV. of Sweden and Christina of Hesse, which King Frederick for political reasons was determined to prevent, precipitated hostilities The war was very unpopular in Denmark, and the closing of the Sound against foreign shipping, in order to starve out Sweden, had exasperated the maritime powers and all the Baltic states. On New Year's Day, 1570, Frederick threatened to abdicate; but the peace of Stettin (Dec. 13, 1570) reconciled all parties, and though Frederick had now to relinquish his ambitious dream of re-establishing the Union of Kalmar, he had at least succeeded in maintaining the supremacy of Denmark in the north.

After the peace Frederick aspired to the dominion of all the seas which washed the Scandinavian coasts, and before he died he suppressed the pirates who for so long had haunted the Baltic and the German Ocean. He also erected the fortress of Kronborg, to guard the Sound. Frederick gave free scope to ministers whose superiority in their various departments he frankly recognized, rarely interfering personally unless absolutely called upon to do so. His influence, always great, was increased by his genial and unaffected manners as a host. He was one of the few kings of the house of Oldenburg who had no illicit *liaison.* He died at Antvorskov on April 4, 1588. No other Danish king was ever so beloved by his people.

See *Lund (Troels), Danmarks og Norges Historie i Slutningen af det XVI. Aarh.* (Copenhagen, 1879); *Danmarks Riges Historie* (Copenhagen, 1897–1905), vol. 3; R. N. Bain, *Scandinavia,* cap. 4 (Cambridge, 1905).

FREDERICK III. (1286?–1330), surnamed "the Fair," German king and duke of Austria, was the second son of the German king, Albert I. In 1298, when his father was chosen king, Frederick was invested with some of the family lands (*see* HABSBURG), and in 1306, when his elder brother Rudolph became king of Bohemia, he succeeded to the duchy of Austria. In 1307 Rudolph died, and Frederick failed to obtain the Bohemian throne. Neither did he obtain the German crown on his father's death in 1308, and the relations between the new king, Henry VII., and the Habsburgs were far from friendly. Frederick asked to be confirmed in the possession of Austria, and be invested with Moravia, a demand which Henry refused; and the duke eventually agreed to renounce Moravia in return for a payment of 50,000 marks. Frederick then became involved in a quarrel with his cousin Louis IV., duke of Upper Bavaria (afterwards the emperor Louis IV.), over the guardianship of Henry II., duke of Lower Bavaria. He was defeated by Louis at the battle of Gammelsdorf (Nov. 9, 1313), and compelled to renounce his claim.

Meanwhile the emperor Henry VII. had died in Italy, and a stubborn contest ensued for the vacant throne. After a long delay Frederick was chosen German king at Frankfort by a minority of the electors on Oct. 19, 1314, while a majority elected Louis of Bavaria. Six days later Frederick was crowned at Bonn by the archbishop of Cologne, and war broke out between the rivals. Frederick drew his chief strength from southern and eastern Germany, and was supported by the full power of the Habsburgs. The struggle continued for seven years At Mühldorf (Sept. 28, 1322) Frederick was finally defeated and sent as a prisoner to Trausnitz, where he remained for three years. Then by the treaty of Trausnitz (March 13, 1325) Frederick acknowledged the kingship of Louis in return for freedom, and promised to return to captivity unless he could induce his brother Leopold to make a similar acknowledgment. As Leopold refused, Frederick, although released from his oath by Pope John XXII, returned to Bavaria.

It was agreed that Frederick should govern Germany while Louis went to Italy for the imperial crown. But this arrangement did not prove generally acceptable, and the death of Leopold in 1326 deprived Frederick of a powerful supporter. He returned to Austria, and died at Gutenstein on Jan. 13, 1330. He was buried at Mauerbach, whence his remains were removed in 1783 to the cathedral of St. Stephen at Vienna. He married Elizabeth, daughter of James I, king of Aragon, and left two daughters.

Frederick's voluntary return into captivity is used by Schiller in his poem *Deutsche Treue,* and by J. L. Uhland in the drama *Ludwig der Bayer.*

See E. M. Fürst von Lichnowsky, *Geschichte des Hauses Habsburg* (Vienna, 1836–44); H. Schrohe, *Der Kampf der Gegenkönige Ludwig und Friedrich* (1902); Vancsa, *Geschichte Nieder- und Oberosterreichs* (vol. 2, 19261.

FREDERICK III (1609–1670), king of Denmark and Norway, son of Christian IV and Anne Catherine of Brandenburg, was born on March 18, 1609, at Hadersleben. While still a lad he became successively bishop of Bremen, bishop of Verden and coadjutor of Halberstadt, while at the age of 18 he was the chief commandant of the fortress of Stade. In 1643 he married Sophia Amelia of Brunswick-Lüneburg. During the disastrous Swedish War of 1643–45 Frederick was appointed *generalissimo* of the duchies by his father; he quarrelled with the Earl-hlarshal Anders Bille, nho commanded the Danish forces, and the Danish nobility began to regard him with extreme distrust. The death of his elder brother Christian in June 1647 opened to him the prospect of the succession, but the question mas still unsettled when Christian IV died on Feb. 28, 1648. On July 6 Frederick III was acknowledged king, after he had signed a *Haandfaestning* or charter, by which the already diminished royal prerogative was still further curtailed.

Frederick lacked the brilliant qualities of his impulsive, jovial father, but he possessed compensating virtues of moderation, sobriety and self-control. He rightly regarded the accession of Charles X of Sweden (June 6, 1654) as a source of danger to Denmark. Charles's invasion of Poland (July 1654) came as a distinct relief to the Danes, who had feared an attack on themselves, but even the Polish War was full of latent peril to Denmark. Frederick resolved on a rupture with Sweden at the first convenient opportunity. The *Rigsdag* of 1657 granted subsidies for mobilization and other military expenses; on April 23 Frederick received the assent of the majority of the *Rigsraad* to an attack on Sweden's German provinces; in the beginning of May the still pending negotiations with Sweden were broken off, and on June 1 Frederick signed the manifesto justifying a war which was never formally declared. The Swedish king traversed ali the plans of his enemies by his passage of the frozen Belts, in Jan. and Feb. 1658 (see CHARLES X of Sweden). Frederick III at once sued for peace; and. persuaded by the English and French ministers, Charles finally agreed to be content with mutilating instead of annihilating the Danish monarchy (treaties of Taastrup, Feb. 18, and of Roskilde, Feb. 26, 1658). The conclusion of peace was followed by a remarkable episode. Charles X was the Danish king's guest for three days (March 3–5) at the castle of Fredriksborg, and friendship seemed to be established. But on July 17, without any reasonabie cause, without a declaration of war, in defiance of all international equity, Charles again attacked Denmark.

The main Snedish army landed at Korsör in Zealand. None had anticipated the sudden and brutal attack, and the Danish capital was inadequately fortified and garrisoned. The Danes had only three days' warning of the approaching danger; and the vast and dilapidated line of defense had at first but 2.000 regular defenders. But government and people displayed exemplary energy, under the constant supervision of the king, the queen and burgomaster Hans Nansen. Charles X began a regular siege, which he abandoned when, on Oct. 29, an auxiliary Dutch fleet. after reinforcing and reprovisioning the garrison, defeated, in conjunction with the Danish fleet, the Swedish navy of 44 liners in the sound. The traditional loyalty of the Danish middle classes was transformed into a boundless enthusiasm for the king personally, and for a brief period Frederick found himself the most popular man in his kingdom. He used his popularity to convert an elective into an absolute monarchy by the Revolution of 1660 (see DENMARK: *History).* Frederick III died on Feb. 6, 1670 at the castle of Copenhagen.

See R. N. Bain, "Scandinavia," in *Cambridge Modern History* (1905); Knud Fabricius, *Kongeloven* (1920).

FREDERICK VIII (1843–1912), king of Denmark, eldest son of Christian IX, was born at Copenhagen on June 3, 1843. As crown prince of Denmark he took part in the war of 1864 against Austria and Prussia, in which the duchies of Schleswig-Holstein and Lauenburg were lost. He then assisted his father in the duties of government. becoming king on Christian's death in Jan. 1906. In 1869 Frederick married Louise (1851–1926), daughter of Charles XV of Sweden, by whom he had four sons and four daughters. In 1907, during a visit to Iceland. Frederick appointed a mixed commission to draft a measure of home rule, but it was thrown out at the next election, when the island claimed full state independence, though "personal union" with Denmark was retained (see ICELAND). During his reign he gained the confidence of his people by his energetic interest in politics, his genial manner, and his simple mode of living. He died at Hamburg on May 14, 1912.

He was succeeded by his eldest son Christian X (*q.v.*) and his second son, Charles (b. 1872), who married his cousin Maud. daughter of Edward VII of Great Britain, became king of Norway as Haakon VII (*q.v.*) in 1905.

FREDERICK IX (1899–), king of Denmark, was born March 11, 1899, eldest son of Prince Christian. later King Christian X (1912–1947), and Princess, later Queen, Alexandrine, former duchess of Mecklenburg-Schwerin. Frederick came of the house of Schleswig-Holstein-Sonderburg-Gliicksbug and was christened Christian Frederick Franz Michael Carl Waldemar Georg. Following the pattern of his ancestors who from 1j13 had taken alternately the names Christian and Frederick, he became Frederick IX on the death of Christian X, April 20, 1947. In 1935 Frederick, crown prince after 1912, married Ingrid, only daughter of Crown Prince Gustav Adolf of Sweden. The royal pair had three daughters.

The king began to participate in state affairs as soon as he reached the age of 21, and served as regent during his father's illness in 1942 and during the last days of King Christian's life from April 8 to April 20, 1947.

Thirty-seven kings of Denmark had been army men; Frederick was the first to take his training in the navy, and by 1946 he had attained the rank of rear-admiral. He loved the sea from boyhood, sailed the royal yacht, and rowed with the students rowing club. He was fond of speed and activity in many forms, including bicycling, motoring and railroading, which became a hobby. He was the first to test-drive some of the new Diesel-electric expresses out of Copenhagen. His love of music also enabled him to conduct for the royal opera orchestra and the royal life guard band on certain occasions. In 1939 Frederick and Ingrid opened the Danish House at the New York World's fair.

Despite his royal rank the new king was trained to be a democratic monarch, first citizen among 4,000,000 Danish people.

(F. D. S.)

FREDERICK I (1657–1713), first king of Prussia, and (as Frederick III) elector of Brandenburg, was the second son of the great elector, Frederick William, by his first marriage with Louise Henriette of Orange. Born at Königsberg on July 11, 1657, he was educated and greatly influenced by Eberhard Danckelmann, and became heir to the throne of Brandenburg through the death of his elder brother, Charles Emil, in 1674. He appears to have taken some part in public business before his father's death; and the court at Berlin was disturbed by quarrels between the young prince and his stepmother, Dorothea of Holstein-Glücksburg. In 1686 Dorothea persuaded her husband to bequeath outlying portions of his lands to her four sons; and Frederick, fearing he would be poisoned, left Brandenburg determined to prevent any diminution of his inheritance. By promising to restore Schwiebus to Silesia after his accession he won the support of the emperor Leopold I; but eventually he gained his end in a peaceable fashion. After he became elector of Brandenburg in May 1688, his half-brothers renounced their rights under their father's will in return for a sum of money, and the new elector thus secured the whole of Frederick William's territories. He fulfilled his bargain with Leopold and gave up Schwiebus in 1695. At home and abroad Frederick continued the policy of the great elector. He helped William of Orange to make his descent on England; added various places, including Bonn, Quedlinburg, the principality of Neuchâtel, to his lands; and placed his large and efficient army at the disposal of the emperor and his allies (see BRANDENBURG). He was present in person at the siege of Bonn in 1689, but was not often in command of his troops. The elector sought to model his court upon that of Louis XIV and directed his main energies toward obtaining for himself the title of king. He gave Leopold, in return for a promise of military aid, the imperial sanction to Frederick's request in Nov. 1700; and the elector, hurrying at once to Konigsberg, crowned himself king of Prussia on Jan. 18, 1701. During the War of the Spanish Succession the troops of Brandenburg-Prussia rendered great assistance to the allies at Blenheim and elsewhere. Frederick, who was deformed through an injury to his spine, died Feb. 25, 1713. He founded the university of Halle, and the Academy of Sciences at Berlin; welcomed and protected Protestant refugees from France and elsewhere; and lavished money on the erection of public buildings. The king was married three times. His second wife, Sophie Charlotte (1668–1705), sister of the English king George I, was the friend of Leibnitz and one of the most cultured princesses of the age; she bore him his only son, his successor, King Frederick William I.

See W. Hahn, Friedrick I, *König* in Preussen (Berlin, 1876); J. G. Droysen, *Geschichte* der *preussischen Politik,* Band iv (Leipzig, 1872); E. Heyck, *Friedrich* I und *die* Begründung des *preussischen Königtums* (Bielefeld, 1901); *Aus dem Briefwechsel König Friedrichs I von Preussen und seiner Familie,* ed. Berner (Berlin, 1901); H. von Hymmen, Der erste preusszsche *König* (1904).

FREDERICK II, known as "the Great" (1712–1786), king of Prussia, was born on Jan. 24, 1712. Two elder brothers having died in infancy, he became heir of his father, Frederick William I, who brought him up with extreme rigour, in the hope that he would become a hardy soldier, and "acquire thrift and frugality." The result was just the opposite. Encouraged by his mother, and under the influence of his governess Madame de Roucoulle, and of his first tutor Duhan, a French refugee, Frederick acquired a taste for literature and music, secretly learned Latin, which his father had forbidden, scoffed at religion, refused to ride or shoot, preferred the French language, literature and dress, and openly despised German habits and life. His discontent was heartily shared by his sister, Wilhelmina, a bright and intelligent young princess for whom Frederick had a warm affection.

Early Years.—Frederick William, seeing his son absorbed in frivolous and effeminate amusements, conceived for him an intense dislike, which had its share in causing him to break off the negotiations for a double marriage between the prince of Wales and Wilhelmina, and the princess Amelia, daughter of George II, and Frederick; for Frederick had been so indiscreet as to carry on a separate correspondence with the English court and to vow that he mould marry Amelia or no one. Frederick William's hatred of his son, openly avowed, displayed itself in violent outbursts and public insults, and so harsh was his treatment that Frederick frequently thought of running away and taking refuge at rhe English court. He at last resolved to do so during a journey which he made with the king to south Germany in 1730. He was helped by his two friends, Lieutenant Katte and Lieutenant Keith; but the secret was found out.

Frederick was arrested, deprived of his rank as crown prince, tried by court-martial, and imprisoned in the fortress of Custrin. Keith escaped; but Katte was captured and sentenced by court martial to imprisonment for life. This sentence the king changed to one of death and, to enforce the example, had Katte beheaded in Frederick's presence (Nov. 5, 1730). The object-lesson had some effect. The prison chaplain reported that Frederick's heart was changed, while the emperor himself interceded for him. His father released him from solitary confinement and sent him to work in the auditing office of the departments of war and agriculture at Custrin, pending the earning of a full pardon. "The whole town shall be his prison," wrote the king; "I will give him employment, from morning to night, in the departments of war, and agriculture, and of the Government. He shall work at financial matters, receive accounts, read minutes and make extracts. . . . But if he kicks or rears again, he shall forfeit the succession to the crown, and even, according to circumstances, life itself."

Frederick's submissive conduct under these conditions earned him gradual alleviations. On Nov. 30, 1731, he was allowed again to appear in uniform, and in 1732 was made colonel in command of the regiment at Neuruppin. On June 12, 1733, he married the princess Elizabeth Christina, daughter of the duke of Brunswick-Bevern, a niece of the empress and cousin of Maria Theresa. He was given the estate of Rheinsberg, near Neuruppin, and there he lived until he succeeded to the throne. These years were perhaps the happiest of his life, although the marriage, concluded by his father's orders, was unhappy. He seldom visited his wife, who was childless, treating her harshly and even brutally. His conscientious performance of his duties, however, at last earned his father's esteem. At the same time, he was able to indulge his personal tastes.

He carried on a lively correspondence with Voltaire and other French men of letters, and was a diligent student of philosophy, history and poetry. Two of his best-known works were written at this time—*Considérations sur l'état présent* du corps *politique de l'Europe* and his *Anti-Macchiavel.* In the former he calls attention to the growing strength of Austria and France, and insists on the necessity of some third power, by which he clearly means Prussia, to counterbalance their excessive influence The second treatise, which was issued by Voltaire in The Hague in 1740, contains a generous exposition of some of the favourite ideas of the 18th-century philosophers respecting the duties of sovereigns, which may be summed up in the famous sentence "the prince is not the absolute master, but only the first servant of his people." It was during this period that he became a freemason, and finally repudiated Christianity.

The Throne and Austria.—On May 31, 1740, he became king. He maintained all the forms of government established by his father, but ruled in a far more enlightened spirit; he tolerated every form of religious opinion, abolished torture, except for wholesale murder, conspiracy, lèse-majesté and high treason, was most careful to secure an exact and impartial administration of justice, and, while keeping the reins of government strictly in his own hands, allowed every one with a genuine grievance free access to his presence. The Potsdam regiment of giants was disbanded, but the real interests of the army were carefully studied. for Frederick realized that the two pillars of the Prussian state were sound finances and a strong army. On Oct. 20, 1740, the emperor Charles VI died. Frederick at once began to make extensive military preparations, with a view to asserting the ancient claims put forward by his house, but always denied by Austria, to the three Silesian duchies. Frederick undoubtedly believed in the justice of his claims, and the lawfulness of repudiating, for Silesia, his father's guarantee of the Pragmatic Sanction He confessed, however, himself, that his scheme was prompted by "the desire of glory, even curiosity," and "a means of acquiring reputation and of increasing the power of the State."

Frederick sent an ambassador to Vienna, offering, in the event of his rights in Silesia being conceded, to aid Maria Theresa against her enemies. The queen, who regarded the proposal as that of a mere robber, haughtily declined; whereupon Frederick immediately invaded Silesia with an army of 30,000 men. His first victory was gained at Mollwitz on April 10, 1741. Under the impression, in consequence of a furious charge of Austrian cavalry, that the battle was lost, he rode rapidly away at an early stage of the struggle—a mistake which gave rise for a time to the groundless idea that he lacked personal courage. A second Prussian victory was gained at Chotusitz. near Časlau, on May 17, 1742; and Maria Theresa was forced to conclude the Peace of Breslau (June 11, 1742), ceding Breslau to Prussia, Upper and Lower Silesia as far as the Oppa, together with the county of Glatz. Frederick made good use of the next two years, fortifying his new territory, and repairing the evils inflicted upon it by the war. By the death of the prince of East Friesland, without heirs. he also gained possession of that country (1744). In the same year, in view of Austria's increasing strength and determination to recover Silesia, Frederick formed the union of Frankfurt with Bavaria, the Elector Palatine and Hesse-Cassel, concluded a secret treaty with France (June 4, 1744) and suddenly invaded Bohemia, taking Prague. He nas forced to retreat, but in 1745 won a series of victories, and the Peace of Dresden (Dec. 2j, 1745) assured to Frederick a second time the possession of Silesia. *(See* AUSTRIAN SUCCESSION, WAR OF THE.)

Internal Administration. — Frederick was now, at the age of 33, the most conspicuous sovereign of his time. He was a thoroughly absolute ruler, his so-called ministers being mere clerks whose business was to give effect to his will. To use his own famous phrase, however, he regarded himself as but "the first servant of the State"; and during the next 11 years he proved that the words expressed his inmost conviction and feeling. All kinds of questions were submitted to him, important and unimportant, even questions of trivial detail. A keen judge of character, he filled the public offices with faithful, capable, energetic men, who were kept up to a high standard of duty by the consciousness that their work might at any time come under his strict supervision. The Academy of Sciences, which had fallen into contempt during his father's reign, he restored. infusing into it vigorous life; and he did more to promote elementary education than any of his predecessors. He did much, too, for the economic development of Prussia, especially for agriculture; he established colonies, peopling them with immigrants, extended the canal system, drained and diked the great marshes of the Oderbruch, turning them into rich pasturage, encouraged the planting of fruit trees and of root crops; and, though in accordance with his ideas of discipline he maintained serfdom, he did much to lighten the burdens of the peasants. All kinds of manufacture, too, particularly that of silk, owed much to his encouragement. To the army he gave unremitting attention, reviewing it at regular intervals, and sternly punishing negligence on the part of the officers. Its numbers were raised to 160.000 men, while fortresses and magazines were always kept in a state of readiness for nar. The influence of the king's example was felt far beyond the limits of his immediate circle. The nation was proud of his genius, and displayed something of his energy in all departments of life. Gotthold Lessing, who as a youth of 20 came to Berlin in 1749, composed enthusiastic odes in his honour, and Johann Gleim, the Halberstadt poet, wrote of him as of a kind of demigod. These may be taken as fair illustrations of the popular feeling long before the Seven Years' War.

Tastes and Character. — He despised the German language although it is remarkable that at a later period, in a French essay on German literature, he predicted for it a great future. He habitually wrote and spoke French, and had a strong ambition to rank as a distinguished French author. Nobody can now read his verses, but his prose writings have a certain calm simplicity and dignity, without, however, giving evidence of the splendid mental qualities which he revealed in practical life. To this period belong his *Mémoires pour servir à l'histoire de Brandebourg* and his poem *L'Art de la guerre*. The latter, judged as literature, is intolerably dull; but the former is valuable, throwing as it does considerable light on his personal sympathies as well as on the motives of important epochs in his career. He continued to correspond with French writers, and induced a number of them to settle in Berlin, Maupertuis being president of the academy. In 1752 Voltaire, who had repeatedly visited him, came at Frederick's urgent entreaty, and received a truly royal welcome. The famous Hirsch trial. and Voltaire's vanity and caprice, greatly lowered him in the esteem of the king, who, on his side, irritated his guest by often requiring him to correct bad verses, and by making him the object of rude banter. The publication of *Doctor Akakia,* which brought down upon the president of the academy a storm of ridicule, finally alienated Frederick; while Voltaire's wrongs culminated in the famous arrest at Frankfurt, the most disagreeable elements of which were due to the misunderstanding of an order by a subordinate official.

The king lived as much as possible in a retired mansion, to which he gave the name of Sans-Souci. The new palace, which was not built until after the Seven Years' War, was never a favourite residence. He rose regularly in summer at 5, in winter at 6, devoting himself to public business till about 11. During part of this time, after coffee, he would aid his reflections by playing on the flute, of which he was passionately fond, being a really skilful performer. At 11 came parade, and an hour afterward, punctually, dinner, which continued till 2, or later, if conversation happened to be particularly attractive. After dinner he glanced through and signed cabinet orders written in accordance nith his morning instructions, often adding marginal notes and postscripts, many of which were in a caustic tone. These disposed of, he amused himself for a couple of hours with literary work; between six and seven he would converse with his friends or listen to his reader (a post held for some time by Julien la Mettrie); at seven there was a concert; and at half-past eight he sat down to supper, which might go on till midnight. He liked good eating and drinking, although even here the cost was sharply looked after, the expenses of his kitchen mounting to no higher figure than £1.800 a year. At supper he was always surrounded by a number of his most intimate friends, mainly Frenchmen; and he insisted on the conversation being perfectly free. His wit, however, was often cruel, and any one who responded with too much spirit was soon made to feel that the licence of talk was to be complete only on one side. At Frederick's court ladies were seldom seen, a circumstance that gave occasion to much scandal. The queen he visited only on rare occasions, though he provided her with a generous income, half of which she gave away in charity. Although without charm, she was a woman of many noble qualities; and, like her husband, she wrote French books, some of nhich attracted a certain attention in their day. She survived him by 11 years, dying in 1797.

War and Reconstruction. — From 1756 to 1763 Frederick's energies were wholly taken up in the Seven Years' War (*q.v.*) in which virtually the whole continent was in arms against him. Although Prussia was fearfully exhausted by this struggle, and at times seemed on the verge of ruin, Frederick's tenacity and military genius carried him through, and the peace of Hubertushof (Feb. 15, 1763) restored the territorial *status quo ante bellum.* Morally, however, the Seven Years' War was a great victory for Prussia. It was now universally recognized as one of the great powers of the continent, and definitely took its place in Germany as the rival of Austria. From this time it was inevitable that there should be a final struggle between the two nations for predominance, and that the smaller German states should group themselves around one or the other.

Frederick's first care after the nar was, as far as possible, to enable the country to recover from its terrific losses; a task which he undertook nith genius and energy. Pomerania and Neumark were freed from taxation for two years. Silesia for six months. Many nobles whose lands had been wasted received corn for seed; his war horses were within a few months to be found on farms all over Prussia; and money was freely spent in the re-erection of houses which had been destroyed. The coinage, which had been debased, was gradually restored to its proper value, and trade received a favourable impulse by the foundation of the Bank of Berlin. All these matters were carefully looked into by Frederick himself, nho, while acting as generously as his circumstances would allow, insisted on the maximum of efficiency and economy.

Unfortunately, he adopted the French ideas of excise, and the French methods of imposing and collecting taxes—a system known as the Regie. This system secured a large revenue, but led to much petty tyranny, all the more intolerable because it was carried out by French officials. It was continued to the end of Frederick's reign, and nothing did so much to injure his otherwise immense popularity. He was quite aware of the discontent the system excited, and the good nature with which he tolerated the criticisms directed against it and him is illustrated by a well-known and well-authenticated incident. Riding along the Jager Strasse one day, he saw a crowd of people. "See what it is," he said to the groom who was attending him. "They have something posted up about your Majesty," said the groom, returning. Frederick, riding forward, saw a caricature of himself: "King in very melancholy guise," says Preuss (as translated by Carlyle), "seated on a stool, a coffee-mill between his knees, diligently grinding with the one hand, and with the other picking up any bean that might have fallen. 'Hang it lower,' said the king, beckoning his groom with a wave of the finger; 'lower, that they may not have to hurt their necks about it.' No sooner were the words spoken, which spread instantly, than there rose from the whole crowd one universal huzzah of joy. They tore the caricature into a thousand pieces, and rolled after the king with loud '*Lebe Hoch*, our Frederick for ever,' as he rode slowly away."

Frederick took particular interest in the proper administration of justice. He disliked the formalities of the law, and in one instance, "the miller Arnold case," where he thought injustice had been done to a poor man, he dismissed the judges, condemned them to a year's fortress arrest and compelled them to make good out of their own pockets the loss sustained by their supposed victim—really a violation of justice, but one springing from a generous motive. He once defined himself as "l'avocat du pauvre," and few things gave him more pleasure than the famous answer of the miller whose windmill stood on ground which was wanted for the king's garden. The miller sturdily refused to sell it. "Not at any price?" said the king's agent; "could not the king take it from you for nothing, if he chose?" "Have we not the Kammergericht at Berlin?" was the answer, which became a popular saying in Germany.

The Prussian Code.—Soon after he became king Frederick began to make preparations for a new code. In 1747 appeared the *Codex Fridericianus*, by which the Prussian judicial body was established. But a greater monument of Frederick's interest in legal reform was the *Allgemeines preussisches Landrecht*, completed by the grand chancellor Count Johann H. C. von Carmer (1721–1801) on the basis of the *Project des Corporis Juris Fridericiani*, completed in 1749–51 by the eminent jurist Samuel von Cocceji (1679–1755). The *Landrecht*, a work of vast labour and erudition, combines the two systems of German and Roman law supplemented by the law of nature; it was the first German code, but did not go into force until 1794, after Frederick's death.

Looking ahead after the Seven Years' War, Frederick saw no means of securing himself so effectually as by cultivating the good will of Russia. In 1764 he accordingly concluded a treaty of alliance with the empress Catherine for eight years. Six years afterward, unfortunately for his fame, he joined in the first partition of Poland, by which he received Polish Prussia, without Danzig and Thorn, and Great Poland as far as the river Netze. Prussia was then for the first time made continuous with Brandenburg and Pomerania.

Relations **With** Austria.—Joseph II greatly admired Frederick and visited him at Neisse, in Silesia, in 1769, a visit which Frederick returned in Moravia in the following year. The young emperor was frank and cordial; Frederick was more cautious, for he detected under the respectful manner of Joseph a keen ambition that might one day become dangerous to Prussia. Nothing came of these suspicions till, in 1777, the death of Maximilian Joseph (elector of Bavaria, without children) led ultimately to the War of the Bavarian Succession (the Potato war) in which Frederick invaded Bohemia (July 1778). No general engagement was fought, and after many delays the Treaty of Teschen was signed on May 13, 1779. Austria received the circle of Burgau, and consented that the king of Prussia should take the Franconian principalities.

Frederick never abandoned his jealousy of Austria, whose ambition he regarded as the chief danger against which Europe had to guard. He seems to have had no suspicion that evil days were coming in France. It was Austria which had given trouble in his time; and if its pride were curbed, he fancied that Prussia at least would be safe. Hence one of the last important acts of his life was to form, in 1785, a league of princes (the "Fürstenbund") for the defense of the imperial constitution, believed to be periled by Joseph's restless activity. The league came to an end after Frederick's death; but it is of considerable historical interest, as the first open attempt of Prussia to take the lead in Germany.

Last Years.——Frederick's chief trust was always in his treasury and his army. By continual economy he left in the treasury the immense sum of 70,000,000 thalers; the army, at the time of his death, numbered 200,000 men, disciplined with all the strictness to which he had throughout life accustomed his troops. He died at Sans-Souci on Aug. 17,1786; his death being hastened by exposure to a rainstorm during a military review. He died on the eve of tremendous events, which for a time obscured his fame; but now that he can be impartially estimated, he is seen to have been in many respects one of the greatest figures in modern history.

He was below middle size; inclined to stoutness in youth; lean in old age; and of vigorous and active habits. An expression of keen intelligence lighted up his features, and his large, sparkling gray eyes darted penetrating glances at every one who approached him. He was unclean in his personal habits. In his later years an old blue uniform with red facings was his usual dress, and, generally, on his breast was some Spanish snuff, of which he consumed large quantities. He shared many of the chief intellectual tendencies of his age, including its scepticism. Of Christianity he always spoke in the mocking tone of the "enlightened" philosophers, regarding it as the invention of priests; but after the Seven Years' War, the trials of which steadied his character, he sought to strengthen the church for the sake of its elevating moral influence.

In his judgments of mankind he often talked as a misanthrope. When a school inspector named Sulzer expressed to him the opinion that "the inborn inclination of men is rather to good than to evil," he replied. "Ah, my dear Sulzer, you don't know this damned race" *(Ach, mein lieber Sulzer, er kennt nicht diese verdammte Rasse)*. This fearful saying unquestionably expressed a frequent mood of Frederick's; and he sometimes acted with great harshness and seemed to take a malicious pleasure in tormenting his acquaintances. Yet he was capable of genuine attachments. He was extremely loyal to his mother and his sister Wilhelmina; his letters to the duchess of Gotha are full of a certain tender reverence; the two Keiths found him a devoted friend. In his lonely old age, his best-loved companions were his greyhounds, who slept in his bed; he erected monuments to them, and gave orders that he was to be buried near them. As a king, however, he laboured genuinely for humanity.

Taking the reign of Frederick II as a whole, it must be said that he looked upon his power rather as a trust than as a source of personal advantage; and the trust mas faithfully discharged according to the best lights of his day. He often has been condemned for doing nothing to encourage German literature; and it is true that he was supremely indifferent to it. Before he died a tide of intellectual life was rising all about him; yet he failed to recognize it, declined to give Lessing even the small post of royal librarian and thought *Götz von Berlichingen* a vulgar imitation of vulgar English models. But when his taste was formed, German literature did not exist; the choice was between Jean Baptiste Racine and Voltaire on the one hand and Johann Gottsched and Christian Gellert on the other. He survived into the era of Immanuel Kant, Johann Wolfgang von Goethe and Johann Christoph von Schiller, but he was not of it, and it would have been unreasonable to expect that he should in old age pass beyond the limits of his own epoch. It was better, indeed, that he let German literature alone, thus letting it become a thoroughly independent product. He promoted it indirectly by deepening the national life from which it sprang. At a time when there was no real bond of cohesion between the different states, he stirred among them a common enthusiasm; and in making Prussia great he laid the foundation of a genuinely united empire.

BIBLIOGRAPHY.—The main sources for the biography of Frederick the Great are his own works, which, in the words of Leopold von Ranke, "deal with the politics and wars of the period with the greatest possible objectivity, *i.e.,* truthfulness, and form an imperishable monument of his life and opinions." A magnificent edition of Frederick's complete works was issued (1846–57), at the instance of Frederick William IV, under the supervision of the historian Johann D. E. Preuss (1785–1868). It is in 30 volumes, of which 6 contain verse, 7 are historical, 2 philosophical, and 3 military, 12 being made up of correspondence. So long as the various state archives remained largely inaccessible historians relied upon this as their chief authority. Among works about this period may be mentioned Thomas Carlyle, *History of Frederick II of Prussia* (6 vols., 1858–65); J. G. Droysen, *Friedrich der Grosse* (2 vols., Leipzig, 1874–76, forming part V of his *Geschichte der preussischen Politik*); Ranke, *Friedrich II, König von Preussen (Werke,* vols. li and lii). A great stimulus to the study of Frederick's history has been given by the publication of collections of documents preserved in various archives. Of these the most important is the great official edition of Frederick's political correspondence (35 vols., Berlin, 1879–1911). Of later works, based on modern research, may be mentioned L. Paul-Dubois, *Frédéric le Grand, d'après sa correspondance politique* (1903); W. F. Reddaway, *Frederick the Great and the Rise of Prussia* (1904); E. Zeller, *Friedrich der Grosse als Philosoph* (1886); H. Pigge, *Die Staatstheorie Friedrichs des Grossen* (1904); T. von Rernhardi, *Friedrich der Grosse als Feldherr* (2 vols., 1881); Ernest Lavisse, *La Jeunesse du Grand Frédéric* (1891, 3rd ed., 1899; Eng. transl., 1891); R. Brode, *Friedrich der Grosse und der Konflikt mit seinem Vater* (1904); W. von Bremen, *Friedrich der Grosse* (Bd. ii of *Erzieher des preussischen Heeres,* 1905); *Dreissig Jahre am Hofe Friedrichs des Grossen. Aus den Tagebüchern des Reichsgrafen Ahasuerus Heinrich von Lehndorff, Kammerherrn der Konigin Elisabett Christine von Preussen* (1907). The great work on the wars of Frederick is that issued by the Prussian General Staff: *Die Kriege Friedrichs des Grossen* (15 vols. in three parts, 1890–1913). *See* also G. Kiinstel, *Politisches Testament Friedrichs des Grossen von 1752* (1911); G. Koser, *Geschichte Friedrichs des Grossen* (4 vols., 1912–14); N. Young, *The Life of Frederick the Great* (1919); Werner Hegemann, *Friedrich der Grosse* (1924, English trans. by Winifred Ray, *Frederick the Great,* 1929). For a list of other works *see* Dahlmann-Waitz, *Quellenkunde* (1912). (J. Sı.; X.)

FREDERICK III (1831–1888), king of Prussia and German emperor, was born at Potsdam on Oct. 18, 1831, being the eldest son of prince William of Prussia, afterward first German emperor, and the princess Augusta. He was carefully educated, and in 1849–50 studied at the university of Bonn. The next years were spent in military duties and in travels, in which he was accompanied by Moltke. In 1851 he visited England on the occasion of the Great Exhibition. He married Victoria, princess royal of Great Britain, in London on Jan. 25, 1858. On the death of his uncle in 1861 and the accession of his father, Prince Frederick William, as he was then called, became crown prince of Prussia. His education, the influence of his mother, and perhaps still more that of his wife's father, the Prince Consort, had made him a strong Liberal, and he disliked the course of events in Prussia after the appointment of Bismarck as minister. In June 1863, he publicly dissociated himself from the press ordinances which had just been published. He ceased to attend meetings of the council of state and was much away from Berlin. The opposition of the crown prince to the ministers was increased by Bismarck's refusal to support the claims of his friend the prince of Augustenburg to Schleswig-Holstein.

During the war with Denmark Frederick had his first military experience, being attached to the staff of Marshal von Wrangel; he performed valuable service in arranging the difficulties caused by the disputes between the field marshal and the other officers and was eventually given a control over him. After the war he continued to support the prince of Augustenburg and was strongly opposed to the war with Austria. During the campaign of 1866 he received the command of an army consisting of four army corps. He was assisted by General von Blumenthal, as chief of the staff, but took a very active part in directing the difficult operations by which his army fought its way through the mountains irom Silesia to Bohemia, fighting four engagements in three days, and showed that he possessed genuine military capacity. In the decisive battle of Königgrätz the arrival of his army on the field of battle; after a march of nearly 20 mi., secured the victory. During the negotiations which ended the war he persuaded the king to accept Bismarck's policy as regards peace with Austria. He was anxious to see the king of Prussia unite the whole of Germany, with the title of emperor, and was impatient of the caution with which Bismarck proceeded.

He played a conspicuous part in the year 1870–71, being appointed to command the armies of the Southern States, General Blumenthal again being his chief of the staff; his troops won the victory of Wörth, took an important part in the battle of Sedan and later in the siege of Paris. During the years that followed, little opportunity for political activity was open to him. He and the crown princess took a great interest in art and industry, especially in the royal museums; and the excavations conducted at Olympia and Pergamum were chiefly due to him. In 1878, when the emperor was incapacitated by the shot of an assassin, the prince acted for some months as regent.

His palace was the centre of all that was best in the literary and learned society of the capital. For many reasons the accession of the prince was looked forward to with great hope by a large part of the nation. Unfortunately he was attacked by cancer in the throat; he spent the winter of 1887–88 at San Remo; in January 1888 the operation of tracheotomy had to be performed. On the death of his father, (March 9), he at once journeyed to Berlin; but he came to the throne only to die. While the Liberals hoped the emperor would use his power for some signal declaration of policy, the adherents of Bismarck made bitter attacks on the empress. The emperor's most important act was a severe reprimand addressed to von Puttkamer, the reactionary minister of the interior, which caused his resignation; in the distribution of honours he chose many who belonged to classes and parties hitherto excluded from court favour. Queen Victoria visited Berlin to see her dying son-in-law. He died at Potsdam on June 15, 1888, after a reign of 99 days. After the emperor's death Professor Geffcken, a personal friend, published in the *Deufsche Rundschau* extracts from the diary of the crown prince containing passages which illustrated his differences with Bismarck during the war of 1870. The object was to injure Bismarck's reputation, and a very unseemly dispute ensued. The treatment of the crown prince's illness also gave rise to an acrimonious controversy, for which *see* MACKENZIE, SIR MORELL.

The empress Victoria, who, after the death of her husband, was known as the empress Frederick, died on Aug. 5, 1901, at the castle of Friedrichskron, Cronberg, near Homburg, where she spent her last years. Of the emperor's children two, Prince Sigismund (1864–1866) and Prince Waldemar (1869–1879), died in childhood. He left two sons, William, his successor as emperor, and Henry, who adopted a naval career. Of his daughters, the princess Charlotte was married to Bernard. hereditary prince of Meiningen; the princess Victoria to Prince Adolph of Schaumburg-Lippe; the princess Sophie to the duke of Sparta, crown prince of Greece; and the princess Margaretha to Prince Friedrich Karl of Hesse.

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FREDERICK III (1272–1337), king of Sicily, third son of King Peter of Aragon and Sicily, and of Constance, daughter of Manfred. Peter died in 1285, leaving Aragon to his eldest son Alphonso, and Sicily to his second son James, When Alphonso died in 1291 James became king of Aragon and left his brother Frederick as regent of Sicily. The war between the Angevins and the Aragonese for the possession of Sicily was still in progress, and although the Aragonese were successful in Iraly James's position in Spain became very insecure owing to internal troubles and French attacks. Peace negotiations were begun with Charles II of Anjou, but were interrupted by the successive deaths of two popes; at last under the auspices of Boniface VIII, James concluded a shameful treaty, by which, in exchange for being left undisturbed in Aragon and promised possession of Sardinia and

Corsica, he gave up Sicily to the church, for whom it was to be held by the Angevins (1295). The Sicilians refused to be made over once more to the hated French whom they had expelled in 1282 and found a national leader in the regent Frederick. In vain the pope tried to bribe him with promises and dignities; he mas determined to stand by his subjects and was crowned king by the nobles at Palermo in 1296.

Although the second Frederick of Sicily, he called himself third, being the third son of King Peter. He reformed the administration and extended the powers of the Sicilian parliament, which was composed of the barons, the prelates and the representatives of the towns.

War with the **Angevins.**—His refusal to comply with the pope's injunctions led to a renewal of the war. Frederick landed in Calabria, where he seized several towns, encouraged revolt in Naples, negotiated with the Ghibellines of Tuscany and Lombardy and assisted the house of Colonna against Pope Boniface. In the meanwhile James married his sister Yolanda to Robert, the third son of Charles II. Unfortunately for Frederick, a part of the Aragonese nobles of Sicily favoured King James, and both John of Procida and Ruggiero di Lauria went over to the Angevins, and the latter completely defeated the Sicilian fleet off Cape Orlando. Charles's sons Robert and Philip landed in Sicily, but after capturing Catania mere defeated by Frederick, Philip being taken prisoner (1299). For two years more the fighting continued with varying success, until Charles of Valois, who had been sent by Boniface to invade Sicily, was forced to sue for peace, his army being decimated by the plague, and in Aug. 1302 the treaty of Caltabellotta was signed, by which Frederick was recognized king of Trinacria (the name Sicily was not to be used) for his lifetime and was to marry Eleonora, the daughter of Charles II; at his death the kingdom was to revert to the Angevins (this clause was inserted chiefly to save Charles's face), and his children would receive compensation elsewhere. Boniface tried to induce King Charles to break the treaty, but the latter was only too anxious for peace, and finally in May 1303 the pope ratified it, Frederick agreeing to pay him a tribute.

Later Struggles.— For a few years Sicily enjoyed peace, and the kingdom was reorganized. But on the descent of the emperor Henry VII. Frederick entered into an alliance with him, and in violation of the pact of Caltabellotta made nar on the Angevins again (1313) and captured Reggio. He set sail for Tuscany to cooperate with the emperor, but on the latter's death (1314) he returned to Sicily. Robert, who had succeeded Charles II in 1309, made several raids into the island. A truce was concluded in 1317, but as the Sicilians helped the north Italian Ghibellines in the attack on Genoa, and Frederick seized some Church revenues for military purposes, the pope (John XXII) excommunicated him and placed the island under an interdict (1321) which lasted until 1335. An Angevin fleet and army, under Robert's son Charles, was defeated at Palermo by Giovanni da Chiaramonte in 1325, and in 1326 and 1327 there were further Angevin raids on the island, until the descent into Italy of the emperor Louis the Bavarian distracted their attention. The election of Pope Benedict XII (1334), who was friendly to Frederick, promised a respite; but after fruitless negotiations the war broke out once more, and Chiaramonte went over to Robert, owing to a private feud In 1337 Frederick died at Paternione, and in spite of the peace of Caltabellotta his son Peter succeeded. During Frederick's reign the Aragonese dynasty became thoroughly national and helped to weld the Sicilians into a united people.

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FREDERICK I (1676–1751), king of Sweden from 1720 to 1751, was born on April 28, 1676, the eldest surviving son of the landgrave Charles of Hesse-Kassel. His natural bent was toward scientific and military studies, and he became an exceptionally brave and resourceful officer, serving under William III of England (1695–97) and in the War of the Spanish Succession. He married Louise of Brandenburg (1700), but she died childless in 1705. In 1708 a more ambitious project was suggested; viz., that Frederick should marry the sister of Charles XII of Sweden, Ulrika Eleonora who, after the recent death of her elder sister, seemed likely to succeed her unmarried brother on the throne. After protracted negotiations (chiefly necessitated by Ulrika Eleonora's fears that her marriage to a Calvinist might prejudice her chances and benefit those of her Lutheran nephew, Charles Frederick of Holstein-Gottorp) the wedding took place in 1715.

Ulrika Eleonora became so devoted to her husband that his hopes of finally possessing the Swedish crown for himself seemed justified. Frederick got on well with Charles XII and took an active part both in the campaigns in Norway and in the organization of Swedish defenses against Russian attacks from the east. During the preparations for the big military offensive of 1718, however, he became increasingly preoccupied with safeguarding his wife's interests vis-à-vis the Holstein-Gottorp candidature in case Charles XII should die without having named his heir. He established contacts mith the antiabsolutist opposition to Charles XII, and it has been strongly suspected that the king's death (Dec. 11, 1718) was a murder arranged by Frederick in order to prevent the situation's moving in favour of his wife's rival. Opinion on this matter is divided, but it would seem that Frederick had neither the desire nor the need to plot Charles XII's death. He was, however, very well prepared for it and, by seizing the initiative. he secured Ulrika Eleonora's proclamation as queen, though at the cost of concessions to the antiabsolutist forces in the estates (riksdag).

He himself emerged as the real leader in foreign policy and made great efforts, both militarily and diplomatically, to get peace from Russia without making too many concessions. He was unsuccessful, largely because of circumstances beyond his control: he made sacrifices to Hanover, to Denmark and to Prussia in order to obtain help against Russia, but this help did not materialize on the scale arranged, so that Sweden was forced in 1721 to agree to the humiliating peace of Nystad. Frederick had ostensibly greater success in his personal aims in Sweden: in March 1720 the queen declared the estates freed from their oath of loyalty to her, and Frederick was proclaimed king of Sweden. In reality opponents of royal absolutism had taken advantage of both Frederick and the queen, and he took over the crown in a much more dependent position in relation to the estates than had Ulrika Eleonora.

Frederick's reign was a disappointment. He was given far less opportunity to govern than he had expected, and his gifts in the military and diplomatic fields were hardly used. In the enforced idleness to which the Swedish "age of liberty" thus condemned him, his intelligence rusted and his character deteriorated though his charm survived. He filled his time with hunting and love affairs. He had no children by Ulrika Eleonora (though he had two sons and two daughters by one of his mistresses, Hedvig Taube), and his hopes of having the succession fixed in the Hesse family were disappointed. From 1743 he was overshadowed by the heir to the throne. Adolphus Frederick of Holstein-Gottorp, who mas chosen in conformity to Russian wishes as a result of the disastrous war against Russia.

Frederick suffered the first of several strokes in 1748 and died in Stockholm on March 25, 1751.

See Walfrid Holst, *Frederik* I (1953). (R. M. **Ha.**)

FREDERICK I (1372?–1440), elector of Brandenburg, founder of the greatness of the House of Hohenzollern, was born at Nuremberg. a son of Frederick V, burgrave of Nuremberg, and first came into prominence by saving the life of Sigismund, king of Hungary. at the battle of Nicopolis in 1396. In 1397 he became burgrave of Nuremberg, and after his father's death in 1398 he shared Ansbach, Bayreuth and the smaller possessions of the family, with his only brother John, but became sole ruler after his brother's death in 1420. Loyal at first to King Wenceslaus, the king's neglect of Germany drove Frederick to take part in his deposition in 1400, and in the election of Rupert III, count palatine of the Rhine, whom he accompanied to Italy in the following year. In 1401 he married Elizabeth, or Elsa, daughter of Frederick, duke of Bavaria-Landshut (d. 1393), and in 1409 took service again with King Sigismund, whom he assisted in his struggle with the Hungarian rebels. The double election to the German throne in 1410 first brought Frederick into relation with Brandenburg. Sigismund, anxious to obtain another vote in the electoral college, appointed Frederick to exercise the Brandenburg vote on his behalf, and it was largely through his efforts that Sigismund was chosen German king. Frederick then restored a certain degree of order in Brandenburg, and was formally invested with the electorate and margraviate by Sigismund at Constance on April 18, 1417 (see BRANDENBURG). He took part in the war against the Hussites, but became estranged from Sigismund when in 1423 the king invested Frederick of Wettin, margrave of Meissen, with the vacant electoral duchy of Saxe-Wittenberg In 1427 he was one of the band of electors who sought to impose reforms upon Sigismund. An unsuccessful candidate for the German throne in 1438, Frederick was chosen king of Bohemia in 1440, but declined the honour He took part in the election of Frederick III as German king in 1440, and died at Kadolzburg on Sept. 21, of the same year. In 1902 a statue was erected to his memory at Friesack. Another one is in the "Siegesallee," Berlin.

See E. Brandenburg, *König Sigmund und Kurfürst Friedrich I. von Brandenburg* (1891).

FREDERICK III. (1515–1576), called "the Pious." elector palatine of the Rhine, eldest son of John II., count palatine of Simmern, was born at Simmern on Feb. 14, 1515. In 1537 he married Maria (d. 1567), daughter of Casimir, prince of Bayreuth, and in 1546, mainly as a result of this union, adopted the reformed doctrines. In 1557 he became count palatine of Simmern by his father's death. succeeding his kinsman, Otto Henry (1502–1559), as elector palatine two years later. Although inclined to the views of Calvin rather than to those of Luther, and as the breach between the followers of the two reformers became wider, he definitely adopted Calvinism. This form of faith was established in the Palatinate; in its interests the "Heidelberg Catechism" was drawn up in 1563; and Catholics and Lutherans were persecuted alike, while the churches were denuded of all their ornaments. The Lutheran princes wished to root out Calvinism in the Palatinate, but were not willing to exclude the elector from the benefits of the religious peace of Augsburg, which were confined to the adherents of the confession of Augsburg, and the matter came before the diet in 1566. Boldly defending his position, Frederick refused to give way an inch. and as the Lutherans were unwilling to proceed to extremities the emperor Maximilian II. could only warn him to mend his ways. The elector aided the Huguenots in France and the insurgents in the Netherlands with men and money; one of his sons, John Casimir (1543–1592), took a prominent part in the French wars of religion, while another, Christopher, was killed in 1574 fighting for the Dutch at Mooker Heath. Frederick sought in vain to prevent the election of a member of the Habsburg family as Roman king, to secure the abrogation of the "ecclesiastical reservation" clause in the peace of Augsburg, or to obtain for Protestants in the territories of the spiritual princes. He died at Heidelberg on Oct. 26, 1576.

See A. Kluckhohn, *Friedrich der Fromme* (Nördlingen, 1877–79); and *Briefe Friedrichs des Frommen,* edited *by* Kluckhohn (Brunswick, 1868–72).

FREDERICK V (1596–1632), elector palatine of the Rhine and king of Bohemia, was born on Aug. 26, 1596, at Amberg in the Upper Palatinate, the son of the elector Frederick IV and Louisa Juliana, daughter of William of Orange, the liberator of the Netherlands. He received a French education at Sedan and succeeded his father in Sept. 1610. He married Elizabeth, daughter of James I of Great Britain, in Feb. 1613, but was not declared of age until July 1614. Against the advice of his palatine councilors he accepted the election as king of Bohemia (Aug. 26, 1619) by the Bohemian estates who had revolted against the Habsburg king, the Holy Roman emperor Ferdinand II (*q.v.*). He was crowned in Prague on Nov. 4. 1619. but his reign lasted little more than a year—hence his nickname "the Winter King"—as his army was completely routed by the Catholic league under Tilly in the battle of the White Mountain near Prague on Nov. 8, 1620 (*see* THIRTY YEARS' *WAR*). Frederick and his family. including the newly born prince Rupert (*q.v.*), fled without further resistance. The Protestant union, of which Frederick was the nominal head, was restrained by French pressure from assisting him; the Lutheran elector of Saxony was non over by Ferdinand nith the cession of Lusatia; James I of England was bent on appeasing Catholic Spain. After two years Frederick's cause collapsed through lack of funds for the maintenance of his troops under Ernst von Mansfeld and Christian of Brunswick (*qq.v.*). The Palatinate was occupied by the league and the Spaniards, and the electoral dignity nas transferred to Maximilian I (*q.v.*) of Bavaria. Frederick spent the rest of his life as a pensioner of the Dutch states-general and a hanger-on of Gustavus Adolphus of Sweden. He died in Mainz on Nov. 29, 1632. Through his youngest daughter Sophia (1630–1714), the mother of George I, Frederick became the ancestor of the Hanoverian dynasty in Great Britain.

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FREDERICK I. (1370–1428), surnamed **"the** Warlike," elector and duke of Saxony, was the eldest son of Frederick "the Stern," count of Osterland, and Catherine, daughter and heiress of Henry VIII., count of Coburg. He was born at Altenburg on April 11, 1370, and was a member of the family of Wettin. In the division of their father's lands in 1382 Frederick and his brothers shared Meissen and Thuringia with their uncles Balthasar and William. Frederick's brother George died in 1402, and his uncle William in 1407. A further dispute then arose, but in 1410 a treaty was made at Naumburg, when Frederick and his brother William added the northern part of Meissen to their lands; and in 1425 the death of William left Frederick sole ruler. In the German town war of 1388 he assisted Frederick V. of Hohenzollern, burgrave of Nuremberg, and in 1391 did the same for the Teutonic Order against Ladislaus V., king of Poland and prince of Lithuania. He supported Rupert III., elector palatine of the Rhine, in his struggle with King Wenceslaus for the German throne, probably because Wenceslaus refused to fulfil a promise to give him his sister Anna in marriage. He took a leading part in the war against the Hussites, receiving from the German King Sigismund, as a return for his services, various places in Bohemia and elsewhere in pledge, together with the vacant electoral duchy of Saxe-Wittenberg. He was formally invested at Budapest on Aug. 1, 1425. The elector was endeavouring to rouse the German princes to aid him in prosecuting the war against the Hussites when the Saxon army was almost annihilated at Aussig (1426). Frederick died at Altenburg on Jan. 4, 1428. In 1402 he married Catherine of Brunswick, by whom he left four sons and two daughters. He and his brother William founded the university of Leipzig for German students who had just left the university of Prague. Frederick's importance as an historical figure arises from his having obtained the electorate of Saxe-Wittenberg for the house of Wettin, and transformed the margraviate of Meissen into the territory which afterwards became the kingdom of Saxony. The ex-king of Saxony, the sovereigns of England and of the Belgians are his direct descendants.

See C. W. Bottiger and Th. Flathe, *Geschichte des Kurstaates und Königreichs Sachsen* (Gotha, 1867–73); and J. G. Horn, *Lebens- und Heldengeschichte Friedrichs des Streitbaren* (Leipzig, 1733).

FREDERICK II. (1411–1464), called "the Mild," elector and duke of Saxony, eldest son of the elector Frederick I., was born at Leipzig on Aug. 22, 1411. He succeeded his father as elector in 1428, but shared the family lands with his three brothers, and was at once engaged in defending Saxony against the attacks of the Hussites. He obtained the burgraviate of Meissen in 1439, and some part of Lower Lusatia after a struggle with Brandenburg about the same time. In 1438 it was decided that Frederick, and not his rival, Bernard IV., duke of Saxe-Lauenburg, was entitled to exercise the Saxon electoral vote at the elections for the

German throne. On the death of their cousin Frederick, margrave of Thuringia, the brothers Frederick and William divided Frederick's territory, but this arrangement was not satisfactory, and war broke out between them in 1446. After a struggle known as the *Brüderkrieg* peace was made in Jan. 1451, when William received Thuringia, and Frederick Altenburg and other districts. He died at Leipzig on Sept. 7, 1464. By his wife, Margaret (d. 1486), daughter of Ernest, duke of Styria, he left two sons and four daughters. In July 1455 occurred the celebrated *Prinzenraub*, the attempt of a knight named Kunz von Kaufungen (d. 1455) to abduct Frederick's two sons, Ernest and Albert. Having carried them off from Altenburg, Hunz was making his way to Bohemia when the plot was accidentally discovered and the princes restored.

See W. Schäfer, *Der Montag vor Kiliani* (1855); J. Gersdorf, *Einige Aktenstücke zur Geschichte des sächsischen Prinzenraubes* (1855); and T. Carlyle, *Critical and Miscellaneous Essays*, vol. iv. (1899).

FREDERICK III THE *WISE* (1463–1525), elector of Saxony from 1486 to 1525, was born at Torgau on Jan. 17, 1463, the eldest son of the elector Ernest and Elizabeth, daughter of Albert duke of Bavaria. His education was wide and strongly influenced by the Renaissance, his main early interests being music and German history. Succeeding his father as elector in 1486, Frederick retained the government of Saxony in his own hands but shared the possessions of his family in other parts of Germany with his brother John the Steadfast (1468–1532).

Frederick made his court at Wittenberg a centre of artistic activity, Albrecht Dürer and Lucas Cranach the elder being among the many artists patronized by him. He was also a great collector of religious relics, bringing many back from a pilgrimage to the Holy Sepulchre (1493) and housing them in the ducal chapel at Wittenberg. To add to the collection he maintained agents in Venice and in the Netherlands. He further took an interest in scholarship, being a friend of the humanist Georg Spalatin and founding, in 1502, the University of Wittenberg.

In 1495 Frederick had been among the princes who pressed the need for constitutional reform upon the German king Maximilian I, and in 1500 he became president of the newly formed imperial regency council (*Reichsregiment*). In 1519, however, he declined to stand as a candidate in the imperial election and assisted in procuring the election of Charles V, being the only elector to refuse a bribe.

Frederick, who had appointed Martin Luther professor of philosophy at Wittenberg in 1508 and Phillip Melanchthon professor of Greek there in 1518, refused to implement the papal bull against Luther in 1520. In 1521, after Luther had been placed under the imperial ban by the diet of Worms, Frederick had him conveyed to Wartburg castle and there protected him. He himself finally accepted Luther's reformed doctrines in 1524, but died shortly afterward at Langau, near Annaberg, on May 5, 1525.

BIBLIOGRAPHY.—There is a modern edition of Georg Spalatin's life of Frederick by C. G. Neudecker and L. Preller (1851). *See* also M. M. Tutzschmann, *Friedrich der Weise, Kurfürst von Sachsen* (1848); T. Kolde, *Friedrich der Weise und die Anfange der Reformation* (1881); W. Kalkofi, *Die Kaiserwahl Friedrichs IV. und Karls V.* (1925).

FREDERICK, a city of Maryland, U.S., 45 mi. W. of Baltimore and the same distance northwest of Washington, D.C., on a tributary of the Monocacy river; the seat of Frederick county. It is a trading, farming and manufacturing centre, with large flour and feed mills, brush and silo factories, creameries and corn-canning factories. Manufactures include chrome cooking utensils, stokers, pumps and electronic equipment.

Hood college for women, affiliated with the United Church of Christ, was organized as a college in 1893 but was originally founded as a ladies' seminary in 1839. Also located in Frederick is the state school for the deaf (1867); on its grounds is a stone barracks built in 1777, which quartered prisoners from Saratoga, N.Y., Trenton, N.J., and Yorktown, Va., during the American Revolution and served as a Union hospital during the Civil War. The town clock, in the tower of Trinity chapel, has been in constant service since 1796.

Frederick was the birthplace of Francis Scott Key and of Adm. Winfield Scott Schley. A number of beautiful colonial homes remain in and near the city. Settled by Germans in 1733 and laid out in 1745, Frederick was named for the last Lord Baltimore or the then prince of Wales, or possibly for Frederick the Great of Prussia. There in 1755 Gen. Edward Braddock prepared for his ill-fated expedition against Ft. Duquesne; and in the county courthouse on Nov. 23, 1765, the 12 county judges took official action (the first jurists of the country to do so) repudiating the British Stamp act. The city was incorporated in 1817. During the Civil War Frederick was occupied at different times by Union and Confederate troops. The battle of Monocacy (July 1864) was fought 3 mi. S. The flag-waving by Barbara Fritchie, which through John Greenleaf Whittier's ballad became a cherished national legend, took place, if at all, during "Stonewall" Jackson's march to Harpers Ferry, in 1862. A replica of Mrs. Fritchie's house serves as a museum for Civil War and early Frederick historical items. For comparative population figures *see* table in MARYLAND: *Population*. (R. M. LA.)

FREDERICK AUGUSTUS I. (1750–1827), king of Saxony, son of the elector Frederick Christian, was born at Dresden on Dec. 23, 1750. He succeeded his father under the guardianship of Prince Xavier in 1763, and was declared of age in 1768. In 1769 he married Maria Amelia, daughter of Duke Frederick of Zweibrücken, by whom he had one daughter, Princess Augusta. He was methodical and conscientious, and a good example to all his officials, whence his surname "the Just." He sided with Frederick the Great in the short Bavarian succession war of 1778 against Austria. At the peace of Teschen, which concluded the war, he received 6 million florins. In 1785 he joined the league of German princes (*Deutscher Fürstenbund*) formed by Prussia, but without prejudice to his neutrality. Thus he remained neutral during the quarrel between Austria and Prussia in 1790. In the following year he declined the crown of Poland. He refused to join the league against France (Feb. 7, 1792), but when war was declared his duty to the empire necessitated his taking part in it. Even after the peace of Basel (April 5, 1795) he continued the war. But when the French army, during the following year, advanced into the heart of Germany, he was compelled by General Jourdan to retreat (Aug 13, 1796). In 1806 he joined Prussia against France. After the disastrous battle of Jena he concluded peace with Napoleon at Posen (Dec. 11 1806), and, assuming the title of king, he joined the Confederation of the Rhine. But he did not alter the constitution and administration of his new kingdom. After the peace of Tilsit (July 9, 1807) he was created by Napoleon grand-duke of Warsaw, but his sovereignty of Poland was little more than nominal. In 1809 Frederick Augustus fought with Napoleon against Austria. On several occasions (1807, 1812, 1813) Napoleon was entertained at Dresden, and when, on his return from his disastrous Russian campaign, he passed through Saxony by Dresden (Dec. 16, 1812), Frederick Augustus remained true to his friend and ally. In April 1813 he made overtures to Austria, but he soon afterwards returned to the side of the French. He returned to Dresden on May 10 and was present at the terrible battle of Aug. 26 and 27, in which Napoleon's army and his own were defeated. He fell into the hands of the Allies after their entry into Leipzig; and, although he regained his freedom after the congress of Vienna, he was compelled to give up the northern part—three-fifths—of his kingdom to Prussia (May 21, 1814). He entered Dresden on July 7, and was enthusiastically welcomed by his people. The remainder of his life was spent in repairing the damages caused by the Napoleonic wars, in developing the agricultural, commercial and industrial resources of his kingdom, reforming the administration of justice, establishing hospitals and other charitable institutions, encouraging art and science and promoting education. He had a special interest in botany, and originated the beautiful park at Pillnitz. He died on May 5, 1827.

BIBLIOGRAPHY.—The earlier lives, by C. E. Weisse (1811), A. L. Herrmann (1827), Pölitz (1830), are mere panegyrics. On the other side *see* Flathe in *Allgemeine deutsche Biographie*, and Böttiger-Flathe, *History of Saxony* (2nd ed., 1867 ff.), vols. ii. and iii.; A. Bonneions, *Un Allié de Napoléon, Frédéric Auguste, premier roi de Saxe . . .* (1902); Fritz, Friedrich, *Politik Sachsens 1801–1803* (1898); P. Rühlmann, *Öffentliche Meinung . . . 1806–1813* (1902). There are many pamphlets bearing on the Saxon question and on Frederick Augustus during the years 1814 and 1815.

FREDERICK AUGUSTUS II (1797–1854), king of Saxony from 1836 to 1854, was born in Dresden on May 18, 1797, the eldest son of Prince Maximilian of Saxony and of Carolina of Parma. In Oct. 1819 he married the archduchess Caroline, daughter of the Austrian emperor Francis I. Nominated as joint regent of Saxony with his uncle King Antony in Sept. 1830 (as a consequence of the July revolution in Dresden), Frederick Augustus was partly responsible for the constitution of 1831, which introduced a measure of representative government. In May 1832 his first wife died, and in April 1833 he married Maria, daughter of Maximilian I king of Bavaria. On June 6, 1836, he became king in succession to his uncle Antony. At first he favoured the plan for German unity put forward at Frankfurt in 1848, though refusing to acknowledge the democratic constitution of the Frankfurt assembly. This attitude led to the May insurrection in Dresden in 1849, which was suppressed with the help of Prussian troops. F. F. von Beust, the minister who had called in the troops and who was also the leader of the reactionary pro-Austrian party in Saxony, then became the director of Saxon policy.

From that time Frederick Augustus took little part in government and devoted himself to the study of botany, in which he had long been interested, having already published Flora *Marien*badensis, oder *Pflanzen und* Gebirgsarten (1837) and traveled extensively in search of specimens. He died, childless, on Aug. 9, 1854, as a result of a carriage accident near Brennbühel in the Tirol.

See C. *W*. Böttiger and T. Flathe, *Geschichte des Kurstaates und Konigreiches Sachsen,* vol iii *(1873)*; H. Kretzschmar, "Die Sächsische Königtum in 19 Jahrhundert," *Historische Zeitschrift,* no. *70 (1950)*.

FREDERICK CHARLES (FRIEDRICH KARL NIKOLAUS), PRINCE (1828–1885), Prussian general field marshal, son of Prince Charles of Prussia and grandson of King Frederick William III., was born in Berlin on March 20 1828. He entered the army on his tenth birthday as second lieutenant in the 14th Foot Guards He studied at Bonn where he lived for two years, being accompanied throughout by Major von Roon, afterwards the famous war minister. He served in the Schleswig-Holstein War on the staff of Marshal von Wrangel. In 1849 he took part in the campaign against the Baden insurgents, and was wounded at the action of Wiesenthal while leading a desperate charge against entrenched infantry. In 1852 he became colonel, and in 1854 major-general and commander of a cavalry brigade. In this capacity he was brought closely in touch with General von Reyher, the chief of the general staff, and with Moltke. He married, in the same year, Princess Marie Anne of Anhalt.

In 1858 he visited France, where he minutely investigated the state of the French army, but was recalled when Prussia mobilized her forces during the Franco-Austrian war. The prince was made a divisional commander in the II. army corps with a liberty of action which had previously been denied to him. About this time (1860) he gave a lecture to the officers of his command on the French army and its methods, the substance of which (*Eine militärische Denkschrift von* P.F.K., Frankfort on Main, 1860) was circulated more widely than the author intended, and in the French translation gave rise to much indignation in France. In 1861 Frederick Charles became general of cavalry. He was then commander of the III. (Brandenburg) army corps. This post he held from 1860 to 1870, except during the campaigns of 1864 and 1866, and in it he displayed his real qualities as a troop leader. Ten years of his continuous and thorough training brought the III. corps to a pitch of real efficiency which the Guard corps alone, in virtue of its special recruiting powers, slightly surpassed. Prince Frederick Charles' work was to be tested when von Alvensleben and the III. corps engaged the whole French army on Aug. 16, 1870. In 1864 the Prussian contingent under Frederick Charles formed a corps of the allied army, operating against the Danes, and half of it was drawn from the III. corps. After the storming of the Duppel lines the prince succeeded Wrangel in the supreme command, with Moltke as his chief of staff. These two great soldiers then planned and brilliantly carried out the capture of the island of Alsen, after which the war ended.

In 1866 came the Seven Weeks' War with Austria. Prince Frederick Charles was appointed to command the I. Army, which he led through the mountains into Bohemia, driving before him the Austrians and Saxons to the upper Elbe, where on July 3, took place the decisive battle of Koniggratz or Sadowa. This was brought on by the initiative of the leader of the I. Army, which had to bear the brunt of the fighting until the advance of the II. Army turned the Austrian flank. After the peace he returned to the III. army corps, which he finally left, in July 1870, when appointed to command the II. German Army in the war with France. In the early days of the advance the prince's ruthless energy led to much friction between the I. and II. Armies (see FRANCO-GERMAN WAR), while his strategical mistakes seriously embarrassed the great headquarters staff. The advance of the II. Army beyond the Saar to the Moselle and from that river to the Meuse displayed more energy than careful strategy, though the "red prince" (as he was called from the colour of his favourite hussar uniform) was in thorough sympathy with the king's headquarters on the one hand and the feelings of the troops on the other. Then came the discovery that the French were not in front, but to the right rear of the II. Army (August 16). Alvensleben with the III. corps held the French to their ground at Vionville while the prince hurried together his scattered forces. He himself directed with superb tactical skill the last efforts of the Germans at Vionville, and the victory of St. Privat on the 18th was due to his leadership (see METZ), which shone all the more by contrast with the failures of the I. Army at Gravelotte. The prince was left in command of the forces which blockaded Bazaine in Metz, and received the surrender of that place and of the last remaining field army of the enemy. He was promoted at once to the rank of general field marshal, and shortly afterwards the II. Army was despatched to aid in crushing the newly organized army of the French republic on the Loire. Here again he retrieved strategical errors by energy and tactical skill, and his work was in the end crowned by the victory of Le Mans on Jan. 12, 1871.

He now became inspector-general of the 3rd "army inspection," and a little later inspector of cavalry, and in the latter post he brought the Germany cavalry to a high degree of perfection in manoeuvre and general training. His sternness of character kept him aloof from the court and from his own family, and he spent his leisure months chiefly on his various country estates. In 1872 and in 1882 he travelled in the Mediterranean and the Near East. He died on June 15, 1885, at Klein-Glienicke near Berlin, and was buried at the adjacent church of Nikolskoe. His third daughter, Princess Louise Margareta, was married, in March 1879, to the duke of Connaught. His *Denkwürdigkeiten* were edited by W. Foerster in 1910.

See Müller-Bohn, *Der Eiserne Prinz* (1902).

FREDERICK HENRY (1584–1647), prince of Orange, the youngest child of William the Silent and Louise de Coligny was born at Delft in Holland, on Jan. 29, 1584, that is, about six months before his father's assassination. In 1594 he went to the University of Leiden. In 1597 he joined the army under his brother Maurice and was present at the siege of Rijnberk. From Dec. 1597 to April 1599 he was in France with his mother, who wanted him to know and understand her country. On his return to the Netherlands, Frederick Henry again joined the army, becoming colonel of a Walloon regiment. In 1603 he was a member of the embassy sent by the estates of Holland to James I of England to congratulate him on his accession. During the conflicts which divided the Dutch republic in the 1610s Frederick Henry favoured the Remonstrants, but he did not actively support them since his brother Maurice, the stadholder, supported the Counter-Remonstrants.

The 12 years' truce with Spain ended in 1621 and Frederick Henry took a leading part in the war which followed (see NETHERLANDS: History). On Maurice's death in 1625 Frederick Henry succeeded him as stadholder of Holland, Zeeland, Utrecht, Gelderland and Overijssel and was also appointed captain-general and admiral-general of the United Provinces. Thenceforward his military genius—exemplified by the capture of Grol (1627), 'S Hertogenbosch (1629). Maastricht (1632) and Breda (1637)—his political skill and the tenacity with which he pursued his dynastic ambitions all combined to win him a semimonarchical prestige, and his court at The Hague became an international centre. In 1640 his position at home was made still stronger by his succession to the stadholderships of Groningen and Drenthe. In 1625, moreover, he had married Amalia of Solms, and the marriage of his son William to Mary, the daughter of Charles I of England, in May 1641 enhanced the standing of his house abroad.

In domestic affairs Frederick Henry used his great powers to stabilize the situation, as for example in his toleration of the Remonstrants, and this policy was fairly successful until 1644. After that year, however, weakened in mind and body, he was unable to resist the increasing opposition to the dynastic and pro-Stuart tendencies of his regime and to his reluctance to end the war with Spain by breaking the French alliance of 1635. In 1646 negotiations were begun which were to culminate in the treaty of Münster between Spain and the United Provinces in 1648, but meanwhile Frederick Henry had died on March 14, 1647. He left an account of his campaigns, which was published as *Mémoires de Frédéric Henri* in 1733.

See P. J. Blok, *Frederik Hendrik, Prins van Oranje* (1924); also G. Edmundson, "Frederick Henry, Prince of Orange" *Cambridge Modern History,* vol. iv *(1907).* (E. H. K.)

FREDERICK LOUIS (1707–1751), prince of Wales, eldest son of George 11, was born at Hanover on Jan. 20, 1707. After his grandfather, George I, became king of Great Britain and Ireland in 1714, Frederick was known as duke of Gloucester (though never actually created) and made a knight of the Garter. He had been betrothed to Wilhelmina Sophia Dorothea (1709–1758), daughter of Frederick William I, king of Prussia, and sister of Frederick the Great, but the match was prevented by the ill will between the parents. On the accession of George 11 in 1727 Frederick went to England and in 1729 was created prince of Wales; but the relations between father and son were unfriendly, and the king refused to make him an adequate allowance. In 1735 Frederick wrote, or inspired the writing of, the *Histoire du prince Titi,* a book containing offensive caricatures of both king and queen; "he made his court" says Lecky, "the special centre of opposition to the government, and he exerted all his influence for the ruin of Walpole." After a marriage between the prince and Lady Diana Spencer, afterward the wife of John, 4th duke of Bedford, had been frustrated by Walpole, Frederick married in April 1736 Augusta (1719–1772), daughter of Frederick 11, duke of Saxe-Gotha. George proposed to allow the prince £50,000 a year; but this sum was regarded as insufficient by the latter, whose appeal to parliament was unsuccessful. After the birth of his first child, Augusta, in 1737, Frederick was ordered by the king to quit St. James's Palace, and foreign ambassadors were requested to refrain from visiting him. In 1745 George 11 refused to allow his son to command the British army against the Jacobites. On March 20, 1751, the prince died in London, and was buried in Westminster Abbey. He left five sons and two daughters. The sons were George (afterward King George 111); Edward Augustus, duke of York and Albany (1739–1767); William Henry, duke of Gloucester and Edinburgh (1743–1805); Henry Frederick, duke of Cumberland (1745–1790); and Frederick William (1750–1765). The daughters were Augusta (1737–1813), wife of Charles William Ferdinand, duke of Brunswick; and Caroline Matilda (1751–1775), wife of Christian VII, king of Denmark.

See Lord Hervey of Ickworth, *Memoirs of the Reign of George II,* edited by J. W. Croker (1884); Horace Walpole, *Memoirs of the Reign of George II* (1847); and Sir N. W. Wraxall, *Memoirs,* edited by H. B. Wheatley, vol. i (1884).

FREDERICKSBURG, a city of Virginia, U.S., lies in Spotsylvania county but is politically independent of it. It is served by the Richmond, Fredericksburg and Potomac railway; it marks the head of navigation for the Rappahannock river. Fredericksburg's chief industry is a viscose company. Mary Washington college, the women's branch of the University of Virginia, is located in the city. (For comparative population figures *see* table in VIRGINIA: *Population.)*

Fredericksburg was laid out as a town in 1727 and named for the father of King George 111 of England. Its founders and earliest residents included Col. Henry Willis, Rev. James Marye, John Tennent, Susanna Livingston and William Lynn. William Paul, brother of John Paul Jones (*q.v.*), set up the first tailor shop there. In 1732 George Washington's father, who owned "Ferry Farm" across the Rappahannock, bought three lots in the town and became one of its trustees. Fredericksburg was incorporated as a town in 1781. Among Fredericksburg's historic sites are the homes of Mary Ball Washington, mother of George Washington; "Kenmore," the home of Washington's only sister; the law office of James Monroe (*q.v.*), the Hugh Mercer apothecary shop; and the Civil War battlefields.

The **Battle of Fredericksburg.**—A bloody engagement of the Civil War was fought at Fredericksburg on Dec. 13, 1862. In search of more aggressive leadership, the Lincoln administration had removed Gen. G. B. McClellan from command of the Army of the Potomac on Nov. 7 and appointed Gen. A. E. Burnside (*q.v.*) in his place. In the middle of November, Burnside began moving from Warrenton, Va., planning to cross the Rappahannock at Fredericksburg and advance on the southern capital at Richmond. Gen. R. E. Lee countered by taking a strong position on high ground behind Fredericksburg and extending his right about five miles south. His force numbered about 78,000. Burnside, with 122,000 men, held off attacking until his pontoon bridges arrived. When he finally began his assault on Dec. 13, he made it piecemeal. Gen. W. B. Franklin, commanding the Union left, interpreted Burnside's vague orders as restricting his action to a single division. At first this division made good headway against Gen. "Stonewall" Jackson on the heights below Fredericksburg. But, without support, it fell back about midafternoon. Troops brought across the river from Gen. Joseph Hooker's reserve arrived too late for another attempt. Meanwhile, at 1 o'clock, Burnside had sent Gen. E. V. Sumner with the troops on the right to strike behind Fredericksburg itself. Two Union divisions and then a third advanced over exposed ground in front of a stone wall below Marye's heights. Still more troops were added, but few ever got within 100 yd. of the wall. A final Union charge lost over 1,000 men in 15 min. Thus, Burnside's attack on the right proved as futile as that on the left and far more costly. In the end his casualties totaled 12,653 compared with only 5,309 for the carefully entrenched Confederates. And yet Burnside had to be dissuaded from renewing the attack next morning. During a storm on the night of Dec. 15, the army of the Potomac recrossed the Rappahannock and took up its bridges. For his conduct of this battle Burnside has been strongly criticized by students of military history. Lincoln relieved him of his command on Jan. 27, 1863. Like McClellan, and Gen. John Pope before him, Burnside had failed in what should have been the Union objective—destruction of the army of Virginia. Richmond seemed as far away as ever. For the south, the victory restored morale lost after Lee's retreat from Maryland following his unsuccessful Antietam (*q.v.*) campaign in October. *See* also AMERICAN CIVIL WAR.

See J. T. Goolrick, *Historic Fredericksburg* (1922); *R.* U. Johnson and C. C. Buel (eds.), *Battles and Leaders of the Civil War, 4* vol. (1888). vol. 3, pp. 71–147; Col. G. F. R. Henderson, *The Civil War: a Soldier's View,* ed. *by J.* Luvaas, (1958). (E. J. N.)

FREDERICK WILLIAM I (1688–1740), king of Prussia, son of Frederick I by his second marriage, was born on Aug. 15, 1688. He was early imbued with a passion for military life, and this was deepened by acquaintance with the duke of Marlborough (1709), Prince Eugene, whom he visited during the siege of Tournai, and Prince Leopold of Anhalt (the "Old Dessauer"). In nearly every respect he was the opposite of his father, having frugal, simple tastes, a passionate temper and a determined will. His life was simple and puritanical, being founded on the teaching of the Bible. He was, however, fond of hunting and somewhat given to drinking. He intensely disliked the French, and highly disapproved of the imitation of their manners by his father and his court. When he came to the throne (Feb. 25, 1713) his first act was to dismiss from the palace every unnecessary official and to regulate the royal household on principles of the strictest parsimony. The greater part of the beautiful furniture was sold. His importance for Prussia is twofold: in internal politics he laid down principles which continued to be followed long after his death; he was one of the greatest administrators who have ever worn the Prussian crown. His foreign policy was less successful, though under his rule the kingdom acquired some extension of territory.

Thus at the peace of Utrecht (April 11, 1713), after the War of the Spanish Succession, he acquired the greater part of the duchy of Gelderland. By the treaty of Schwedt, concluded with Russia, he was assured of an important influence in the solution of the Baltic question, and Swedish Pomerania, as far as the Peene, was occupied by Prussia. But Charles XII. on his return turned against the king, though without success, for the Pomeranian campaign of 1715 ended in favour of Prussia (fall of Stralsund, Dec. 22). This enabled Frederick William I. to maintain a more independent attitude towards the tsar; he refused, for example, to provide him withtroops for a campaign (in Schonen) against the Swedes. When on May 28, 1718, in view of the disturbances in Mecklenburg, he signed at Havelberg the alliance with Russia, he confined himself to a defensive attitude, and. on the other hand, on Aug. 14, 1719, he also entered into relations with his former enemies, England and Hanover. By the treaty of Stockholm (Feb. 1, 1720), Frederick William succeeded in obtaining the consent of Sweden to the cession of that part of Pomerania which he had occupied (Usedom, Wollin, Stettin, Hither Pomerania, east of the Peene) in return for a payment of 2,000,000 thalers.

In order to secure the succession to the Lower Rhine duchies of Julich and Berg, Frederick William finally agreed to the treaty of Wiisterhausen (Oct. 12, 1726; ratified at Berlin, Dec. 23, 1728), in which he recognised the Pragmatic Sanction. In the War of the Polish Succession against France (1734–35), Frederick William remained faithful to the emperor's cause, and sent an auxiliary force of 10.000 men. The peace of Vienna, which terminated the war, led to a reconciliation between France and Austria, and so to a further estrangement between Frederick William and the emperor. In 1738 the western Powers, together with the emperor, insisted in identical notes on the recognition of the emperor's right to decide the question of the succession in the Lower Rhine duchies. A breach with the emperor was now inevitable, and this explains why in a last treaty (April 5, 1739) Frederick William obtained from France a guarantee of a part, at least, of Berg (excluding Dusseldorf).

But Frederick William's failures in foreign policy were more than compensated for by his splendid services in the internal administration of Prussia. He saw the necessity of rigid economy not only in his private life but in the whole administration of the state. During his reign Prussia obtained for the first time a centralized and uniform financial administration. It was the king himself who composed and wrote in the year 1722 the famous instruction for the general directory (Generaldirektorium) of war, finance and domains. When he died the income of the state was about seven million thalers (£1,050,000). The consequence was that he paid off the debts incurred by his father, and left to his successor a well filled treasury. In the administration of the domains he made three innovations: (1) the private estates of the king were turned into domains of the crown (Aug. 13, 1713); (2) the freeing of the serfs on the royal domains (March 22, 1719); (3) the conversion of the hereditary lease into a short-term lease on the basis of productiveness. His industrial policy was inspired by the mercantile spirit. On this account he forbade the importation of foreign manufactures and the export of raw materials from home, a policy which had a very good effect on the growth of Prussian industries.

The work of internal colonization he carried on with especial zeal. Most notable of all was his rktablissement of East Prussia, to which he devoted six million thalers (c. £900,000). His policy in respect of the towns was motived largely by fiscal considerations, but at the same time he tried also to improve their municipal administration; for example, in the matter of buildings, of the letting of domain lands and of the collection of the excise in towns. Frederick William had many opponents among the nobles because he pressed on the abolition of the old feudal rights, introduced in East Prussia and Lithuania a general land tax (the General hufenschoss), and finally in 1739 attacked in a special edict the *Legen, i.e.,* the expropriation of the peasant proprietors.

He did nothing for the higher learning, and even banished the philosopher Christian Wolff at 48 hours' notice "on pain of the halter," for teaching, as he believed, fatalist doctrines. Afterwards he modified his judgment in favour of Wolff, and even, in 1739, recommended the study of his works. He established many village schools, which he often visited in person; and after the year 1717 (Oct. 23) all Prussian parents were obliged to send their children to school (*Schulzwang*). Under him the people flourished; and although it stood in awe of his vehement spirit it respected him for his firmness, his honesty of purpose and his love of justice. He was devoted also to his army, the number of which he raised from 38,000 to 83,500, so that under him Prussia became the third military power in the world, coming next after Russia and France. There was not a more thoroughly drilled or better appointed force. The Potsdam guard, made up of giants collected from all parts of Europe, sometimes kidnapped, was a sort of toy with which he amused himself. The reviewing of his troops was his chief pleasure. But he was also fond of meeting his friends in the evening in what he called his Tobacco-College, where amid clouds of tobacco smoke he not only discussed affairs of state but heard the newest "guard-room jokes." He died on May 31, 1740, leaving behind him his widow, Sophia Dorothea of Hanover, whom he had married on Nov. 26, 1706. His son was Frederick the Great (see FREDERICK II., king of Prussia), who opposed him. This opposition became so strong in 1730 that the crown prince fled from the court, and was later arrested and brought before a court martial. A reconciliation was brought about, at first gradually. In later years the relations between father and son came to be of the best.

See the references *s.v.* Prussia; also *Hohenzollernjahrbuch,* viii. (1905), for particulars of Frederick William's education and death; letters to Prince Leopold of Anhalt-Dessau in the *Acta Borussica* (1905). There is a picturesque account of him in Thomas Carlyle's Frederick the Great.

FREDERICK WILLIAM II. (1744–1797), king of Prussia, son of Augustus William, second son of King Frederick William I. and of Louise Amalie of Brunswick, sister-in-law of Frederick the Great, was born at Berlin on Sept. 25, 1744, and became heir to the throne on his father's death in 1757. Although the prince had a numerous family, he was completely under the influence of his mistress, Wilhelmine Enke, afterwards created Countess Lichtenau, a woman of strong intellect and much ambition. He was a handsome man, and devoted to the arts — Beethoven and Mozart enjoyed his patronage and his private orchestra had a European reputation. Frederick the Great, who had employed him in various services — notably in an abortive confidential mission to the court of Russia in 1780 — openly expressed his misgivings as to the character of the prince and his surroundings.

The misgivings were justified by the event. Frederick William's accession to the throne on the death of the great Frederick (Aug. 17, 1786) was: indeed, followed by a series of measures for lightening the burdens of the people, reforming the oppressive French system of tax-collecting, and encouraging trade by the diminution of customs dues and the making of roads and canals. The educated classes were pleased by his removal of Frederick's ban on the German language by the admission of German writers to the Prussian Academy, and by the active encouragement given to schools and universities. But these reforms were vitiated in their source. In 1781 Frederick William, then prince of Prussia, had joined the Rosicrucians, and had fallen under the influence of the fanatical Johann Christof Wollner (1732–1800), and by him the royal policy was inspired. On Aug. 26, 1786 Wollner was appointed privy councillor for finance (Geheimer *Oberfinanzrath*). Though not in name, in fact he was prime minister, and the fiscal and economic reforms of the new reign were the application of his theories. Bischoffswerder, another Rosicrucian, was also called into the king's counsels; by 1789 he was already an adjutant-general. In 1788 Wöllner became privy councillor of state and of justice and head of the spiritual department for Lutheran and Catholic affairs. War was at once declared on what — to use a later term — we may call the "modernists." On July 9 was issued the edict forbidding ministers to teach anything not contained in the letter of their official books, proclaiming the necessity of protecting the Christian religion against the "enlighteners" (*Aufklärer*), and placing educational establishments under the supervision of the orthodox clergy. On Dec. 18, a new censorship law was issued, to secure the orthodoxy of all published books; and finally, in 1791, a sort of Protestant Inquisition was established at Berlin (*Immediat-Examinations-commission*) to watch over all ecclesiastical and scholastic appointments. The effects of this policy of blind obscurantism outweighed any good that resulted from economic and financial reform; and even this reform was but spasmodic and partial. Far more fateful for Prussia was the king's attitude towards the army and foreign policy. Frederick William, who had no taste for military matters! put his authority as "War-Lord" into commission under a supreme college of war (*Oberkriegs-Collegium)* under the duke of Brunswick and General von Möllendorf. It was the beginning of the process that ended in 1806 at Jena.

The Dutch campaign of 1787, entered on for purely family reasons, was indeed successful; but Prussia received not even the cost of her intervention. An attempt to intervene in the war of Russia and Austria against Turkey failed of its object; Prussia did not succeed in obtaining any concessions of territory from the alarms of the Allies, and the dismissal of Hertzberg in 1791 marked the final abandonment of the anti-Austrian tradition of Frederick the Great. For, meanwhile, the French Revolution had entered upon alarming phases, and in Aug. 1791 Frederick William, at the meeting at Pillnitz, arranged with the emperor Leopold to join in supporting the cause of Louis XVI. A formal alliance was signed on Feb. 7, 1792, and Frederick William took part personally in the campaigns of 1792 and 1793. A subsidy treaty with the sea powers (April 19, 1794) filled his coffers; but the insurrection in Poland that followed the partition of 1793, and the threat of the isolated intervention of Russia, hurried him into the separate treaty of Basle with the French Republic (April 5, 1795), which was regarded by the great monarchies as a betrayal, and left Prussia morally isolated in Europe on the eve of the revolutionary era. Prussia had paid a heavy price for the vast territories acquired at the expense of Poland in 1793 and 1795, and when, on Nov. 16, 1797, Frederick William died, he left the state in bankruptcy and confusion, the army decayed and the monarchy discredited.

Frederick William II. was twice married: (1) in 1765 to Elizabeth of Brunswick (d. 1841), by whom he had a daughter, Frederika, afterwards duchess of York, and from whom he was divorced in 1769; (2) in 1769 to Frederika Louisa of Hesse-Darmstadt, by whom he had four sons, Frederick William III., Louis (d. 1796), Henry and William, and two daughters, Wilhelmina, wife of William of Orange, afterwards William I., king of the Netherlands, and Augusta, wife of William II., elector of Hesse. Besides his relations with his *maîtresse en titre,* the countess Lichtenau, the king—who was a frank polygamist—contracted two "marriages of the left hand" with Fraulein von Voss and the countess Donhoff.

See article by von Hartmann in ***Allgem. deutsche Biog.*** (Leipzig, 1878) ; Stadelmann, ***Preussens Könige** in ihrer Tatigkeit fur die Landeskultur,* vol. iii. "Friedrich Wilhelm IT." (Leipzig, 1885); Paulig, *Friedrich Wilhelm II., sein Privatleben u. seine Regierung* (Frankfurt-an-der-Oder, 1896).

FREDERICK WILLIAM III. (1770–1840), king of Prussia, eldest son of King Frederick William II., was born at Potsdam on Aug. 3, 1770. His father, then prince of Prussia, was out of favour with Frederick the Great and entirely under the influence of his mistress, and the boy led a solitary and repressed life. As a soldier he received the usual training of a Prussian prince, obtained his lieutenancy in 1784, became a colonel commanding in 1790, and took part in the campaigns of 1792–94. In 1793 he married Louise, daughter of Prince Charles of Mecklenburg-Strelitz, whom he met at Frankfort. He succeeded to the throne on Nov. 16, 1797, and at once began to remedy the worst abuses of his father's reign. But he had neither the strength nor the ability to meet the difficult foreign situation. The consequences of his infirmity of purpose are written large on the history of Prussia from the treaty of Lunéville in 1801 to the downfall that followed the campaign of Jena in 1806. By the treaty of Tilsit (July 9, 1807) Frederick William had to surrender half his dominions, and what remained to him was exhausted by French exactions and liable at any moment to be crushed out of existence by Napoleon. Only the indomitable courage of Queen Louise helped the weak king not to despair of the state. She seconded the reforming efforts of Stein and the work of Scharnhorst and Gneisenau in reorganizing the army, by which the resurrection of Prussia became a possibility. When Stein was dismissed at the instance of Napoleon, Hardenberg succeeded him as chancellor (June 1810). In the following month Queen Louise died, and the king was left alone to deal with circumstances of ever-increasing difficulty. He was forced to join Napoleon in the war against Russia; and even when the disastrous campaign of 1812 had for the time broken the French power, it was not his own resolution, but the loyal disloyalty of General Tork in concluding with Russia the convention of Tauroggen that forced him into line with the patriotic fervour of his people.

Once committed to the Russian alliance, however, he became the faithful henchman of the emperor Alexander. He was one of the original co-signatories of the Holy Alliance, though he signed it with reluctance; and in the counsels of the Grand Alliance he allowed himself to be practically subordinated to Alexander and later to Metternich. At the various congresses, from Aix-la-Chapelle (1818) to Verona (1822), he showed himself in sympathy with the repressive policy formulated in the Troppau Protocol. The promise of a constitution, which in-the excitement of the War of Liberation he had made to his people, remained unfulfilled. But though reluctant to play the part of a constitutional king, Frederick William laboured assiduously at the enormous task of administrative reconstruction involved in welding the heterogeneous elements of the new Prussian kingdom into a united whole. He was sincerely religious; but his well-meant efforts to unite the Lutheran and Reformed Churches, revealed the limits of his paternal power; not till 1834, after a regime of coercion and confiscation, was outward union secured on the basis of common worship but separate symbols, the opponents of the measure being forbidden to form communities of their own. With the Roman Catholic Church, too, the king came into conflict on the vexed question of "mixed marriages," a conflict in which the Vatican gained an easy victory (*see* BUNSEN, CHRISTIAN CHARLES JOSIAS).

The revolutions of 1830 strengthened Frederick William in his reactionary tendencies; the question of the constitution was indefinitely shelved. and in 1831 Prussian troops concentrated on the frontier helped the task of the Russians in reducing the military rising in Poland. Yet, in spite of all. Frederick William was beloved by his subjects. who valued him for the simplicity of his manners. the goodness of his heart and the memories of the dark days after 1806. He died on June 7, 1840. In 1824 he had contracted a morganatic marriage with the countess Auguste von Harrach. whom he created Princess von Liegnitz. He wrote *Luther in Bezug auf die Kirchenagenda von 1822 und 1823* (Berlin, 1827), *Reminiszenzen* aus *der Kampagne 1792 in Frankreich,* and *Journal meiner Brigade* in *der Kampagne am Rhein 1793.*

The correspondence (*Briefwechsel*) of King Frederick William **III.** and Queen Louise with the emperor Alexander I. has been published (Leipzig, 1900) and also that between the king and queen (*ib.* 1903), both edited by P. Bailleu. *See* W. Hahn, *Friedrich Wilhelm III. und Luise* (3rd ed., Leipzig, 1877) ; M. W. Duncker, *Aus der **Zeit** Friedrichs des Grossen und Friedrich Wilhelms III.* (Leipzig, 1876) ; *Briefe und Aktenstücke zur Geschichte Preussens unter Friedrich Wilhelm III.* (ed. Rühl, 3 vols., 1899–1902).

FREDERICK WILLIAM IV. (1795–1861), king of Prussia, eldest son of Frederick William III., was born on Oct. 15, 1795. From his first tutor, Johann Delbruck, he imbibed a love of culture and art, but after a time Delbruck was dismissed, his place being taken by the pastor and historian Friedrich Ancillon, while a military governor was also appointed. By Ancillon he was grounded in religion, in history and political science, and his tutor impressed upon him his own hatred of the Revolution and its principles. This hatred was confirmed by the sufferings of his country and family in the terrible years after 1806, and his first experience of active soldiering was in the campaigns that ended in the occupation of Paris by the Allies in 1814. On his return to Berlin he studied art under the sculptor Christian Daniel Rauch and the painter and architect Karl Friedrich Schinkel (1781–1841), proving himself in the end a good draughtsman, a born architect and an excellent landscape gardener. At the same time he was being tutored in law by Savigny and in finance by a series of distinguished masters. In 1823 he married the princess Elizabeth of Bavaria, who adopted the Lutheran creed. The union, though childless. was very happy. A long tour in Italy in 1828 was the beginning of his intimacy with Bunsen and did much to develop his knowledge of art and love of antiquity.

On his accession to the throne in 1840 Frederick William reversed the unfortunate ecclesiastical policy of his father, allowing a wide liberty of dissent, and releasing the imprisoned archbishop of Cologne; he modified the press censorship; he promised the deputations of the provincial diets to create a central constitution, which he admitted to be required by the royal promises. But the idea of the sovereignty of the people was to him utterly abhorrent, and even any delegation of sovereign power on his own part would have seemed a betrayal of a God-given trust. "I will never," he declared, "allow to come between Almighty God and this country a plotted parchment. to rule us with paragraphs, and to replace the ancient, sacred bond of loyalty." His vision of the ideal state was that of a patriarchal monarchy, surrounded and advised by the traditional estates of the realm—nobles, peasants, burghers—and cemented by the bonds of evangelical religion. In Prussia, with its traditional loyalty and its old-world caste divisions, he believed that such a conception could be realized, and he stood half-way between those who would have rejected the proposal for a central diet altogether as a dangerous "thin end of the wedge," and those who would have approximated it more to the modern conception of a parliament. With a charter, or a representative system based on population, he would have nothing to do The united diet which was opened on Feb. 3, 1847, was no more than a congregation of the diets instituted by Frederick William III in the eight provinces of Prussia Unrepresentative though it was—for the industrial working-classes had no share in it—it at once gave voice to the demand for a constitutional system

The revolutionary outbreaks of 1848 rudely awakened Frederick William from his mediaeval dreamings; he even allowed himself to be carried a ay for a while by the popular tide. The loyalty of the Prussian army remained inviolate; but the king was too tender-hearted to use military force against his "beloved Berliners." and when the victory of the populace was thus assured his impressionable temper yielded to the general enthusiasm. He paraded the streets of Berlin wrapped in a scarf of the German black and gold, symbol of his intention to be the leader of the united Germany; and he even wrote to the indignant tsar in praise of "the glorious German revolution" But the united Germany which he was prepared to champion was not the democratic state of the Frankfort national parliament, but the old Holy Roman Empire, the heritage of the house of Habsburg. Finally, when Austria had been excluded from the new empire, he replied to the parliamentary deputation that came to offer him the imperial crown that he might have accepted it had it been freely offered to him by the German princes, but that he would never stoop "to pick up a crown out of the gutter."

In fact the German empire would have lost immeasurably had it been the cause rather than the result of the inevitable struggle with Austria. However that may be, Frederick William's refusal gave the deathblow to the parliament and to all hope of the immediate creation of a united Germany. For Frederick William the position of leader of Germany now meant the employment of the military force of Prussia to crush the scattered elements of revolution that survived the collapse of the national movement. His establishment of the northern confederacy was a reversion to the traditional policy of Prussia in opposition to Austria, which, after the emperor Nicholas had crushed the insurrection in Hungary, was once more free to assert her claims to dominance in Germany. But Prussia was not ripe for a struggle with Austria, and the result was the humiliating convention of Olmütz (Nov. 29, 1850), by which Prussia agreed to surrender her separatist plans and to restore the old constitution of the confederation. Yet Frederick William had so far profited by the lessons of 1848 that he consented to establish (1850) a national parliament, though with a restricted franchise and limited powers.

In religious matters Frederick William sought a *rapprochement* between the Lutheran and Anglican churches, the first-fruits of which was the establishment of the Jerusalem bishopric under the joint patronage of Great Britain and Prussia; but the only result of his efiorts was to precipitate the secession of J. H. Newman and his followers to the Church of Rome. In the summer of 1857 he had a stroke of paralysis, and a second in October. From this time, with the exception of brief intervals, his mind was completely clouded, and the duties of government were undertaken by his brother William (afterwards emperor), who on Oct. 7, 1858, was formally recognized as regent. Frederick William died on Jan. 2, 1861.

Selections from the correspondence (*Briefwechsel*) of Frederick William IV. and Bunsen were edited by Ranke (Leipzig, 1873); his proclamations, speeches, etc., from March 6, 1848 to May 31, 1851, have been published (Berlin, 1851); also his correspondence with Bettina von Arnim, *Bettina von Arnim und Friedrich Wilhelm IV., ungedruckte Briefe und Aktenstiicke*, ed. L. Geiger (Frankfort-on-Main, 1902). *See* L. von Ranke, *Friedriclz Wilhelm IV., Ronig oon Preussen* (works 51, 52 also in *Allgem. deutsche Biog.* vol. vii.), especially for the king's education and the inner history of the debates leading up to the united diet of 1847; H. von Petersdorff, *Konig Friedriciz Wilhelm IV.* (Stuttgart, 1900); H. von Poschinger (ed.), *Unter Friedrich Wilhelm IV. Denkwürdigkeiten des Ministers Otto Frhr. von Manteuffel, 1848–1858* (3 vols., 1902), and *Preussens auswärtige Politik, 1850–1858* (3 vols., *ib.*, 1902), documents selected from those left by Manteuffel; F. Rachfahl, *Deutschland, Konig Friedrich Wilhelm IV. und die Berliner Marzrevolution* (Halle, 1901), *Die deutsche Politik Konig Friedrich Wilhelm IV., im Winter 1848–49* (Munich, 1919).

FREDERICK WILLIAM (1620–1688), elector of Brandenburg, called the "Great Elector," was born in Berlin on Feb. 16. 1620, the son of the elector George William of Brandenburg and Elizabeth Charlotte, daughter of Frederick IV elector palatine. From 1634 to 1637 he was at the University of Leiden, where his outlook was strongly influenced by what he saw of the maritime and commercial strength of the Netherlands and of the policy of the house of Orange, conducted as it was in the shadow of the great powers Spain and Austria.

In Dec. 1640 Frederick William succeeded his father. He came to power at a time when Brandenburg, devastated already in the course of the Thirty Years' War (*q.v.*), was closely bound to Austria by the peace of Prague of 1635 but in fact still occupied by Swedish troops. In these circumstances a new ruler could attempt no sudden change of policy, and Frederick William's aim was to extricate himself gradually from the oppressive Austrian connection and to gain an armistice with Sweden. The latter he achieved in July 1641, thus terminating the fighting in Brandenburg without waiting for the general peace negotiations, which were not concluded till the peace of Westphalia (1648). By this treaty Frederick William had to abandon his designs on western (Swedish) Pomerania—with its control of the Oder estuary and the important harbour of Stettin—and to be content with eastern Pomerania together with the secularized bishoprics of Halberstadt and Minden and the reversion of Magdeburg.

During the Swedish invasion of Poland (1655–56) Frederick William, by unscrupulously breaking his alliance with the Poles, was able to assert Brandenburg's sovereignty over ducal Prussia (East Prussia), hitherto held as a fief of the Polish crown; and he won international recognition for this change at the peace of Oliva (1660). His growing activity in foreign affairs reflected the increasing military and financial strength of his lands. His widely scattered territories, hitherto united only by allegiance to the ruling house, were now integrated administratively. while the ruler made his revenues independent of the consent of the estates by developing a fixed system of direct and indirect taxation, thus laying the financial basis for a standing army. These developments provoked strenuous opposition from the estates, especially in Prussia, and entailed the abrogation of many traditional liberties, but Frederick William overcame all resistance. Thus under him the Hohenzollern state received the imprint of absolutism, and the foundation of the future strength of the Prussian monarchy was laid.

From his time the army was the focus of the developing state and its administrative organization, and the mercantilist economy, invigorated by increasing income from taxation. was orientated to meet the army's requirements. Under Frederick William, however. the strength of the army was still variable between peacetime and wartime. Moreover, it could not yet be maintained solely on the electoral and ducal revenues, so that foreign subsidies were also required, and these in turn restricted Brandenburg's freedom in the diplomatic field.

During the struggle between Louis XIV of France and the Habsburgs of Austria and of Spain the elector had alternately sought an alliance with France and with Austria, and the changeability of his policy demonstrated the relative weakness of a ruler not yet able to maintain an independent course between the great powers. This weakness was emphasized by the scant attention paid to Brandenburg in the various peace negotiations. Thus in spite of extreme military exertions he never achieved his ultimate aim, the acquisition of western Pomerania, and Brandenburg remained with no satisfactory seaport. Even after his brilliant victory over the Swedes at Fehrbellin (June 1675) and their final expulsion from Germany (Jan. 1679). Frederick William was obliged. under French pressure, to give up his conquests at the peace of Saint-Germain-en-Laye (June 1679). Thus he could never realize fully his plans to found a maritime and commercial power on the Dutch model. His establishment of a navy and his formation of an Africa company (1682), with the subsequent colonizing ventures along the Guinea coast, are a mere episode in Brandenburg-Prussian history.

Nevertheless by the edict of Potsdam (Nov. 8, 1685), which welcomed French Huguenot immigration, Frederick William introduced to his state a new population both shrewd and industrious, without which the industrial and commercial development of 18th-century Prussia would have been unthinkable. In this, the interests of the state and the elector's personal convictions combined as in no other of his undertakings. The protection of Protestantism in Europe was always an essential element in Frederick William's policy no matter how often it might have to give place to expediency. His tenacious political ambition drew much of its strength from his Calvinistic belief in predestination, which enabled him to regard himself and his state as the instruments of God.

Frederick William represented the best type of 17th-century continental ruler. For him as for Louis XIV the person of the monarch and the interest of the state constituted an inseparable unity. His dynastic-patrimonial view of the state and his belief in the traditionally religious nature of the princely office were expressed in his political testaments of 1667, 1680 and 1686. Frederick William died at Potsdam on May 9, 1688.

During his stay in the Netherlands Frederick William had made the acquaintance of Frederick Henry, prince of Orange, whose daughter: Louisa Henrietta, he married in 1646. Their eldest son Karl Emil had died in 1674, and it was the second son Frederick (III) who succeeded to the electorate on Frederick William's death. By his second wife, Dorothea of Holstein-Glückburg, whom he married in 1668, Frederick William had four other sons. who received territories from the family lands under his will. Frederick William's enactments have been published as *Urkunden und Aktenstücke zur Geschichte* dcs *Kurfürsten Friedrich Wilhelms* von *Brandenburg,* 23 vol. (1864–1929).

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FREDERICTON, the capital of New Brunswick, Can., and the seat of York county. is situated on the banks of the Saint John river, about 85 mi. from its mouth. and is surrounded by wooded hills. A small city (1961 pop. 19,683), it is the site of the provincial University of New Brunswick, founded 1785, and the provincial Teachers' college, founded 1847, and is the episcopal seat of the Anglican diocese of Fredericton and the headquarters of the New Brunswick area of the Canadian army and of the Royal Canadian Mounted Police. There are many fine buildings including those of the university. the provincial legislature. the Lord Beavcrbrook Art gallery. the buildings of the dominion research station maintained by the federal department of agriculture, and the Anglican cathedral.

Originally settled by United Empire Loyalists under the name of St. Ann's Point in 1783, Fredericton was made provincial capital in 1785 and became a city in 1848. Primarily a centre of government and education. it also has some industrial and commercial importance: it is the shopping and distributive centre of central New Brunswick; it has several quality shoe 'factories; and it has a number of industries concerned with the processing of wood—a canoe factory, lumber mills and a plastics plant. But perhaps Fredericton's chief claim to distinction is its literary tradition: among its first Loyalist residents was the Rev. Jonathan Odell, the Tory satirist of the American Revolution; the first novel by a native Canadian, *St. Ursula's* Convent, or, *The Nun of Canada* (1824) was written there by Julia Catherine Hart; three of the leading Canadian poets. Charles (later Sir Charles) Roberts. Bliss Carman and Francis Sherman, were born there: and the city is the site of publication of two literary magazines—The *Fiddlehead* and *The Atlantic Advocate.* (D. P.)

FREDERIKSBERG, an independent municipality in the metropolitan area of greater Copenhagen (*q.v.*), Den. Pop. (1960) 114,285. Founded in 1651 by King Frederik III, it became completely encircled by Copenhagen early in the 20th century when the capital absorbed several former municipalities. It contains the Frederiksberg park, the Copenhagen zoo. the town hall (1953), the Royal Veterinary and Agricultural High school, the state broadcasting service. a commercial college and the military academy in Frederiksberg palace (*c.* 1700). The main industries include the Royal Copenhagen Porcelain factory and a cable and wireworks. (C. F. G. A.)

FREDERIKSBBRG *amt,* a county in northeast Zealand, Den.. named after the magnificent castle of Frederiksborg in the town of Hillerdd. Pop. (1960) 181.663. Area 519 sq.mi. Lying between Ise Fjord and the busy Øresund, its greatly undulating surface of glacial sands and clays is lake strewn and well wooded. The fertile loams support prosperous mixed farming. The port of Elsinore (*q.v.;* Helsingør) is the largest town (pop. 23,897 in 1955) followed by Hillerød (10.840). the county administrative centre. Kronborg castle near Elsinore once controlled the northern entry to Øresund. (HA. T.)

FREDHOLM, ERIK IVAR (1866–1927), Swedish mathematician, whose chief contribution to mathematics was on integral equations. was born at Stockholm. April 7, 1866, and died there Aug. 17, 1927. He took his doctor's degree at Uppsala in 1898, became an actuary and in 1906 was appointed professor of theoretical physics in Stockholm. He published his paper on integral equations in 1903, inaugurating the modern theory of this topic. For this he received the Wallmark prize of the Swedish Academy of Science and the French Academy's Poncelet prize.

See *Oeuvres complètes de Ivar Fredholm* (1955). (O. OE.)

FREDONIA, a village of Chautauqua county in western New York, U.S., 45 mi. S.W. of Buffalo. It mas settled in 1804 and incorporated in 1829. It is in the grape-growing region and manufactures grape products as its major industry. The first gas well in the C.S. to be harnessed for fuel was discovered nearby in 1821 and Fredonia soon boasted the nation's first gaslit street. General La Fayette visited Fredonia during his 1824–25 visit to the U.S. The first local unit of the Grange and one of the first local organizations that helped found the Woman's Christian Temperance union mere formed there. The village is served by excellent rail, highway and air transportation facilities, and ocean-going vessels serve Dunkirk, two miles away on Lake Erie. The State University of New York college of education is in Fredonia. For comparative population figures see table in NEW YORK: Population. (A. W. B.; X.)

FREDRIKSTAD, a town of Østfold *fylke* (county), Norway, located 58 mi. S. of Oslo. Pop. (1959 est.) 13.827. It lies at the mouth of the Glomma river on the eastern shore of Oslo fiord and has a first-class harbour that is kept open in winter. It is a lumber-milling and fishing town with a variety of manufactures. In 1957 a 2,700-ft. high-level bridge over the Glomma was opened. The town was founded by Frederick II in 1567, and its grass-covered ramparts and fortified gates date from that time. The environs of Fredrikstad are rich in rock carvings, monumental stones and grave barrows from the early centuries of the Christian era. (S. KN.)

FREEBENCH, in English lam, the interest which a widow had in the copyhold lands of her husband, corresponding to dower in the case of freeholds. It depended upon the custom of the manor. but as a general rule the widow took a third for her life of the lands of which her husband died seized, but it might be an estate greater or less than a third. Freebench disappeared with the abolition of copyhold tenures by the Law of Property act 1922 and the Administration of Estates act 1925.

FREE CHURCH FEDERAL COUNCIL, an organization that enables the free churches of England and Wales to act unitedly in matters of common concern, was formed in 1940 by the union of the National Council of the Evangelical Free Churches (founded 1896) and the Federal Council of the Evangelical Free Churches (formed 1919). It works through nearly 500 local councils, which send delegates to an annual congress and elect representatives to the national council; the associated free church denominations, which include the Methodists, Baptists, Congregationalists. Presbyterians and some others, send direct representatives to congress and council. The annual congress hears distinguished preachers and speakers and discusses matters of common concern. The council attends to continuing business, which includes encouragement of co-operation between the free churches, maintenance of rights, representation of the free-church viewpoint to parliament, negotiation with central and local authorities and the expression of free-church opinion on public questions. The council has a chaplaincy department, responsible with the ministry of health for free-church chaplains in hospitals, and a youth and education department. which co-ordinates youth work among the free churches and maintains contact with the ministry of education and the Church of England on religious instruction in schools.

The council is presided over by the moderator. who holds office for a year and is the representative leader of the free churches.

See E. K. H. Jordan, *Free Church Unity* (1956). (A. .

FREE CHURCH OF SCOTLAND. In one sense the Free Church of Scotland dated its existence from the Disruption of 1843, in another it claimed to be the rightful representative of the National Church of Scotland (see SCOTLAND, CHURCH OF) as it was reformed in 1560. In the ecclesiastical history of Scotland the Free Church saw three great reforming periods. In each of these the inherent scriptural right of the church to exercise a spiritual jurisdiction in which it is responsible to Christ alone was asserted and practically maintained. The first reformation extended from 1560, when the church freely held its first general assembly and of its own authority acted on the *First Book of Discipline,* to 1592, when its presbyterian order mas finally and fully ratified by the parliament. The second period began in 1638, when, after 20 years of suspended animation, the assemblv once more shook off episcopacy, and terminated in 1649, when the parliament of Scotland confirmed the church in its liberties in a larger and ampler sense than before. The Westminster standards were ratified, lay patronage was abolished and the coronation oath itself framed in .accordance with the principles of presbyterian church government. The Revolution settlement of 1690 was not so entirely favourable to the freedom of the church as the legislation of 1649 had been. Presbyterianism was re-established, and the old rights of patrons were again discontinued: but the large powers which had been conferred on congregations by the act of 1649 were not wholly restored. Nevertheless, the great principle of a distinct ecclesiastical jurisdiction, embodied in the Confession of Faith, was accepted without reservation, and a presbyterian polity effectively confirmed both then and at the ratification of the treaty of union. This settlement, however, did not long subsist unimpaired. In 1712 the Act of Toleration, restoring patronage to its ancient footing, was passed in spite of the earnest remonstrances of the Scottish people. For many years afterward (until 1784) the assembly continued to instruct each succeeding commission to make application, to the king and the parliament for redress of the grievance. But meanwhile a new phase of Scottish ecclesiastical politics commonly known as Moderatism had been inaugurated. during the prevalence of which the church became even more indifferent than the lay patrons themselves to the rights of the congregations with regard to the "calling" of ministers.

The "Veto" Act.—The result was a protracted struggle—identifiable as the third reforming period in the Scottish church, which lasted until the Disruption of 1843—which entered on its final stage with the passing in 1834 of the "Veto" act. This declared it to be a fundamental law of the church that no pastor should be intruded on a congregation contrary to the will of the people, and provided that the simple dissent of a majority of heads of families in a parish should be enough to warrant a presbytery in rejecting a presentee. The question of the legality of this measure soon came to be tried in the civil courts; and it was ultimately answered in a sense unfavourable to the church by the decision (1838) of the court of session that a presbytery had no right to reject a presentee simply because the parishioners protested against his settlement, but was bound to disregard the veto (see CHALMERS, THOMAS).

This decision elicited from the assembly of that year a new declaration of the doctrine of the spiritual independence of the church. The "exclusive jurisdiction of the civil courts in regard to the civil rights and emoluments secured by law to the church and the ministers thereof" was acknowledged without qualification. At the same time it was insisted that "in all matters touching the doctrine, discipline and government of the church her judicatories possess an exclusive jurisdiction founded on the Word of God." And it was resolved to assert, and at all hazards defend. this spiritual jurisdiction, and firmly to enforce obedience to the same upon the office bearers and members of the church. The decision of the court of session having been confirmed by the house of lords early in 1839, it was decided in the assembly of that year that the church should reaffirm the principle of "non-intrusion" as an integral part of the constitution of the Reformed Church of Scotland, and that a committee should be appointed to confer with the government with a view to the prevention, if possible, of any further collision between the civil and ecclesiastical authorities.

Yet the conference with the government had no practical result, and grave complications were arising over other cases where congregations objected to ministers "intruded" by patrons. In the circumstances it was resolved by the assembly of 1842 to transmit to the queen, by the hands of the lord high commissioner, a "claim, declaration and protest," complaining of the encroachments of the court of session. and also an address praying for the abolition of patronage. The home secretary's answer (received in Jan. 1843) gave no hope of redress.

Difficulties of the Church.—A final appeal to parliament by petition was made in March 1843, when, by a majority of 135, the house of commons declined to attempt any redress of the grievances of the Scottish Church. At the first session of the following general assembly (May 18, 1843) the reply of the non-intrusion party was made in a protest, signed by upward of 200 commissioners, to the effect that since, in their opinion, the recent decisions of the civil courts. and the still more recent sanction of these decisions by the legislature, had made it impossible at that time to hold a free assembly of the church as by law established they therefore "protest that it shall be lawful for us, and such other commissioners as may concur with us, to withdraw to a separate place of meeting, for the purpose of taking steps for ourselves and all who adhere to us—maintaining with us the Confession of Faith and standards of the Church of Scotland as heretofore understood—for separating in an orderly way from the Establishment, and thereupon adopting such measures as may be competent to us, in humble dependence on God's grace and the aid of His Holy Spirit, for the advancement of His glory. the extension of the gospel of our Lord and Saviour, and the administration of the affairs of Christ's house according to His holy word." The reading of this document was followed by the withdrawal of the entire nonintrusion party to another place of meeting, where the first assembly of the Free Church was constituted, with Thomas Chalmers as moderator. This assembly sat from May 18 to May 30 and transacted a large amount of important business. On May 23, 396 ministers and professors publicly signed their names to the Act of Separation and deed of demission by which they renounced all claim to the benefices they had held in connection with the Establishment, declaring them to be vacant and consenting to their being dealt with as such. By this impressive proceeding the signatories voluntarily surrendered an annual income amounting to fully £100.000.

The first care of the voluntarily disestablished church was to provide incomes for its clergy and places of worship for the people. Chalmers had already prepared a carefully matured scheme, according to which "each congregation should do its part in sustaining the whole, and the whole should sustain each congregation"; and at the first assembly it was announced that upward of £17,000 had already been contributed. Each successive year showed a steady increase in the gross amount of the fund. To provide for the erection of the buildings which, it was foreseen, would be necessary, a general building fund, in which all should share alike, was also organized, and local building funds were as far as possible established in each parish, with the result that at the first assembly a sum of 6104,776 was reported available.

At the end of four years considerably more than 700 churches had been provided. During the winter session 1843–44 the divinity students who had joined the Free Church continued their studies under Chalmers and David Welsh (1793–1845); and at the assembly of 1844 arrangements were made for the erection of suitable collegiate buildings. The New college. Edinburgh, was built in 1847 at a cost of £46,506; and divinity halls were subsequently set up also in Glasgow and Aberdeen.

The Nonintrusion Party. — During the conflict preceding disruption the nonintrusion party strenuously denied that in any one respect it was departing from acknowledged principles of the National Church. It continued to do so after the disruption. In 1846, however, it was found to have become necessary, "in consequence of the late change in the outward condition of the church," to amend the "questions and formula" to be used at the licensing of probationers and the ordination of office bearers

These were amended accordingly; and at the same time it was declared that, "while the church firmly maintains the same scriptural principles as to the duties of nations and their rulers in reference to true religion and the Church of Christ for which she has hitherto contended, she disclaims intolerant or persecuting principles, and does not regard her Confession of Faith, or any portion thereof when fairly interpreted, as favouring intolerance or persecution or consider that her office bearers by subscribing it profess any principles inconsistent with liberty of conscience and the right of private judgment."

The main difference between the "formula" of the Free Church and that of the Established Church (as at the year 1900) was that the former referred to the Confession of Faith simply as "approven by general assemblies of this Church," while the latter described it as "approven by the general assemblies of this National Church, and ratified by law in the year 1690, and frequently confirmed by divers Acts of Parliament since that time"; and the Free Church inserted an additional clause, "I also approve of the general principles respecting the jurisdiction of the church, and her subjection to Christ as her only Head, which are contained in the Claim of Right and in the Protest referred to in the questions already put to me"; and also added the words which are here distinguished by italics, "And I promise that through the grace of God I shall firmly and constantly adhere to the same, and to the utmost of my power shall in my station assert, maintain and defend the said doctrine, worship, discipline and government of this church by kirk-sessions, presbyteries, provincial synods and general assemblies, *together with the liberty and exclusive jurisdiction thereof;* and that I shall, in my practice, conform myself to the said worship and submit to the said discipline [and] government, *and exclusive jurisdiction*, and not endeavour directly or indirectly the prejudice or subversion of the same."

In 1863 a motion was made and unanimously carried in the Free Church assembly for the appointment of a committee to confer with a corresponding committee of the United Presbyterian synod, and with the representatives of such other disestablished churches as might be willing to meet and deliberate with a view to an incorporating union. Formal negotiations between the representatives of the two churches were begun shortly afterward, which resulted in a report laid before the following assembly. From this document it appeared that the committees of the two churches were not at one on the question as to the relation of the civil magistrate to the church. While on the part of the Free Church it was maintained that he "may lawfully acknowledge, as being in accordance with the Word of God, the creed and jurisdiction of the church," and that "it is his duty, when necessary and expedient, to employ the national resources in aid of the church, provided always that in doing so, while reserving to himself full control over the temporalities which are his own gift, he abstain from all authoritative interference in the internal government of the church," it was declared by the committee of the United Presbyterian Church that, "inasmuch as the civil magistrate has no authority in spiritual things, and as the employment of force in such matters is opposed to the spirit and precepts of Christianity, it is not within his province to legislate as to what is true in religion, to prescribe a creed or form of worship to his subjects, or to endow the church from national resources."

Thus in a very short time it had been made perfectly evident that a union between the two bodies, if accomplished at all, could be brought about only on the understanding that the question as to the lawfulness of state endowments should be an open one. The Free Church assembly, by increasing majorities, manifested a readiness for union, even although unanimity had not been attained on that theoretical point. But there was a minority which did not sympathize in this readiness, and in 1873, after ten years of fruitless effort, it was found to be expedient that the idea of union with the United Presbyterians should for the time be abandoned. Other negotiations, however, which had been entered upon with the Reformed Presbyterian Church at a somewhat later date, proved more successful; and a majority of the ministers of that church with their congregations were united with the Free Church in 1876.

Theological Developments. — The mind of the Free Church was not absorbed only in questions of ecclesiastical polity. The colleges of the church have been the home of the most active interest in theological and historical questions. There was a stormy period, however, when extreme conservatism appeared to gain a victory. In 1870 W. Robertson Smith *(see* SMITH, WILLIAM ROBERTSON) was ordained to the office of professor of oriental languages and Old Testament exegesis in the Free Church college, Aberdeen. There from the first he advocated views which though now widely accepted were then regarded with apprehension. In 1876 a committee of the Free Church reported so adversely on his writings that Smith demanded a formal trial. The indictment failed; but a vote of want of confidence was passed, and in 1881 he was removed from his chair. This event, however, was no adequate expression of the real mind of the church. During the last quarter of the 19th century the Free Church continued to be the most active, theologically, of the Scottish churches. The college chairs were almost uniformly filled by theologians and historians of progressive views, inspired more or less by A. B. Davidson of New college, Edinburgh. A. B. Bruce, author of *The Training of the Twelve,* etc., was appointed to the chair of apologetics and New Testament exegesis in the Glasgow college in 1875; Henry Drummond (author of *Natural Law in the Spiritual World*, etc.) was made lecturer in natural science in the same college in 1877 and became professor in 1884; and George Adam Smith (author of *The Twelve Prophets*, etc.) was called to the Hebrew chair in 1892. Attempts were made between 1890 and 1895 to bring all these professors except Davidson (similar attacks were also made on Marcus Dods, afterward principal of the New college, Edinburgh) to the bar of the assembly for unsound teaching or writing; but in every case these were abortive, the assembly never taking any step beyond warning the accused that their primary duty was to teach and defend the church's faith as embodied in the confession. In 1892 the Free Church, following the example of the United Presbyterian Church and the Church of Scotland (1889), passed a Declaratory act relaxing the stringency of subscription to the confession, with the result that a small number of ministers and congregations, mostly in the Highlands, severed their connection with the church and formed the Free Presbyterian Church of Scotland, on strictly orthodox lines. Meanwhile other changes were taking place. The standard of parochial and congregational activity was raised, a new method of operation devised. The use of instrumental music was sanctioned and special attention given to the promotion of edification, order and reverence in public worship. And the establishment principle was almost entirely abandoned.

Establishment of United Free Church. — During the last four or five years of the 19th century the Free and United Presbyterian Churches, which after the failure of their union negotiations in 1873 had been connected together by a Mutual Eligibility act enabling a congregation of one church to call a minister from the other, devoted their energy to the arrangement of an incorporating union. The synod of the United Presbyterian Church resolved in 1896 to "take steps toward union," and in the following year the Free assembly responded by appointing a committee to confer with a committee of the other church. The joint committee discovered a "remarkable and happy agreement" between the doctrinal standards, rules and methods of the two bodies, and with very few concessions on either side a common constitution and common "questions and formula" for the admission of ministers and office bearers were arranged. A minority, always growing smaller, of the Free Church assembly protested against the proposed union and threatened if it were carried through to test its legality in the courts; nevertheless the union was carried through. The supreme courts of the churches met separately for the last time on Oct. 30, 1900, and on the following day the union was completed, and the United Free Church of Scotland (*q.v.*) entered on its career. The protesting and dissenting minority at once claimed to be the Free Church. They met outside the Free assembly hall on Oct. 31 and, failing to gain admission to it, withdrew to another hall, where they held the remaining sittings of the assembly.

It was reported that between 16,000 and 17,000 names had been received of persons adhering to the antiunionist principle. At the assembly of 1901 it was stated that the Free Church had 25 ministers and at least 63 congregations. The character of the church is indicated by the fact that its office bearers were the faithful survivors of the decreasing minority of the old Free Church, which had protested against the disestablishment resolutions, against the relaxation of subscription, against toleration of the teaching of the Glasgow professors and against the use in worship of organs or of human hymns. Its congregations were mostly in the Gaelic-speaking districts of Scotland. It was confronted with a very arduous undertaking; congregations grew in number but were far from each other, and there were not nearly enough ministers. But the little church continued with indomitable courage and without any compromise of principle. The Declaratory act of 1892 was repealed after a consultation of presbyteries, and the old principles as to worship were declared. The desire of the Church of Scotland to obtain relaxation of its formula was declared to make union with it impossible.

The decision of the house of lords in 1904, which declared that the funds and property of the Free Church belonged to the minority who had opposed the union of 1900 (see UNITED FREE CHURCH OF SCOTLAND), did not bring the trials of the Free Church to an end. In the absence of any arrangement with the United Free Church, it could gain possession of the property only by an application in each particular case to the court of session, and a series of lawsuits began. The urgent task was that of supplying ordinances to congregations. The problem was faced with energy and enthusiasm, but remained serious.

In 1956 the Free Church of Scotland was constituted of 15 presbyteries, of which 12 were in northern Scotland and the Hebrides. It had foreign mission centres at Kingwilliamstown, South Africa; Lima, Peru; and Lakhnadan, Madhya Pradesh, India. Under its overseas missions it had congregations at Vancouver, B.C., Fort William and Toronto, Ont., Winnipeg, Man., Prince Edward Island and Detroit, Mich. For the training of its ministers it had maintained its own theological college in Edinburgh.

See SCOTLAND, CHURCH OF; UNITED FREE CHURCH OF SCOTLAND.

FREEDMEN'S BUREAU (officially the BUREAU OF FREEDMEN, REFUGEES AND ABANDONED LANDS), a bureau created in the United States war department by an act of congress (March 3, 1865), to last one year. but continued until 1872 by later acts. Its establishment was due partly to the fear entertained by the north that the southerners if left to deal with the Negroes would attempt to re-establish some form of slavery, partly to the necessity for extending relief to needy Negroes and whites in the lately conquered south, and partly to the need of creating some commission or bureau to take charge of lands confiscated in the south. At the head of the bureau was a commissioner, Gen. O. O. Howard, and under him in each southern state was an assistant commissioner with a corps of local superintendents, agents and inspectors. The officials had the broadest possible authority in all matters that concerned the Negroes. The work of the bureau may be classified as follows: (1) distributing rations and medical supplies among the Negroes; (2) establishing schools for them and aiding benevolent societies to establish schools and churches; (3) regulating labour and contracts; (4) taking charge of confiscated lands; and (5) administering justice in cases in which Negroes were concerned. For several years the former slaves were under the almost absolute control of the bureau. Whether this control had a good or bad effect is still disputed. Much necessary relief work was done, but demoralization was also caused by it. In educating the Negroes the bureau made some progress, but the instruction imparted by the missionary teachers resulted in giving the former slaves notions of liberty and racial equality that led to much trouble, finally resulting in the hostility of the whites to Negro education. When Negro suffrage was imposed by congress upon the southern states, the bureau aided the Union league (*q.v.*) in organizing the Negroes into a political party opposed to the whites. A large majority of the bureau officials secured office through their control of the Negroes. The failure of the bureau system, its discontinuance, in the midst of reconstruction, without harm to the Negroes, and the intense hostility of the southern whites to the institution, caused by the irritating conduct of bureau officials, are indications that the institution was not well conceived nor wisely administered.

FREEMAN, EDWARD AUGUSTUS (1823–1892), English historian, an authority on English history of the 11th and 12th centuries, was regius professor of modern history at Oxford from 1884 until his death. He was born at Harborne, Staffordshire, on Aug. 2. 1823, and educated privately. He went to Trinity college, Oxford, with a scholarship in 1841 and became a fellow there four years later. Thereafter he devoted himself to a life of study, publishing an enormous number, even by 19th-century standards, of books, pamphlets and articles in periodicals. A great controversialist, he campaigned actively in support of Gladstone, especially in condemning the "Bulgarian atrocities," and stood unsuccessfully for parliament on several occasions. He died while on holiday at Alicante, Spain, on March 16. 1892.

Freeman's cardinal virtue is insistence on the unity of history and on the use of original sources, but he was insufficiently critical to be a reliable interpreter of those sources he himself used and he brought to historical controversy acerbity, bias and intolerance, notably in his prolonged attack on J. A. Froude (*q.v.*) through the agency of the Saturday Review, in a degree which was harmful and misleading. Modern scholarship would hardly differ from the emphasis placed in Freeman's great work, History of the Norman Conquest (6 vol., 1867–79), on the continuity of Anglo-Saxon elements after 1066, but in detail the work exhibits many of the faults which its author was quick to criticize in others. In particular, Freeman's description of the battle of Hastings, or, as he with mistaken pedantry would have it. the battle of Senlac, was shown by J. H. Round *(Feudal England,* 1895) to be quite inaccurate.

FREEMAN, JOHN RIPLEY (1855–1932), U.S. civil engineer. was born in West Bridgeton. Me.. on July 27, 1855. Graduated from Massachusetts Institute of Technology in 1876, he spent about ten years in hydraulic engineering and another ten years as chief engineer of a fire insurance company. He became consultant for various water commissions in Massachusetts and Rhode Island (1895–1904) and for the New Tork Board of Water Supply from 1905 until his death. He served as consultant on the Panama canal (1905–08) and planned the Hetch Hetchy water supply for San Francisco (1908–10). He was adviser to the Chinese government on the improvement of the Grand canal (1917–20). In 1924 he was consultant for the Chicago sanitary district on the control of Great Lakes levels. Freeman was president of the Manufacturers Mutual Fire Insurance Co., Providence. R.I., from 189j. He wrote extensively on hydraulics, fire protection and earthquake damage.

Freeman died at Providence on Oct. 6, 1932. (S. C. HR.)

FREEMAN, MARY ELEANOR (née WILKINS) (1852–1930), U.S. writer whose best stories and novels are concerned with New England village life, was born in Randolph, Mass., Oct 31, 1852. In 1867 the family moved to Brattleboro. Vt. Mary graduated from high school there. had one year at Mount Holyoke seminary, South Hadley, Mass., and read omnivorously. She began writing stories and verse for children. When death took her immediate family, she returned to Randolph and lived with the John Wales family; in their house, in the 1880s and 1890s, she did her best writing.

In 1902 she married Charles M. Freeman of Metuchen. N.J.. where she lived till her death on March 13, 1930.

Though she produced a dozen volumes of short stories and as many novels. Mrs. Freeman is remembered chiefly for the first two collections of stories — *A Humble Romance* (188;) and *A New England Nun And Other Stories* (1891) and the novel *Pembroke* (1894). Her theme is pride within poverty. Typically, her upstanding characters ask more of life than could be had in their cramped New England villages. Defeated, they develop abnormalities of pride and will. This is a grim subject but it is handled deftly, at times humorously and with fine narrative art.

See Edward Foster, *Mary* E. *Wilkins Freeman* (1956), a full length study with bibliography. (E F.)

FREEMAN, SIR RALPH (1880–1950), British civil engineer, distinguished as the designer of great bridges. was born in London on Nov. 27, 1880. On leaving the Central Technical college, Kensington. in 1901 he joined a firm of consulting engineers, of which he was made a partner 11 years later. He became senior partner in 1921 and remained in active control of the firm, knonn later as Freeman, Fox and partners, until his death. He carried out important work in many parts of the world, including the Victoria falls bridge over the Zambesi river, the Royal Naval Propellant factory during World War II, the Furness shipbuilding yard and the five major bridges constructed in the Rhodesias for the trustees of Alfred Beit.

Freeman's best-known work was the Sydney harbour bridge, completed in 1932; its main arch span, 1,650 ft. long, is one of the largest in the world. Freeman prepared designs for the bridge over Auckland harbour, N.Z.; the Dome of Discovery for the Festival of Britain, 1951; and, as joint engineer, for the projected River Severn suspension bridge. He played an active part in the development of engineering science, being from 1923 to 1936 a member of the Steel Structures Research committee and chairman of the panel responsible for producing the committee's recommendations for design.

He was knighted in 1947 and died at Finchley. London. on March 11, 1950. (J. F. BR.)

FREEMAN, the term specifically applied to one who possesses the freedom of a city, borough or company. Before the passing of the Municipal Corporations act of 1835, each English borough admitted freemen according to its own peculiar custom and by-laws. The rights and privileges of a freeman, though varying in different boroughs, generally included the right to vote at a parliamentary election of the borough, and exemption from all tolls and dues. The act of 1835 respected existing usages, and every person who was then an admitted freeman remained one, retaining all his former rights and privileges. The admission of freemen is regulated by the Municipal Corporations act of 1882, whereby the term freeman includes any person of the class whose rights and interests are reserved by the act of 1835 under the name either of freemen or of burgesses. No person can be admitted a freeman by gift or by purchase; that is, only birth, servitude or marriage are qualifications. By the Honorary Freedom of Boroughs act, 1885, however, the council of every borough may admit persons of distinction to be honorary freemen.

A person may become a freeman or freewoman of one of the London livery companies by (1) apprenticeship or servitude; (2) patrimony: (3) redemption; (4) gift.

See W. C. Hazlitt, *The Livery Companies of the City of London* (1892).

FREEMASONRY is a word used to describe the beliefs and practices of Freemasons and the way in which local units. called lodges, are governed and linked together. A craft rather than an order, it is secret only in having rituals and other matters not to be divulged to nonmembers, a society with secrets but not a secret society. Its places of meeting are prominently identified, and its governing bodies publish annual proceedings. The membership is a matter of record and, particularly in the United States, public knowledge. In Communist and completely totalitarian countries Freemasonry is proscribed. The Roman Catholic Church forbids its members to be Freemasons. although many of that faith were active Freemasons in the 18th and early 19th centuries. In Great Britain, the commonwealth countries, Scandinavia, the United States and other nations with similar institutions, heads of government, dignitaries and distinguished citizens are Freemasons. Men from all walks of life meet together in their adherence to a moral code whose principles are largely conveyed through symbols and allegories connected with the art of building, emphasizing benevolence. A Mason. it was said in 1734–35, "is to be a Man of Benevolence and Charity, not sitting down contented while his Fellow Creatures, but much more his Brethren, are in Want, when it is in his Power (without prejudicing himself or Family) to relieve them" (William Smith, *A Pocket Companion for Free-Masons* [London, 1735]).

In order that the nature and development of Freemasonry may be explained, some account must be given of the following subjects: (1) the meaning of the word freemason; (2) the organization of mediaeval building operations; (3) the connection between operative and speculative masonry; (4) the foundation in 1717 of the grand lodge, from which orthodox Freemasonry in its modern form derived; (5) the relation of Freemasonry to religion; (6) Masonic ceremonies; (7) the diffusion of Freemasonry after 1717.

The Meaning of Freemason. — In all probability freemason originally meant a craftsman working with ax, mallet and chisel in freestone. That is suggested, first, by the occurrence of Latin and French terms such as *sculptor lapidum liberorum, mestre mason de franche peer* and *magister lathomus liberarum petrarum.* Second, the building accounts relating to Eton college in 1442 and 1445–46 and Kirkby Muxloe castle in 1481 distinguish between freemasons and rough masons or row masons, the latter including bricklayers. Third, there are other examples of workmen called after the materials in which they worked; such were hardhewers (working in the hard ragstone of Kent), marblers and alabasterers. It may well have been the case, however, that in later times the freemason was understood to be a mason who was free in the sense of being a member of a guild or company or one who was free to carry on his trade in a municipality.

The Organization of Mediaeval Masonry. — Such craftsmen differed from most others of the mediaeval period in several respects, and the organization of masons was determined to a large extent by these special characteristics. First, unlike the weaver or blacksmith, the ordinary mason was entirely a wage earner; second, he was commonly more mobile, travelling voluntarily in search of employment or further experience. or, as was often the case during the 13th and later centuries, being conscripted for work on the crown's large building operations, such as the castles of Caernarvon and Windsor. These and other works, such as Cistercian abbeys, were often carried on in remote parts of the country, and, for that and other reasons, the municipal craft guild was not a suitable form of organization for all masons. Such a guild did, indeed, exist in 14th-century London; but for many masons a nearer and more familiar association was the lodge connected with the building on which they were employed. The lodge mas not only a workshop but the place for a siesta in the middle of the day, for drinking at permitted times and also, no doubt, for the exchange of news and for airing grievances and discussing matters relating to the craft. Hence the stress on keeping secret, from nonmasons and from employers, what was said in the lodge.

The Old Charges.—*Of* the Old Charges. known also as the *MS. Constitutions of Masonry,* about 100 versions exist, and there is reason to believe that another 15 have existed (D. Knoop and G. P. Jones, *A Handlist of Masonic Documents*, p. 12 [Manchester, 1942]). The oldest surviving manuscript is almost certainly the *Regius MS.* (British Museum, Bibl. Reg. 17 A, 1), written probably about 1390, in verse, and the next oldest the so-called *Cooke MS.* (British Museum, Add. ms. 23198), dating from about 1400 or 1410, in prose. Nothing is certainly known about the circumstances in which either was written (for suggestions, *cf.* H. Poole, *The Old Chwges,* pp. 19–21 [London, 1924]), but it is probable that their main elements are older than the manuscripts. The masons' customs, or articles and points. there set out may be presumed to have been gradually developed over a comparatively long period, but the account given of the history of the craft may well have been supplied by a single, if unknown, author.

His curious legend deals first of all with the number of noblemen's children in early times who, not being provided with an income, had to find work "that they mygth gete here [their] lyuynge ther-by." Euclid was consulted and recommended "thys onest craft of good masonry"; thus the genesis of masonry is found in Egypt. Many years afterward it reached England "yn tyme of good kynge adelstonus (Aethelstan's) day." He called an assembly of dukes, earls, barons, knights, squires and burgesses, at which 15 points and articles were drawn up for the amendment and regulation of the craft. Some of them are addressed to master masons in charge of building operations and others to ordinary skilled workmen. Masters are to pay the workmen, or fellows, as they deserve and the fellows honestly to earn their pay; one master is neither to supplant another without cause nor to undertake work which he cannot complete, and he must come, when summoned, to the general assembly of the craft. Thieves are not to be harboured nor adultery committed. A mason is not to defame his fellow nor to decry his work but, at need, to help him to do better. Great stress is laid on the teaching of apprentices, who are to be whole of limb and not of servile origin. In short, the rules attempt to harmonize and further the interests of all parties: the person for whom building work is undertaken, the master in charge of it, the journeymen working upon it and the apprentices learning the trade.

There follows an account of the *Quatuor Coronati,* masons alleged to have been martyred for Christianity in Roman times. Their cult was widespread on the continent of Europe among workers in the building trades but, though known, never became very important among masons in England *(cf.* D. Knoop. G. P. Jones and D. Hamer, *The Two Earliest Masonic MSS.*, pp. 50–51) and is certainly no evidence that English freemasonry was derived from Germany. Then comes a longer account of the origin of masonry in which the tower of Babylon and Euclid are mentioned and the seven sciences, or seven liberal arts, including geometry, are enumerated and described. The compiler was apparently a priest, line 629 reading "And when the gospel me rede schal." The last 100 lines are evidently based upon *Urbanitatis (Cott. MS., Caligula* A 11) and John Mirk's *Instructions for a Parish Priest (Cott. MS.,* Claudius A 11), instructions such as lads and even men would need who were ignorant of the customs of polite society and of correct deportment in church and in the presence of their social superiors.

The simple narrative of the *Regius MS.* does not conflict with known historical fact. The authors of later manuscript versions of the same narrative, however, added embellishments and details which do not stand up under scrutiny, tending to make the legend or history of doubtful validity.

The major elements in these late mediaeval documents (*i.e.,* a legend or history. the craft regulations, including the injunction about secrecy, and a prayer) are found, in various arrangements, in the later versions of the *MS. Constitutions.* Particulars may be found in W. J. Hughan, *The Old Charges of the British Freemasons;* the more important ones and some others were reproduced in the six volumes of *Quatuor Coronatorum Antigrapha* and the *"Yorkshire" Old Charges of Masons* which were edited by H. Poole and F. R. Worts.

It may be presumed that some version of the history and charges was read or recited to operative masons in mediaeval times; and there is proof that this was also done in lodges of Freemasons in the 17th and 18th centuries, each lodge apparently having one or more copies kept for the purpose. The Aberdeen lodge, for instance, in 1670 ordered that the mason charter, which was a version of the Old Charges, should be read "at the entering of every entered prentice"; a similar order was made at Alnwick in 1701.

The Mason Word.—The second main element in the masonic tradition. the mason word, is more obscure in its origin and development than the Old Charges, but it was certainly a Scottish institution and it may have existed as early as 1550. In Scotland the organized craft contained, besides apprentices, a category of entered apprentices; *i.e.,* craftsmen who had learned their trade and might be allowed to undertake a limited amount of work by themselves but who were required to serve for several years before becoming masters of the craft, or fellows. The interests both of entered apprentices and fellows might, however, be harmed by cowans; *i.e.,* workmen who had not been apprenticed or had been inadequately or irregularly taught; and it is probable that the mason word originated as a method of distinguishing either between cowans and entered apprentices or between entered apprentices and fellows and that it consisted of a sign, either a word, a handgrip or both. communicated in such a fashion that unauthorized persons could not acquire it. By 1696. as the *Edinburgh Register House MS.* (text in D. Knoop, G. P. Jones and D. Hamer, *The Early Masonic Catechisms)* shows. whatever the original method may have been, the mason word was communicated in two steps or ceremonies, one for entered apprentices and a second for fellows.

Development of Speculative Masonry.—The lodges in which the mason word was given and the Old Charges were read during the 16th and part of the 17th centuries were, no doubt, for the mbst part lodges of working craftsmen—operative masons. Those of the 18th century, on the other hand, were nearly all lodges in which operative masons mere few or nonexistent. The intervening period, which has been called the age of Accepted Masonry, was one in which nonoperatives either joined existing lodges or formed new ones; and it was from these lodges, constituted increasingly or entirely of gentlemen masons (Adopted masons) or Accepted masons, that there developed symbolical or speculative Masonry—Freemasonry in the modem sense of the term.

The first nonoperative mason about whom we can be quite sure was John Boswell, laird of Auchinleck, who attended the Edinburgh lodge in June 1600. Others who joined the same lodge were Lord Alexander, Sir Anthony Alexander and Sir Alexander Strachan in 1634, Gen. Alexander Hamilton in 1640 and Quartermaster Gen. Robert Moray, who was initiated at Newcastle in 1641, while the Scottish army was in occupation. The famous mother lodge Kilninning had the earl of Cassillis for its deacon in 1672, and among his successors were Sir Alexander Cunningham and the earl of Eglinton. The oldest membership roll of the Aberdeen lodge contains the names of the earl of Finlater, the earl of Erroll, the earl of Dunfermline and Lord Pitsligo. Among English nonoperative masons were the famous antiquary Elias

Ashmole, admitted at a lodge held in Warrington in 1646, and Randle Holme, third of the name, the Chester genealogist, who belonged to a lodge in Chester. There is evidence to suggest that a duke of Richmond attended a lodge at Chichester in 1696. Sir George Tempest presided in 1705–06 over a York lodge in which, at Bradford in 1713, "18 gentlemen of the first families in that Neighbourhood were made Masons." There would, therefore, appear to be confirmation of the statement made by Robert Plot in 1686 in his *Natural History of Staffordshire* (Oxford) that the custom "of admitting Men into the *Society of Free-masons"* was "spread more or less all over the *Nation."* Especially in the Staffordshire moorlands he "found persons of the most eminent quality, that did not disdain to be of this *Fellowship."*

Evidence is too scanty to enable the nature of these lodges to be determined in every instance. Some of them, such as the one maintained in Warrington in 1646 and the one at Chichester in 1696, were perhaps of an occasional kind. The Aberdeen lodge (on which *cf.* A. L. Miller, *Notes on the Early History and Records of the Lodge, Aberdeen)* may have originated as far back as 1483 and was probably for long an operative lodge; though, by 1670, out of 49 fellows belonging to it only about 10 were operative masons. In the Chester lodge, about 1673, there were six masons (and 15 other tradesmen possibly connected with building and house decorating) out of 26 known members. Of the persons present at the Warrington lodge in 1646 not one was an operative mason.

There can be little doubt that in the transitional era Masonry was more organized in Scotland than in England. There is evidence of that for instance in the statutes promulgated in Dec. 1598 by William Schaw, master of work to the crown of Scotland, "with the consent of the masters after specified," whose names, unfortunately, have not been preserved. A year later, further statutes and ordinances were issued by the same authority, giving to the lodge of Kilwinning certain supervisory powers over others in lower Clydesdale, Glasgow, Ayr and Carrick. South of the border there is no very conclusive evidence of any effective link between lodges or of any district or central control, though it is asserted in a document of 1722 (text in D. Knoop, G. P. Jones and D. Hamer, *Early Masonic Pamphlets,* p. 71 ff.) that a general assembly was held on Dec. 8, 1663, at which new articles were agreed upon. Two of those imply the existence of some regional authority:

> I That no Person, of what Degree soever, be accepted a Free Mason, unless he shall have a Lodge of five Free-Masons at the least, whereof one to be a Master or Warden of that Limit or Division where such Lodge shall be kept, and another to be a Workman of the Trade of Free Masonry. . . .
>
> III. That no Person hereafter, which shall be accepted a Free Mason, shall be admitted into any Lodge or Assembly, until he hath brought *a* Certificate of the Time and Place of his Acception from the Lodge that accepted him, unto the Master of that Limit and Division where such Lodge was kept, which said Master shall enroll the same in Parchment in a Roll to be kept for that Purpose, and give an Account of all such Acceptions, at every General Assembly.

The last sentence implies a wider authority, as does another article:

> V. That for the future the said 'Society, Company and Fraternity of Free-Masons shall be regulated and governed by one Master, and as many Wardens as the said Company shall think fit to chuse at every Yearly General Assembly.

Even if, on the strength of a statement made nearly 60 years after the alleged event, the assembly of 1663 be accepted as a fact, there is no record of any further assembly nor any proof that the new articles, if made, were observed. It is, therefore, likely, on the whole, that 17th-century English Masonry was in some danger of developing haphazardly in a way that might well have given rise to irregularities. Sooner or later, therefore, an attempt was likely to be made to provide Freemasonry with a degree of unity and uniformity more in accord with its past traditions and its existing needs.

Foundation of the Grand Lodge (1717).—The main and perhaps the only independent evidence relating to the foundation of the grand lodge is that of the Rev. James Anderson (1679–1739), who included an account of the matter in the second edition (1738) of the *Book of Constitutions.* Anderson, who was not himself connected with the grand lodge at its foundations, is now regarded as a careless and uncritical historian; but there seems no reason to doubt that in 1716 a meeting was held at the Apple Tree tavern, near Covent Garden, attended by "some old Brothers" and by Masons from four separate lodges that met at the Goose and Gridiron alehouse in St. Paul's churchyard, the Crown alehouse in Parker's lane, the Apple Tree tavern and the Rummer and Grapes tavern in Westminster. As a result of the deliberations at this meeting, presumably, another was held at the Goose and Gridiron in June 1717, at which Anthony Sayer was elected grand master and installed. His high-sounding title implied, however, no extensive jurisdiction, the authority of the early grand lodge being limited to lodges in or near London and Westminster and the major purposes of the new authority being to arrange an annual feast, to establish a quarterly communication between lodge officers and generally to promote union and harmony among lodges.

Not long after its foundation, however, though there may have been some inertia and resistance at first, the authority and scope of the grand lodge increased considerably. The number of lodges in its jurisdiction rose from four in 1717 to 63 (in places as distant as Bath, Bristol, Carmarthen, Chester and Salford) in 1725 and 126 in 1733. Provincial organization had begun by 1725, when there existed a provincial grand master, provincial deputy grand master and provincial grand wardens in Cheshire. The collection of old writings relating to Freemasonry was started in 1719, and *The Constitutions of the Free-Masons,* an officially approved revision and restatement of the history and articles, was published by Anderson in 1723. Provision was made for an important part of Masonic activity by the establishment in 1730 of the Standing Committee for Charity.

One significant characteristic of Freemasonry in the period following 1721 was the aristocratic origin of its highest officials. a fact which no doubt conferred upon the craft a much greater degree of respectability than any order of merely operative masons could have achieved. It is indeed true that one of the four old lodges which set up the grand lodge may have consisted mainly of operatives, and that of the ten first grand wardens two were stonecutters, two were carpenters, one was a mason and one a blacksmith. But another of the four lodges, meeting at the Rummer and Grapes in Westminster, had the duke of Richmond for its master in 1723, at which time most of its members were titled persons or army officers. The first grand master, Anthony Sayer, before the end of his life was a recipient of charity; the second, who was also the fourth, George Payne, was probably a man of more wealth and at the time of his death was secretary to the tax office; the third, the Rev. Dr. J. T. Desaguliers, was a man of greater eminence, being a fellow of the Royal society and chaplain to the duke of Chandos and the prince of Wales. His successor, in 1721, was the duke of Montague. Thereafter Irish and Scottish peers shared with those of England the distinction of presiding over the grand lodge; and from 1782 to 1813 their royal highnesses the duke of Cumberland, the prince of Wales or the duke of Sussex occupied the Masonic throne. From 1753 to 1813 there existed a rival grand lodge, but, under the "ancient" grand master the duke of Kent, amalgamation was decided upon and the duke of Sussex became grand master of the united body. On the death of that prince in 1843 the earl of Zetland succeeded. and he was followed in 1874 by the marquess of Ripon, on whose resignation the prince of Wales became grand master. Soon after succeeding to the throne as King Edward VII he ceased to govern the English craft and his place was taken by the duke of Connaught. From 1737 to 1907 about 16 English princes of royal blood joined the brotherhood. The list of past grand masters up to mid-20th century includes the names of eight princes who later became monarchs: George IV, Edward VII, Edward VIII and George VI of England; Oscar II and Gustav V of Sweden; and Frederick VIII and Christian X of Denmark.

The premier grand lodge, formed in 1717, did not immediately acquire jurisdiction over all lodges in England. The extension of its authority was a gradual process throughout the remainder of the 18th century. Existing lodges independent of the grand lodge continued to work and to make Masons. The old lodge at York denominated itself the "Grand Lodge of All England," held assemblies and even created other lodges. Masonry at York did not come under obedience to the grand lodge at London until late in the century. In 1751 a group of Irish Masons in London formed a rival grand lodge in protest of alleged innovations practised by the 1717 grand lodge which they claimed departed from ancient tradition. The rival grand lodge became known as the Ancients and the original grand lodge as the Moderns. For a time, supported by the grand lodges of Ireland and Scotland, the Ancients were more active and influential than the Moderns, but by 1813 both united into the present United Grand Lodge of England.

Freemasonry and Religion.—During the third and fourth decades of the 18th century not only was the jurisdiction of the grand lodge extended geographically but the lodges were opened to men who, in an earlier period, would have been excluded because of their religious beliefs. Mediaeval operative masons were required "princypally to [loue] god and holy chyrche & alle halowis." By 1583 reference to the saints had disappeared and masons were bidden to be "trewe men to god and holly Churche and . . . vse no Errour nor heresye," an injunction which in England required membership of the established church and in Scotland of the kirk. These limits were removed by the first charge as that is given in Anderson's *Conststutions*:

"A *Mason* is oblig'd, by his Tenure, to obey the Moral Law; and if he rightly understands the ***Art,*** he will never be a stupid Atheist, nor an irreligious Libertine . . . 'tis now thought more expedient only to oblige them [masons] to that Religion in which all Men agree, leaving their particular Opinions to themselves; that is, to be good Men and true, or Men of Honour and Honesty, by whatever Denominations or Persuasions they may be distinguish'd."

In short, it is conceived that there exists a moral law, to be apprehended by human reason and binding upon all men alike; and adherence to this, if a man be acceptable in other respects, is sufficient for Masonic purposes. It should be clear that Freemasonry by no means requires a man to limit his beliefs to this minimum or to reject the faith in which he has been brought up or the established religion of his country. The Freemasonry of Anderson's day, that is, was not specifically deist; but it was, and thereafter remained, open to men of differing religions. Jews were, in fact, admitted not long after 1723. Atheists and agnostics were, of necessity, barred.

Masonic Ceremonies.—Experts have differed on the way in which the modern form of Masonic ceremonies was reached, and the matter remains obscure partly because of difficulty in deciding how far some of the evidence, the catechisms. can be trusted. It may, however, be regarded as almost certain, first, that the ceremonies were not simply invented or arbitrarily elaborated by Anderson and Desaguliers but were developed from the practices of lodges, possibly from practices known in the 17th century. Second, the changes came about under speculative influence, so that the Old Charges, of importance to operative masons, played a less important part. Third, though the development cannot be fully traced, it is likely that two ceremonies used by operative masons, often telescoped into one when nonoperatives sere admitted in Scotland, were elaborated into three ceremonies—one for each grade in what is now known as the trigradal system—namely the entered apprentice, the fellow of the craft and the master mason. These, and the ritual and secrets connected with them, are fundamental in modern Freemasonry. The ceremonies were carried out in a room representing a lodge. The grand lodge. no doubt, played an important part in bringing about uniformity in the ceremonies and acceptance of the trigradal system. It is believed to have been stimulated also by the wide circulation of Samuel Prichard's *Masonry Dissected,* first published in 1730. About 30 editions of it are known to have been printed in England and 8 in Scotland.

Diffusion of Freemasonry After 1717.—Within half a century of the foundation of the grand lodge. Freemasonry had spread not only to the European continent but also to America and Asia. In Ireland, nhere a Freemasons' lodge existed as early as 1688, a grand lodge was established perhaps in 1723 and certainly by 172j. and in 1726 there was a Munster grand lodge. The grand lodge of Scotland, formed on a similar basis to that of the grand lodge of England, dates back to 1736. In India, lodges were constituted at Fort William, Bengal (1729), Calcutta (1730), Madras (1752) and Bombay (1758) In the West Indies Freemasonry was practised in Antigua (1728), St. Christopher (1739) and Jamaica (1742). A "deputation" was issued in 1730 appointing one Daniel Cox provincial grand master in New York, New Jersey and Pennsylvania, but there is no proof that he ever constituted a lodge there.

There is a tradition that in 1725 the earl of Derwentwater founded a lodge in Paris, but the first in France to be constituted by the grand lodge was in 1732. Four years earlier. as the grand lodge minute book shows. one had been constituted in Madrid and in the next year another at Gibraltar. Others were also opened in Germany (1733) Portugal (1735), the Setherlands (1735), Switzerland (1740), Denmark (1745), Italy (1763), Belgium (1765), Russia (1771) and Sweden (1773). In most of these countries grand lodges were subsequently created and continued in existence except in states where Freemasonry was proscribed. In Germany, following suppression of Freemasonry by the nazis, the united grand lodge of that country was re-established in 1949, although in the Communist zone it remained proscribed.

In at least two continental countries there had been associations, of some importance, of operative masons, namely the *Steinmetzen* in Germany and the *compagnonnages* in France; but there would appear to be no evidence in either case of any close or continuous connection with speculative Masonry. In some respects the *compagnonnages* resembled organizations of English or Scottish operative masons, having arrangements to help journeymen traveling the country in search of employment or wider experience. They also had rituals for initiation and legends connected with Hiram, Solomon's master mason, who was murdered by three apprentices, with Maître Jacques, Hiram's colleague and the maker of two pillars, and with Père Soubise, also one of Solomon's master workmen. These legends, however, cannot be satisfactorily dated nor can their evolution be clearly traced. It is by no means impossible that the *compagnonnage* rituals were based on, or greatly influenced by, English Masonic catechisms (E. Martin St. Léon, *Le Compagnonnage,* p. 223 [Paris. 1901]), and it may have been the case that legends were borrowed as well. In any event, even if it be taken that French. English and Scottish operative masons had some common traditions. of mediaeval origin. it is also clear that in one important respect the *compagnonnages* differed from other organizations of craftsmen. They consisted of journeymen and excluded independent masters of the craft. Their primary concern was with the economic conditions of journeymen, a matter of little or no interest to French speculative masons, for whom, during the 18th and 19th centuries, provision could be made in lodges following the English grand lodge tradition. These lodges were, like the *compagnonnages,* subject to difficulties because neither the church nor the state, under the *ancien régime* and restored Bourbons, regarded them favourably. The theological faculty in Paris in 1645 declared the rituals of the *compagnonnages* to be blasphemous and the use of their watchwords to be mortal sin; and Popes Clement XII and Benedict XIV in 1738 and 1751 condemned Freemasonry in bulls which, however, the secular authority did not enforce. Nevertheless, under Louis XVIII and Charles X, Freemasonry was only barely tolerated; and it is therefore no wonder that French Freemasons tended to be hostile to both ecclesiastical and secular authorities. Finally the French *Grand Orient* became so anticlerical as to abolish what English Freemasons regarded as a fundamental condition of membership, the requirement to believe in the Great Architect of the Universe. For that reason the English grand lodge in 1878 severed relations with it and thereafter refused to recognize any variety of Freemasonry erring in the same way.

While Freemasonry was thus being carried to the ends of the earth it was also developing additional activities and manifestations. In addition to the three fundamental degrees, others were at various times established. Among them are those of the Royal Arch, connected with a legend of Zerubbabel and the rebuilding of the Temple (Ezra iii, 2; iv, 2–3; v, 2), and governed by the supreme grand chapter of Royal Arch Masons, whose authority by 1952 was recognized by 2,450 chapters in the world. Others are those respectively of the Mark grand lodge, the grand priory of Knights Templars and the Ancient and Accepted Rite. Only

Freemasons may proceed to these degrees but they are optional and many members of the craft do not seek admission to them. The organizations named are mutually complementary and intimately connected in England and more or less so in Ireland, Scotland, North America and wherever the degrees are worked on a similar basis. European countries in which Masonry is permitted also have their own *hautes grades.*

Some idea of the strength of modern Freemasonry may be based on the fact that there were in 1952, within the jurisdictions of the three oldest authorities, nearly 9,000 lodges (English grand lodge. 6,510; Irish grand lodge, 1,014; Scottish grand lodge, 1,463) in parts of the world as distant from each other as London and Shanghai or Aberdeen and Trincomalee. In addition there were. in many of the same countries. grand lodges with jurisdictions of their own; for instance, seven in Australasia and nine in Canada. There were 49 autonomous grand lodges recognized by the grand lodge of England in the United States, 5 in Central America and Mexico, 11 in South America and 2 in the West Indies. In Europe there were one each in Denmark, Finland. France. Greece. Iceland. the Netherlands, Norway, Sweden and Switzerland; and there was one in the Philippines.

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UNITED STATES

As the organizational structure of Freemasonry in the United States is not exactly duplicated elsewhere in the world, its evolution deserves particular attention.

Freemasonry was planted in the American colonies by English. Scottish and Irish Masons during the early decades of the 18th century. In 1734 Benjamin Franklin. then 28 years of age, was elected grand master of Masons in Pennsylvania; and in the same year he published the first Masonic book printed in America, a reprint of Anderson's The *Constitutions* of *the Free-Masons.* At this time it was estimated there were about 6,000 Masons in all the colonial states from Maine to Georgia. Individual lodges had small memberships, ordinarily about 15, and a lodge with 25 or more members was considered quite large.

During the colonial period a majority of the lodges worked under English constitutions. Ancient or Modern, a few receiving their charters from the grand lodges of Scotland or Ireland. They were governed by provincial grand lodges, and the provincial grand masters were authorized or appointed from Great Britain. At the culmination of the Revolutionary War these provincial grand bodies set themselves up as independent grand lodges, their sovereignty becoming everywhere recognized within a few years. Each confined itself within the geographical area corresponding to state boundaries. a custom followed by all grand lodges subsequently organized in the United States. This was the origin of the now firmly established American Masonic doctrine of "exclusive jurisdiction," the point of which is that each grand lodge is sole and sovereign in Masonic matters within its own acknowledged territory; invasion of such territory by another Masonic body is grounds for discontinuing fraternal recognition. Accordingly, there were 49 independent grand lodges in the United States by 1956, with a total membership of approximately 4,000,000 Belief in God, the presence of the Holy Bible on the altar. the forbidding of any political activity or discussion within the lodge, strict nonsectarianism in religion and cognizance of the moral law are among the fundamentals adhered to by all grand lodges.

In the latter part of the 18th century, and at intervals thereafter, efforts were made to establish a general grand lodge for the United States. All these attempts failed, and each of the grand lodges remained independent without a national governing body. In 1912 a co-operative undertaking among the grand lodges to erect in Alexandria, Va., a George Washington Masonic National Memorial led to annual meetings and to a separate annual conference of grand masters of North America and the conference of grand lodge secretaries. These conferences became forums for the exchange of ideas and information but exercise no administrative authority over any grand lodge. A majority but not all of the grand lodges participate in another national body, the Masonic Service Association of the United States. As its name implies, this association, with headquarters in Washington, D C., acts for the participating grand lodges in matters of service, relief and education but is in no sense a governing body over any grand lodge.

The York Rite. — During the 18th century Masonic degrees beyond those of the first three were being devised in Great Britain and Europe and becoming known in America, but throughout this time they remained degrees only and lacked organizational form. In America, as in England, the Royal Arch degree was conferred in lodges of Master Masons or by lodge authority. By the end of the century Royal Arch chapters had begun to appear, leading to the establishment of the Capitular Rite. That rite consists of local chapters conferring four degrees: Mark Master, Past Master (Virtual), Most Excellent Master and the Royal Arch. Chapters are governed by grand chapters in the same form and jurisdictional pattern as lodges and grand lodges. Applicants must be Master Masons in good standing. There is also a general grand chapter in which the grand chapters of Pennsylvania, Texas, Virginia and West Virginia do not participate.

In America the earliest surviving written record of the conferral of the Knights Templar degree is in St. Andrew's lodge, Boston, 1769. Like the Royal Arch degree, it was conferred in a lodge or by authority of a lodge, until the appearance of local commanderies. In 1816 earlier efforts culminated in the formation of the General Grand Encampment of Knights Templar and the Appendant Orders for the United States, now known as the Grand Encampment of Knights Templar of the United States of America. The point of entrance is the local commander~and applicants must be Royal Arch Masons in good standing. The commandery confers three orders: Red Cross, Knights of Malta and Knights Templar, and is governed by grand commanderies under the grand encampment. The Templar Rite is exclusivelv Christian.

Prior to 1870 the Scottish Rite of Freemasonry conferred three side or optional degrees: Royal Master, Select Master and Super-Excellent Master. In that year these degrees were relinquished by the Scottish Rite and thereafter conferred in local councils of Royal and Select Masters, governed by grand councils, a general grand council, and known as the Cryptic Rite. The grand councils of Pennsylvania, Texas, Virginia and West Virginia do not participate in the general grand council, Capitular and Cryptic work being combined in those grand jurisdictions.

The term "York Rite" is merely a name and has no separate organizational substance. It is an over-all name for the bodies of the Capitular, Cryptic and Templar rites and is symbolic of antiquity in Freemasonry. As the Knights Templar is the culminating degree of the York Rite, the Cryptic Rite follows the Capitular and precedes the Templar degrees. The Cryptic degrees have retained their optional character and are not a requirement for applicants in the commanderies. Since the Capitular, Cryptic and Templar Masonry evolved in this form and sequence in the United States, and is not exactly duplicated elsewhere, it has frequently been proposed that these bodies should be named the American Rite, but the term York Rite persists through long usage.

The Scottish Rite.—The degrees of the Ancient and Accepted Scottish Rite first evolved on the continent of Europe, and its conception as an organization was set forth' in what are known as the Grand Constitutions of 1762 and 1786, the latter traditionally believed to have had the sanction of Frederick the Great in Germany, himself a Mason. The "Scottish" appelation is obscure, possibly derived from the influence of early Scottish Freemasonry in Europe, particularly in France. Transmitted through Jamaica to the American mainland, the first supreme council of the Scottish Rite was established at Charleston, S.C., in 1801. French Masons had brought some of the Scottish Rite degrees to America in the late 18th century, and local lodges of perfection had conferred them; but the organization of the Scottish Rite began with the formation of the supreme council at Charleston, and all regular supreme councils in the world descended from it.

The Grand Constitutions provide for only one supreme council in any one country, but difficulties of travel in the colonial states led in 1813 to the establishment of a second American supreme council. The Charleston supreme council authorized a supreme council for the northern jurisdiction, to govern the rite in a territory consisting of all states north of the Ohio river and east of the Mississippi river; and retained, as the supreme council for the southern jurisdiction, the remaining states and territorial possessions of the United States.

A supreme council is the parent body, elects its own members and is self-perpetuating. Unlike the grand bodies of the York Rite, a supreme council is not composed of representatives from the subordinate bodies. It charters the subordinate local bodies. These are four in number and, in the southern jurisdiction, are called Lodge of Perfection, conferring the 4° through 14°; Chapter of Rose Croix, conferring the 15° through 18°; Council of Kadosh, conferring the 19° through 30°; and the Consistory, conferring the 31° and 32°. Applicants must be Master Masons in good standing. The names of these four local bodies, the degrees conferred by each, as well as the names and character of the degrees, vary somewhat under different supreme councils. In the late 19th century, Albert Pike (1809–91) rewrote the degree rituals of the southern jurisdiction. While the Pike versions are widely used they are not universal throughout the rite under other supreme councils.

The supreme council confers the 33rd degree, which is honorary, in recognition of outstanding services, and may not be requested. In the United States, under both supreme councils, there were by the latter 1950s approximately 900,000 Scottish Rite Masons; and of this number there were approximately 6,000 of the 33rd degree (honorary). A supreme council itself is composed of "active" 33rd degree Masons, and each of these Masons is the highest officer of the Scottish Rite in his respective jurisdiction (states being referred to as orients). In states where there is no "active" 33rd degree Mason, the highest officer of the rite is a deputy of the supreme council.

In addition to the two American supreme councils, there were, by the latter 1950s, supreme councils in 31 other countries. Those which existed in Poland, Czechoslovakia and Rumania had been suppressed by the Communists. All Freemasonry had likewise been proscribed under Franco in Spain. but a supreme council of Spain in exile had been set up in Mexico.

Appendant Orders.—The masonic bodies properly so called are those of the symbolic lodges of the first three degrees (oiten referred to in the United States as "blue lodges," for the official colour) and the bodies of the York and Scottish rites. This main body of Freemasonry should not be confused with a large number of independent, primarily social organizations predicating their membership upon good standing in a lodge or body of the York or Scottish rites. Notable among these many appendant groups are: the International Order of the Eastern Star, admitting Master Masons and the wives, daughters or sisters of Master Masons; the Ancient Arabic Order of Nobles of the Mystic Shrine, in which applicants must be either 32nd degree Masons or Knights Templar (the "Shrine." so-called, is well known to the general public because of its colourful costumes and parades and the events it sponsors to support the organization's 1j hospitals ior the care of crippled children of all races and creeds); the Royal Order of Scotland, in the United States composed of those who have been five years or longer a 32nd degree Mason; the Red Cross of Constantine, with a membership limited in number and to Royal Arch Masons; the Mystic Order of Veiled Prophets of the Enchanted Realm, and the Tall Cedars of Lebanon, open to Master Masons; the Order of DeMolay for boys; the Order of Job's Daughters, for girls; and many others. In addition to these there are several hundreds of Masonic clubs, most of them local, social and benevolent in character, some independently organized. Many of these clubs are chartered by the National League of Masonic Clubs, the province of which is sufficiently indicated by its title. Again, these appendant orders are a United States development in Freemasonry not duplicated on the same scale elsewhere.

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All the Masonic grand bodies in the United States publish annual *Proceedings*, and most of them have published histories of their respective jurisdictions; the general grand bodies publish triennial *Proceedings;* the supreme council, southern jurisdiction, publishes biennial *Transactions*, and the supreme council, northern jurisdiction, publishes annual *Proceedings*. The Conference of Grand Masters of Masons in North America and the Conference of Grand Lodge Secretaries publish annual *Proceedings*, and many of the separate grand lodges publish official magazines or bulletins. (R. B. Hs.)

FREEPORT, a city in northern Illinois, U.S., 110 mi. W. of Chicago and seat of Stephenson county, is located in a prosperous dairy-farming area where corn, oats and wheat are major crops.

Founded by William Baker in 1835, the town was first settled by Pennsylvania Germans disappointed with conditions in the Galena lead-mining district, where they had planned to live. Freeport was designated the county seat in 1837 and changed its name from Winneshiek at that time. It was incorporated as a city in 1855. Manufactures include batteries, food products, oil burners, hardware, toys, medicines and toilet preparations. (For comparative population figures see table in Illinois: *Population*.)

Freeport was the site of the second Lincoln-Douglas debate on Aug. 27, 1858. There Abraham Lincoln asked Stephen A. Douglas to answer four questions, the second being: "Can the people of a United States Territory, in any lawful way, against the wish of any citizen of the United States, exclude slavery from its limits prior to the formation of a state constitution?" Douglas' affirmative answer pointed out that in spite of contrary supreme court decisions "... the people have the lawful means to introduce it or exclude it as they please, for the reason that slavery cannot exist ... unless it is supported by local police regulations." This Freeport doctrine was generally accepted by Illinois Democrats but was attacked savagely in the south. So profound mas its effect on the south that it is cited as one of the reasons Douglas could not control the Democratic party in the presidential campaign of 1860. "Lincoln the Debater," a statue by Leonard Crunelle, in Taylor park, commemorates the debate. (C. C. W.)

FREE PORTS. This term is more accurately applied to zones within port$ rather than to port units as a whole. In mediaeval times, when the nature and scale of international trade was limited, free ports grew out of the practice whereby certain cities granted foreign merchants privileges which approached freedom of trade. With the rise of the mercantile system, however, it became normal for a country to impose many restrictions upon overseas imports. It was realized that these restrictions might seriously impede trade and as a result some maritime cities were granted exemption, thus becoming free ports. The increased volume and variety of goods handled by the large ports commonly led to the tariff concessions being limited to a zone within them.

A free port or free zone within a port is an area within which goods may be landed, handled, manufactured and reshipped without the intervention of the customs authorities. It follows that the normal facilities of a port will exist, for instance, for lading and unlading; supplying the water, fuel and other requirements of ships; for storage of goods; for providing transport within the port or zone; and alloning contact with inland areas. The defined area is subject to all the usual laws concerning health, labour conditions, inspection of vessels, immigration and postal service but is entirely exempt from customs. It is only when the goods are moved to consumers within the country in which the free port zone is located that they become subject to the prevailing customs duties.

The primary purpose of a free port or free port zone is to facilitate consignment and transshipment trade. It has been for long a system by which an attempt has been made to remove from a port with many geographical advantages for trade those hindrances to trade caused by high tariffs and complex customs regulations. Hamburg and Bremen, both admirably situated for trade between highly developed areas of Europe and the rest of the world, have long been associated with the practice. Hamburg was one of the most famous of Hanseatic towns and, from the period of freedom of trade associated with the Hanseatic league, retained the principle so that, through a free zone within this great port, the advantages of geographical location for transshipment were strengthened and the range and variety of commodities handled much increased. Many ports of northwestern Europe (*e.g.*, Copenhagen, Danzig, Stockholm, Gothenburg and Lübeck) and other ports along the Adriatic coast (*e.g.*, Trieste and Rijeka [Fiume]) have had long experience with the system and through its application may well have both maintained and extended their trade. From the end of the 19th century several additions were made to the list of free ports or free port zones, including Singapore, Penang, New York City, Puerto Mexico and Salina Cruz. The primary objectives in creating a free port zone are not always the same; for example, when the scheme was put in motion in Colon, Panama, in 1950 much emphasis was placed on the values to be obtained through encouraging the manufacture of commodities as well as from amplifying the transit trade. Thus an area was deliberately set aside as a free-zone industrial area, and a number of industries have been established.

Although the free port system became more widespread, it was not universally adopted. Several important trading countries, including Great Britain. did not adopt the practice. In the United States, with the passing of the Celler Foreign Trade Zones act in 1934, it seemed that several free ports might come into being; but only limited developments followed as, for example, in the ports of New York City and New Orleans. Among the advantages of the system that have been emphasized are the quicker turn-round of ships through the reduction in the formalities of customs examinations and the ability to display and often fabricate goods freely. Any increase in trade attributable to the existence of a free port zone must lead to greater receipts for the port authority and to the provision of additional employment. Yet in many instances there is no strong case for believing that an increase in trade would result from the introduction of the system. On the other side it has been stated that the free port zone system tends to allow the dumping and holding duty-free of goods which are later released on the market at a critical time to the detriment of the nianufacturers of the country concerned. Furthermore the physical features and built-up character of some ports do not allow the setting aside of a distinct and closely supervised free port zone. Suggestions have been made that free zones should be created in Britain (particularly within the ports of south Wales) and in Canada; but in these countries: as elsewhere, the location of the port, the political and geographical conditions that apply and the extent to which advantages would be given to re-export trade and to manufacturing must be taken into account in deciding whether the system should be introduced.

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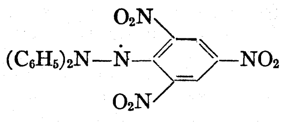
FREE RADICALS. According to 19th-century chemical nomenclature a radical is a group of atoms which, in combination with another radical or atom, forms a stable molecule. Thus a free radical may be defined as a molecule in which one of the atoms has one of its valences unoccupied; *i.e.*, a molecule in which one of the atoms exhibits a valence one unit lower than normal. In a free radical. therefore, carbon appears to be trivalent rather than quadrivalent. nitrogen bivalent rather than trivalent. Numerous unsuccessful attempts to prepare free radicals at one time led to the belief that free radicals were incapable of existence. However a number are now recognized as stable entities. and others play important roles as transient intermediates in chemical reactions. An alternative definition of a free radica! derives from the theory of chemical valence developed by G. N. Lewis (1916 and later. see VALENCE). Most molecules contain an even number of electrons. The chemical bond. or valence. which holds together two atoms consists of a pair of electrons shared by the two atoms. The free valence of a free radical consists of a single unshared electron. and the radical is an odd molecule containing an odd number of electrons (Lewis, 1923). If consideration is restricted to molecules containing only the elements most commonly encountered in organic chemistry (*i.e.*, carbon, hydrogen, nitrogen, oxygen, the halogens and the like) the two definitions are equivalent. However, if one wants to consider also compounds containing atoms of the transitional groups of the periodic system (see PERIODIC LAW. THE). this is no longer true. Thus. although ferric ion Fe^{+++}, contains an odd number of electrons. it is not ordinarily considered a free radical. Further, complex organic molecules may be imagined having two unsatisfied valences but an even number of total electrons. Examples of such diradicals are also known.

Radicals of Appreciable Stability. — The history of this field of chemistry begins in 1900 with M. Gomberg's discovery of rriphenylmethyl with the structure I. In this compound the central carbon

$(C_6H_5)_3C\cdot$ **I** $\qquad (C_6H_5)_3C—C(C_6H_5)_3$ II

is trivalent since it is combined with three phenyl groups instead of four, and its unshared electron is represented by a dot. By withdrawing chlorine from triphenylchloromethane, $(C_6H_5)_3CCl$, Gomberg expected to obtain hexaphenylethane II as a result of the cornhination of two triphenylmethyl radicals I. The product obtained (in solution) was. however, a mixture of I and II. Actually, solution I and II are in rapid equilibrium with each other, hexaphenylethane forming by the dimerization of two triphenylmethyl radicals. a process in which the two odd electrons become paired to form the central carbon-carbon bond. and the free radicals are continuously being regenerated by dissociation of the hexaphenylethane. Free radicals of this type are stable only in certain organic solvents. and are rapidly destroyed by irreversible reactions in the presence of air. water or strong acids. The degrees of dissociation of compounds such as hexaphenylethane vary ,considerably when the phenyl groups are replaced by other aromatic groups. Thus, when each phenyl. C_6H_5. is replaced by biphenyl. $C_6H_5.C_6H_4$. dissociation into free radicals is practically complete. In an analogous manner, free radicals are formed to a small extent by the breaking of the nitrogen-nitrog'en bond in aromatic hydrazines of the general structure $R_2N—NR_2$. or, to a greater extent. by the breaking of the central nitrogen-nitrogen bond in aromatic tetrazanes. $R_2N—RN—NR—NR_2$. Thus. the radical diphenylpicrylhydrazyl III exists as a stable violet solid. showing no tendency to dimerize to a tetrazane even in the solid state. Examples of free radicals with the odd electron on oxygen are also known, *e.g.*, the 2, 4. 6-tri-*t*-butylphenoxy radical IV, a blue substance which is also unknown in the dimeric form.



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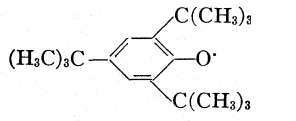
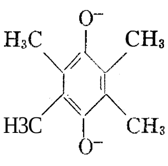


IV

Another free radical is typified by the semiquinones. If the dianion of durohydroquinone V (existing in alkaline solutions of durohydroquinone) is treated with oxidizing agents, it loses two electrons and is converted to duroquinone VI. An intermediate stage of oxidation is possible in which a single electron has been lost to yield the free radical semiquinone ion VII. Actually,



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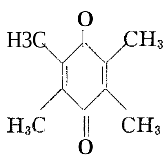

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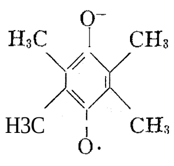

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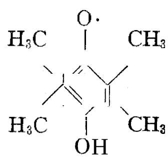


VIII

in partially oxidized systems all three species are in mobile equilibrium, and mixing solutions of V and VI immediately gives rise to detectable quantities of the yellow semiquinone. Semiquinones of a variety of types are known, and in some cases may be obtained in pure form in the solid crystalline state. However, they are usually in rather unfavourable equilibrium with the completely oxidized and reduced forms of the molecule, so that for many years their existence was overlooked.

Another type of stable radical ion, a metal ketyl, forms when a substance such as benzophenone, $(C_6H_5)_2C=O$, is treated with metallic sodium to give the coloured ketyl $(C_6H_5)_2\dot{C}—O^-$. The reaction involved is essentially a reduction, the sodium being oxidized to sodium ion, Na^+. Rather similarly, in certain solvents such as tetrahydrofuran sodium reacts with complex aromatic hydrocarbons such as naphthalene $C_{10}H_8$ converting it to the highly coloured radical ion $C_{10}H_8^-$.

A final class of relatively stable organic free radicals are those containing the group >NO. Such a group necessarily contains an odd electron (apparently distributed between the nitrogen and oxygen) and the resulting molecule is thus a free radical. An example is diphenylnitrogen oxide. $(C_6H_5)_2NO$, which is obtained by the oxidation of diphenylhydroxylamine, $(C_6H_5)_2NOH$, and which shows no tendency to dimerize or to disproportionate to products of higher and lower oxidation state. A somewhat similar behaviour of nitrogen is found in nitric oxide, NO, and nitrogen dioxide. NO_2, which are also odd molecules.

Structural Requirements for Stable Radicals.—Certain structural features appear to be requirements for the existence of stable free radicals. One condition of particular importance is shown by the semiquinone radical ion VII. As depicted, the upper oxygen atom has a negative charge, and the lower one an odd electron. However, this assignment is arbitrary, and the same molecule nould be represented if the charge and odd electron were interchanged. A7hen a situation of this type is encountered, the actual average distribution of electrons within the molecule is presumed not to be that of either of the structures just described. but to be intermediate between the two. This ambiguity is called delocalization or resonance (see RESONANCE, THEORY OF); according to quantum mechanics the resonance increases considerably the stability of the molecule, and, in this case, the probability of existence of the semiquinone ion. When the oxidation of durohydroquinone is conducted in an acid medium, so that the semiquinone anion would be converted to the neutral radical VIII, this ambiguity as to structure disappears, and under such conditions no semiquinone can be detected.

Similar arguments account for the stability of the other free radicals discussed above. In the case of triphenylmethyl I, it is considered that the odd electron is in effect distributed over the three phenyl groups as well as the central carbon atom. In addition, the dissociation of hexaphenylethane may be considerably facilitated by repulsive forces between the three bulky phenyl groups on one carbon atom and those on the other. As a measure of the magnitude of these two phenomena, dissociation of the carbon-carbon bond in the simple molecule ethane, $H_3C—CH_3$, requires an energy of 84 kg. cal. per mole of ethane. In hexaphenylethane only 12 kg. cal. are required.

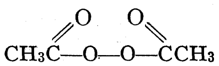
Magnetic Properties of Free Radicals.—The magnetic properties of free radicals provide a powerful tool for their detection and study. Molecules with even numbers of paired electrons are diamagnetic; *i.e.*, they are slightly repelled by a magnet. However, free radicals are paramagnetic and attracted by a magnet because of the spin of the odd electron (see QUANTUM MECHANICS: *Electron Spin)*, the spins of the remaining paired electrons effectively canceling each other. The magnetic property of a substance which is commonly studied is its magnetic susceptibility, effectively its behaviour in an inhomogeneous magnetic field, and the extent of its paramagnetism is described in terms of its magnetic dipole moment, expressed in Bohr magnetons. The magnitude of this dipole moment is the same for all free radicals, and, when arising from the spin of a single electron, amounts to $\sqrt{3}=1.73$ Bohr magnetons. This value has been confirmed experimentally with free radicals which may be obtained in the solid state, or at known concentrations in solution. Magnetic susceptibility measurements also may be used to demonstrate the existence of free radicals and to measure the position of equilibrium between radicals and their dimers or disproportionation products (see also MAGNETOCHEMISTRY). Diradicals, with even numbers of electrons two of which are, however, not paired, are also paramagnetic, the oxygen molecule, O_2, being probably the simplest example.

The paramagnetic resonance spectra of free radicals provide another technique for their detection and study. According to quantum mechanics, the spin of the odd electron of a free radical, when placed in a magnetic field, may have two, and only two, orientations, one with and the other against the field. These two orientations differ slightly in energy by an amount proportional to the strength of the magnetic field, and the majority of the electrons have the orientation of lowest energy. If a system containing free radicals is placed in a magnetic field and exposed to electromagnetic radiation (usually in the microwave region of very short radio waves), molecules with the lower energy orientation absorb radiation of a frequency corresponding to an energy just sufficient to flip over the electron into its higher energy state. This phenomenon was first observed by E. Zavoisky in 1945, and, in the simplest case, gives rise to a paramagnetic resonance absorption spectrum consisting of a single sharp absorption line. The technique is sensitive, and will detect extremely small concentrations of free radicals, examples of as little as one part in 10^7 having been reported. In many organic free radicals, interaction of the odd electron with the magnetic moments of the nuclei of different atoms in the molecule (most commonly with the nuclei of hydrogen atoms) gives rise to a more complicated system of energy levels. and an absorption spectrum consisting of a series of lines. The nature of the spectrum observed permits the identification of particular free radicals, and also gives information about their electronic structure. As an example, the simple semiquinone radical ion. $\cdot OC_6H_4O^-$ (analogous to VII, but with the CH_3 groups replaced by hydrogen atoms), exhibits a spectrum of five equally spaced lines, indicating that the odd electron spends part of its time near the hydrogen nuclei. Accordingly it is not only associated with the two oxygen atoms, but is effectively delocalized over the entire molecule. Similarly, the triphenylmethyl radical I shows a complex spectrum, consistent with the idea that its stability arises from the spreading of its odd electron over all three phenyl groups.

Unstable Radicals of Short Life.—Simple free radicals such as methyl, $\cdot CH_3$, are also capable of existence, and play important roles as transient intermediates in many chemical reactions. The existence of the methyl radical was first demonstrated by F. Paneth and W. Hofeditz in 1929 by the following experiment. The vapours of tetramethyl lead, $Pb(CH_3)_4$, mixed with gaseous hydrogen, H_2, were passed through a silica tube at low pressure. When a portion of the tube was heated to about 800° C. the tetramethyl lead was decomposed and a mirror of metallic lead deposited on the internal surface of the tube. The gaseous products of the decomposition were found capable of causing the disappearance of a second lead mirror, deposited at a more distant cool point in the tube. Since none of the recognized stable products of the decomposition was able similarly to dissolve a lead mirror, the inference was drawn that methyl radicals. formed in the high-temperature decomposition. reacted with lead at the cool mirror to regenerate tetramethyl lead. The methyl radicals obtained in this way proved to be highly reactive and short-lived. They not only reacted with lead and other metals, but disappeared rapidly and spontaneously, largely by dimerization to ethane, CH_3CH_3. In hydrogen at a total pressure of 2 mm.; *e.g.*, the concentration of methyl radicals was estimated to decrease to half its original value in about 0.006 seconds. In subsequent years, techniques for producing reactive free radicals in the gas phase have been greatly extended by Paneth and his co-workers and many other investigators. It has been found that a variety of unstable species such as ethyl. $\cdot C_2H_5$, propyl, $\cdot C_3H_7$, and hydroxyl, $\cdot OH$. can be obtained by several methods which include: (1) the thermal or photochemical decomposition (see PHOTOCHEMISTRY) of a wide variety of organic and inorganic materials; (2) the reaction between sodium vapour and an alkyl halide; (3) the discharge of electricity through a gas at low pressure. Atoms which arise from dissociation of a diatomic molecule (such as the chlorine atom, $\cdot Cl$, from the dissociation of the chlorine molecule Cl_2) can also be obtained, and have the properties of short-lived radicals of this type.

The existence of the various known unstable free radicals, like that of methyl itself, is most commonly demonstrated by the reactions which they undergo. Thus, ethyl radicals, formed from tetraethyl lead. $Pb(C_2H_5)_4$, dissolve zinc and antimony mirrors. The resulting ethyl derivatives of zinc and antimony, $Zn(C_2H_5)_2$ and $Sb(C_2H_5)_3$, have been isolated and identified by the usual chemical and physical tests. In a few instances, unstable radicals also have been identified spectroscopically. Here the important technique of flash photolysis, the use of a single, intense flash of light to produce a momentary high concentration of free radicals, has been developed by R. G. W. Norrish and G. Porter.

Transient unstable free radicals also may be produced in the liquid phase (*e.g.*, in solution in a liquid solvent) by several means. A number of molecules, of which organic peroxides are typical, possess such weak chemical bonds that they decompose irreversibly into free radicals on warming in solution. The behaviour of diacetyl peroxide,



has been studied by M. S. Kharasch, M. Szwarc and others, and it is considered to decompose, at least in large part, into carbon dioxide. CO_2, and methyl radicals.

These in turn rapidly attack most organic solvents, often by abstracting hydrogen to give methane, CH,, together with other products. Irradiation of solutions of many organic substances with ultraviolet light leads to the absorption of sufficient energy to disrupt chemical bonds and produce free radicals, and in fact most photochemical processes are at present thought to involve free radical (sometimes diradical) intermediates. The chemical changes which occur when solutions (and also gases) are exposed to high-energy radiation (α, β, and γ rays from nuclear reactions, X-rays, electron beams. etc.) also frequently appear to involve the transient formation of free radicals. Thus, a major consequence of passing high-energy radiation into water. H_2O, is believed to be its dissociation into hydroxyl radicals. $\cdot OH$, and hydrogen atoms, $\cdot H$. Short-lived radicals are also formed in some oxidation-reduction processes. Organic hydroperoxides of the general formula R—OOH react rapidly with ferrous ion. Fe^{++}, the first step being the formation of ferric ion, Fe^{+++}, hydroxide ion, $OH-$, and an alkoxy radical, $RO\cdot$.

An interesting method for prolonging the lifetime of highly reactive radicals is to produce them in a glassy or solid medium where they are unable to diffuse together and disappear by dimerization and similar processes. The technique was first developed by G. N. Lewis who irradiated various organic molecules, chiefly dyes, in glassy solvents at liquid air temperatures and was able to observe the colours of the resulting unstable radicals, mhich, in some cases, could be preserved for days. Similarly, the irradiation of organic plastics (and many other solid organic materials) with high-energy radiation at ordinary temperatures can produce high concentrations of trapped radicals which may be detected and studied via their paramagnetic resonance spectra.

Radicals as Intermediates in Chemical Reactions.—It is commonly believed that free radicals are transient intermediates in many high-temperature reactions such as combustion and the thermal cracking of hydrocarbons, in many photochemical processes, and in a number of other important reactions in organic chemistry, although their concentrations are in general too low for direct detection. One class of free radical reaction is of particular importance, and is illustrated by the following example. Methane. CH,, reacts with chlorine, Cl_2, by an over-all process which gives methyl chloride. CH_3Cl, and hydrogen chloride. HCl. The reaction is enormously accelerated by light, and apparently involves the following steps:

$$Cl_2 \xrightarrow{\text{light}} 2Cl\cdot \qquad (1)$$

$$Cl\cdot + CH_4 \longrightarrow \cdot CH_3 + HCl \qquad (2)$$

$$\cdot CH_3 + Cl_2 \longrightarrow CH_3Cl + Cl\cdot \qquad (3)$$

$$2\,Cl\cdot \longrightarrow Cl_2 \qquad (4)$$

Chlorine atoms are produced in (1) and destroyed in (4), while the products which are actually isolated arise from (2) and (3). Since chlorine atoms consumed in (2) are regenerated in (3). a single atom of chlorine can lead to the production of many (actually many thousand) molecules of methyl chloride. Such processes, in which an intermediate is continually regenerated, are known as chain reactions and their study constitutes an important branch of chemical kinetics (for further details see articles on CATALYSIS; REACTION KINETICS; and POLYMERIZATION). Similar chains involving transient free radicals are involved in the halogenation of many other organic molecules, in many of the polymerization reactions employed in the manufacture of plastics and synthetic rubber, and in the reaction of molecular oxygen, O_2, with a great number of organic molecules. In general these chain processes occur with great rapidity—a typical lifetime of a chain may be of the order of a second. during which many thousands of individual steps such as (2) and (3) may occur—although at any one time perhaps only one molecule out of 10^9 in the system exists as a free radical. Since a relatively small number of free radicals can produce significant chemical reaction in this manner, the initiation of typical radical chain processes (such as polymerization of certain unsaturated molecules) provides one of the best demonstrations of the existence of transient free radicals in chemical systems.

While most reactions of molecular oxygen with organic molecules appear to involve free radical intermediates, the situation in other oxidations and reductions depends much upon the particular system involved. Thus, the oxidation of isopropyl alcohol, $(CH_3)_2CHOH$, to acetone, $(CH_3)_2C{=}O$, by ferrous ion and hydrogen peroxide apparently involves the intermediate radical $(CH_3)_2\dot{C}-OH$. On the other hand, there is good evidence that when chromic acid, H_2CrO_4, is the oxidizing agent, the oxidation occurs in one step without the intervention of any intermediate radical. Basically, the presence or absence of intermediate free radicals in oxidations and reductions depends upon whether the reactions involve the transfer of single electrons (which necessarily produces an odd molecule as an intermediate), or involve two-electron transfers (which do not produce odd molecules). In many reactions, including most of the important oxidation-reductions occurring in biochemical systems, which sort of path is followed is not yet known.

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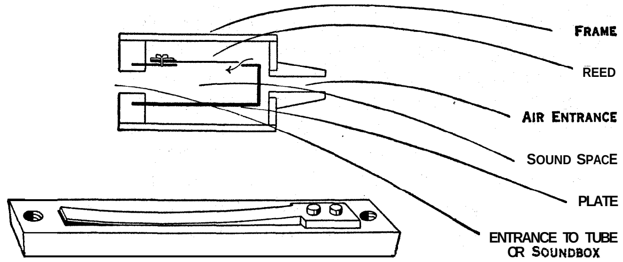
FREE REED VIBRATOR, in musical instruments, a thin metal tongue fixed at one end and vibrating freely either in surrounding space, as in the accordion and concertina, or enclosed in a pipe or channel, as in certain reed stops of the organ or in the harmonium.

Air under three different conditions must be dealt with in considering the acoustics of the sound produced by free reeds: (1) the stationary column in pipe or channel containing the reed, nhich is normally at rest; (2) the wind or current of air fed from the bellows with a variable velocity and pressure, which is broken up into periodic air puffs as its entrance into pipe or channel is alternately checked or allowed by the vibrator; (3) the disturbed condition of no. 1 when acted upon by the metal vibrator and by no, 2, whereby the air within the pipe is forced into alternate pulses of condensation and rarefaction.

The most valuable characteristic of the free reed is its power of producing all the delicate gradations of tone between forte and piano by virtue of a law of acoustics governing the vibration



FROM DUFF, "TEXT-BOOK OF PHYSICS" AND HELMHOLTZ, "THE SENSATIONS OF TONE"
DIAGRAM ILLUSTRATING ACTION OF THE FREE REED VIBRATOR (ABOVE) SHOWING DIRECTION OF AIR CURRENT WHICH CAUSES VIBRATION OF FREE END OF REED; AND (BELOW) PERSPECTIVE OF ORGAN REED

of free reeds, whereby increased pressure of wind produces a proportional increase in the volume of tone. The sound produced by the free reed itself is weak and requires to be reinforced by means of an additional stationary column or stratum of air. Free reed instruments are therefore classified according to the nature of the resonant medium provided: (1) free reeds vibrating in pipes, as in organs; (2) free reeds vibrating in reed compartments and reinforced by air chambers of various shapes and sizes. as in the harmonium (*q.v.*); (3) free reeds set in vibration through a valve. but having no reinforcing medium, as in the accordion and concertina. The quality of tone of free reeds is due to the tendency of air set in periodic pulsations to divide into aliquot vibrations or loops, producing the phenomenon known as harmonic overtones or upper partials, which may, in the highly composite tone of free reeds, be discerned as far as the 16th or 20th of the series. For the history of the application of the free reed to keyboard instruments. see HARMONIUM.

FREESIA, a genus of South African herbs belonging to the Iris family (Iridaceae), containing three species but scores of horticultural forms. The plants grow from a bulblike corm (as in *Gladiolus*) which sends up a tuft of long narrow leaves and a slightly branched stem bearing a few leaves and loose! one-sided spikes of fragrant. narrowly funnel-shaped. but slightly irregular flowers, which are typically yellow, but white, pink or red in some of the horticultural forms. They form pretty greenhouse plants which are readily increased from seed. They are extensively grown for the florists, as their fragrance is much desired. By potting successively throughout the autumn a supply of flowers is obtained through winter and spring.

The culture of freesias in the United States is extensive. Corms are planted in a rich loam, somewhat sandy, about the middle of August and kept in a cool greenhouse. By planting every two weeks, bloom is extended until March or April, although they are normally winter-flowering. (N. TR.)

FREE-SOIL PARTY, a minor 19th-century U.S. political party which opposed the extension of slavery. The Free-Soilers later became one of the component elements in the Republican party on its organization in the mid-1850s.

Abolitionists were scarce in mid-19th century United States but opponents of the slave power as it dominated the national government were growing in numbers. When Pres. James K. Polk, in 1846, asked congress for an appropriation to be used in settling the Mexican boundary, Rep. David Wilmot moved that the money be granted provided that any territory bought with it be free soil. This Wilmot proviso was,defeated but it was to provide the fundamental principle of the emerging Free-Soil party.

In 1848, when over 500,000 sq.mi. were acquired from Mexico, Free-Soilers insisted that slavery be forever excluded from this land. They knew that otherwise states formed from it would strengthen the slave power with more senators, representatives and presidential electors.

In Aug. 1848 the Free-Soilers held their first national convention at Buffalo, the geographic centre of the zone of greater New England settlements, New England furnishing the strongest 19th-century opposition to the extension of slavery. Seventeen states sent delegates, among whom were antislavery Whigs, antislavery Democrats and the remnants of the declining Liberty party, all determined to fight extension of slavery. They were less exasperated with slavery as an institution than with the slave power which dominated the national government in the interest of cotton and tobacco to the neglect of important northern interests.

The ideology uniting Free-Soilers was not abolition of slavery but repugnance to the presence of the Negro and they wanted no Negroes, either free or slave, in the territories. "Let the soil of our extensive domains." as they put in their 1848 platform, "be kept free for the hardy pioneers of our own and the oppressed and banished of other lands, seeking homes of comfort and fields of enterprise in the New World." The final plank contained their historic slogan, "Free soil, free speech, free labor, and free men." They nominated former Pres. Martin Van Buren of New York for president and Charles F. Adams of Massachusetts for vice-president but polled only slightly more than 10% of the popular vote for president.

In 1852 the Free-Soil candidates were John P. Hale for president and George W. Julian for vice-president; they polled not quite 5% of the popular vote. In 1856 the Free-Soilers were absorbed by the new Republican party (*q.v.*), which had adopted the Free-Soil program. In terms of economic interests the Free-Soilers constituted a combination of small farmers, village merchants, household and mill workers and debtors.

See Theodore Clarke Smith, "The Liberty and Free Soil Parties in the Northwest," ***Harvard*** *Historical Studies,* vol. vi *(1897).*

(W. E. BY.)

FREESTONE, stone used in architecture for mouldings, tracery and other work required to be worked with the chisel. The oolitic stones (*i.e.,* limestones) are generally so called, although in some countries soft sandstones are used; in some churches an indurated chalk called clunch is employed for internal lining and for carving.

FREETOWN, the capital and main port of the independent state of Sierra Leone, west Africa, lies on the south side of the estuary of the Sierra Leone river, about 5 mi. E. of the cape of that name. Pop. (1957 est.) 80,000. It stands on the seaward tip of the range of wooded hills to which the Portuguese Pedro da Cintra gave the name Sierra Leona ("Lion Mountains") about the year 1460.

The climate is humid, wet tropical and trying for the white man, with an annual average rainfall of 138 in. Health conditions have, however, been greatly improved.

Freetown possesses one of the world's finest natural harbours, in which more than 250 ships sheltered at one time during World War II when it was an important naval base. The city extends along the water front for a few miles and rises inland on gently sloping ground. The historic buildings and places of interest include the Anglican St. George's cathedral (1852); the old Fourah Bay college building (1851); Fort Thornton, residence of the governor, first built in 1796 and modernized in 1952; the giant silk cotton tree (1787); and the stone bearing the name of the Dutch admiral Michel Adriaanszoon de Ruyter who landed there for uater in 1664. New modern buildings for the Fourah Bay University college (affiliated with the University of Durham, Eng.) on Mount Aureol, which overlooks the city, and new commercial offices (including the country's first seven-story building) are rapidly changing the town centre. In 1957 a museum was opened near the famous cotton tree. The main streets include Water street, along the water front; Westmoreland street. running through the central ward; and Kissy street, leading to the eastern suburbs and into the main trunk road to the provinces.

The airport of Lungi is 10 mi. N. on the sea coast across the estuary. Air services link Freetown with Europe and with other parts of west Africa and the world, and there is an internal air service between Freetown and provincial towns. The port has a deep-water quay, and there are regular shipping services between Freetonn and British and other overseas ports. A government-owned railway and a steadily expanding road system link the city with provincial centres.

Freetown is not an industrial city. As the chief port of Sierra Leone. the country's principal exports and imports pass through it, and many of the inhabitants are occupied in handling the merchandise. Many others, including women, are engaged in professional and public services. A large proportion of the merchants are Lebanese.

Freetown was founded as an attempt to atone for the horrors of the slave trade which made the area now occupied by the city and surroundings a raiding ground for about three centuries. In the movement to abolish slavery, Freetown was designed as a home for slaves freed and destitute in England. The first settlers were sent out in 1787; and in 1790 the enterprise was taken on by the Sierra Leone company, which was given a royal charter in 1799 Freetown acquired effective municipal government in 1893 and was, before independence in 1961, the oldest British colonial municipality in Africa. The descendants of the liberated Africans. known as Creoles, are a minority in the city. The majority of inhabitants are members of the country's two largest tribal groups, the Mende and Temne *See* also SIERRA LEONE. (T. A. L D.)

FREE TRADE, the antithesis of protection (*q.v.*), is a policy by which a government does not discriminate against imports in favour of national products or interfere with exports in order to favour consumers in the home market. This meaning became accepted usage in the struggle to abolish the English Corn laws (import duties on nheat and other grain) in 1846. Before then the term was used in other senses. Thus, early in the 17th century "free trade" bills were promoted by those seeking entry into the closed corporations of the chartered companies (such as the East India company). Later, "free trade" nas used to mean the right to trade in a foreign region without joining a company. It was sometimes used as a euphemism for smuggling.

Free trade does not mean that a government abandons all control and taxation of imports and exports; merely that this control and taxation is not used to protect the home producer against foreign competition or to favour the home against the foreign consumer. Thus, if an import tax is imposed for revenue, it is countervailed in a free trade system by an excise duty on home-produced goods. Export taxes formed an important part of the British protective system in the 18th century and mere so much resented by the American colonists that section 9 of the constitution of the United States included export taxes among the poners denied to the federal government.

The Case for Free Trade. — There is a long history of the struggle for free trade in the broadest sense of absence of governmental restraint upon the freedom of traders to move and to transact business within a country and between countries. It was widely discussed by the French Physiocrats, an 18th-century school of economists who coined the phrase *laissez faire, laissez aller* (let them act, let them go) still used to describe free enterprise. *(See* PHYSIOCRATIC SCHOOL.) Freedom of movement and trade was deduced from the philosophic principle of natural liberty.

The Scottish philosopher Adam Smith applied the principle to economic activity, and particularly to trade. in his *Inquiry Into the Nature and Causes of the Wealth of Nations,* published in 1776. The economic case for free trade is still based on his argument that division of labour leads to specialization, efficiency and greater production. Each country will specialize upon producing those goods for which it has natural advantages and therefore cheaper costs of production. It will be driven by competition to efficient methods.

There is also a strong political case for which Adam Smith's work laid the foundation. If governments interfere with competition to protect local interests, there is great danger that small and inefficient producers will be subsidized at the expense, not of the foreigner, but of the majority of their fellow countrymen, who as consumers must pay higher prices. bloreover, the regulation of trade becomes expensive and cumbersome. Duties and regulations which serve no useful purpose survive and develop into a network of restrictions.

Adam Smith's argument was particularly effective on this political level. His economic argument was elaborated by the English school of classical economists headed by David Ricardo (1772–1823), who propounded the theory of comparative costs. This theory explained the advantages of specialization. The argument for free trade on a competitive private enterprise basis was systematized by John Stuart Mill (1806–73) and was accepted by the majority of economists well into the 20th century. After the turn of that century economic discussion centred not upon the case for securing the maximum of production by territorial division of labour, but upon the division of the gains between trading countries. It was shown that there are cases where governmental intervention may, in theory, secure to a country a greater share of the gain from its external trade than nould accrue under free competition. There are obvious administrative difficulties in timing such intervention and in judging its extent; but the theoretical argument weakened the economic case for free trade.

Economists since Adam Smith have always recognized that exceptions to free trade might be justified on noneconomic grounds. Smith himself made exceptions on grounds of defense, to countervail domestic taxation, to retaliate against other countries and on grounds of humanity when foreign competition might inflict hardship upon great numbers of norkers. Following the publication of J. M. Keynes's *General Theory of Employment, Interest and Money* in 1936. and the widespread acceptance of "full employment" as a criterion of economic policy, this latter exception became the main argument against free trade. It was reinforced in countries of backward industrial development by the argument that temporary protection is necessary to modernize production methods. It should be recognized, honever, that in practice much of the protection extended to local industries may be a device in which minority interests justify their action by invoking patriotic reasons that will not bear analysis. Despite theoretical refinements and exceptions, many economists claim that the broad economic case for free trade has never been refuted.

Adam Smith's criticism of arguments for protection and of the administrative abuses of protective practices quickly stimulated a movement toward freer trade. In 1786 William Pitt the Younger negotiated a commercial treaty with France, which lowered tariffs and removed prohibitions in both countries. War broke out in 1793 and further steps toward free trade were not possible until after the end of the Napoleonic wars in 181j.

METHODS OF PROMOTING FREER TRADE

There are three methods of achieving freer trade. The most direct and effective is the unilateral reduction of trade barriers by each country independently of the policy followed by other countries. This was the method advocated and carried to completion by the British free trade movement in the second quarter of the 19th century. A second method, not in conflict with but supplementary to the first, is the negotiation of bilateral commercial treaties or agreements in which a reciprocal bargain is struck to remove tariff and other trade barriers to an approximately equal degree in both countries. It is the oldest method, since commercial treaties have a very long history; but it was given new life by the Anglo-French treaty negotiated by Richard Cobden and Michel Chevalier in 1860. The method of bilateral negotiation was also used in the agreements made by the United States after the Reciprocal Trade Agreements act in 1934. The third method, folloned after the negotiation of the General Agreement on Tariffs and Trade at Geneva in 1947, is the multilateral negotiation of a simultaneous agreement among many countries.

Unilateral Free Trade. — After the Napoleonic wars, a strong free trade movement in Britain was directed and financed by manufacturers and merchants who tried to break the power of the landowners, so that food and raw materials might be imported more cheaply. The British tariff was then very complicated, partly because it was the result of special legislation accumulated over a long period, partly as a result of the additional duties imposed to finance the wars. When William Huskisson became president of the board of trade in 1823 he found no fewer than 1,500 statutes operative. He began to consolidate and simplify these statutes as well as the supporting regulations and customs procedures. The Navigation acts, which imposed heavy duties on a long list of enumerated articles if carried in foreign ships, were an important part of the protective system. In 1823 a Reciprocity of Duties bill relaxed the acts. Huskisson also reduced import duties on such materials as raw silk and wool, lowered the export duty on wool and gave artisans freedom to emigrate.

The main battle for free trade, however, was fought over wheat. With growing population and developing industrial manufactures, Britain had become a wheat-importing country. Prices, and with them the rent of agricultural land, rose during the Napoleonic wars as a result of inflation and restricted imports. In 1815 and 1822 import duties were raised in an effort to maintain prices, but deflation followed the wars and there was an outcry against high bread prices in recurring crises of unemployment and falling prices, notably in 182 j–26. The privy council was then authorized to suspend the wheat duties as an emergency measure, but in 1828 a Tory government imposed a sliding-scale tariff in which duties went up as prices went down. The landowners controlled parliament. Until the Reform bill of 1832 extended the franchise and redistributed seats, the manufacturing north of England had little political power. In 1837 another acute crisis brought an Anti-Corn-Law league into existence in London. Leadership, however, was taken over by the league formed in Manchester in 1838. Richard Cobden and John Bright, two cotton manufacturers, devoted themselves to a great campaign of education and agitation throughout the country. They identified free trade with the cause of peace, attacked the landowners and adduced practical examples of the costs of protection. Resistance was strong, but minor tariff concessions were obtained, notably in 1842. In 1845 the English harvest was short and the Irish potato crop failed almost completely. The league redoubled its efforts. In June 1846 Sir Robert Peel reduced the wheat duties immediately and abolished them as from 1849.

In 1849 also the Navigation acts were abolished. Successive budgets, notably those of W. E. Gladstone in 1853 and 1860, continued the process of tariff reduction. The latter incorporated the reductions negotiated in the Cobden-Chevalier treaty. By 1874, when some timber duties were abolished, the British tariff was reduced to a small number of revenue duties on such items as spirits, wine, beer and tobacco, countervailed by excise duties on competing domestic products. Shipping was freed of protective restraints and migration of persons was also freed. All export duties were abolished.

Britain, in its own interests, had adopted complete free trade and maintained it until World War I, when "safeguarding duties" were introduced. The principle was not abandoned until the great depression of the 1930s, when a protective tariff was again adopted. During the free trade era which lasted for nearly three-quarters of a century, Britain was the greatest manufacturing, shipping and investing country in the world, but became dependent upon imports for the bulk of its food and raw materials.

Not only the United Kingdom, but the dependent empire. including India, Burma, Malaya and the African and West Indian colonies, followed a free trade policy. Most of the self-governing colonies which later became dominions imposed protective tariffs for development; but the rest of the British empire was a solid free trade area until 1932.

Bilateral Commercial Treaties.—There is a long history of commercial agreements dating back to antiquity. They were common between towns and city-states in the middle ages. As nation-states developed, friendly states from time to time concluded trading agreements. Some British commercial treaties still in force in the 1950s date from the middle of the 17th century. The United States signed its first commercial treaty with France in 1778. Treaties with the Netherlands (1782), Sweden (1783) and Prussia (178j) preceded the important treaty with Britain (1794).

The 19th-century world trading system was built upon a commercial treaty network. The rights of private traders and of private property were guaranteed. A substantial body of international law in specific detail was accepted over the larger part of the trading world and gave legal security to international enterprise and investment. Traders were free to come and go, organize, invest and trade almost as freely and as safely abroad as at home. They travelled without passports or visas, could buy or rent property, employ labour and take legal proceedings on an equal footing with nationals. Customs formalities were simple. There were no monetary and few immigration controls at the frontiers. Exchange rates were stable because the national currencies were pegged on gold and freely convertible. The principle of "national treatment" by which an alien was placed on an equal footing with nationals was not only embodied in treaties of commerce and navigation but was defined in detail and supported by a growing body of case law.

This legal basis for trade was more important than the reciprocal tariff reductions sometimes embodied in commercial treaties. When Cobden and Chevalier negotiated the Anglo-French treaty of 1860. they were attacked by free trade advocates who maintained that each country should reduce its tariffs unilaterally and not clutter the treaties and endanger the continuance of their legal guarantees by injecting the tariff issue. However, the successful conclusion of this treaty initiated a chain of similar agreements incorporating tariff reductions among many European countries.

The effect of reduced tariffs was generalized by widespread adoption of the "most-favoured-nation clause." Before the end of the 18th century it had become common for the parties to a bilateral commercial treaty to guarantee to each other treatment as favourable as that accorded to any other country. The wording of this clause became standardized. Incorporated in the Anglo-French treaty of 1860 and copied in subsequent treaties, it became a powerful instrument of tariff reduction. Every reduction in any treaty immediately applied to imports from all countries enjoying most-favoured-nation treatment with the country making the reduction. Moreover, treaties ran for long periods and sometimes until denounced, so that it became more difficult to engage in tariff wars or retaliations since the lower duties were embedded in the treaty network. The general adoption of most-favoured-nation treatment is best described by the modern American phrase "equality of trading opportunity."

There were two forms of the clause—conditional and unconditional. The former accorded the lower duties only when there were reciprocal concessions by another trading country. The latter grants them, without any question of reciprocal concessions, to every country with which there is a treaty incorporating the clause. The United States adhered to the conditional form until 1923, when it adopted the practice, by then almost universal, of the unconditional form. It had proved difficult to define the reciprocal concessions that warranted application of the conditional clause.

The method of bilateral negotiation, incorporating most-favoured-nation treatment, was adopted by the United States in the Reciprocal Trade Agreements act of 1934. This act gave power to the administration for three years to negotiate executive agreements rather than treaties requiring the advice and consent of two-thirds of the senate. The act was renewed by congress at periodic intervals thereafter. Between 1934 and the entry of the U.S. into World War II in Dec. 1941, agreements were signed with 17 countries. By July 31. 1955, the United States was a party to trade agreements, including the General Agreement on Tariffs and Trade, with 44 other countries. Many of these had been amended. The original act in 1934 gave power to the administration to raise or reduce duties up to a limit of 50%. The 1945 renewal gave power to cut duties up to 50% of the existing level, even if they had already been cut 50% from the original levels of the 1930 (Hawley-Smoot) tariff. An effort was made to make the reduction in the agreement with the "principal supplier" of an import. but most-favoured-nation treatment generalized the reduction to all suppliers.

The United States had moved substantially toward a low-tariff policy, but foreign exporters pointed out that the tariff remained effective on competitive imports, that the complicated and restrictive regulations, particularly for valuation of imports, remained those of the Tariff act of 1930, and that other protective methods such as import prohibitions and quotas, export subsidies and excise taxes on imported raw materials had been used to nullify the effect of tariff reductions. The power of review given the bipartisan tariff board to investigate any reduction which might injure a domestic industry crippled the potentiality of the Reciprocal

Trade Agreements act. While there was evidence of gro ing support in big business and banking circles for free trade, there was widespread opposition from groups, including farm organizations, which feared import competition in the home market. No movement for unilateral tariff reduction had developed in the United States, and the limits of bilateral negotiations were narrowed after renewal of the Reciprocal Trade Agreements act in 1948.

The United States had taken the lead, however, in negotiating new bilateral treaties of commerce and development, designed to replace the older treaties of commerce and navigation. "National treatment" was worked out in regard to investment, transfer of profits, taxation, employment policies and other modern issues. The number of treaties negotiated along these lines grew slowly, primarily because it was difficult to reconcile the viewpoints of the developing countries with those of the creditor countries. Double taxation treaties were even more difficult to negotiate since no government likes to exempt its citizens from taxes even on income earned abroad and likes still less to exempt resident aliens from taxes on income earned in its own territory. The attempts made to negotiate such treaties, however, indicated that the nature of trade in the second half of the 20th century would be different from the 19th-century trade based on treaties of commerce and navigation. Large corporations rather than individual traders, complex manufacturing operations rather than simple mechanical processes, heavy capital investments rather than mercantile offices had created relations which were not foreseen by the earlier treaties. The negotiation of treaty bases upon which the new forms of trade might develop was hampered by extensive government intervention involving heavy taxes. Greatest progress had been made by the corporations themselves, negotiating directly with governments ,where they wish to expand.

Return to Protection. — The leaders of the 19th-century British free trade movement insisted that, whatever other countries might do. unilateral free trade would benefit Britain. They believed that other countries would realize this and follow the British example. The belief was not unreasonable in the first flush of success. There was a spurt of production and overseas trade in the 1850s, aided by rising price levels after the California (1849) and Australian (1851) gold discoveries. The competition of imported foodstuffs. mainly wheat from the United States. did not become serious until the extension of railroads and steam shipping poured a flood of cheap grain into European ports in the 1870s. This coincided with the collapse of inflationary price levels following the Civil War in the United States and the German wars in Europe — Denmark (1864). Austria (1866) and France (1870). During the 1860s there had been a widespread movement toward free trade among European countries. The proclamation of the German empire at Versailles in 1870 disturbed the European balance of power and checked this movement. The increasing volume of cheap American grain endangered agricultural stability and reinforced the demand for a return to protection in France and most other European countries. Britain sacrificed its agriculture and concentrated on manufacturing for export. The freedom of the London money market and the great volume of commerce and finance cleared through London made it the commercial capital of the world. where transactions were financed and cleared. As Germany, the United States and Japan challenged British manufactured exports in world markets, these commercial and financing functions became more important to the British economy. Only a few small western European countries to which trade was important — Belgium, Denmark. the Netherlands and Switzerland—followed the British free trade example.

Until World War I, the main challenge to British supremacy in world trade came from Germany. Manufacturing capacity of the United States expanded rapidly but was mainly absorbed by the domestic market. During the Civil War high tariffs to countervail the multiplicity of direct taxes imposed by the North to finance the war were maintained after domestic controls and taxes were abolished. Support for free trade had been concentrated in the cotton-exporting South, which lost its political influence after the war. But neither the United States nor the self-governing British colonies competed seriously with British manufactures in export markets. Japan built its manufactures with government aid behind a protective tariff and was beginning to compete particularly in the markets for cheap textiles. but did not establish its shipping and trade on a world basis until after World War I.

There had been a strong free trade movement in Prussia after the Napoleonic wars. The Prussian tariff of 1818. under the influence of *Smithianismus,* reduced duties heavily. A combination of this free trade movement with German nationalism led in 1834 to the formation of the most famous of all customs unions. the *Zollverein.* All trade restrictions were abolished. so that there was complete free trade among the German states. The British free-traders applauded this development and opposed Palmerston's manoeuvres designed to prevent or delay the customs union. Externally. also, the Zollverein pursued a low-tariff policy. which was continued in the first years of the German empire. Both the industrialists of the Rhineland and the large landholders (Jrrnkers) of eastern Germany. who exported grains mainly to Britain. supported free trade. However, when France reverted to protection after 1870 and the free trade movement in Europe was checked. Bismarck negotiated in 1879 a new political agreement upon a basis of protection both for industry and for agriculture. This was known as the compact of iron and rye. By this time American grain exports had conquered the British market and were landing in German ports. After 1879 Germany pursued an active policy of state encouragement to industry and agriculture behind a high protective tariff. Externally also state aid was given to the drive for world trade, shipping and investment in the form of consular services, language training, subsidies and credit facilities. The applied science and technical training which was a feature of German universities and industrial laboratories gave leadership in the new chemical and electrical industries as well as metallurgy and dyes. German world trade and investment were expanding and the mark was becoming a world currency competing with sterling, when resort to arms in 1914 resulted in complete defeat.

German experience threw light upon the possibility that regional customs unions might be used as an approach to world-wide free trade. A customs union eliminates duties within the union. The price is usually adoption by all parties of the tariff of one protectionist participating country. This was the case with the United States, which based its first tariff on Pennsylvania's. The German Zollverein had a low-tariff policy for more than 40 years, but when it adopted protection it was a formidable cause of protectionism elsewhere. There is no assurance that the regional route to free trade (or peace) will not end in creating larger units of economic warfare. The only promising route is by unilateral tariff reduction on the part of the great trading and creditor countries.

After World War I Britain's position had been weakened and its vulnerability demonstrated. Other countries continued the reinforced protective policies adopted during the war. In 192j Britain returned to a gold basis for sterling at the prewar parity and was involved in deflation at home and intensified competition in export markets. When the great depression was signalled by the collapse of the New Tork stock market in Nov. 1929, financial difficulties in Europe led to the depreciation of sterling in Sept. 1931. At this point Britain reverted to a protectionist tariff and simultaneously adopted both imperial preference, with lower duties on empire goods, and protective tariffs in the dependent colonies.

Later Methods *of* Trade *Regulation.*—After the breakdown of the international gold standard and Britain's reversion to protection in the great depression of 1929–33, a new array of protective trade restrictions was developed. At first these were emergency devices to check swollen imports from demoralizing national markets, prevent panic flights of capital and safeguard national currency systems from inflationary risks consequent on unbalanced external payments. These devices were ad *hoc.* Each country in the panic of 1931 dealt with its own trading unbalance as best it could. The methods fell mainly into two groups — direct restrictions on the quantities of particular imports, and restrictions on the use of foreign exchange. however acquired. After years of experiment and negotiation it became clear before the outbreak of World War II that exchange control had become the effective overriding technique of trade regulation. Import quotas, price controls and bilateral commodity agreements in various forms were supplementary techniques. The ultimate control was the power of a government to centralize dealings which resulted in its citizens' acquiring or losing purchasing power in other countries Such dealings might be in the form of trade, exporting goods for sale or importing precious metals or other valuables to hoard; or they might be monetary and speculative. Once embarked on the regulation of external transactions, governments were forced to extend their control over all payments entering and leaving the country. Such control was systematically centralized in monetary authorities.

War financing, together with the organization of economic warfare, increased the effectiveness of these systems of state regulation, gearing the external with the internal controls over national economies. When the war ended in 1945, there had been something approaching a codification of these restrictive trade and monetary practices, together with an evolution and rationalization of bargaining procedures in a succession of bilateral and multilateral conferences. A generation of officials and businessmen had grown up with no experience of free competitive trading on the basis of stable convertible currencies. A generation of economic theorists had come to regard restrictive trade practices as normal, From 1914 through 1955 there had been an approximation of exchange stability and free trading for only four years—between 1925 when Britain and many other countries returned to the gold standard and 1929 when the stock market crashed in New York.

The Bretton Woods agreements negotiated among the western Allies in 1944 were intended to set up funds adequate to provide exchange reserves that could be drawn upon by countries which needed temporary support when their external payments were freely resumed on a basis of competitive trade. It was recognized that exchange controls and their supplementary devices could not be abolished immediately. A transitional period was envisaged. But the countries which agreed to set up the International Monetary fund and the International Bank for Reconstruction and Development did so with the understanding that after this transitional period exchange controls and quantitative import restrictions would be abolished. (*See* BANK FOR RECONSTRUCTION AND DEVELOPMENT, INTERNATIONAL.) The final act of the Bretton Woods conference urged national governments to create "in the field of international economic relations conditions necessary for the attainment of the purposes of the Fund and of the broader primary objectives of economic policy." Earlier. in the financial agreements providing for lend-lease aid. each of these governments had pledged itself "to the elimination of all forms of discriminatory treatment in international commerce, and to the reduction of tariffs and other trade barriers."

Nevertheless, the discriminatory and restrictive practices of exchange control a-ere extended and consolidated after the war ended. Greater emphasis was placed by most governments. and particularly by the British government, upon the principle of full employment. This had also been written into the master lend-lease agreements, into the charter of the United Nations and into many other international agreements. Conflict developed between the attainment of domestic stability at full employment on the one hand and external stability on the other. There was a considerable liberalization of trade between the western European countries, members of the European Payments union created in 1950. At the same time preparatory steps were taken in the United Kingdom to relax restrictions on sterling convertibility into currencies other than the dollar. In the latter 1950s, however, most countries still employed import quotas and exchange control regulations.

Multilateral Tariff Negotiations.—Economic nationalism after the 1930s made bilateral negotiations less effective. Tariff duties became less important as compared with other kinds of government intervention. Most-favoured-nation treatment had been applied in tested detail to tariff duties, but no formula could be found to assure it in respect of exchange and quota allocations, government purchases and price controls. Moreover, trade and payments are not bilateral. The transactions between two countries affect other countries, so that there is a chain of payments among all trading countries. When World War II ended in 1945, it became clear that multilateral action was necessary both to restore the treaty basis and to attack the new discriminatory obstacles to trade, such as quotas and exchange control.

The United States in 1944 initiated negotiations aiming at creating an International Trade organization (I.T.O.) as a United Nations agency comparable with the International Monetary fund. The charter of the I.T.O. was designed as a pledged statement of the rules for freer trade. In successive conferences at London (1946), Geneva (1947) and Havana (1947–48), the charter mas elaborated with so many exceptions and escape clauses that Pres. Harry S Truman decided not to submit it to congress for ratification. It therefore did not become operative.

At the Geneva conference, however, a group of 23 nations signed a General Agreement on Tariffs and Trade (G A.T.T.), incorporating the substance of the charter as originally proposed by the Cnited States. The secretariat of G.A.T.T. called successive conferences and secured new adherents At each conference further tariff reductions were negotiated multilaterally. At the end of 1955, there were 35 members of G.A.T.T. Proposals had been made in that year for the creation of an Organization for Trade Cooperation (O.T.C.) to administer the existing agreements and call annual conferences

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FREE VERSE is a prosodic term used in so many ways that it has almost lost any useful meaning, but it was originally a literal translation of the French *vers libre*. When Francis Vielé-Griffin declared in his preface to *Joies* (1888–89), "Le vers est libre," he gave a name to a kind of poem being written in France in the 1880s on novel prosodic principles. The French language does not havc accent or stress on fixed syllables as in English, and until about 1880 metrists believed that the number of syllables was the basic principle of French versification, which used mainly the alexandrine (*see* ALEXANDRINE VERSE). Victor Hugo began the loosening up of the rigid alexandrine and the Symbolist poets continued the process. Gustave Kahn, an early vers libre poet, believed that the French language as actually spoken has accent, its position being dependent upon the meaning of the phrase and the emotion of the speaker, the intervals constituting the rhythm of the verse. This belief was confirmed by phoneticians in scientific laboratory experiments. Vers libre theory. therefore, called for the disregarding of number of syllables and observance only of the musical cadence. The prosodic unit was the phrase, not the foot or the line, and the complete sentence became the strophe. Rhyme was optional. Kahn, Francis Jammes and André Spire developed controlled techniques for handling this new verse form.

The first English poets to be influenced by vers libre were close students of French poetry. The most important were T. E. Hulme, F. S. Flint, Richard Aldington, Ezra Pound and T. S. Eliot. The movement called Imagism, started in England in 1912 by Aldington, Pound, Flint and Hilda Doolittle (H.D.), was concerned with more than versification. but one of its principles was "to compose in sequence of the musical phrase, not in sequence of the metronome." But almost from the beginning the free-verse movement split into two separate groups. a formal one led by Pound, and a popular and confused one led by Amy Lowell. Eliot's early verse was influenced by the disintegrating blank verse of 17th-century English dramatists and by the vers libre of Jules Laforgue, but by 1920 he turned back to formal metrics, though henceforth the iambic metre was to be used in the English language with more variety and subtlety. By mid-20th century most of the younger poets had followed the example of Eliot, and even Pound had become more metrical, but some of the older poets, especially Carl Sandburg. William Carlos Williams, Marianne Moore and Wallace Stevens, continued to write some variety of "free verse." The versification of Williams and Moore most closely resembled the techniques of the vers libre poets of France.

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(G. W. A.)

FREE WILL. The problem of free will, or of the freedom of the will, is complicated for various reasons. In the first place, the traditional formulation of the problem, its very name, is misleading. To ask whether the will is free assumes that there is such a thing as a will, which may or may not be free in its activities. This is a relic of the old and generally discredited faculty psychology (*q.v.*). Will is really a general term describing certain sorts of events (volitions) and not the name of an agent which performs them. As John Locke said, "We may as properly say that the singing faculty sings and the dancing faculty dances as that the will chooses." (Essay on the *Human* Understanding, book 2, ch. XXI, 1). It would be better to speak of the freedom of the self, that is of the person, than of an abstract will. But the term free will is too well established to be dislodged. Moreover the expression freedom of the self (or personal freedom) might suggest the problems of political liberty rather than the philosophical and psychological problems traditionally associated with the term free will.

The problem is complicated too because of the various points of view from which it may be approached. The psychologist and the epistemologist are mainly interested in the apparent conflict between freedom of choice and the usual scientific assumption that all things, including mental events, are subject to law and necessity. The moral philosopher is primarily interested in free will as a postulate of the moral life. For if a man is compelled by past circumstances to do what he does and no alternative action is open to him, how can we say he ought to have done otherwise or blame him for what he did? "I could not help it" is a complete defense. The jurist is concerned with the relations between free will and responsibility. Can punishment be justified if the criminal had no choice but to commit the crime? Lastly, the theologian has an interest in the problem, since free will seems to involve the denial of God's omniscience and omnipotence or of his justice. For if men are truly free to choose then God cannot foreknow their actions or control their choice; but if men are not free then God cannot be justified in punishing or rewarding them for their deeds.

The central problems were accurately formulated by Henry Sidgwick. "Is my voluntary action at any moment completely determined by (1) my character as it has been partly inherited partly formed by my past actions and feelings, and (2) my circumstances, or the external influences acting on me at the moment? or not? Could the volition I am just about to originate be certainly calculated by anyone who knew my character at this moment and the forces acting upon me? Or is there a strictly incalculable element in it?" (Methods *of* Ethics, p. 46.)

The Scientific Problem.—By the beginning of the 19th century there had developed a sharp opposition between science and free will. No scientist indeed would defend the crude fatalistic theory that my action, or my fate, is determined by forces wholly independent of me, so that it is bound to come no matter what I do to prevent it. Nowhere in nature is the fate of any object determined wholly by factors independent of the object itself. Its own nature must always contribute to the result.

But scientists had worked for three centuries on the assumption that all observable events can be brought under the law of universal causation. Their triumphs had been continuous and unchecked. Could it be possible then that the behaviour of a single species on a minor planet in one of the countless solar systems should escape a type of determination which had been found to apply to the smallest particles of matter and the largest and most distant heavenly bodies? Everywhere nature showed itself to be the playground of irresistible forces and subject to complete and exact scientific prediction. To explain an event was to give the causes whose conjunction rendered it inevitable. It was true that until 18jo these claims had been justified only in the world of inanimate matter. But Charles Darwin in biology, Karl Marx in sociology, and Ivan Pavlov and Sigmund Freud in psychology were now to advance causal explanation across the frontiers of life and mind. It could surely be only a matter of time before life was synthesized in a laboratory and human action was predicted and thus controlled by the same techniques as had tamed the elements. Some scientists continued to make these claims for science and many ordinary men to think of science as presenting this solid front against free will.

From the beginning of the 20th century, however, the scientific atmosphere completely changed. There came to be little talk of irresistible forces in science or indeed of any forces at all. To say that a magnet attracts iron filings is unscientific: for this attraction is completely unobservable. What can be verified and therefore should be said is that, in the vicinity of a magnet, iron filings move in certain paths or arrange themselves in certain patterns. There is no compulsion here. What is observed is regular conjunction and no more. Again, in this regularity there is no observable necessity. Scientists no longer claimed to explain why events occur. They describe how they occur. And since no one can see why events are conjoined as they are, the only evidence for such a conjunction is repeated observation of its occurrence. Moreover the predictions based on such observations are only probable, just as the measurements which the observations involve are only approximate. No scientist will claim to say why any event happens; no scientist will even claim to predict with certainty *that* it will happen. Finally, it was shown that scientific laws cannot be applied with complete exactness to the behaviour of the electrons which are the ultimate constituents of matter. It has been well said that this "principle of indeterminacy" is not a "principle of indeterminism." It says that the position and motion of an electron cannot be precisely determined (discovered by measurement or predicted). But this does not mean that the position or motion is not determined (*i.e.*, correlated with pre-existing conditions of the electron and its environment according to a set of laws). In particular it does not justify us in attributing to the electron anything corresponding to free will or to talk of it as suddenly deciding, for no special reason, to jump from one orbit to another. Nevertheless, if it is true that certain facts about electrons cannot be disco ered by measurement or predicted from no matter what evidence, this underlines the conclusion that all scientific prediction is based on observed statistical regularities and can never yield more than a probable result.

Even if these admissions were all that science would make, they would suffice to render free will possible. For, as will be argued below, no free will theory need claim that a man can choose in complete independence of his past and his environment, nor deny that decisions of a certain kind are probable,—for example, that a man who has resisted a certain temptation frequently mill probably resist it next time.

There are, however, some special features of human conduct which make even the milder claims of modern science doubtful when applied here. There are three features of scientific method which seem essential for any close approximation to accurate prediction. The first is measurement. There are always differences between the specimen whose behaviour is to be predicted and those other specimens on whose observed behaviour the law was based—differences of mass, of distance from other bodies, of proportions of elements, etc. When the scientific law is applied to the new specimen, these differences have to be represented by giving quantitative values to the variables in the law. For example, in order to predict from the law of gravity how much body x will attract body y we must insert the distdnce between them as a quantity in our calculations. Now the psychological phenomena from which human conduct would have to be predicted are not measurable. While it makes sense to say that I am in greater pain or less angry than I was, it does not make sense to ask whether my pain has trebled or my anger been reduced by 9%. The only hope of measuring psychological phenomena is to measure their physiological accompaniments. But to predict conduct wholly from physiological conditions results in denying either the existence or the causal relevance of psychological states. The former denial (that involved in materialism or behaviourism) became generally discredited. The view of psychological states as "epiphenomena"—events accompanying but not making any difference to physiological processes—is difficult to reconcile with evolutionary theory. For such epiphenomena1 states would be useless to the organisms which manifested them and should therefore have atrophied and disappeared long ago, instead of increasing in number and complexity as they clearly have.

If these psychological phenomena are not quantitatively measurable, prediction is impossible. For example, a psychologist may establish that a child who is shut up in a dark cupboard will subsequently tend to fear the dark. But he cannot give any quantitative value to this fear and can therefore do nothing to predict whether, in a particular case, the rival forces will defeat this fear if it appears in conscious form or be able to repress it altogether so that it shows itself only in dreams.

The other two features of scientific method which may make it inapplicable in full rigour to human conduct are analysis and repetition. By analysis is meant the power to concentrate on certain features of an object—*e.g.,* its mass and motion, or its chemical constitution, or its spectroscopic behaviour—and to regard others of its features as irrelevant. Not that every one of its features can be dealt with in isolation; for mass and motion are both involved in the laws of physics, and chemical constitution is found to be connected with spectroscopic behaviour. But if no feature of a substance could be excluded as irrelevant to the establishment of a lam concerning its behaviour then no such laws could be established. Two bodies may have the same mass and different acceleration, the same chemical constitution and different shape or size or weight. If this mere not so, no experimental work would be possible in science. Now there are good grounds for holding that this kind of abstraction is impossible (or possible only for very general classes of events and in a very rough and ready fashion) in regard to human beings and their psychological states. The traits of a man's chardcter are so interwoven that none of them would be what it is without the others; and these traits correspond to the force or features which determine the behaviour of a scientific object. His quick temper helps to determine his kind of courage, his wit gives his quick temper its peculiar edge, his intelligence lightens his nit, his sensitivity broadens his intelligence, his imagination extends his sensitivity; and so on. Similarly his psychological state at a given moment defies analysis into anger plus fear plus shame plus jealousy, etc. The unity of the self and of its psychological states makes the attempt to study one motive or element in isolation from the others a falsification of the facts. Such dissection spells death.

The third feature of scientific prediction is repetition. By this is meant the assumption that the set of factors isolated by analysis can be trusted to recur in other specimens, and that most differences between the specimens will be irrelevant, while those that are relevant can be expressed as quantitative values of the variables in the scientific law in question. But each human personality is unique. Study of a number of pieces of sodium provides good evidence for the behaviour of the next piece of sodium. But study of the behaviour of Smith, Jones and Brown is poor evidence for the behaviour of Robinson. It is just this irruption of uniqueness of personality which has made authorities on aesthetics, on textual criticism, on strategy and on education deny that these studies can ever be adequately dealt with by scientific method or ever achieve scientific standards of predictive accuracy.

There is also one special difficulty in regarding human conduct as completely determined and completely predictable. Human thought is part of human conduct; and the scientific or philosophical views of any man would have to be regarded as predictable consequences of his causal situation. While this kind of explanation is welcomed by any thinker as accounting for the errors of his opponents, he can never accept it as applicable to the truth of his own view. A Marxist maintains that all human conduct is determined by economic processes, by the class structure of society. A man may think he is deciding on a course of conduct because it is right. This is an illusion; all his decisions are determined by class interest. What he calls morality is that set of rules which enables the class in power in his society to preserve its domination. The Benthamite laissez-faire theory of economics has no rational validity; it merely reflects the interests of the bourgeois industrialists among whom it arose. But, if so, Marxist economic determinism itself has no rational validity. It also is an illusion, a mere by-product of local and temporary class interests, bound to be superseded as history develops. It was bound to be believed by 19th-century working men. but there is no need for any other people at any other time to accept it. Its claim to truth is as much an illusion as the moral values it tries to undermine, the religious dogmas it opposes, or the rival economic doctrines it attacks.

It may be said that any attempt to shut off an area as impervious to scientific treatment is a counsel of despair. Whenever this has been tried before it has failed. Science has swept in and conquered. The area of human conduct, too, is an insignificant one on a world scale. Why in this remote corner should laws not hold and prediction fail? Perhaps an answer is that only in this remote corner, so far as we know, can such questions even be asked. Knowledge of the universe is already so astonishing an exception to the general pattern that it would be surprising indeed if other special features did not distinguish man's life. It is surrender to sheer size that tempts men to think the spiral nebulae a more impressive wonder than the minds of Sir Isaac Newton and Albert Einstein.

Moreover the argument so far does not shut off any area from scientific inquiry. Psychology, sociology and economics are entitled to try any methods they like. All that is said is that their predictions will have a lower probability than predictions in other fields. They will succeed so far as quantitative physiological behaviour is found to provide an accurate clue to psychological processes, so far as elements in the self have a nature of their own in isolation from the rest, so far as men resemble each other in the characteristics relevant to the inquiry and so far as their differences do not seriously affect the result. There is good reason to believe that in all the parts of human conduct which matter most to man (parts other than blinks and knee-jerks) these conditions are largely unfulfilled. Nevertheless for large-scale statistical purposes, such as insurance or advertising, prediction may yield a result both generally informative and practically useful.

The Ethical Problem.—So far the argument has concerned the second half of the problem as posed by Sidgwick in the passage quoted near the beginning of this article: "Could the volition I am about to originate be certainly calculated?" It may be said, however, that determinism does not require predictability. A man's act may be completely determined by his character and circumstances even if his character is so unified as to be unanalysable and so unique that no one else resembles him; so that prediction remains impossible. The first half of Sidgwick's question is still to be answered: "Is my voluntary action completely determined by my character and my circumstances?"

It was previously supposed that nothing could stand against the deterministic march of science except our direct awareness of free choice and the fact that free choice is required for moral responsibility. Various attempts have been made to show that moral responsibility, far from requiring indeterminism or free will, really requires determinism. For when we praise or blame an action we praise or blame a man for his action; that is, we commend the self or character from which the action issues. But then it must issue from the self or character. If it were the case that, given my self as it is now, two alternative actions were possible (a brave and a cowardly one) then neither could issue from my self, nor be connected with anything else. Choice is equivalent to chance, caprice or chaos. If I give a reason why I acted (that I admire Bach or that I was hungry) this cannot be the reason; for, given exactly that degree of hunger or admiration, I could still have acted otherwise. Mental life for the indeterminist is a mere sequence of isolated decisions.

Now the determinism which these criticisms invoke is something different from determinism as understood by science. Historically the first and most influential of such theories was propounded by Immanuel Kant. Kant held that, if science could give a complete causal account of human conduct, moral experience mould be inexplicable, The scientist must go ahead with his determinist assumptions and his causal explanations. But the whole sequence of causes and effects which he unfolds is merely appearance. Human conduct must also be regarded as determined by moral laws. Man, as appearance, is subject to causal law: man, as reality, is subject to moral law. Moral law is the command of man's reason and in obeying this law man is free. Now this view is unsatisfactory as an account of freedom. It leads to the view that good or dutiful actions are determined (non-causally) by moral law and that bad actions are determined (causally) by scientific law, and that only the good actions are free. But it is essential for moral responsibility that bad actions should be free just as much as good actions. It is also essential for morals that man as a moral agent should be "under" or "obliged by" moral law but not *determined* by it. For the meaning of "ought" excludes "must."

From this Kantian view of freedom many related theories developed. A man was held to be free only when his higher or rational self, or his ideal personality, determined his action. Thus, in politics law and liberty could be reconciled, and a man could be forced to be free when the law of his state imposed on him actions which his higher self would approve, but which desire would otherwise have compelled him to shirk. Or again, a good chess player will see alternative moves which an inferior player confronted with the same position does not see. And one is tempted to say that the skilled player has more freedom than the unskilled and thus to link freedom with intelligence. These tendencies often arise from the demand that some *positive sense* should be given to freedom. The self which is free must be of a different kind from the unfree self. So we hear of "the true self," "the real self." "my real will" and, in the prayer, the phrase "whose service is perfect freedom." Freedom and service are of course compatible provided that the service is chosen, and the right and reasonable action may be freely done. But these identifications are fatal to responsibility. It is essential to maintain the compatibility of freedom with desire and with the primrose path. Service of the devil must be perfect freedom too.

There is a different version of self-determinism, which allows both good and bad acts to issue from the self. I have various *motives* and among these are desires and the sense of duty. When I do my duty this shows that the motive called sense of duty is stronger than alternative motives (desires). The process called "deliberation" is how the conflict of motives appears to the agent at the stages when no one motive is yet strong enough to win in the face of all the rest. "Choice" is the appearance to the agent of the final sning-over by which duty (or desire) defeats its rivals.

Now in addition to the difficulty of analyzing the self into motives (noted above) there are two special difficulties about this account. Firstly, the term motive was required because desire and duty are so different in character. It is an abuse of language to say that there is a desire to do one's duty and then to maintain that the strongest desire always wins. We are too well aware of cases where we know we ought to sacrifice what we most desire. But the term motive has its own difficulties. Suppose I want to see a play and am also comfortable by the fire and am aware of a conflict; but finally I go off to the play. It would be absurd to call this a conflict of motives; for then desire for warmth and comfort would have been one of my motives; and if on my way to the theatre I had been asked what my motives had been I should have had to say I had two, a desire to see the play and a desire to stay by the fire. We only call anything a motive if in fact it did lead to action. So to say that any motive whatever wins the day is a tautology. If to avoid this we coin a new name to cover all the competitors, say "psychode," we may now say that the strongest among the psychodes will win. But the only evidence I can possibly have that this psychode was the strongest is that it did win. So here again is a tautology which does nothing to assist determination, just as the fact that the candidate with most votes is the winner does nothing to inhibit the freedom of the electors.

The failure of any such analysis of the self may lead to another version of determinism, according to which the self-as-a-whole is the cause of its actions. Such a view (represented in English by F. H. Bradley) will refuse to dissect the self or treat it as a case under a general law. Yet it will maintain that unless the self is the cause of its acts, these acts are contingent, capricious, irrational and irresponsible. There are two independent routes to this goal. One starts from the facts of praise and blame, reward and punishment, which are supposed to require freedom of will. The difficulty is to find any criterion of freedom of will to distinguish acts for which me hold a man responsible from acts for which we do not, so that we can determine, before we praise or blame or punish, whether we are entitled to do these things. The argument starts from punishment. It is admitted that there still lingers in the minds of many people a retributive attitude to punishment, the idea that a man should be made to pay for his sin. But it is held that this attitude is retrograde and barbaric and is anyhow on the decline. It has been almost entirely replaced by the view that punishment is deterrent and reformative. This latter view is utilitarian and justifies punishment by its consequences. If we now ask which acts we are justified in punishing they are those from which men can be deterred by punishment. And here is one criterion for responsibility. A man is responsible for a theft if punishment would have deterred him from doing it and will deter him from doing it again. We do not punish the kleptomaniac because punishment will not deter him. We say he was not free or responsible for his action. But this is not an additional reason for not punishing him. It is the same reason over again. To say he was not responsible is to say punishment would not have deterred him. The same theory is applied to praise and blame. The *only* justification for praising or blaming anyone is to encourage or discourage him and others in that course of action. That the man has freely done the thing for which he is praised or blamed is not *another* justification for praise or blame. It is only another way of saying this is an action which praise and blame could have affected. Now this is obviously a determinist theory of conduct. For the distinction it draws between free and unfree action is not a distinction between uncaused and caused action but a distinction between actions whose causes can include praise, blame, reward, and punishment and those whose causes exclude these. (Similarly deterrence and reform theories of punishment imply a determinist view of human conduct.)

Now this ingenious theory seems to miss an essential feature in punishment and blame. A deterrence or reform theory of punishment is quite compatible with punishing a man for something he did not do. And this is felt by most people to be the worst fault in any punishment. That this is no retrograde or barbaric survival, "on the way out" in modern times, is shown by the ever-increasing care that guilt should be confirmed beyond question, that *mens rea* should be established, and also by our repugnance to the "framed case" or the "confession trial," whose objects are indubitably (and perhaps very successfully) deterrent.

The second line of argument which maintains a necessary connection between self-determinism and responsibility is that mentioned earlier in this article. When we praise an action, we praise a man for the action. "That is a brave deed" and "That is the deed of a brave man" are equivalent, and the latter expresses more explicitly what we want to say. But if so the act must issue from the self and give a clue to its nature. If, given my self as it is now and the circumstances as they are now, two or more alternative actions are possible, then none of them can be said to be caused by the self as it is now or give a clue to its nature. Further, it is said, this determinism does not offend our natural dignity as human beings. If anyone predicts my action on the grounds that budget estimates show conclusively how much beer or tobacco I shall consume in the coming year, I laugh at him. If he says: "I know what you will do because I have calculated the strength of the rival forces. your desire for praise, your love of your family, your passion for bridge; and the answer comes out as follows," I laugh louder still. Or he says: "I know what you will do, because I know what people of your class and profession do when put in this kind of position"; and I am offended. But suppose he says: "I *knew* you well enough to know you could not have done that";

or, "You are one of our most reliable members; I was sure: *knowing* yon, that you would be here." I accept and welcome this prediction because it is based not on statistics, not on comparisons or on abstractions, but on knowledge of me.

Now it seems true that this theory is the only one of all determinist theories which comes within sight of doing justice both to the nature of human personality and to the demands of moral experience. Yet it too has serious difficulties. It claims that a prediction of my action based on knowledge of my character is both legitimate and acceptable to any self-respecting person. But it is acceptable only if the action predicted is a good one. If a man says: "I knew you well enough to know you would not have done that—you are too afraid of unpopularity"; or, "You are one of our most reliable members; I was sure, knowing you, that you would keep us all waiting." I shall not be likely to accept or welcome such predictions. When I accepted and welcomed those other predictions I was confusing prediction based on character with praise for a good choice and approval of a good character. It mas these I welcomed. Moreover prediction from character has its own pitfalls as a rational process. It implies that character cannot be changed by action. But it is obvious that all a man does makes a difference to him. There can be no adequate evidence from others what this difference will be nor what the new self will do, as it will have been in the making right up to the moment of action. Winston Churchill described how the German ainbassador to London was recalled for not having foreseen David Lloyd George's Mansion house speech of 1911. Churchill comments: "How could he know what Mr. Lloyd George was going to do? Until a few hours before, his own colleagues did not know. Working with him in close association, I did not know. Until his mind was definitely made up, he did not know himself." Nevertheless the self-determinist theory has a very strong case in demanding a connection between the self and its acts even if prediction is still held to be impossible. even on the basis of the agent's own character as deduced from his previous actions.

Indeterminism on the other hand need not deny all connection between character and actions. The free choice it defends must be a choice between *presented* alternatives; and the alternatives that occur to a man will obviously reflect his character and his desires. Indeterminism need not reject probability. It is indeed improbable that a drunkard will resist temptation, for the possibility of yielding to it will present itself to him with great attractiveness, Some indeterminists find the only evidence for free will in choices mhich go against the strongest desire, choices which require an effort of will. While these cases certainly provide the strongest evidence for free will, it seems unwise to maintain that only in these cases is free will exercised. For a man must be free to put forth or to refrain from such efforts, and the drunkard must be as free when he succumbs as when he resists. It is once more the search for some positive sense of freedom and for a link between freedom and moral goodness which has tended to conceal this requirement.

Here perhaps is the place to refer to the evidence for freedom gained from direct experience. It is possible to hold that me might be directly aware of the efficiency of our will; we might see directly that our volition was a cause or part-cause of our thoughts or images. This is doubtful, but even if granted it is not enough. What free will requires is that our volition should be uncaused; and it is hard to see how we could directly experience an event as uncaused. It is true that we have an ineradicable belief in our own freedom and in open alternatives for our choice. This might be an illusion, for its survival could well be a tribute to its biological utility. As Sir David Ross said, a man is more likely to work for an examination and therefore to pass it if he thinks it is uncertain whether he will pass or fail. If he thought either was certain he might well slacken his efforts. Yet we also saddle ourselves with burdens of guilt and remorse and these beliefs would seem to hinder effective action and to be useless illusions and therefore biologically puzzling.

The arguments' for self-determinism (without prediction) and for indeterminism both seem powerful and neither can wholly answer the other or wholly satisfy the demands of moral experience. In such a situation no quick and easy solution is to be expected. Most philosophers who have given full and careful consideration to free will describe it as the most difficult problem in philosophy and themselves show dissatisfaction with their own tentative solutions. But when two opposing cases seem equally strong and yet both seem open to fatal objections it might be that something was wrong with the question to mhich both were answers. The question was "Given my self as it is now and the circumstances as they are now, is only one action possible or are alternative actions open to me?" Now what may be wrong here is the absence of any indication of the time of the action or actions in question. There are two possibilities. The problem may be "Given. . . . etc.. is only one action possible for me *now?*" or "Given. . . . etc., is only one action possible for me at some future-time?" Careful scrutiny of the passage from Sidgwick quoted near the beginning of this article will show that in the first sentence Sidgwick adopts the first alternative ("My action *at any moment*" . . . . "influence acting on me *at the moment*") and in the second sentence the second alternative ("the volition I am *just about* to originate" . . . "character *at this moment*"). Let us take the first alternative "Given my self as it is *now,* is only one action possible *now?*" Yes, because the action in question is the volition (and not any physical movement) and the volition *is* the state of myself now. If I see a man frowning and ask him to describe his self "as it is *now*" he may say: "I am trying to understand this article on free will." If I ask him what action he is performing *now*, he will reply: "Trying to understand this article on free will." So the question cannot be put in the first form without becoming a tautology. We pass to the second alternative. "Given myself as it is *now*, is only one action possible *at some future time?*" No, because what my self will do and accordingly how it will change in the time intervening between "now" and the "future time" is not specified and, unless it is, alternatives cannot be eliminated. An attempt may be made to meet this difficulty by shortening the interval between the date of the "given self" and the date of the "action." But so long as there is any interval the objection holds and when the interval completely disappears we are back with the first solution and its tautology.

This emphasis on the time factor finds support in more careful analysis of the one strong argument for self-determinism. When we praise an action we praise the self whose action it is; and we are therefore committed to a necessary connection between the self and the action, and this is determinism. But what self do we praise? Not his *past* self; not even his very recently past self. R e praise a man's character—his courage, his integrity, his sense of humour. Now these are dispositions. Elasticity is a disposition of rubber. We say: "It is elastic so it will stretch or compress." But it is not because the rubber *was* elastic that it *now* stretches. Those who have built on these facts about praise and blame a determinist theory have confused the relation between a cause and its effect with the relation between a disposition and its manifestations. It is not the courage of a man in the immediate past which explains his present prowess. If it were, there would be time (however short a time) for it to dwindle. The connection between the self and its action is more like that between the hammer and its weight; the hammer is not the cause of the weight. But this removes the one remaining argument for determinism, and free will seems to hold the field.

The Juridical Problem.—It was mentioned above that the deterrence and reform theories commonly acceptzd as best explaining punishment imply a determinist view of human conduct; but, on the other hand, the one essential feature of punishment is that only the guilty should be punished and this implies responsibility and freedom of will. This raises the other juristic problem in this field, that of deciding when a man is responsible. The difficulties arise over the plea of insanity. Though they cannot be fully dealt with here; it may be said, in relation to the central problem, that no jurist would propose to abolish altogether the distinction between responsibility and insanity. A man will be held responsible unless there is special evidence that rebuts this assumption and indicates that the impulse to action was irresistible. But on the determinist theory of action, every impulse from which a man does in fact act is irresistible. Thus, though the difficulties of deciding which acts are free are serious, their existence is an argument for and not against free will.

The Theological Problem.— During the middle ages the problem of free will was urgent because of its seeming conflict with the omniscience and omnipotence of God. If man is free, his action is not under God's control; nor can God foretell it. These are still major problems of theology and only possible approaches to them can be considered here. If omnipotence required determinism, men would be like well-constructed automatons producing results foreseen and intended by God. There could then be no moral value in any human action. Good men and bad alike (as Spinoza held) would be the channels of God's purpose. A slaveowner can do what he likes with his slaves, including setting them free. Of course, after they are free he loses power over them. But he could have avoided this limitation only by accepting that other (not to be able to set them free).

As to omniscience, the claim would be that an event must be determined if it is to be predictable. This assumes that God's foreknowledge is a scientific calculation from prior observation. But God's knowledge must be timeless; it does not move from observation of one phase to prediction of another. We know the past partly from present observation and inference involving causal laws and partly by memory which does not involve causal laws. Memory and observation have a better claim to be called knowledge than the probable inferences which rest on them. God's foreknowledge should be assimilated to these higher types. The fact that we can observe and remember does not require that what we observe and remember should be causally determined. So no such conclusions need follow from the foreknowledge of God.

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(J. D. M.)

FREEZING MACHINE: *see* Refrigeration and Its Application.

FREGATIDAE: *see* Frigate Bird.

FREGE, GOTTLOB (1848–1925), German mathematician and logician, was born at Wismar. After attending the *gymnasium* there he studied in the universities of Jena and Göttingen, and then taught mathematics at Jena as *privatdozent* (1871), associate professor (1879) and titular professor (1896). Not content with what had been achieved in the arithmetization of analysis, he made it his life's work to exhibit arithmetic itself as a development of logic.

In his *Begriffsschrift* (1879) Frege began by expounding a new *calculus philosophicus et ratiocinator* such as Leibniz had projected, and gave the first clear account of a propositional function, the first set of axioms sufficient for the restricted calculus of propositional functions and the first definition of the so-called ancestral relation. Discouraged by the poor reception of this effort towards logical rigour, he then tried to win favour for his main thesis by writing *Die Grundlagen der Arithmetik* (1884) in plain German. Apart from criticisms of rival views, this contains a definition of natural numbers by use of the notion of one-to-one correlation between the objects falling under various concepts. But in his *Grundgesetze der Arithmetik* (1893 and 1903) he returned to his ideal of rigour. Though this work employs the same logical symbolism as the *Begriffsschrift,* it contains new doctrines about meaning first expounded in his three Papers, *Funktion und Begriff* (1891), *Begriff und Gegenstand* (1892), and *Sinn und Bedeutung* (1892). At this period he wrote also *Über die Zahlen des Herrn H. Schubert* (1899).

One of the few readers of the first volume of the *Grundgesefze* was Bertrand Russell, and in an appendix to the second volume Frege ruefully admitted that this young philosopher had derived from his system a paradox about the class of all classes which are not members of themselves, but he said that he was still convinced of the possibility of deriving arithmetic from logic, and he made some suggestions for evading the difficulty. After this he wrote a few papers on logic, but did not contribute further to the controversy about the foundations of arithmetic. The importance of his achievements in mathematical logic was not fully recognized until some time after his death, probably because his symbolism had been superseded by that of Guiseppe Peano, A. N. Whitehead, and Bertrand Russell.

The *Grundlagen* was translated by J. L. Austin as *The Foundations of Arithmetic* (Oxford, 1950), and there are also *Translations from the Philosophical Writings of Gottlob Frege by* P. Geach and M. Black (Oxiord, 1952). (W. C K.)

FREGELLAE, an ancient town of Latium on the Via Latina, 11 mi. W.N.W. of Aquinum, near the left branch of the Liris. It is said originally to have been occupied by Opici and Volscians and later to have been destroyed by Samnites. In 328 B.C. a Latin colony was established there. Captured by the Samnites in 320 but recaptured by Rome in 312, it remained loyal to Rome during the Pyrrhic and Hannibalic Wars, hampering Hannibal in 211 and leading the loyal colonies in 209. It flourished because of its command of the crossing of the Liris and its fertile territory. In 125 it revolted against Rome, but was captured by treachery and destroyed. In 124 B.C. Fabrateria Nova was founded 3 mi. S.E. on the opposite bank of the Liris, and a post station Fregellanum (mod. Ceprano) grew up; Fregellae itself, however, continued to exist as a village even under the empire. The site is about half a mile east of Ceprano, but the remains are very scanty.

See G. Colasanti, "Fregellae,"in *Biblioteca di geografia storica,* vol. i (Rome. 1906).

FREIBERG or Freyberg, a town of Germany in the *Land* of Saxony, on the Münzbach, near its confluence with the Mulde, 19 mi. S.W. of Dresden by rail. Pop. (1939) 35,847. It owes its origin to the discovery of silver mines (*c.* 1163). The town, with the castle of Freudenstein, was built in 1175, and its name, which first appeared in 1221, is derived from the extensive mining franchises granted to it about that time. From the end of the 13th century until 1485 Freiberg remained common property. The Reformation was introduced in 1536 by Henry the Pious, who resided there.

The town suffered severely during the Thirty Years' War, and again during the French occupation from 1806 to 1814. A part of its ancient walls still remains; the other portions have been converted into public walks and gardens. Freiberg is the seat of the general administration of the mines throughout the reich, and its mining academy (*Bergakademie*), founded in 1765, is famous. Among its distinguished scholars were Abraham Werner (*q v.*), who was also a professor there, and Alexander von Humboldt.

Freiberg has manufactures of gold and silver lace, woollen cloths, ironwares, china, sugar and cigars. In the vicinity are its famous silver and lead mines, of which the principal ones became state property in 1886. The castle of Freudenstein or Freistein, rebuilt by the elector Augustus in 1572, has been used as a military magazine. The cathedral, rebuilt in late Gothic style after its destruction by fire in 1484 and restored in 1893, was founded in the 12th century. Of the original church a German Romanesque doorway, known as the Golden Gate (*Goldene Pforte*), survives. Henry the Pious and several of his successors are buried there.

The town hall dates from the 15th century.

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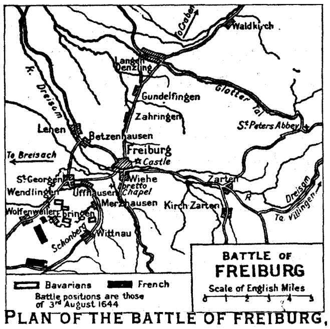
FREIBURG, a town of Germany in Prussian Silesia, on the Polsnitz, 3; mi. S.W. of Breslau, by rail. Pop. (1933) 9,137. Its industries include watchmaking, linen weaving and glassmaking. In the neighbourhood are the old and modern castles of the Fürstenstein family from which the town is sometimes distinguished as Freiburg unter dem Fiirstenstein.

FREIBURG IM BREISGAU, archiepiscopal see and city of Germany in the *Land* of Baden, situated on the Dreisam at the foot of the Schlossberg, 40 mi. N. of Basle by rail. Pop. (1939) 111,860.

In 1120 Freiburg became a free town, with privileges similar to those of Cologne; but in 1219 it fell into the hands of a branch of the family of Urach. It purchased its freedom in 1366; but, unable to reimburse its creditors, it was, in 1368, obliged to recognize the supremacy of the house of Hapsburg. In the 17th and 18th centuries it played a considerable part as a fortified town. Since 1821 it has been the seat of an archbishop with jurisdiction over the sees of Mainz, Rottenburg and Limburg. The waters of the river flow through the streets in open channels; and the old fortifications have been replaced by public walks and vineyards. It possesses a famous university, the Ludovica Albertina, founded by Albert VI., archduke of Austria, in 1457. The Freiburg minster is considered one of the finest Gothic churches in Germany. It was probably erected between 1122 and 1252; but the choir was not built till 1513. The tower is 386 ft. in height. In the interior of the church are some beautiful stained glass windows and paintings by Holbein and by Hans Baldung (*c.* 1470–1545). The palaces of the grand duke and the archbishop, the old town-hall and the *Kaufhaus* or merchants' hall, a 16th-century building with a handsome façade, are noteworthy. On the Schlossberg above the town there are ruins of two castles destroyed by the French in 1744; and about 2 m. N.E. stands the castle of Zahringen. Situated on the ancient road which runs by the Hollenpass between the valleys of the Danube and the Rhine, Freiburg early acquired commercial importance, and it is still the principal centre of the trade of the Black Forest. It manufactures buttons, tobacco, silk thread, paper, sugar, surgical and musical instruments.

See Schreiber, *Geschichte und Beschreibung des Münsters zu Freiburg* (1820 *and* 1825); *Geschichte der Stadt und Universität Freiburgs* (1857–59); *Der Schlossberg bei Freiburg* (1860); and Albert, *Die Geschichtsschreibung der Stadt Freiburg* (1902).

Battles of **Freiburg,** Aug. 3, 5 and 10, 1614.—During the Thirty Years' War the neighbourhood of Freiburg was the scene of a series of engagements between the French under Louis de Bourbon, duc d Enghien (afterwards called the great Condé), and Henri de la Tour d'Auvergne, vicomte de Turenne, and the Bavarians and Austrians commanded by Franz, Freiherr von Mercy. At the close of the campaign of 1643 the French "Army of Weimar," having been defeated and driven into Alsace by the Bavarians, had there been reorganized under the command of Turenne, then a young general of 32 and newly promoted to the marshalate. In May 1644 he opened the campaign by recrossing the Rhine and raiding the enemy's posts as far as Überlingen on the lake of Constance and Donaueschingen on the Danube. The French then fell back with their booty and prisoners to Breisach, a strong garrison being left in Freiburg. The Bavarian commander, however, revenged himself by besieging Freiburg (June 27), and Turenne's first attempt to relieve the place failed. During July, as the siege progressed, the French Government sent the duc d'Enghien, who was ten years younger still than Turenne, but had just gained his great victory of Rocroy, to take over the command. Enghien brought with him a veteran army, called the "Army of France," Turenne remaining in command of the Army of Weimar. The armies met at Breisach on Aug. 2, by which date Freiburg had surrendered. At this point most commanders of the time would have decided not to fight, but to manoeuvre Mercy away from Freiburg; Enghien, however, was a fighting general, and Mercy's entrenched lines at Freiburg seemed to him a target rather than an obstacle. A few hours after his arrival, therefore, without waiting for the rearmost troops of his columns. he set the combining armies in motion for Krozingen, a village on what was then the main road between Breisach and Freiburg. The total force immediately available numbered only 16,000 combatants. Enghien and Turenne had arranged that the Army of France was to move direct upon Freiburg by Wolfenweiter, while the Army of Weimar was to make its way by hillside tracks to Wittnau and. thence to attack the rear of Mercy's lines while Enghien assaulted them in front. Turenne's march (Aug. 3, 1644) was slow and painful as had been anticipated. and late in the afternoon, on passing Wittnau, he encountered the enemy. His men carried the outer lines of defence without much difficulty, but as they pressed on towards Merzhausen the resistance became more and more serious. Turenne's force was little more than 6,000, and these were wearied with a long day of marching and fighting on the steep and wooded hillsides of the Black Forest Thus the. turning movement came to a standstill far short of Uffingen, the village on Mercy's line of retreat that Turenne was to have seized, nor was a flank attack possible against Mercy's main line, from which he was separated by the crest of the Schonberg. Meanwhile, Enghien's army had at the prearranged hour (4 P.M) attacked Mercy's position on the Ebringen spur. A steep slope, vineyards, low stone walls and abatis had all to be surmounted, under a galling fire from the Bavarian musketeers, before the Army of France found itself, breathless and in disorder, in front of the actual entrenchments of the crest. A first attack failed, as did an attempt to find an unguarded path round the shoulder of the Schonberg. The situation was grave in the extreme, but Enghien resolved on Turenne's account to renew the attack although only a quarter of his original force was still capable of making an effort. He himself and all the young nobles of his staff dismounted and led the infantry forward again, the prince threw his baton into the enemy's lines for the soldiers to retrieve, and in the end, after a bitter struggle, the Bavarians, whose reserves had been taken away to oppose Turenne in the Merzhausen defile, abandoned the entrenchments and disappeared into the woods of the adjoining spur. Enghien hurriedly re-formed his troops, fearing at every moment to be hurled down the hill by a counterstroke; but none came. The French bivouacked in the rain, Turenne making his way across the mountain to confer with the prince, and meanwhile Mercy quietly drew off his army in the dark to a new set of entrenchments on the ridge on which stood the Loretto Chapel. On Aug 4 the Army of France and the Army of Weimar met at Merzhausen, the rearmost troops of the Army of France came in, and the whole was arranged by the major-generals in the plain facing the Loretto ridge. This position was attacked on the 5th. Enghien had designed his battle even more carefully than before, but as the result of a series of accidents the two French armies attacked prematurely and straight to their front, one brigade after another, and though at one moment Enghien, sword in hand, broke the line of defence with his last intact reserve, a brilliant counterstroke, led by Mercy's brother Kaspar (who was killed), drove out the assailants. It is said that Enghien lost half his men on this day and Mercy one-third of his, so severe was the battle. But the result could not be gainsaid; it was for the French a complete and costly failure.



PLAN OF THE BATTLE OF FREIBURG, AUGUST 3RD, 5TH AND 10TH, 1644

For three days after this the armies lay in position without fighting, the French well supplied with provisions and comforts from Breisach, the Bavarians suffering somewhat severely from want of food, and especially forage, as all their supplies had to be hauled from Villingen over the rough roads of the Black Forest. Enghien then decided to make use of the Glotter Tal to interrupt altogether this already unsatisfactory line of supply, and thus to force the Bavarians either to attack him at a serious disadvantage, or to retreat across the hills with the loss of their artillery and baggage and the disintegration of their army by famine and desertion. With this object, the Army of Weimar was drawn off on the morning of Aug. 9 and marched round by Betzenhausen and Lehen to Langen Denzling. The infantry of the Army of France, then the trains, followed, while Enghien with his own cavalry faced Freiburg and the Loretto position.

Before dawn on the 10th the advance guard of Turenne's army was ascending the Glotter Tal. But Mercy had divined his adversary's plan, and leaving a garrison to hold Freiburg, the

Bavarian army had made a night march on the 9–10th to the Abbey of St. Peter, whence on the morning of the 10th Mercy fell back to Graben, his nearest magazine in the mountains. Turenne's advanced guard appeared from the Glotter Tal only to find a stubborn rearguard of cavalry in front of the abbey. A sharp action began, but Mercy hearing the drums and fifes of the French infantry in the Glotter Tal broke it off and continued his retreat in good order. Enghien thus obtained little material result from his manoeuvre. Only two guns and such of Mercy's wagons that were unable to keep up fell into the hands of the French. Enghien and Turenne did not continue the chase farther than Graben, and Mercy fell back unmolested to Rothenburg on the Tauber.

The moral results of this sanguinary fighting were, however, important and perhaps justified the sacrifice of so many valuable soldiers. Enghien's pertinacity had not achieved a decision with the sword, but Mercy had been so severely punished that he was unable to interfere with his opponent's new plan of campaign. This, which was carried out by the united armies and by reinforcements from France, while Turenne's cavalry screened them by bold demonstrations on the Tauber, led to nothing less than the conquest of the Rhine Valley from Basle to Coblenz, a task which was achieved so rapidly that the Army of France and its victorious young leader were free to return to France in two months from the time of their appearance in Turenne's quarters at Breisach.

FREIDANK (VRÎDANC), the name by which a Middle High German didactic poet of the early 13th century is known. It has been disputed whether the word, which is equivalent to "free-thought," is to be regarded as the poet's real name or only as a pseudonym; the latter is probably the case. Little is known of Freidank's life. He accompanied Frederick II. on his crusade to the Holy Land, where, in 1228–29, a portion of his work was composed; and it is said that on his tomb at Treviso there was inscribed, with allusion to the character of his style, "he always spoke and never sang." Wilhelm Grimm originated the hypothesis that Freidank was to be identified with Walther von der Vogelweide; but this is no longer tenable. Freidank's work, *Bescheidenheit, i e.,* "practical wisdom," consists of a collection of proverbs, and moral and satirical reflections, arranged under general heads. Its popularity till the end of the 16th century is shown by the great number of mss. extant.

Sebastian Brant published the *Bescheidenheit* in a modified form in 1508. Wilhelm Grimm's edition appeared in 1834 (2nd ed. 1860), H. F. Bezzenberger's in 1872. A later edition is by F. Sandvoss (1877). The old Latin translation, *Fridangi Dzscretzo,* was printed by C. Lemcke in 1868; and there are two translations into modern German, A. Bacmeister's (1861) and K. Simrock's (1867). *See* also F. Pfeiffer, *fiber Freidank* (*Zur deutschen Literaturgeschichte,* 1855), and *H.* Paul, *Über die ursprüngliche Anordnung von Freidanks Bescheidenheit* (1870).

FREIENWALDE, a town of Germany in the Prussian province of Brandenburg, on the Oder, 28 m. N.E. of Berlin by rail. Pop. (1939) 12,567. It has a small palace, built by the Great Elector, and manufactures machinery and pianos. It is a favourite summer resort of the inhabitants of Berlin. Freienwalde, as distinguished from the smaller town of the same name in Pomerania, first appears as a town in 1364.

FREIESLEBENITE, a rare mineral consisting of sulphantimonite of silver and lead $(PbAg_2)_5Sb_4S_{11}$. The monoclinic crystals are prismatic in habit, with deeply striated prism and dome faces. The colour is steel-grey, and the lustre metallic; hardness $2\frac{1}{2}$, specific gravity 6·2. It occurs with argentite, chalybite and galena in the silver veins at Freiberg, Saxony, where it has been known since 1720. The species was named after J. K. Freiesleben, who had earlier called it *Schilf-Glaserz.* Groups of large crystals have come from Hiendelaencina near Guadalajara in Spain.

FREIGHT: *see* AFFREIGHTMENT.

FREILIGRATH, FERDINAND (1810–1876), German poet, was born at Detmold on June 17, 1810. He was educated for a commercial career. The years from 1831 to 1836 he spent in a bank at Amsterdam, and 1837 to 1839 in a business house at Barmen. In 1838 his *Gedichte* appeared, and he abandoned commerce. His repudiation of the political poetry of 1841 and its revolutionary ideals induced Frederick William IV., to give him a pension of 300 thalers a year. He married, and, to be near his friend Emanuel Geibel, settled at St. Goar. Before long, however, Freiligrath was himself carried away by the rising tide of liberalism. In the poem *Ein Glaubensbekenntnis* (1844) he avowed his sympathy with the political movement led by his old adversary, Georg Herwegh; the day, he declared, of his own poetic trifling with romantic themes was over; romanticism itself was dead. He sacrificed his pension, went to Switzerland, and then after the publication of his *ça ira!* (1846), for greater safety, to London, where he resumed the commercial life he had broken off seven years before. When the revolution of 1848 broke out, it seemed to Freiligrath, as to all the liberal thinkers of the time, the dawn of an era of political freedom; and in his *Politische und soziale Gedichte* (1849–1851), he welcomed it with unbounded enthusiasm. He returned to Germany and settled in Diisseldorf; but the publication of his poem, *Die Toten an die Lebenden* (1848) led to his arrest on a charge of *lèse-majesté.* He was acquitted, but his association with the democratic movement rendered him suspect, and in 1851 he returned to London, where he lived for 17 years. In 1868 he returned to Germany, settling first in Stuttgart and in 1875 in the neighbouring town of Cannstatt, where he died on March 18, 1876.

Literary Significance.—Freiligrath was the most gifted poet of the German revolutionary group. His own purely lyric poetry re-echoes for the most part the familiar thoughts and imagery of his romantic predecessors; but at an early age he had been attracted by the work of French contemporary poets, and he reinvigorated the German lyric by grafting upon it the orientalism of Victor Hugo. In this reconciliation of French and German romanticism lay Freiligrath's significance for the development of the lyric in Germany. Freiligrath, when he is at his best, displays a vigour and strength, a power of direct and cogent poetic expression, not to be found in any other political singer of the age. He translated many English and Scottish ballads, and much contemporary English verse (*Englische Gedichte aus neuerer Zeit,* 1846; *The Rose, Thistle and Shamrock,* 1853, 6th ed. 1887); he also translated Shakespeare's *Cymbeline, Winter's Tale* and *Venus and Adonis,* as well as Longfellow's *Hiawatha* (1857).

Freiligrath's *Gedichte* have passed through some 50 editions and his *Gesammelte Dichtungen,* first published in 1870, have reached a considerable number. *Nachgelassenes* (including a translation of Byron's *Mazeppa*) was published in 1883. A selection of Freiligrath's best-known poems in English translation was edited by his daughter, Mrs. Freiligrath-Kroeker, in 1869; also *Songs of a Revolutionary Epoch* were translated by J. L. Joynes in 1888. Cf. E. Schmidt-Weissenfels, *F. Freiligrath, eine Biographie* (1876); W. Buchner, *F. Freiligrath, ein Dichterleben in Briefen* (2 vols., 1881); G. Freiligrath, *Erinnerungen an F. Freiligrath* (1889); P. Besson, *Freiligrath* (Paris, 1899); K. Richter, *Freiligrath als Übersetzer* (1899); E. G. Gudde, *Freiligrath Entwicklung als politischer Dichter* (Berlin, 1922).

FREISCHÜTZ, in German folklore, a marksman who by a compact with the devil has obtained a certain number of bullets destined to hit without fail whatever object he wishes. As the legend is usually told, six of the *Freikugeln* or "free bullets" are thus subservient to the marksman's will, but the seventh is at the absolute disposal of the devil himself. Stories about the Freischiitz were especially common in Germany during the 14th, 15th and 16th centuries; but the first time that the legend was turned to literary profit is said to have been by Apel in the *Gespensterbuch* or "Book of Ghosts." It formed the subject of Weber's opera *Der Freischiitz* (1821). The name by which the Freischiitz is known in French is Robin des Bois.

See Kind, *Freyschützbuch* (Leipzig, 1843); *Revue des deux mondes* (Feb. 1855); Grasse, *Die Quelle des Freischiitz* (Dresden, 1875).

FREISING, a town of Germany, in the *Land* of Bavaria, on the Isar, 16 mi. by rail N.N.E of Munich. Pop. (1939) 19,456. The cathedral, which dates from about 1160 is famous for its crypt. Noteworthy also are the old palace of the bishops, later a clerical seminary, and the town-hall. Near the town is the site of the Benedictine abbey of Weihenstephan, which existed from 72j to 1803. Freising is said to have been founded by the Romans.

Destroyed by the Hungarians in 955, it was fortified by the emperor Otto II in 976 and by Duke Welf of Bavaria in 1082. A bishopric was established here in 724 by St. Corbinianus, whose brother Erimbert was consecrated second bishop by St. Boniface in 739. In the 17th century the bishops became princes of the Empire. In 1802 the see was secularized, the bulk of its territories being assigned to Bavaria and the rest to Salzburg, of which Freising had been a suffragan bishopric. There are iron-foundries and trade is in corn and cattle.

FRÉJUS, a town in the department of the Var in S.E. France. Pop. (1954) 6,101. It is 18 mi S E. of Draguignan. It has fine Roman remains. Since the 4th century it has been a bishop's see, in the ecclesiastical province of Aix en Provence. In modern times the neighbouring fishing village at St. Raphaël (2½ mi. S E. by rail and on the seashore) has become a town of 6,711 inhabitants (1946). In 1799 Napoleon disembarked there on his return from Egypt and re-embarked for Elba in 1814, while nowadays it is much frequented as a health resort, as is also Valescure (2 mi. N.W. on the heights above). The cathedral church in part dates from the 12th cent., and small portions of the mediaeval episcopal palace are now visible, as it was rebuilt about 1823. The ramparts of the old town can still be traced for a long distance, and there are fragments of two moles, of the theatre and of a gate. The amphitheatre, which seated 12,000 spectators, is better preserved. The ruins of the great aqueduct which brought the waters of the Siagnole, an affluent of the Siagne, to the town, can still be traced for a long distance. The town of Forum Iulii was founded by Julius Caesar on this site, formerly the capital of the Oxybii, to secure a harbour independent of Marseilles. The buildings, of which ruins exist, were mostly built by Caesar or by Augustus, and show that it was an important naval station and arsenal. But the town suffered much at the hands of the Arabs and Barbary pirates, and its inhabitants have used the ruined Roman buildings as a quarry. The old harbour (really a portion of the lagoons) is now completely silted up.

Corks, bricks, tiles and fine pottery are made, and rushes are woven. There are mines of coal and bituminous shale.

FRELINGHUYSEN, FREDERICK THEODORE (1817–1885), American lawyer and statesman, of Dutch descent, was born at Millstone, N.J., on Aug. 4, 1817. His grandfather, Frederick Frelinghuysen (1753–1804), was an eminent lawyer, a soldier in the American Revolution, and a member (1778–79 and 1782–83) of the continental congress, and in 1793–96 of the U.S. Senate; and his uncle, Theodore (1787–1862), was a U.S. senator from New Jersey in 1829–35, the Whig candidate for vice-president on the Clay ticket in 1844, chancellor of the University of New York in 1839–50 and president of Rutgers college in 1850–62. Frederick Theodore, left an orphan at the age of three, was adopted by his uncle, graduated at Rutgers in 1836 and studied law in Newark with his uncle, to whose practice he succeeded in 1839. He became attorney for the Central railroad of New Jersey, the Morris Canal and Banking company and other corporations, and from 1861 to 1867 was attorney-general of New Jersey. In 1861 he was a delegate to the peace congress at Washington, and in 1866 was appointed by the governor of New Jersey, as a republican, to fill a vacancy in the U.S. Senate. In the winter of 1867 he was elected to fill the unexpired term, but a democratic majority in the legislature prevented his re-election in 1869. From 1871 to 1877 he was again a member of the U S. Senate, in which he was prominent in debate and in committee work, and was chairman of the committee on foreign affairs during the Alabama claims negotiations. In 1881 he was appointed secretary of state by President Arthur to succeed James G. Blaine, and served until the inauguration of President Cleveland in 1885. He died in Newark, May 20, 1885.

FREMANTLE, a city and the principal seaport of Western Australia, on the Swan river, 12 mi. S.W. of Perth. Pop. (1954) 22,795. The principal industries of the city are those connected with the port. There are also wool warehouses, oil refineries, steel roller mills and engineering works. There is an industrial estate covering 400 ac. three miles from the city. This is one of the most important industrial centres in Western Australia and has attracted industries from overseas and from the eastern states of Australia. Inland is an area of about 1,600 ac. devoted to market gardening. Fremantle handles 72% of the state's trade. It is the first Australian port of call for ships from Europe and is related to the South African. Asian and European trade routes. Two moles, prolonging the banks of the Swan river seaward, provide a safe approach 5,000 ft. long and 450 ft. wide. The inner harbour has more than 10,000 lineal feet quay space and a low-water depth of 36 ft. The port is connected by rail with the state's chief wheat- and wool-producing areas, and is the terminus of the Australian Trans-Continental railway.

FRÉMIET, EMMANUEL (1824–1910), French sculptor who devoted himself chiefly to animal sculpture and to equestrian statues in armour, was born in Paris on Dec 6, 1824. Though he was a nephew and pupil of Jean François Rude, the detailed naturalism of his sculpture was closer to the art of Antoine Louis Barye, whom he succeeded as professor of animal drawing at the Natural History museum of Paris. Frémiet's first employment was making lithographs of comparative anatomy for a painter of natural history. After initial success with his animal studies, he won a medal of honour at the 1887 salon with the representation, in bronze, of a gorilla carrying off a Negro woman (Nantes)

In imposing equestrian statues, with accoutrements carefully rendered, Frémiet achieved convincing portrayals of warriors such as "Jeanne d' Arc" (second version. 1899; Place des Pyramides, Paris) and "Du Guesclin" (1902; Dinan). For Mount Vernon square, Baltimore, he made "Colonel Howard" (1903) and for Bogotá, Colombia, "Bolívar" (1910). Frémiet ascended the ladder of honours to membership in the Académie des Beaux-Arts in 1892, but his fame did not aithstand the later shift of taste away from his chosen subject matter, despite his acknowledged mastery there. He died in Paris on Sept. 10, 1910. (J. W. F.)

FRÉMONT, JOHN CHARLES (1813–1890), American explorer, soldier and political leader, was born in Savannah, Georgia. His father, a native of France, died when the boy was in his sixth year, and his mother, a member of an aristocratic Virginia family, removed to Charleston, S C., where Frémont's youth was spent. In 1828 he entered the junior class of the College of Charleston, where he displayed marked ability, especially in mathematics. His degree was withheld because of irregular attendance but finally conferred in 1836. Joel R. Poinsett's influence secured his appointment in 1833 as teacher of mathematics on board the sloop-of-war "Natchez" and Frémont sailed with that vessel on a cruise along the South American coast which lasted two and a half years. Upon his return he declined an appointment as professor of mathematics in the United States navy and chose instead to serve as assistant engineer of a survey undertaken to find the best pass for a proposed railway from Charleston to Cincinnati. Following this Poinsett secured for him an appointment as second lieutenant of topographical engineers in the United States army, and for the next three years he was an assistant to the French explorer, Jean Nicholas Nicollet, employed by the war department to survey and map a large part of the country lying between the upper waters of the Mississippi and Missouri rivers. In 1841 Frémont alone headed an expedition to survey the Des Moines river to complete Nicollet's map. These years under Nicollet furnished invaluable training and experience for use in his later career and gave him a desire for further western adventure. Upon his return he married Jessie Benton, daughter of Senator Thomas Hart Benton of Missouri, and it was in no small measure Benton's great interest in the West and his influence with the Government that enabled Frémont to accomplish within the next few years the exploration of much of the territory between the Mississippi valley and the Pacific ocean.

When emigration over the Oregon trail to the Oregon country began to be important in 1842, Frémont was sent at the head of a party to explore the route beyond the Mississippi as far as South pass in Wyoming. He surveyed the trail thoroughly and his excellent descriptions greatly aided the emigrants of following years. He ascended to the summit of the second highest peak of the Wind River mountains, since known as Frémont's peak. The year following he was sent to complete the survey of the trail to the mouth of the Columbia. His guide on this as well as on the previous expedition was the famed and picturesque Christopher (Kit) Carson (*q.v.*). The Oregon settlements mere quickly reached, and then Frémont turned south and east via the Klamath lakes to northwestern Nevada, continuing to the Truckee and Carson rivers. This portion of the journey over previously untravelled country added greatly to geographical knowledge of the west. Frémont then accomplished with his entire expedition an extremely difficult and rash crossing of the Sierra Nevada in midwinter—an exploit which added greatly to his fame—and spent the winter near Sutter's Fort on the Sacramento river in California. His return was round the southern end of the Sierra Nevada and across to Great Salt lake mainly via the old Spanish trail from Santa FC to California.

Thousands of copies of his report of this expedition were printed and eagerly read. War with Mexico over the annexation of Texas seemed imminent, and in the spring of 1845 Frémont was dispatched on a third expedition for the professed purpose of further exploring the Great basin and Pacific coast, but with secret instructions for action in case of a war with Mexico. He and his party of 62, after traversing the Great basin by a new route directly west from Great Salt lake and down the valley of the Humboldt. reached California. in Jan. 1846. after a second winter crossing of the Sierras. The Mexican authorities became suspicious and ordered Frémont out of the province. Frémont refused to leave at once and fortified his position, but later thought better of this indiscreet action and led his party toward the Oregon border. He was overtaken by a messenger direct from Washington and at once turned about and led his force back into California. The official documents delivered gave Frémont no excuse for hostile actions. but what orders the private letters and verbal instructions contained is unknown. While Frémont's men were in camp the Americans in northern Mexico revolted from Spain and created the Bear-Flag republic. Frhmont took no part in the hostilities but certainly gave his moral support. When news of the declaration of mar with Mexico did reach California all the northern region was already in American hands. Frémont was appointed by Commodore R. F. Stockton major of a battalion made up mainly of American volunteers, and by Jan. 184; he and Stockton had completed the conquest of the future state. Gen. Stephen W. Kearny. in the meantime. entered California from the southeast with orders similar to those of Stockton. namely to conquer the region and establish a government. This conflict of orders led to a conflict of authorities between which Frémont was caught. Stockton had already appointed him governor of California, hut Kearny would not recognize the appointment. Frémont, obeying the officer from whom he had received his commission, disregarded Kearny's contradictory orders and was arrested by the latter, who by this time, unknown to Frémont, had received later orders from Washington establishing his authority without contradiction. Frémont was tried by court-martial in Washington. found guilty of mutiny, disobedience and conduct prejudicial to military discipline. and sentenced to be dismissed. Pres. James Polk approved of the verdict except as to mutiny, but remitted the penalty. Frémont, in a bitter mood, resigned.

The explorer now intended to establish his home on an estate which he had purchased in California. and on his way thither decided to lead, at his own and Senator Benton's expense, a fourth expedition to find passes for a Pacific railroad which he was eager to see built. Kit Carson not being available, Frémont employed the eccentric "Bill" Williams as guide. Westward from the headwaters of the Rio Grande the party tried to penetrate the massive San Juan range in December. Williams led them into a high, unknown pass where they mere caught by a blizzard. After weeks of intense cold and the loss of 11 men and the entire outfit, the exhausted party in retreat reached the first settlements in the upper Rio Grande. Frémont continued by the southern route to California and was greeted with news of the discovery of gold. Rich veins were discovered on his great 40.000 ac. estate on the Mariposa river at the base of the Sierras. and he spent the next few years developing mines which quickly made him a multimillionaire. In Dec. 1849 he was elected one of the first two senators from California, but, drawing the short term, he served only from Sept. 1850 to March 1851. He was defeated for re-election by the proslavery party. His opposition to slavery. however, and the popularity his explorations and his part in the conquest of California had won for him. led to his nomination for the presidency in 1856 by the newly formed Republican party. In the election he was defeated by Buchanan by 174 to 114 votes.

Soon after the Civil War began, Frémont was appointed major general and placed in command of the western department with headquarters at St. Louis, Mo. The task of organizing an effective army with insufficient arms, insufficient supplies and only a few thousand untrained men in a slave state which needed policing at all points proved too much of a task for Frémont's ability. Political and military enemies made the most of his failures, and he was blamed for several distressing defeats, though it is doubtful if they could have been avoided. Furthermore, on Aug. 30, 1861, he issued a proclamation in which he declared the property of Missourians in rebellion confiscated and their slaves emancipated. Pres. Abraham Lincoln regarded this proclamation as premature, fearing that it might alienate the border states whose loyalty he still hoped to keep. The adverse reports of agents sent by Lincoln to investigate Frémont's management led to his removal by the president. Out of consideration for the "radicals" who backed Frémont, he was placed in command of the mountain department of Virginia. Kentucky and Tennessee in 1862 but was ineffective and seemingly dazed by the rapid manoeuvres of "Stonewall" Jackson, his opponent. When his army was united with the army of the Potomac to form the army of Virginia, which was placed under the command of his old enemy in Missouri, Gen. John Pope. Frémont resigned. He was still popular enough to be nominated for the presidency in 1864 by the radical wing of the Republican party, but when he saw that he had no chance and would possibly only split the party to defeat Lincoln, he withdrew. He retired from public life and devoted himself to building a railroad by the southern route to the Pacific. The finances of the enterprise were unsound and in the collapse in 1870 Frémont lost the fortune he had made in California. In his embarrassment he welcomed the relief and change of occupation that came with an appointment as governor of Arizona territory in 1878, an office which he occupied until 1881. He died in New York city on July 13, 1890.

It is for the splendid achievements of his early life as an explorer that Frémont will be particularly remembered. It is true that trappers had long before travelled where he followed, but he first surveyed and described the routes. If he was not a pathfinder he was a path marker. "From the ashes of his campfires have sprung cities."

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FREMONT, a city of California. U.S., in Alameda county on the southeastern shore of San Francisco bay. 25 mi. S. of Oakland and a part of the San Francisco-Oakland standard metropolitan statistical area. Incorporated Jan. 10, 1956. and named in honour of John Charles Frémont, the city was formed by joining the five communities of Centerville. Irvington. Niles. Mission San Jose and Warm Springs. The Nimitz freeway, extending from Oakland to San Jose through Fremont. was important in helping to transform Fremont from an agricultural area into one of varied industries. In the city is Mission San José de Guadalupe, founded in 1797; it was 14th in the chain of the 21 California missions. For comparative population figures see table in California: *Population.* (*H.* B. Me.)

FRÉMY, EDMOND (1814–1894), French chemist, made important contributions in a wide range of areas. He was born at Versailles on Feb. 28. 1814. He entered Joseph Louis Gay-Lussac's laboratory in 1831. and became *préparateur* at the École Polytechnique in 1834 and at the Collège de France in 1837; he was *répétiteur* at the École Polytechnique, where in 1846 he became professor.

In 1850 he succeeded Gay-Lussac in the chair of chemistry at the Muséum d'Histoire Naturelle, of which he was director, in succession to M. E. Chevreul, from 1879 to 1891. He died at Paris on Feb. 3, 1894.

His work included investigations of osmic acid, of the ferrates, stannates. plumbates, etc., and of ozone; attempts to obtain free fluorine by the electrolysis of fused fluorides; and the discovery of anhydrous hydrofluoric acid and of a series of *acides sulphazote's,* the precise nature of which long remained a matter of discussion.

He also studied the colouring matters of leaves and flowers, the composition of bone, cerebral matter and other animal substances, and the processes of fermentation, in regard to the nature of which he was an opponent of Pasteur's views. In the field of technical chemistry he contributed to the knowledge of the manufacture of iron and steel, sulfuric acid, glass and paper, and in particular worked at the saponification of fats with sulfuric acid and the utilization of palmitic acid for candlemaking.

In the later years of his life he applied himself to the problem of obtaining alumina in the crystalline form, and succeeded in making rubies identical with the natural gem not merely in chemical composition but also in physical properties.

He wrote a *Traitk de chimie gkne'rale* in six volumes.

FRENCH, ALICE ("OCTAVE THANET") (1850–1934), U.S. author of novels and short stories, wrote under the pseudonym "Octave Thanet." Though her fiction, the background of which was often Arkansas and Iowa, was very popular at the beginning of the 20th century, her works are not considered important contributions to American literature.

She was born in Andover, Mass., on March 19, 1850, and studied at Abbott academy in that town. She later lived in Arkansas and Davenport, Ia.

She participated in the activities of various clubs and organizations and was president of the Iowa Society of Colonial Dames. She was also interested in certain contemporary labour problems of the west.

Novels by Alice French, whose style was clear and simple, include *Knitters in the Sun* (1887); *Expiation* (1890); *The Man of the Hour* (1905); and *A Step on the Stair* (1913).

Her short stories! for which she probably was best known, were collected in a number of volumes, including *Stories of a Western Town* (1893); *A Captured Dream, and Other Stories* (1897); and *Stories That End Well* (1911).

She also published By *Inheritance* (1910) and *And the Captain Answered* (1917).

Alice French never married. She died at Davenport on Jan. 9, 1934.

FRENCH, DANIEL CHESTER (1850–1931), U.S. sculptor whose work is more profoundly American than that of any other American sculptor, was born at Exeter, N.H., April 20, 1850. His father, Judge Henry Flagg French, was assistant secretary of the treasury through three presidential administrations. French studied anatomy with William Rimmer in Boston, worked for one month with J. Q. A. Ward in New York city, and then two years under Thomas Ball in Italy.

His first important commission came when he was 22, from the town of Concord, Mass., where he lived, for the statue of "The Minute Man." Unveiled by Ralph Waldo Emerson at the Old North bridge on the centennial of the Concord fight, April 19. 1875, it later became the symbol for defense bonds, stamps and posters of World War II, and copies of the statue may be seen in many New England towns.

This commission launched the artist on a career unparalleled in American sculpture. Fifty years later, in 1922, he witnessed the dedication of his great marble—the seated Lincoln in the Lincoln memorial in Washington. D.C.

Between these two triumphs there poured from his studio a constant stream of sculpture.

Among his better-known works are "Death and the Sculptor." Forest Hills cemetery, Boston, 1893; the equestrian statues of Gen. U. S. Grant, Philadelphia, 1898, and General Washington. Paris, 1900; three pairs of bronze doors for the Boston Public library, 1902; the groups of the "Four Continents" for the New York customhouse, 1907; the "Standing Lincoln," Lincoln, Neb., 1912; the statue of Emerson in the Public library, Concord, 1914; the "Alma Mater" at Columbia university, 1915; and the 1st division memorial, Washington, D.C., 1924.

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(M. F. CN.)

FRENCH, NICHOLAS (1604–1678), bishop of Ferns, Ire., was an Irish political pamphleteer, born at Wexford. He was educated at Louvain, and before 1646 was appointed bishop of Ferns. His political activities made it prudent for him to leave Ireland in 1651.

French acted as coadjutor to the archbishops of Santiago de Compostella and Paris, and to the bishop of Ghent. and died at Ghent on Aug. 23, 1678. His most important historical works were published by S. H. Bindon (Dublin, 1846).

See Irish Manuscripts Commission, *Commentarius Rinuccinianus . . .,* ed. by J. Kavanagh, 6 vol. (Dublin, 1932–49), *De Praesulibus Hiberniae,* ed. by J. F. O'Doherty, 2 ool. (Dublin. 1944); T. Carte, *Life of James, Duke of Ormonde,* 6 vol., new ed. (Oxford, 1851).

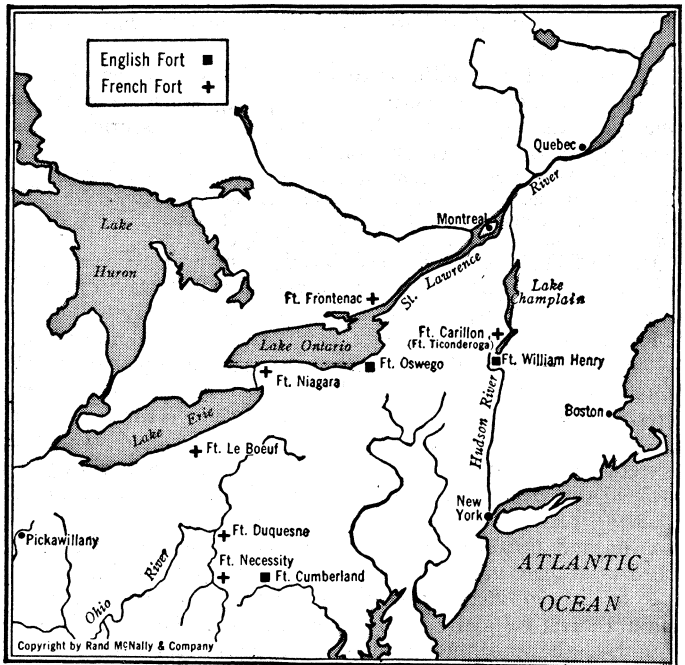
FRENCH AND INDIAN WAR. This war was the American phase of a world-wide, nine years' war that was waged between 1754 and 1763. It was called by contemporary writers the "Maritime War" or the "Great War," the "Late Glorious War" or simply the "Late War," but it is most accurately termed the "Great War for the Empire." It involved at first only the empires of Great Britain and France. Later the electorate of Hanover, of which the king of England was head, and two other western German states, Brunswick and Hesse-Cassel, closely associated with Hanover, were drawn into it when France attacked Hanover.

Spain and Portugal became participants when in 1762 Spain, allied to France, invaded Portugal, allied to Great Britain. This is to be distinguished from the Seven Tears' War (*q.v.*) that began in central Germany in 1756 over issues having nothing to do with those that precipitated the war already in progress. The participants in the Seven Years' War were, on the one hand, Prussia, allied to Great Britain by a subsidy treaty, and. on the other hand, Austria, Russia, Sweden and most of the southern German states, all of whom were allied to France likewise by subsidy treaties but with none of whom Great Britain was at war. The two wars were, moreover, terminated by distinct treaties, one at Paris and the other at Hubertusburg, and no nation was a signatory of both.

Conflicting British and French Claims.—The Great War for the Empire began over the specific issue as to whether the upper Ohio valley was a part of the British empire and therefore open for trade and settlement on the part of the inhabitants of Pennsylvania and Virginia, or whether it was part of the French empire. But behind this issue loomed an infinitely greater one—nothing less than the question as to which nation with its peculiar civilization. including language, forms of government and social mores, was to dominate the heart of the continent of North America.

British territorial claims rested upon the John and Sebastian Cabot discovery of the North American continent in the latter part of the 15th century and the grant by English royal charter in the early part of the 17th century, to both the Virginia company and the Grand Council for New England, of all the land within certain limits between the Atlantic and Pacific oceans. Further, in 1663 there was created to the south of Virginia the province of Carolina that also received a sea-to-sea grant and out of which were later formed North Carolina. South Carolina and Georgia. Thus all the lands to the south of French Canada and to the north of Spanish Florida stretching from sea to sea were claimed by England. In conflict with this was the claim of France to the whole of the Mississippi valley. including that of the Ohio, based upon the discoveries of René Robert Cavalier, sieur de la Salle, who, starting from Canada, moved through the Great Lakes and then, after descending the Mississippi river in 1682, took possession in the name of the king of France of all lands drained by this river and its tributaries.

For about 60 years the issue as to which nation had the better right to the lands in the great Mississippi basin was to remain in abeyance. The English gradually settled all along the Atlantic seaboard to the south of the Gulf of St. Lawrence where about 14 colonies—including British Nova Scotia, founded in 1749—came into existence and flourished. The inhabitants of these colonies in the course of time pushed westward from the tidewater to establish themselves in the piedmont country. By the middle of the 18th century the small cabins of the Virginians were to be found even to the west of the Applachians on the upper waters of



FRENCH AND INDIAN WAR: GENERAL AREA OF FIGHTING, INCLUDING SOME OF THE SITES OF MAJOR BATTLES

such streams as the New and the Holston. By that period hundreds of Pennsylvania traders had likewise settled in the villages of Indian tribes of the upper Ohio valley with whom Great Britain was in alliance.

On the other hand, the French. firmly in control of Canada from the early 17th century, gradually began, through trade, the exploitation of the Great Lakes region. They established permanent settlements at Detroit, in the so-called Illinois country, at the mouth of the Mississippi and at Biloxi and Mobile bay. By 1750 they had, in addition, many trading posts among those Indian tribes with whom they were in alliance.

Beginning of **Hostilities.**—A conflict between the two nations over their rival North American claims was doubtless inevitable, but it might have been delayed for many years, since their areas of trade exploitation were widely separated, had not the governor general of New France forced the issue.

Although the French had developed no trade relations in the neighbourhood of the Allegheny river and the upper Ohio where Pennsylvania traders were concentrated, the governor general ordered Pierre Joseph Céloron de Blainville in 1749 to go into this region and compel the traders to lower the British flag flying over their trading houses and, as trespassers on the king of France's lands, to retreat to the eastern slopes of the Appalachians. Since this move did not have the desired effect, force was applied in 1752 when the important British colonial trading centre at Pickawillanp on the upper Great Miami river was destroyed.

This was followed by the plundering, capture or killing of every English-speaking trader in the upper Ohio valley that the French and their Indian allies could find.. These actions not only struck directly at the people of Pennsylvania but at those of Virginia as well.

In fact. the government of Virginia took the position that the lands of the upper Ohio were clearly included in the charter grant of 1609 to that colony—a grant which gave the colony a more valid claim to them than that of New France, based upon La Salle's much later journey down the Mississippi. In harmony with this point of view the governor and council had by the end of 1752 granted conditionally about 1,500,000 ac. of Ohio valley land with the result that almost every important Virginia family, including members of the SVashington. Lee and Randolph families, was vitally interested in the fate of the Ohio area. When, therefore. the news reached Williamsburg, the capital of the province, that the French were not only driving out the English traders but were building forts on the headwaters of the Allegheny river in order to consolidate their positions, it was determined late in 1753 to send young George SVashington to the French Ft. Le Boeuf, located near the upper waters of the Allegheny, to warn the garrison there that it was occupying lands that belonged to Virginia. After that daring mission had failed. the Ohio company of Virginia, which had received. under certain stipulations a special royal grant of upper Ohio valley land, was encouraged to build a fort at the forks of that river—that is, at the place where the Allegheny and Monongahela rivers join to create the Ohio river and where Pittsburgh now stands—with the understanding that Virginia troops would support the undertaking.

The French, however, were too quick. Descending the Allegheny river in numbers in the spring of 1754, their troops, under the command of French regular officers: overwhelmed the little force of woodcutters and carpenters busy constructing the palisaded log fort before the Virginia troops and the company of South Carolina Independents coming to their support under Col. Joshua Fry and Lieutenant Colonel Washington had arrived. Upon the death of Fry, Washington took command and, in view of the strength of the French at the forks, decided to entrench himself at Ft. Xecessity. There he was attacked and in the face of great odds compelled to surrender.

While hostilities between the two nations had preceded the action at Ft. Necessity, it was this clash between British and French armed forces that precipitated the Great War for the Empire. Ultimately the war was to spread from the Ohio valley to every part of the world where either of the two nations had territorial interests.

The government of Virginia appealed to the king for assistance, particularly for two British regiments so that regulars could be pitted against regulars in this wilderness contest. Fearing the outbreak of a new war with France, after having as recently as 1748 made peace with the latter, George II at first stubbornly refused to consider the request, agreeing with the position taken by his minister, the duke of Newcastle, who said: "Let Americans fight Americans" in distant new world clashes. But when it became clear from further reports sent by the government of Virginia that ram Virginia militia could not be expected to make headway against seasoned French regulars, George finally agreed to order Gen. Edward Braddock to go to Virginia with a force to clear the forks of the Ohio of the French invaders. Moreover, Adm. Edward Boscawen was sent into the region of the Gulf of St. Lawrence with a powerful fleet to prevent further reinforcements of French troops from arriving in Canada.

Spread of the War.—The war thus begun to defend British territorial claims in the Ohio valley spread like wildfire to other parts of the world. It became a contest between the two greatest maritime powers.

France, however, was far superior to Great Britain in land forces. This superiority was soon used against King George's electorate; Hanover, which as a German state was not interested in Anglo-French rivalry in the new world. The war thereupon presented two facets: one a struggle for empire in North America, the West Indies, the African coast and India; the other an effort on the part of the British to prevent Hanover's being used as a pawn in this territorial rivalry.

Early French Successes.—During the first four years of the fighting the over-all advantage was with the French. especially in North America. It seemed to most contemporaries that they would succeed in enclosing the British colonials firmly to the east of the Appalachian mountains, thus condemning them to remain simply a seaboard people—like modern Chile with a long coast line and a narrowly restricted interior. For in those years the British regulars and American colonials suffered one stunning reverse after another.

Braddock's army was defeated and scattered in 1755 when approaching the new Ft. Duquesne that the French had erected at the forks of the Ohio. In 1756 the defenders of Ft. Oswego on Lake Ontario were obliged to surrender, as were the defenders of Ft. William Henry near Lake Champlain in 1757. Lord Loudoun's amphibious expedition from New York city against the great French fortress Louisbourg on Cape Breton Island ended in that year in dismal failure, and Gen. James Abercrombie, attacking the French Ft. Ticonderoga in 1758, had his army almost destroyed. Moreover, the frontier settlements in what is now central New York, central Pennsylvania, western Maryland and western Virginia were deserted while thousands of families fled eastward in panic from the torch, sword and tomahawk carried by the French and their Indian allies.

During these years of defeat the only notable success scored by the British and New England forces was the capture in 1755 of the well-fortified Ft. Beauséjour. The French had built the fort in 1749 on the narrow isthmus connecting the peninsula of Nova Scotia with the mainland—a region held by British authorities to be a part of Nova Scotia, ceded by France in 1713 in the treaty of Utrecht—chiefly for the purpose of reviving the loyalty to the king of France of the French-speaking Acadians in Nova Scotia. This design so far succeeded that these numerous, hardy people not only steadfastly refused to take an oath of loyalty to the British crown but provided the Beauséjour garrison with provisions and a large labour force to aid it in consolidating its foothold on the isthmus.

Since no large contingent of British soldiers was available to hold in awe the Acadians, who had thrown off their former attitude of neutrality as between the British and the French, it was decided by the authorities at Halifax to disperse them as a war measure. In line with this resolve, transports were provided and most of the Acadians were carried away from their villages in western Nova Scotia and distributed among the inhabitants of the British colonies to the southward.

British Advantages.—In a conflict of this character, which involved such a tremendous stake as the future of a continent, factors other than the series of early French victories were to play a decisive role. First of all, there was William Pitt at the head of the British ministry. He saw correctly that, despite the spread of the Anglo-French war to other parts of the world, the winning of it in North America was the supreme task in hand. With almost fanatical zeal he dedicated himself to that end. He found in such men as Jeffrey, Lord Amherst, James Wolfe and John Forbes first-class military officers.

Pitt recruited new regiments of regulars to replace or to reinforce the old, shattered ones, drawing heavily upon that martial people, the Highland Scots; he persuaded parliament to grant him almost unlimited funds; he promised the colonies a liberal reimbursement of their expenses, were they to do their part in the effort by furnishing men for the colonial line; finally, every important detail with respect to operations in North America came under his personal scrutiny so as to guard against further fiascoes. Pitt, in a very true sense, was the organizer of victory in the Great War for the Empire.

In Pitt's favour were other factors that were destined to permit him to overwhelm his opponents. One was the growing superiority of the British navy which slowly but relentlessly swept not only French merchantmen but also French ships of war and troop transports from the seas, thus shutting off the means of bringing reinforcements of troops and munitions from France to Canada.

In this connection two great naval battles must be mentioned. The destruction, as a fighting unit, of the French Mediterranean fleet under Admiral de la Clue was accomplished by Boscawen off Lagos in Portugal in 1759, as the French sought to gain the seaport of Brest. The virtual annihilation of the main French fleet brought about later that same year in the decisive battle of Quiberon bay, when Adm. Sir Edward Hawke's fleet bore down upon it with devastating effect.

Moreover, there were available in Great Britain vastly greater financial and industrial resources than in France, which before the end of the struggle was faced with national bankruptcy and economic paralysis. The British colonies also had great quantities of food supplies of all sorts for provisioning the armed forces in the new world, while the inhabitants of French Canada faced almost famine conditions when the blockades off the coasts of France and in the Gulf of St. Lawrence made it virtually impossible to secure food from outside. Nor could the soldiers fighting under the fleur-de-lis in North America be supplied any more easily with vitally needed munitions.

Finally, both British regulars and the American colonial line became seasoned wilderness fighters. It should at the same time be pointed out that the Indian or bushranger method of waging war, most successfully employed by the French, brought no great decisions in the desperate contest. In the main, both sides tended to observe well-established principles of strategy and tactics. The war, in other words, witnessed the transfer to America of European methods of fighting, modified, of course, to meet peculiar local conditions. Thus, the domination of the high seas by the British royal navy and the capacity, therefore, to provide the field forces in America with an inexhaustible supply of munitions and provisions, together with growing morale and capacity for achievement of the battle-seasoned soldiers, both Brilish and American, fighting there, were factors of the utmost importance in determining the outcome of the war.

British Victory.—Under these circumstances the French tide in North America reached its crest by the end of 1757. In 1758 Amherst captured Louisbourg. Soon afterward John Bradstreet compelled the garrison of Ft. Frontenac to capitulate and the same year Forbes and Henry Bouquet brought about the fall of Ft. Duquesne. The following year Sir William Johnson forced the surrender of Ft. Niagara. Amherst pushed the French out of Ft. Ticonderoga and Crown Point. Further, Wolfe won the vastly important battle of the heights of Abraham that led to the surrender of Quebec. Faced by hopeless odds, the governor general, the marquis de Vaudreuil, was obliged on Sept. 8, 1760, to surrender not only his last stronghold, Montreal, but all of Canada. Thus the North American phase of the Great War for the Empire came to a close. The capture of Spanish Havana by British and American colonial forces in 1762 must, however, also be mentioned by reason of its implications.

Peace Treaty of 1763.—France and Spain, faced with disastrous defeats in the new world, were ready by 1763 to negotiate a treaty of peace. The signing took place in Paris on Feb. 10. By the treaty France was compelled to cede Canada to Great Britain and relinquish to it all claims to the lands lying east of the Mississippi, outside of the environs of New Orleans. Spain, in order to recover Havana, was obliged to give up Florida, for which loss France compensated Spain by the cession to it of Louisiana, including New Orleans. Thus France, which at the beginning of the war and during the first four years held a dominating position over most of North America, had disappeared from that continent as a political and military power. In contrast, all along the Atlantic seaboard from the northern reaches of Hudson bay to the Keys of Florida the British union jack waved without a rival.

American Colonial Reactions.—On the surface it seemed that, with the triumphant outcome of the war, the British empire would for generations determine the future of North America. However, the very magnitude of the victory of British arms there undoubtedly played a major part in undermining the loyalty of the American colonials to the British crown. Before the war the value of their connection with Great Britain was obvious. With its conclusion this no longer was true—it now seemed that a continued dependence upon the mother country, instead of bringing benefits, would involve most onerous obligations. When the Americans—by reason of the outcome of the Great War for the

Empire—no longer had to live in fear of powerful enemy neighbours on their borders. they understandably sought to narrow as much as possible the range of authority exercised over them by king and parliament. When there was resistance to this, friction developed and reached a white heat in 1775 in the American Revolution.

In 1783. just 20 years after the peace of Paris had signaled the consolidation of all of eastern North America, Great Britain was obliged to agree to the independence of the 13 colonies, although it had been to guarantee their future within the empire that the Great War for the Empire had been waged.

See F. Parkman, *Montcalm and Wolfe* (1884); *H.* R. Casgrain, *Wolfe and Montcalm* (1905); W. Wood, *The Fight for Canada* (1906); J. Windsor, *The Mississippi Basin* (1895); *H.* L Osgood, *The American Colonies in the 18th Century* (1926); *L.* H Gipson, The *British Empire Before the American Revolution* (1936–54). (L. H. G.)

FRENCH ANTILLES (ANTILLES FRANÇAISES), Caribbean islands in the Lesser Antilles, comprise two overseas *départements* of France: Guadeloupe and Martinique. Guadeloupe (*q.v.*) is in the Leeward Islands and lies between Montserrat and Dominica. Its dependencies include the nearby islands of Marie-Galante, La Désirade, Îles des Saintes and Îles de la Petite Terre to the southeast and, about 135 mi. N.W., Île St. Barthélemy and the French part of St. Martin. Martinique (*q.v.*), in the Windward Islands, lies between Dominica and St. Lucia. Total area 1,118 sqmi.; pop. (1960 est.) 542.000. (D. R. H.)

FRENCH BROAD RIVER, western North Carolina and eastern Tennessee, U.S., drains nearly two-thirds of the high southern Appalachians in North Carolina. Rising in the Blue Ridge mountains of southwestern North Carolina, near the South Carolina border. it flows generally north through the upland Asheville basin. Turning northwestuard at Asheville and descending 714 ft. in 14 mi., it continues to the Tennessee state line. From there it turns westward to Knoxville where it unites with the Holston to form the Tennessee river (*q.v.*). Total length 210 mi. Principal tributaries include the Pigeon and Nolichucky rivers. Douglas dam of the Tennessee Valley authority forms Douglas Lake reservoir about 30 mi. above the river's mouth. Originally navigable for about 50 mi. upstream, the river was used only by sand dredges in its lower reaches in the second half of the 20th century. (L. DD.)

FRENCH COMMUNITY, an association of states known in French simply as the COMMUNAUTÉ. In 1958 it replaced the French union, itself the successor of the former French colonial empire.

History.—The first French colonial empire, created in the 17th century, comprised Canada, Louisiana (the whole Mississippi valley), St Domingue (Haiti) and most of the Lesser Antilles, Guiana. two agencies of Senegal, five agencies in India with zones of influence. the Mascarene Islands (Reunion. Mauritius and Rodrigues) and the Seychelles. Between 1763 and 1815. France lost most of this empire. retaining only Martinique, Guadeloupe, Guiana, the agencies of Senegal and India (deprived of their hinterlands) and Réunion Island.

In the course of a century France formed a second colonial empire, which in 1919 consisted of the following lands (1) in north Africa: Algeria. Tunisia and Morocco (protectorates); (2) in west-central Africa: two colonial federations, French West Africa and French Equatorial Africa and two territories mandated by the League of Nations. Togo and Cameroun; (3) in the Indian ocean: French Somaliland. Madagascar and its dependencies (Comoro and the Southern Lands), the five agencies in India (Pondicherry, Chandernagore, Yanaon, Karikal and Mahé) and Réunion Island; (4) in the Pacific ocean: French Indochina (the colony of Cochin-China and the protectorates of Tongking, Annam, Cambodia and Laos), New Caledonia and the French *établissements* of Oceania (all eastern Polynesia); (5) in America: St. Pierre and Miquelon, Martinique, Guadeloupe and French Guiana; (6) in the Levant: the two mandated territories of Syria and Lebanon, which were autonomous republics. The inhabitants of the countries acquired before 1815 were French citizens and elected their representatives to the French parliament. Elsewhere the colonial peoples were subjects without political rights, and the chiefs were subordinate. in lam or in fact, to the French governors.

After World War II the Levantine states gained their independence. In 1944 a conference held at Brazzaville (capital of the former French Equatorial Africa) accepted the right of the colonies to be represented in parliament. The constitution of 1946 created the French union. composed of associated states (the former protectorates1 and of the French republic which consisted, in addition to France. of the overseas *départements* (Algeria, Antilles and Reunion). the overseas territories (the former colonies) and the associated territories (Cameroun and Togo). All the inhabitants were citizens and represented in the French parliament. The territories and Algeria were also granted a local assembly. The union had a president (who was that of the French republic) and a high council and an assembly which were purely consultative.

Developments within this system were somewhat rapid. In 1952 the Indian agencies were transferred to the government of India. The nar in Indochina. launched by communist Vietminh, resulted, in 1954. in the independence of the four states. North Vietnam, South Vietnam, Cambodia and Laos. Tunisia and Morocco gained their independence in 1956. The territories received in 1957, under the "cadre-law," governing councils elected by their assemblies. In Algeria the revolt of certain Muslims who demanded independence, and the determination of the 1,000,000 French colonists to oppose separation, prevented the working out of a constitution. On May 13. 1958, the colonists formeda "committee of public safety"; parliament yielded and called to power Gen. Charles de Gaulle. The constitution of Oct. 5, 1958, ratified by the vote of all the territories (except Guinea, who thus broke with France), created the French Community.

Constitution.—The principle of the community is that of "free determination." The constitution was ratified by universal suffrage. this vote being considered as adherence on the part of each territory. The local assemblies then had to choose between the status of a territory and that of a state. Only the smallest territories chose the status quo. The status of the territories can be modified and every state can become independent.

The French Republic comprises: (1) European France: (2) the overseas *départements,* their administration and legislation being in principle those of the metropolis, but each of which can receive an individual constitution; (3) the overseas territories, which have their onn individual organization nith a territorial assembly elected by universal suffrage; the assembly appoints a governing council, its president being the governor appointed by the central power.

The republic is "one and indivisible"; all the inhabitants are French citizens; those citizens who have a special civil status (in respect. for example, of the Muslim faith or of local customs) retain the benefit of this. All citizens take part in the election of the president of the republic and of the French parliament.

The States do not form part of the French republic; they are independent and work out their own constitution. They may create unions among themselves.

The Community is the association formed between the French republic and the other states. There is only one "citizenship of the community." The community's sphere of competence includes foreign policy, defense, currency and common economic and financial policy.

The President of the Community is the president of the French republic and the states take part in his election. He has a representative (high commissioner) in each state. President de Gaulle reccived in 1958 an absolute majority in all the states.

The Executive Council of the Community meets several times a year. in one or other of the capitals, on the summons of the president who assumes the chair. It is composed of the chiefs of the governments of the different states and the ministers responsible for common affairs.

The Senate of the Community is composed of members of the local assemblies designated by them in numbers proportional to the population of the state. After holding two sessions it was abolished in March 1961.

A Community Court of Arbitration, composed of seven judges nominated by the president, gives decisions in disputes between member states.

Agreements of Association may be made by the community with other states.

There are no longer any associated territories, since Togo and Cameroun have, at the instance of France. had their mandatory status terminated by the United Nations, their independence dating from 1960.

The French Republic. — The French republic consists of the following countries (each of which, as well as the other states, is the subject of a separate article):

(1) European France, including Corsica.

(2) The overseas de'partements, former colonies that were part of the first French colonial empire. The inhabitants are white, black or of mixed race and all are French citizens, subject to French law. These lands are organized in the same way as the *départements* of France, with a *préfet* (the agent of the central government) and an elected general council. Their budget is that of the metropolis and individual dispositions in certain respects may be made by law with regard to them. They are, in the Rest Indies: Martinique, Guadeloupe and its dependencies; in South America: French Guiana; and in the Indian ocean, Réunion.

(3) Algeria and Sahara. These areas, considered an integral part of France, are divided into de'partements, 13 in Algeria and 2 in Sahara. All the inhabitants are French citizens. but the Muslims preserve their former juridical status. All send representatives to the French assemblies and elect municipalities. The particular situation of Algeria has demanded special measures pending the definitive establishment of its status. integration and federation each having its partisans, in addition to the insurgents who demanded independence.

(4) The overseas territories. These are small and very scattered countries which, while participating in the institutions of the republic, enjoy a certain autonomy and have their own budget. They comprise the following in North America: the islands of St. Pierre and Miquelon, remnants of French Canada; in east Africa: French Somaliland; in the Indian ocean: the Comoro Islands, and the Southern (Kerguelen and other islands) and Antarctic territories. administered directly from Paris; in the Pacific ocean: New Caledonia. Wallis and Futuna Islands and French Polynesia. France also has, with Great Britain, the condominium of the New Hebrides, which has no representative institution and does not form part of the republic.

Other Member States. — These were the following, by geographical distribution:

(1) In uest Africa (formerly l'Afrique Occidentale Française, less Guinea:: the republics of Senegal, Mali, Mauritania, Upper Volta, Dahomey, Ivory Coast and Niger. Senegal and the Sudanese republic in 1959 united to form the short-lived Federation of Mali, which in 1960 divided to form two republics, Senegal and Mali. Ivory Coast. Upper Volta. Dahomey and Niger have created the Sahel-Benin entente. All the states agreed to form a customs union. (2) In equatorial Africa (formerly l'Afrique Equatoriale Française): Central African Republic and the republics of Gabon, Congo (former Middle Congo) and Chad.

(3) The Malagasy (in French Malgache) Republic (Madagascar).

Evolution. — The system set up overseas by the constitution of 1958 survived only in Algeria, the Sahara, the overseas *départements* and the overseas territories. Among the states the community functioned only during 1959 when six sessions of the executive council were held in various capitals. Immediately after the sixth session. held in December at Dakar. President de Gaulle agreed to Mali's claim for national sovereignty.

In 1900 the powers of the community were transferred to the various republics. In April agreements were signed between France and Mali and France and Madagascar, recognizing the independence of those two countries. At the same time they made agreements to receive military, economic and cultural aid from France. In July the Ivory Coast, Upper Volta, Niger and Dahomey received their independence and so did the four republics of the former French Equatorial Africa. A similar agreement mas made with Mauritania in October. By 1961 only Senegal. Gabon, Congo. the Central African Republic, Chad and the Malagasy Republic still belonged to the community. The constitutional bodies, however, no longer continued to function and the relations between these member states and France showed no difference from the relations between France and the other formerly French states.

This new system is based purely on contractual agreements. The states are fully independent. with their own flags, their own national anthems, their own representation abroad and their own armed forces. They were admitted as members of the United Nations in Sept. 1960 (except for Mauritania, whose independence came slightly later and was admitted to the UN in 1961). Their new constitutions, for the most part, tended to give increased executive power to the presidents. In the African republics, where dialects are numerous, French remains the official language. The Malagasy Republic allows French alongside Malagasy.

In Sept. 1960, when Senegal broke away from the Federation of Mali, the Sudanese republic took the name of Mali, and declared its previous agreements with France void. The two states, Senegal and Mali, were admitted separately to the United Nations.

Some of the overseas territories demanded a constitution that would give them greater autonomy. A cease-fire agreement ending the Algerian war was announced on March 18, 1962, and De Gaulle's program for an independent Algeria was given overwhelming support by the French people in a referendum held on April 8. 1962. Independence, now a permanent collaboration with France, was approved by the Algerians in the referendum of July 1, 1962. (See ALGERIA: History.)

Economy. — All the states of the former community, as constituted in 1958, with the exception of French Somaliland but with the addition of Tunisia, Togo and Cameroun. form the "franc area" (zone franc) inside which currencies are freely transferable and which is recognized as a monetary unit by the world. European France sends about 35% of its exports to the other countries of the franc area and receives from them 24% of its imports. Of the exports of these countries 75% is absorbed by France, who supplies 74% of their imports.

Algeria is the principal customer of France and its third supplier. France has more trade with west Africa than with Great Britain. The economic ties that are created by the franc area, by customs tariffs and by French enterprises therefore have considerable importance.

The countries of the 1958 community have a surplus of soft wheat. barley, bananas, cocoa. wine, iron, nickel, lead, phosphates and potash. They can normally supply their own requirements of soft wheat, peanuts. rice, citrus fruits, coffee. vegetable oil and sugar. They have to import in quantity cotton, wool, coal and petroleum, though production of the last-named item in the Sahara would limit the necessity for its importation. The commercial exchanges are largely carried in French ships and aircraft. The franc area and the agreed preferences for the products of the community assure the sale of these goods and, in the case of certain products, at rates higher than world prices. European France, for its part, finds an assured market for its manufactured goods in the other countries of the community. The trade balances of the overseas countries, almost everywhere in deficit, are stabilized by the common funds of the franc area.

Furthermore. the still rudimentary economy of most of the overseas countries is stimulated by the investment of European France. These exceed $1,000,000,000 a year. more than three-quarters of which is supplied by French public funds. More than one-half is devoted to the construction of railways, roads, ports, etc., the rest is divided between the improvement of production (agriculture, irrigation, etc.), and social services (health, education). A fund for aid and co-operation (F.A.C.) and a central treasury for economic co-operation (C.C C.E.), as well as a special ministry for community relations assure the implementation by France of the necessary technical assistance. Another ministry is responsible for the overseas *départements* and territories and for the Sahara The prime minister himself has the responsibility for Algeria, which was the object of a special effort (the Constantine plan) to meet the serious problems arising from the rapid increase of the population in a country of limited resources. France also absorbs a considerable part of the surplus of Algerian workers.

French aid to the newly independent states and the solidarity of the franc area constitute an effective formula for co-operation and assistance to the underdeveloped countries.

See H. Deschamps, The French Union (1956); F. Luchaire, Droit d'outremer (1959). (Hu. De.)

FRENCH CONGO, the official name of the French possessions in equatorial Africa from 1888 to 1910. In the last-named year these possessions were renamed *l'Afrique Équatoriale française*, abbreviated to A.É.F. See French Equatorial Africa.

FRENCH EQUATORIAL AFRICA, the former federation in central Africa of French overseas territories, comprised of Gabon, Middle Congo (renamed Republic of Congo), Ubangi-Shari (Central African Republic) and Chad. The four territories became autonomous republics within the French Community in 1958 and independent republics in Aug. 1960. French Equatorial Africa covered 974,130 sq.mi. and, according to the census of 1950, had a population of 4,406,502.

In the west, French Equatorial Africa bordered on the Atlantic ocean between Rio Muni and Kabinda. From the northeastern corner of Rio Muni the boundary ran eastward along Cameroun for more than 300 mi., then roughly north, following Cameroun's eastern border to Lake Chad, where French Equatorial Africa had a short common border with Nigeria. The boundary continued northward along the Republic of Niger until it reached Libya, which formed the northern border. In the east the country adjoined Sudan, and in the southeast it was coterminous with the Republic of The Congo (former Belgian Congo), the border following more or less the courses of the Congo and its chief tributary the Cbangi.

Physical Features.—The area of the former French Equatorial Africa falls within the Congo and Chad basins, toward which all rivers except those of the coastal region flow. The two basins are separated by a low plateau ridge averaging 2,000–3,000 ft., reaching its greatest height in the Bongo massif (4,593 ft.). The Chad basin is closed off from the sea by Cameroon mountain, the Congo basin by the Crystal mountains (4.921 ft.). While the latter basin is naturally drained by the Congo, which has broken through the Crystal mountains near Stanley pool, the Chad basin is not directly drained. Lake Chad absorbing the rivers of this area. The drainage to the sea is incomplete, but the Benue river, the great tributary of the Niger, is cutting through the Cameroon mountain divide and has already captured some streams of the Chad basin. Both basins have an average altitude of 3,000 ft. Lake Chad. the lowest region, is 922 ft. above sea level. The greatest elevations of the territory are in the northeast, where the Tibesti mountains rise 11,204 ft. (Emi Koussi).

The most important rivers belonging to the Congo system are the Ubangi and its tributaries (Kwango, Lobaye), the Sanga and the Alima; the only river of importance ending in Lake Chad is the Shari (*q.v.*), with its tributaries Bahr Salamat and Logone; the chief rivers flowing to the Atlantic are the Ogowe (Ogooué) the Nyanga and the Niari-Kwilu (Kouilou). The four political divisions of the former federation follow approximately the country's configuration. Gabon, extending along the Atlantic coast, falls within the basin of the Ogowe river; the Republic of Congo occupies the region draining to the Congo; the Central African Republic covers most of the plateau between the Congo and Chad basins; Chad lies almost completely within the Chad basin.

Vegetation Zones.—Three dissimilar zones of vegetation are easily discernible. The southern section (Gabon and the greater part of the Republic of Congo) belongs to the tropical rain forest or selva, characterized by close groupings of high trees, averaging more than 100 ft. Where the annual rainfall is less than 50 in., as in some parts of the lower Congo basin, park savanna takes the place of the rain forest. In higher altitudes. above 2,000 ft., the forests are less dense. The rain forest is always densest along the course of rivers, where sunlight can reach the underbrush and smaller trees and give them the luxuriance which is not always characteristic of tropical forests. The forests of Equatorial Africa are its greatest economic asset, although the sporadic way in which valuable trees occur and problems of transportation make commercial exploitation difficult. There are some hardwoods, such as different types of mahogany, ebony: coral wood, ironwood and African walnut. The commonest export woods are those of the okoumé, a light mahogany, the silk cotton and the tulip trees. Commercially important also are the different species of palms, such as the oil palm (Elaeis *guineensis*), the fan palm, the raffia palm (*Raphia Ruffia*) and the piassava palm (Attalea *funifera*) from which fibre is obtained. Among the rubber-bearing plants the landolphia vine and the ireh tree (Funtumia *elastica*) are characteristic of the forest zone.

The Central African Republic belongs to the zone of savanna. In its southern sections the density of trees indicates the proximity to the rain forest which along the course of rivers extends deep into the savanna area. Although well wooded in the south, treeless savanna prevails in the north. Different varieties of acacia, the baobab, the monkey bread tree, and the cotton tree are the typical trees; the wild coffee tree occurs. The open savanna, with a rainfall of from 18 in. to 40 in., is well suited for agriculture. In addition to sorghum and millet: cotton, introduced in 1929, has become an important crop throughout this zone.

The southern districts of Chad fall within the zone of treeless savanna, the northern extend into the Sahara desert where, except for some desert shrubs, vegetation is limited to a few oases. In the lake and swamp area there is a dense growth of hydrophytic grasses, varying in height from 3 ft. to 12 ft.; the ambatch tree occurs. About 28% of Chad's area (140,000 out of 490,733 sq.mi.) is desert.

Animal Life.—The dense forest zone is not particularly inviting to larger animals; it is the home of arboreal creatures such as birds, insects (butterflies, bees. wasps, red ants and mosquitoes), bats, giant squirrels, snakes (cobra, python, puff adder, viper) and monkeys. Most notable among the forest animals are the gorilla (first found in Gabon by Paul du Chaillu in 1856) and the chimpanzee. Land animals are represented by dwarf antelopes, duikers, short-horned okapi, red buffaloes, forest elephants and leopards. Numerous fish, crocodiles and hippopotamuses abound in the rivers. The savanna is inhabited by grazing animals, particularly by many species of antelope; hyena are numerous; the lion occurs sporadically. The savanna region of the Central African Republic is famed as a hunting ground. In the semideserts of Chad ostriches may be seen.

Climate.—The rain forest area of Gabon, Republic of Congo and southern Central African Republic belongs to the region of equatorial heat and humidity. The temperature remains even, seldom varying more than 10° F. throughout the year. The average temperature is close to 80° F. (average in Libreville, 79° F.; Brazzaville, 78° F.). The daily ch'anges of temperature are greater than the annual, amounting to 15°–20°. The rainfall, normally about 60 in., is distributed over the whole year, but since the heaviest rains fall shortly after the apparent northward or southward movement of the sun, rainfall reaches its maximum in different areas at different times. At the equator the heaviest rains fall in April (after the sun has passed the zenith in its movement to the north) and October (when the sun moves to the south). The rainfalls come normally in the afternoon and are accompanied by a temporary dropping of the temperature of as much as 20" F.

The climate in the savanna zone, often called the Sudan type, is also hot. During the warmest months (usually May), the average temperature exceeds 90° F.; in the cooler months, when the diurnal range is great, the average temperature is still above 70° F. From October to March the northeast trade wind, called harmattan, blows across the savanna; it brings dry air into the region. which is very humid during the other seasons of the year. but desiccates vegetation and is loaded with fine particles of dust. During the summer the southwest monsoon blows; it brings the rains, which last from June to October.

The duration of the rainy season decreases toward the north. Also the annual precipitation diminishes from south to north; 50 in. is the average near the forest zone, 10 in. in the fringe of the desert. The northern sections of Chad have desert climate. Since precipitation is practically negligible except for the Tibesti mountains. the humidity is low. Summer temperatures are frequently above 120" F., winter temperatures even below 60° F. Since the diurnal range is frequently around 50°, night frosts are not unusual.

History. — The history of these parts of Africa prior to the French occupation is little known. The coastal region had been visited occasionally by Europeans after the mouth of the Congo was discovered in 1484 by Diogo Cam.

Several African kingdoms existed, of which Loango (*q.v.*) and the Bateke state, called Anzico, were the most prominent. Between 1517 and 1822, the coast was one of the chief centres of the slave trade to the new world. Europeans called at coastal slave depots but did not penetrate into the interior.

French interest in this part of Africa was, in its initial stages, accidental. When, during the first half of the 19th century. the French, like the British, combated the slave trade along Africa's west coast, they desired a supply station for their patrolling warships. On Feb. 9, 1539. Capt. L. E. Bouet-Willaumez obtained, by agreement with Denis. a Seke chief, the right of residence in two small places on the left bank of the Gabon estuary. and in 1843 he secured the right bank by treaty with the Seke chief Louis. Similar agreements were made with other native chiefs, so that by 1862 French authority had extended almost along the whole coast. The first large settlement was established in 1849 with slaves captured from the slaver "Elisia" and was symbolically called Libreville, which became the capital of Gabon. The hinterland was gradually opened by adventurous individuals exploring the Ogowe and other rivers flowing into the Xtlantic. Of the many explorers a few are outstanding: Paul du Chaillu. A. M. A. Aymès, A. Marche. the marquis de Compiegne. A. Bastian and O. Lenz. Yet by the end of the 1860s no one had gone farther inland than the boundaries of the Gabon territory or even all the way up the Ogowe.

France took greater interest in its equatorial possessions after the Franco-German War. The activities of Pierre Savorgnan de Brazza (*q.v.*) created the French empire north of the Congo river. After H. M. Stanley had discovered (1874–77) the course of the Congo, Brazza signed treaties with African chiefs in the interior of the continent and placed them under French protection. Most important was the treaty with King Makoko of 1880, placing the Bateke state, which extended to the southern bank of the Congo. under French control.

In 1880 Brazzaville. the future capital of French Equatorial Africa, was founded near Stanley pool on the Congo. In 1885 the French-held territory south of the river, including the settlement of Kinshasa, was ceded to the Congo Free State.

The General act of the conference of Berlin (1885; see AFRICA) established an "open door" policy for'trade in the Congo basin and rules for the future occupation of the coast of Africa. France in the next 25 years pursued its Airican expansion with great vigour. Between 1885 and 1891 most of Gabon and Middle Congo were secured, and French expeditions began to extend into the Cbangi-Shari and Chad areas, signing treaties with native chiefs according to the rules agreed upon at the Berlin conference. French expansion was aimed in two directions, toward the upper Nile valley and toward the French possessions in north Africa. Expansion toward the Nile failed. By 1896 Victor Liotard had made progress in the Bahr el Ghazal area; and J. Marchand's expedition, which left the Congo in March 1897, reached Fashoda on the Nile in July 1898. But Great Britain objected to the presence of French troops in an area regarded as a British zone of influence and forced the evacuation of Fashoda. In hfarch 1899 the boundary between the French territory and the Anglo-Egyptian Sudan was settled except on the borders of Wadai and Darfur. In 1919 this area was divided, and in 1924 the frontier was demarcated. Expansion toward the north was partially successful.

The conquest of the Chad area, where powerful Negro kingdoms had existed since the middle ages. took several decades. At the time when the French began their expansion, many of these states had been conquered by Rabah Zobeir (*q.v.*), a follower of the mahdi of the Egyptian Sudan. The many expeditions which were sent against this region either iailed or ended in disaster. Émile Gentil, however, succeeded in reaching Lake Chad in 1897; he signed a treaty with the sultan of Baguirmi (*q.v.*), who had been ousted by Rabah and who placed himself under French protection. Although Gentil established himself in the capital of Bagirmi, the following years were filled with bloody fighting against Rabah. Rabah was finally defeated and killed in the battle of Koussri on April 22. 1900. when Gentil's forces were strengthened by those of A. Foureau and F. J. A. Lamy coming across the Sahara from Algeria and by the mission of .Paul Joalland and O. F. F. Meynier arriving from Senegal. Commander Lamy was also killed in this engagement (the capital of Chad, Fort Lamy, was named after him).

The complete pacification of the areas north of the lake, which had been conceded to France by Great Britain in 1899, was not easily accomplished. The state of Wadai was conquered after hard fighting in 1911; and Borku (*q.v.*) in the north of the Chad territory, was finally occupied in 1913. The conquest and organization of the Chad territory was principally the work of Col. Emmanuel Largeau. This northward expansion of French Equatorial Africa succeeded in establishing a junction with the Niger colony of French West Africa and thus secured a continuous French empire extending from the shores of the Mediterranean to the banks of the Congo. In 1911, in return for recognizing French predominance in Morocco, Germany obtained two corridors of land giving access to the Congo and to the Cbangi from the German Cameroons (*q.v.*). But these areas were recovered with the occupation of the Cameroons in 1916; and the treaty of Versailles (1919) restored the unity of the French possessions.

Administrative changes were frequent in the years between the Berlin conference and the end of World War I. The name Congo Français was substituted for that of Ouest Africain as French influence spread over the interior of the continent, but the problem of unification was complicated (1) by Gabon's being outside the area to which the "open door" commercial policy had to be applied and (2) by the fact that conditions naturally differed widely between those areas where European predominance had long been recognized and those where it n-as still precarious. Thus Gabon was at first separate from the rest of the Congo Franqais (1886–89), then merged into it (till 19043 and then made one of three colonies (the other two being Middle Congo and Ubangi-Shari-Chad). In 1905 the commissioner general for the Congo Franqais was raised to the status of governor general; and by a decree of Jan. 15. 1910. the name French Equatorial Africa was given to a *gouvernement général* comprising the three colonies, each of which had its own lieutenant governor and its own budget. Chad, having been detached from the Ubangi-Shari-Chad colonial unit and made a "territory" in 1914, was finally given full colonial status in the *gouvernement général* in 1920.

Vast in area, sparsely populated and lacking easy means of communication, the country was difficult to develop economically and so was long known as the Cinderella of the French colonies. In 1890 Eugène Étienne, undersecretary of state, favoured the establishment of monopoly companies which had worked with success in Belgian and British territories. Although the first attempts failed, they were renewed in 1899. when large concessions (256,865 sq.mi.) were granted to 40 companies for periods of 30 years. Each company had the exclusive right of exploiting the concession area in return for certain payments to the state and colony. The many abuses against the natives (revealed in such trials as the Toqué-Gaud affair of 1903), the international disputes resulting from the companies' interference with the principles of the Act of Berlin and the disappointing financial returns brought an end to this concession system sooner than had been expected. The conflicting stories of the concession system were not unraveled. Savorgnan de Brazza. sent out to investigate conditions in the concession areas?died in 1905 on his way home, and his report was not published. In 1910 most of the companies exchanged their huge land grants for smaller ones; during the following 20 years the government gradually recovered a great share of the original concessions. leasing them again only under more humane and more profitable conditions than had been done theretofore. The concessionnaire companies were finally deprived of their privileges on Aug. 24, 1930; they were given contracts as industrial and development concerns.

The chief obstacle to the development of French Equatorial

Africa after World War I was a continuous budget deficit: but in 1930 the French government voted a 45,000.000-fr. subsidy for a public works program, to be followed by other substantial subsidies. The government began to encourage native production of those goods (such as cotton and coffee) which were in demand in France. An agricultural credit fund was to aid local native production.

On June 30, 1934, the federal constitution of French Equatorial Africa was replaced by unitary administration from Brazzaville, with one single budget; but the four-part zonal division subsisted, to be emphasized by a new process of decentralization from 1937.

In World War II, after the Franco-German armistice of June 1940, the governor of Chad, Félix S. Eboué, a Negro, proclaimed on Aug. 26 that his territory would continue the war on the side of Gen. Charles de Gaulle and the Free French; and the other territories, as well as the mandated territory of Cameroun, followed his example. Brazzaville became the capital of Free France in Africa, and Eboué was appointed governor general of the territory in Nov. 1940. French Equatorial Africa became an important supply base for the Western Allies and the Chad territory became a subsidiary base for the campaigns in North Africa and the near east. The airport of Fort Lamy formed a vital link in the U.S. and British air lines from west Africa to Cairo. From Chad, French troops attacked the Italian station of Kufra in 1941 and 1942; and the French force under Gen. Jacques Leclerc, which in 1943 conquered Fezzan and joined the Allies in North Africa, began its operations in the desert of the Chad region.

Eboué, who died on May 17, 1944, introduced a new policy into French Equatorial Africa. In circulars of Jan. 19. 1941, and Nov. 8, 1942, he expressed himself in favour of increased decentralization and the incorporation of traditional native institutions into the administrative organization. The Brazzaville conference of Jan.-Feb. 1944, when the governors of all French African territories met to discuss the future of the French African empire, was largely the result of his inspiration.

The constitution of 1946 made all the indigenous peoples French citizens, and in the 1950s notable progress was made through the Fund for Economic and Social Development. The territories, which became autonomous republics in 1958 and independent republics in 1960, remained uithin the French Community. In 1960 Chad, Republic of Congo and the Central African Republic formed a confederation known as the Equatorial union (dissolved in the same year).

Population. — The great majority of Africans are Negroes, but there are a few other groups. In the Gabon and Republic of Congo forest a few hordes of Pygmies, first discovered there in 1865 by P. du Chaillu, have survived. North of Chad is inhabited by black Arabs, who occupied large areas after the middle of the 15th century. The Negroes of Gabon and the southern part of the Republic of Congo belong to the Bantu-speaking group, whereas those of the remaining republics are Sudanic-speaking. Most prominent among the former are the Fang (*q.v.*); Pangwe, Pahouin, Bakalai. Bakota and Bateke; while the Sanga. Baya, Banda, Mandya, Azande (*q.v*) and Sara are the larger groups among the latter. As a result of the various Arab and Fulani invasions into the region around Lake Chad, the ethnic situation was greatly changed: the invaders, although adopting the native Sudanic language, intermingled with the Negroes, introduced Islam as a religion and established large states. Within the republics the most important are the sultanates of Wadai, Baguirmi (*qq.v.*) and Kanem. In the northern desert region of Chad live the Tibbu or Teda, who are perhaps a mixture of Negroes and Hamites. The great majority of Kegroes, with the exception of those living in the areas adjacent to the sultanates, are non-Moslems. They have retained their traditional beliefs, mostly centring around ancestor and spirit worship.

According to the 1950 census, the republics had a population of 4,406,520 (4.5 per square mile), including 20,120 Europeans. Population is densest in the Republic of Congo (5.2 per square mile) and thinnest in Gabon (4.0).

The group of territories had 900 primary and 12 secondary schools in 1953, with about 123,000 pupils, of whom 58,000 were receiving education from Christian'missions. In the Moslem areas there were numerous Koranic schools, giving religious training only; and there was a Franco-Moslem secondary school at Abeshr (Abéché) in Chad. A number of students received higher education in France.

Administration. — At the head of the former French administration was a high commissioner, who was responsible to the French ministry of the overseas territories and who was assisted by a secretary-general. The four territories, each of which was under a governor, were divided into *régions*, which were in turn subdivided. The administrative centre of the *gouvernement général* was Brazzaville (pop. [1959 est.] 96,000), in the Middle Congo; the capital of the territory of Middle Congo, however, was Pointe Noire (pop. [1950] 21,400), while that of Gabon was Libreville (pop. [1957] 19,113). that of Ubangi-Shari was Bangui (pop. [1959 est.] 79.634) and that of Chad was Fort Lamy (pop. [1961] 58,179). The native chiefs were appointed by administrators. All the inhabitants were made French citizens in 1946.

There was an elected territorial assembly in each territory; these assemblies elected the members of the grand council of French Equatorial Africa, voted the budget and controlled the administration. French Equatorial Africa was represented in Paris by five deputies in the national assembly, by eight senators in the council of the republic and by seven councillors in the assembly of the French union.

Economy. — This area of central Africa has great natural resources, primarily in forest products and in minerals. Still largely undeveloped up to the outbreak of World War II, the country thereafter was more rapidly developed, since its oilseeds, fibres and minerals were urgently required by Great Britain and by the United States.

Forest products include timber, rubber, oilseeds, copal gum and wax. The Central African Republic and Chad produce considerable quantities of cotton. Coffee is also grown extensively.

Of the minerals, gold is the most important in terms of value. Others found in the territories are lead, zinc, copper, titanium apd diamonds, as well as manganese, of which there is a very large deposit in Gabon.

Communications. — The chief port for the area is Pointe Noire; Port Gentil and Libreville are of less importance. The harbour of Pointe Noire, completed in 1940, was equipped to handle ships of all sizes, thus enabling the republics to become independent of Matadi, the Belgian port used in former years. Pointe Noire is connected with Brazzaville by the Congo-Ocean railway (320 mi.) which was completed in 1930.

(H. A. Wf.; Hu. De.)

FRENCH GUIANA (Guyane Française): *see* Guiana: *French Guiana.*

FRENCH GUINEA, a former territory of French West Africa and from Oct. 1958 the independent republic of Guinea, is bounded on the west by the Atlantic ocean and Portuguese Guinea, north by Portuguese Guinea and Senegal, northeast by Mali, east by Ivory Coast and south by Liberia and Sierra Leone. With a seaboard running north-northwest and south-southeast from 10° 50' N. to 9° 2' N., Guinea extends east 475 mi. in a straight line and attains a maximum width north to south of nearly 325 mi., covering 94,925 sq.mi. Pop. (1959 est.) 2,726,888.

Physiography. — Though in one or two places rocky headlands jut into the sea. the coast is in general sandy. low and much broken by rivers and deep estuaries, dotted with snampy islands, giving it the appearance of a vast delta. In about 9° 30′ N., off the promontory of Conakry. lie the Los Islands (*q.v.*), forming part of the territory. The coast plain, formed of alluvial deposits, is succeeded about 30 mi. inland by a line of cliffs, the Susu (Soussou) hills, which form the first step in the terracelike formation of the interior, culminating in the massif of Fouta Djallon (Futa Jallon), composed chiefly of Archaean and granite rocks. While the coastlands are either densely forested or covered with savannas or parklike country, the Fouta Djallon tableland is mainly covered with short herbage. This tableland. the hydrographic centre of west Africa. is most elevated in its southern parts, where heights of almost 5,000 ft. are found.

Near the Sierra Leone frontier this high land continues westward to within 20 mi. of the sea, where Mt. Kakulima rises about 3.688 ft. East and south of Fouta Djallon the country slopes to the basin of the upper Niger river, the greater part of which is included in Guinea. The southern frontier is formed by the Nimba mountains. which separate the Niger basin from those of the coast rivers of Liberia. Besides the Niger, Gambia and Senegal (*qq.v.*), a large number of streams running direct to the Atlantic rise in Fouta Djallon.

Climate. — The climate of the coast district is hot and moist, with a season of heavy rain lasting from May through October, during which time variable winds, calms and tornadoes succeed one another. There is also heavy rainfall in the Fouta Djallon highlands. but the Niger basin is some\\-hat drier.

Vegetation and Animal Life. — The seashore and the river banks are lined with mangroves, but the most important tree of the coastal belt is the oil palm. The dense forests contain many varieties of rubber vines, while the summits of the higher land are covered mostly with Guinea plum (*Parinarium excelsum*). Gum-producing trees are abundant. and there are many fruit trees, the orange and citron growing well in the Susu and Fouta Djallon districts. The coffee plant is indigenous; banana plantations surround the villages. The baobab and the karité (shea-butter tree) are common only in the Niger districts.

The fauna is not so varied as was formerly the case, large game having been to a great extent driven out of the coast regions. The lion is now common only in the northern parts of Fouta Djallon; leopards, hyenas and wildcats are more common and there are civet cats. Hippopotamus and wild boar are numerous; wart hogs are common in the central region. Black duikers occur in the forests but other antelope, though widespread, are rather rare. Serpents are very common, both venomous and nonvenomous; the pythons attain a great size. Crocodiles infest all the rivers. Birds are very numerous and varied; they include the egret, the marabou and the pelican; touracos and parrots are common.

History. — This part of the caast was made known by the Portuguese voyagers of the 15th century. Largely in consequence of the dangers attending its navigation, it was not visited by the European traders of the 16th-18th centuries as frequently as other regions north and east; but in the Rio Pongo, at Matakong (a diminutive island near the mouth of the Forécariah) and elsewhere, slave traders established themselves; and ruins of the strongholds that they built (and which they defended with cannon) still exist. When driven from other parts of Guinea the slavers made this difficult and little-known coast one of their last resorts. and many barracoons were built in the late years of the 18th century. Not until they had recovered Gorée at the close of the Napoleonic Wars did the French show any marked interest in this region. At that time the British, from their bases at the Gambia and Sierra Leone, were devoting considerable attention to the rivers south of Senegal and also to Fouta Djallon.

On the French side, René Caillié started his journey to Timbuktu from Boké in 1827. From 1838 onward French naval officers, L. E. Bouet-Willaumez and his successors, made detailed studies of the coast. Col. Louis Faidherbe was appointed governor of Senegal in 1854, and under his direction vigorous efforts were made to consolidate French influence in the region. Already in 1848 treaty relations had been entered into with the Nalu, and between that date and 1865 treaties of protectorate were signed with several of the coast tribes. During 1876–80 new treaties were concluded with the chief tribes, and in 1881 the almamy (or amir) of Fouta Djallon placed his country under French protection, the French thus effectually preventing the junction, behind the coastlands, of the British colonies of the Gambia and Sierra Leone. The right of France to the littoral as far south as the basin of the Melakori was recognized by Great Britain in 1882; Germany (which had made some attempt to acquire a protectorate at Conakry) abandoned its claims in 1885; and in 1886 the northern frontier was settled in agreement with Portugal, which had ancient settlements in the same region. (See PORTUGUESE GUINEA.) In 1904 the Los Islands (off the coast of French Guinea) were ceded by Great Britain to France, in part return for the abandonment of French fishing rights in Newfoundland waters.

Until 1890 the newly gained territories were administratively part of Senegal; they were then formed into a separate colony called Rivières du Sud. a name changed about five years later to Guinée Française. In 1895 the colony came under the supreme authority of the newly constituted governor generalship of French West Africa (*q.v.*). It retained administrative and financial autonomy and was administered by a governor. In 1946 all the inhabitants mere made French citizens. At a referendum in Sept. 1958 French Guinea rejected the new French constitution and on Oct 2 the Republic of Guinea was proclaimed. In 1959 Kname Nkrumah, prime minister of Ghana. and Pres. Sékou Tour6 of Guinea, agreed upon a union (not legally defined) of the two states.

Population. — On the banks of the Cogon dwell the Tendas, who are allied to peoples of Portuguese Guinea. The Baga, the Nalu, the Landuman and the Timne, regarded as typical Negroes, migrated southward before the 17th century. Today the Baga occupy the coastland between the Cogon and the Rio Pongo, and the Landuman the country immediately behind that of the Baga. The coastal region south of the Nuñez and all the interior up to Fouta Djallon is occupied by the Susu (Soussou), a tribe of the great Mandingan race, which forced its way seaward about the beginning of the 18th century and pressed back the Timne into Sierra Leone. Fouta Djallon is peopled principally by Fulani (*q.v.*), and the other districts by Malinké and other tribes of Mandinga (*q.v.*). The Mandinga, the Fulani and the Susu are Mohammedans, though the Susu retain many of their ancient rites and beliefs. In the northwestern part of Fouta Djallon are found remnants of the aborigines, such as the Tiapi, the Koniagui and the Bassari. On the Liberian frontier the Kissi and Guerze peoples are found.

The principal towns, in order of their size, are Conakry, the capital, which had 40.000 inhabitants in 1959; Kankan, the terminus of the railway and a principal airport; Labé, the chief town of Fouta Djallon; Siguiri, on a navigable stretch of the Niger, the centre of the gold industry; Kindia, a banana centre; Kouroussa, where the Niger and the railway cross; Beyla; Dinguiraye; Boké; Mamou; and Benty.

Conakry, in 9° 29' N.. 13° 42' W., is the one important port of entry on the coast. It is built on the little island of Tombo which lies off the promontory of Conakry, the town being joined to the mainland by an iron bridge.

Products and Industry. — Guinea possesses a moderately fertile soil, and the area is rich in tropical produce, notably bananas, palm kernels. orange essence, kola nuts and peanuts. Gold exists in alluvial and fluvial deposits and bed lodes. Siguiri being the centre of the industry. Diamonds are mined in the vicinity of Macenta. There are important deposits of iron ore in the Kaloum peninsula and of bauxite in the Los Islands.

Stock raising is practised extensively in Fouta Djallon and in the valley of the upper Niger, and cattle are sent in considerable numbers to Sierra Leone and to Liberia. Guinea's agricultural and mineral products include cereals (mainly rice), palm oil, peanuts, gold and diamonds. The principal exports in the early 1950s were palm kernels, bananas, coffee and bauxite.

(F. R. C.; T. C. WN.; HU. DE.)

FRENCH INDOCHINA (INDOCHINE FRANÇAISE), the territory in southeast Asia which. apart from Japanese partial occupation during World War II. was until 1954 held by France and included the countries now known as Cambodia, Laos, North Vietnam and South Vietnam. The French, from their capital at Saigon, dealt with the so-called Union of Indochina in four separate political units: Cochin China, a directly administered colony now forming the greater part of South Vietnam; the empire of Annam (which included the province of Tongking), indirectly administered as a protectorate and now largely included in communist North Vietnam; and the two kingdoms of Cambodia and Laos, also protectorates, which are now again independent territories under their own names. The territory of Kuang-Chou Wan (*q.v.*), on the east of the Luichow peninsula, leased to France by China for 99 years in 1898–99 and now the municipality of Chan-Chiang (*q.v.*), was returned to China in 1945. See INDOCHINA; VIETNAM; CAMBODIA; and LAOS.

(E. H. G. D.)

FRENCH LANGUAGE. French is one of the Romance languages (*q.v.*). In particular, the name refers to the standard literary language that is taught to natives and foreigners and that is understood and used, albeit with unequal efficiency. by all speakers of French. French also subsumes a number of dialects. These have, however, been losing currency and prestige ever since the middle ages and are now mere local patois.

French uses the same (Latin) alphabet as English, but some letters may be provided with diacritic marks. The vowels may bear an acute accent (*é*), a grave accent (8, *à*) or a circumflex accent (*â, ê, î, ô, û*). The spelling *é* indicates a so-called close pronunciation (as in English "bait," but without the diphthongal, gliding effect), 8 and ê an open pronunciation (as in English "bet"). Other accent marks do not significantly change vowel pronunciation, except that some speakers have a tendency to lengthen circumflexed vowels. The c, which is pronounced k before vowels other than e and i (where it is pronounced s), may by means of a cedilla, written *ç*, be converted into an s sound. . French orthography is not entirely phonetic; pronunciation is not certain from spelling alone, as it is in Spanish, Italian. Russian and other languages, but it is almost so. French orthography is not nearly so unpredictable as English.

French is the native language of some 40,000,000 persons in metropolitan France. About 2,500,000 more speakers (native and non-native) are naturalized French citizens and resident foreigners, and some 500,000 Frenchmen reside abroad. Of about 42,000,000 persons inhabiting French possessions, about 13% speak French, the percentages varying from 2% in French possessions in western Africa to 95% in Martinique. About one-fourth of Canada's inhabitants, mainly in the province of Quebec, speak French. In the U.S. at mid-20th century, there were more than 100,000 French-born persons. American native speakers of French, mostly bilingual, were mainly located in Maine and Louisiana, but their number was diminishing.

French is also one of the official languages of Belgium (see BELGIUM: Population) and of Switzerland (see SWITZERLAND: Population *and* Social Conditions).

HISTORY

The homeland of French (in the wider sense) is the Roman province of Gallia (Gaul), conquered by Caesar in the middle of the 1st century B.C. (except the Provincia, now Provence, which became Roman in 122 B.C.); it corresponds largely to modern France. Before its latinization the country was mainly of Celtic speech, although there is some evidence that in Aquitania (the modern Gascogne) and along some stretches of the Riviera other languages were spoken, by some scholars called Iberian and Ligurian, respectively. But Iberian is virtually unknown, unless Modern Basque, which cannot with confidence be historically or structurally connected with any other known language, is a continuation of Iberian; and Ligurian is little more than a geographical name. The Greeks also had settlements along the Mediterranean coast in Gaul before the Romans; linguistic evidence for this can be found in local names of the Riviera: Nice < Nicaea (Greek Nikeia); Antibes < Antipolis; Port-Vendres < Portus Veneris, a Latin translation of the earlier Greek name Aphrodisias. Otherwise this Greek substratum left no traces. The linguistic inheritance from Celtic, however, extends not only to local names in France (Lyon < Lugdunum; Verdun < Virodunum; names ending in *-ac, -ai,* -i) but also to a number of words, of which some (about 180) are typical of Gaulish Latin and French only. The Celtic of Gaul (Gaulish), poorly attested, was not a uniform language but was spoken in several dialects (surely more than three corresponding to the partes tres into which Caesar divided Gaul). Latinization was speedy and thorough (although the Romans made no concerted effort to impose their language), and Celtic dialects were not long continued and were rarely written: Latin enjoyed all the psychological and material advantages of the idiom of the stronger and politically and economically more advanced conquerors. (The Breton language of Brittany, now dying out owing to the social and cultural pressure exerted by the national French language, is Celtic imported in the early middle ages from Britain, not a native speech of Gaul.)

Although the evidence is defective, it can be safely presumed that. outside the spoken and written Latin lingua franca of the Roman empire, the spoken Latin of the various regions of Gaul continued the dialectal diversities of the Celtic substrata. These were the bases of the emerging Romance dialects. (For the relation between spoken and written Latin see ROMANCE LANGUAGES.)

After a period of peace and prosperity, Gaul was, like the rest of the weakening Roman empire, subject to foreign invasions, particularly by Germanic tribes. In the course of the 5th century the Visigoths settled in the south, the Burgundians in the Rhône valley area, the Saxons along the channel and the Atlantic coast, whence they soon moved to Britain. But the most important contingent was the Franks who, in 486, under their king Clovis, liquidated the kingdom of Syagrius, the Roman governor who was autocratically holding a Roman province in the north, isolated from the empire by the invaders. The Franks moved south, defeated the Visigoths (507) and absorbed the Burgundian kingdom (534). Clovis had himself baptized; the Franks became Christians and acquired Latin as their new language. They bequeathed about 200 Germanic words to the Latin vocabulary, and it is claimed that their habits of articulation caused certain changes typical for the Romance of Gaul (especially the diphthongization of vowels—see below). On the whole, their linguistic influence, though larger than that of other Germans in Gaul, was small. But France (Francia) owes to them its name.

The dynasty of Clovis, the Merovingians, divided the state among the heirs according to Germanic custom, thus producing progressive fragmentation of the land and weakening the monarchy. From the 7th century, the maior *domus* ("mayor of the palace"), originally the first official of the royal household, began usurping something like the duties and powers of a prime minister or regent of the realm, until one of them, Charles Martel. having saved the state from Arab conquest (in the battle of Poitiers, 732), became the virtual ruler. His son, Pepin the Short, actually came to the throne in 751 and established the dynasty of the Carolingians. among whom Charlemagne (768–814) was the most eminent. Under him occurred what is generally called. somewhat exaggeratedly, the Carolingian renaissance. which included a premature and largely ephemeral attempt, for political and ecclesiastical ends, to revive classical Latin. Charlemagne himself mas crowned "Roman" emperor in 800. But the Latin of Cicero had passed away and could not be resuscitated by monarchic fiat. In fact, a return to classical standards estranged Latin even more from the common man, whose Latin had actually become. owing to the passage of time and the influence of Celtic substrata and Germanic superstrata, quite a different language. It could be called Latin at this point only in deference to its earlier form. The church, recognizing this. permitted through the Council of Tours (813) the use of the "rustic" and "vulgar" native tongues for preaching so that everyone could really understand what the priests (many of whom were poor Latinists in any event) were saying.

The new language, thus attaining some prestige and being soon reduced to writing, though not for learned matters, may be called Old French. The oldest available text is that of the oaths of Strasbourg (842), an agreement uniting Louis the German and Charles the Bald. two of Charlemagne's grandsons, against the third, Lothair. in a quarrel over the division of the empire. These oaths, preserved by the historian Nithard, were pronounced in both German and French so that anyone concerned on either side could fully understand their wording. This first written source does not, of course, mark in any sense the birth of French: it had been preceded by a continuous unrecorded development of the speech of Gaul.

The subsequent Old French texts are all literary: the *Cantilène* de *sainte Eulalie* (880), the Passion de Christ, a *Vie* de Saint *Léger* and a fragment of a homily on the prophet Jonas (all of the 10th century), followed by a great flowering of literature in various dialects. The most famous work of the age is the *Chanson* de *Roland,* of the middle of the 11th century, narrating the battle of Charlemagne's nephew (or so he is identified in the Chanson) Roland against the Moslems and his death at Roncesvalles.

In the 9th and 10th centuries: marauding Vikings plagued the northwest of France. They were eventually pacified and their energies usefully employed when land (which they had already conquered) was assigned to them, and they became romanized forthwith. These Northmen, or Normans, gave their name to the province of Normandy. Invading England in 1066 and carrying their language there. they became responsible. if not for the romanization of England, at least for the bulk of the more than 50% of the English vocabulary that is of Romance origin.

After the death of the last Carolingian in 987, Hugh Capet came to the throne. Under him and his successors, although monarchic power was restored in the Île-de-France, the decentralization of the administration of France as a whole and the breaking up of the country into many quasi-independent units. which had commenced after Charlemagne's death, continued. Feudalism came to full flowering. The linguistic consequence was a commensurate linguistic fragmentation and the development of literature in a number of dialects. On their evidence, supported by knowledge of later and current patois, the dialects may be classified thus: (1) eastern — Bourguignon, Franc-Comtois, Lorrain, Champenois; (2) northeastern — Picard, Wallon: (3) northwestern—Normand; (4) western—Poitevin, Angevin, Saintongeais; (4) north-central (Île-de-Francei — Francien.

In the southeast. approximately covering the former Burgundian kingdom, exists an idiom called Franco-Provençal, which some claim to be sufficiently distinct from the others to warrant calling it a separate language. It is so named because in many respects it takes a position intermediate between French and the various southern dialects subsumed under the title Provencal language (*q.v.*), which are spoken in the remainder of France.

From all these. Francien mas to emerge as the standard language of France, with the other idioms becoming gradually substandard patois. This favoured position of Francien, eventually called Français, was not due to any intrinsic excellence (all dialects are potentially equal) but to historic and cultural circumstances. In large part these were provided by the resumption. during the 13th and 14th centuries, of the reins of state by stronger monarchs. residing in Paris, the core of the Francien-speaking region. who managed to concentrate once more in their own hands the power which had eluded their predecessors. Paris became also the artistic, religious and intellectual centre of the realm (the Cniversity of Paris was founded in the middle of the 13th century). The catastrqphe of the Hundred Years' War (1337–1453), though leaving France prostrate, contributed to the prestige of the throne: produced a national French conscience even among the ordinary people and thus helped the establishment of a national language fashioned after the speech of Paris.

From the 13th century, Romance dialects gradually supplanted Latin not only in literature but also in nonliterary documents. It was inevitable that Francien should be favoured, first in official papers of national concern, eventually also in those of local importance. The treaty of Paris, ratified in 1259, was the first document of its type in Francien, or French.

Thanks to great literary productivity, the language of France also acquired extensive renown abroad, especially in Italy. Brunetto Latini, Dante's teacher, wrote (*c.* 1260) his *Trésor,* a kind of medieval encyclopaedia, in French; and Marco Polo dictated his memoirs in French (1298). Again this was due not so much to an intrinsic superiority of French over other European languages (although Brunetto Latini and many others ascribed their predilection for French to this), but rather to the fact that France led other European countries in developing something of a standardized, supraregional, national literary language.

The terms Middle French (15th and 16th centuries) and Modern French (from the 17th century on) refer customarily to the developing Francien dialect. The other dialects of France, including Provencal, once the carrier of a brilliant and influential literature, were henceforth in continued retreat. Jean Froissart (1338–1410?) is the last important author to use a language other than Francien.

The Renaissance, the greatest phenomenon in the cultural history of France of the late 15th and 16th centuries, implies in linguistic history the adoption of Latin and Greek words and expressions. and also, more ephemerally, the cultivation of a somewhat ponderous, solemn, rhetorical latinizing style whose 'long periods ill fitted the grammatical structure of Seo-Latin. Many of the words then borrowed from Greek and Latin, though at first the property of the learned few, have over the centuries become common property; only linguistic analysis uncovers their origins.

The influence of Italy had much to do with the return to Latin sources. In 1494 Charles VIII set out to conquer Italy. He returned beaten, hut he introduced Italy and. above all, the Italian Renaissance: to France. In 1533 Prince Henry (later Henry II) married; at the age of 14, Catherine de' Medici, who brought into France Italians, Italian mores and Italian culture. All these imports, however, were adapted and absorbed, and, regardless of the influence of Latin and Italian (there are about 1000 words of Italian origin in the French lexicon), the French language remained essentially the same.

Under Francis I, the ordinance of Villers-Cotterêts (1j39) banished Latin from its last stronghold in royal jurisdiction. And Calvin's own French translation (*Institution de* la *religion chrétienne,* 1541j of his Latin *Institutio christianae religionis* (1536) brought French into theology. But the Roman Catholic Church now opposed the popularization of the Scriptures; it was, this time, initiated by Protestants and was therefore violently and bloodily combatted. The Sorbonne was on the side of the church, and soon the schools of France found themselves involved, paradoxically, in an anti-French movement. But French did become the language of the Protestant church.

Calvin, although he was not, like his German counterpart Luther, instrumental in the establishment of the national standard language, was a master of prose and therefore influential in the development of literary French. The style of his works and those of his so dissimilar contemporary, Rabelais (1495–1553), served later authors as a model. Rabelais is memorable for the luxuriance of his vocabulary. He not only introduced into the French language neologisms of his own making but also, more importantly, enriched the somewhat formalized and conservative standard language by numerous technical terms and dialectal expressions which had hitherto been shunned as vulgar. There was no word that Rabelais would not use or, indeed, make up, if it fitted his context.

In the domain of poetry, the authors of the Pléiade maintained that if French was not already as good as any other language, it could surely become so if properly cultivated and enriched through borrowing from the classical languages. They issued their manifesto. *La Défense et illustration de la langue française,* written by Joachim du Bellay, in 1549. Grammarians. generally much more interested in Latin than in its modern "corruptions," now also turned their attention to French. The French language was emancipating itself practically and theoretically from the tutelage of Latin. It did so, however, with an *élan* and an exuberance which was soon to call forth, in a new, more sedate and less Rabelaisian cultural climate, a reaction.

In the 17th century, after the freedom, fullness and licence of Renaissance life, and after the upheavals of religious warfare, France entered upon an era of order, rule, restraint and *raison,* of political centralization and autocracy, culminating in the persons of Louis SIII. Louis XIV, Richelieu and Mazarin. In language also, this was a period of contraction and pruning. The riotous growths of Renaissance language were to be weeded out. Franqois de Malherbe battled successfully against archaism, regionalism and neologism in poetry, extolling the norm, restraint and *le bon usage* as practised by the upper classes. In prose, Jean Louis Guez de Balzac advanced similar views. And Claude Favre, Seigneur de Vaugelas was the contemporary grammarian who made usage the proper guide for speaking and writing—albeit the usage of the court and the *honnêtes gens.* In 1635, Richelieu, the severe exponent of monarchic autocracy, officially established the seat of French linguistic autocracy. the Académie Franqaise. which had the task of watching over the French language and preventing its corruption. The first edition of the dictionary of the Académie appeared in 1694 (the eighth in 1932–3j); its purpose was normative rather than descriptive. But arresting the natural development of a language and adding frills known only to a small minority always comport dangers of mummification. French escaped this fate. perhaps because of the very excesses of the fashion and its concomitant restriction to a thin layer of society. Molière (1622–73) lampooned it (in the Femrnes savantes, for example), and his dialogue shows how little the common people were affected, no matter how the learned, the ladies, the young fops and the old fools strained to abide by the rules. This was, moreover, an age in which the court, the aristocracy and high society not only talked themselves but also lived themselves out of contact with the rest of the people, a willful isolation for which the privileged classes paid during the Revolution.

La *raison,* reason as expounded in the philosophy of Descartes (1596–1650), was about to become the watchword of the time; and orderliness and reason, and immutability were the bonds with which some proposed to fetter the literary language. The great classical authors, above all the dramatists Corneille (1606–84) and Racine (1639–99), with their regular Alexandrine metre, their trois unite's (the three unities of time, place and action, which, in the name of reasonableness and verisimilitude, did not allow the drama to occupy more than one day's time or greater space than was encompassed by the presentation on the stage), their classical plots and their restricted vocabulary, partly renounced their linguistic freedom.

Paradoxically, the real and considered enthronement of reason actually brought about liberation from some of the linguistic and literary canons rashly and falsely imposed in its name. For the awakening scientific studies of the 18th century. exemplified by the Encyclopkdie and its founders and writers, by Diderot (1713–84) and by Voltaire (1694–1778), could not develop freely under the restrictions imposed upon the written language in the preceding century. Scientific discourse about new things and new thoughts required new technical terms; localisms and popular words from farm and workshop were employed if they served a purpose. At the same time. the church, the aristocracy and the court. despite the external splendor of Louis XIV's establishment. had lost confidence and prestige among the people. Hence the main pillars of le bon usage were cracking, and the *honnêtes* gens were losing influence. Voltaire and Rousseau (1712–78), both masters of prose and both severe critics of contemporary society, though altogether different in ideas and manners, were alike in rejecting the authority and restraints upon linguistic usage, which the 17th century had favoured.

The French Revolution (beginning in 1789), which attempted to gather the strength of the uhole nation for nationalistic effort, spoke out against patois and "foreignism" in language. But this phase mas soon countered by the literary movements of the 19th century, romanticism, realism and naturalism, whose very names suggest hospitality toward the exotic. the historic and the realistic. and enmity against the traditional, the hidebound and the artificial.

These changes and veerings of fashion concerned mainly vocabulary and style. The structure of the French language was scarcely affected; it remained essentially the same from the Middle French period.

At the present time, linguistic currents and fashions are the same in French as, *mutatis mutandis,* in other languages. The literary standard language spreads continually at the expense of local dialects, leaving only local peculiarities of pronunciation; the process is immeasurably speeded by increased literacy and the penetration of the press, radio and television into regions that were until recently isolated. There is also a spread of an international scientific and technological vocabulary. which is virtually intruding into the nursery. Finally, there is the slow gain, under the impact of linguistic studies of the past century, of an attitude that considers language more a social instrument than a national monument.

INTERNAL DEVELOPMENT

Phonology. — The stressed vowels of late spoken Latin, distinguished from one another by quality and not, as in classical Latin, by quality and quantity (i ẹ ę a ǫ o u: the dot indicates close, the semicircle open, pronunciation) developed in Old French according to their quality and position within the word. The ẹ (continuing both classical Latin ē and ĭ) ẹ o (continuing both classical Latin ō and ŭ) o, when standing at the end of a syllable, in free position, became diphthongs; when within a syllable, in checked position, they remained unchanged. Some think that the free position lengthened the vowels and thus prepared for diphthongization; but this assumption is not essential (tela > teile [Mod. Fr. toile]; *pędem* > pied; *flọrem* > *flour* [Mod. Fr. *fleur*]; *cǫrem* > cuer [Mod. Fr. coeur]; *vĭrga* > verge; *cęruum* > cerf; *rŭpta* > rote [Mod. Fr. route]; *pǫrtam* > porte). Generally ị remained unaltered (Latin infinitives in -ire > French *-ir*); ụ always became *ü,* pronounced like the umlaut in German and spelled *u* (luna > lune), regardless of position. Free a became e; checked a remained (mare > *mer; partem* > part).

Old French also had diphthongs *ai,* ei, oi, *ui,* originating from a combination of a, *e,* o or *u* with a primary or a secondary *i;* the latter having developed, for example, from a palatal or palatalized consonant (factum > *fait; tectum* > teit [Mod. Fr. *toit*]; *gaudium* > *joie; fructum* > fruit) or sometimes from an earlier triphthong (noctem > nueit > *nuit;* but iei is monophthongized: *lectum* > *lieit* > lit). When combined with the *u* resulting from the vocalization of *l* before a consonant, a, ẹ and o also appeared as diphthongs (altum > aut [Mod. Fr. haut]; *feltrum* > feutre; *multum* > *mout*); and ę appeared as a triphthong (*bellus* > bels > beaus [Mod. Fr. *beau*]). The pronunciation of these was diphthongal in Old French, whereas Modern French has reduced most of them to monophthongs while retaining the older spelling.

All these developments. however, may be neutralized or altered in certain phonemic surroundings. The nasalization of vowels before *m* and *n,* with eventual absorption of the consonant, should be noted (*pontem* > *pont; manum* > *main*). Many inconsistencies with the rules here outlined, as well as with those to be mentioned for the consonants, are due to analogical reformation, whereby the sound appearing in a word conforms not to the rules of regular phonemic substitution but to the leveling influence of a paradigm (*fīnīre* became fenir, but then developed into *finir* in analogy with forms in which the first *i* is accented and therefore stable; amo uith stressed free a regularly gives *aime,* but *amare,* where the same a is unstressed, should become amer and not aimer, which is due to analogy).

Nonstressed vowels developed according to their position in the word. They were never diphthongized. The completely unstressed posttonic vowel of a proparoxytone (word accented on the third-from-last syllable) was invariably dropped in French (*populum* > *peuple*). All final unstressed vowels were also dropped (*quando* > *quant* [Mod. Fr. *quand*]), with the exception of a, which evolved into the so-called silent e. It is not always silent but may be pronounced as the schwa sound, which is phonetically transcribed ə (luna > lune). Other final vowels were also retained if they were needed to support a preceding consonant cluster which cannot terminate a French word (*populum* > *peuple;* febrenz > *fièvre*); in Modern French such words sometimes, when the speaker does not pronounce the final -3, also lose the sound of the preceding consonant (peup; *fièv'*).

The vowel of the pretonic syllable behaved like that of the final; hence it is sometimes called counterfinal (*ornamentum* > *ornement; liberare* > *livrer*). The vowel of the initial syllable was generally weakened when unstressed (in particular, a > a); when bearing the secondary stress it remained unchanged.

The development of the consonants was determined more by their position (initial, intervocalic, final or part of a cluster) and their phonetic surroundings than by their quality. The most pervasive phenomenon was palatalization of consonants, by which the sounds k, g, yod (the first sound in "yes") and d plus yod, if followed by e, *i* or yod, became s, ts, sh, dz and zh (*cęruum* > cerf; *civitatem* > citet [Mod. Fr. cite']; gentent > *gent; iungere* > *joindre; diurnum* > *jorn* [Mod. Fr. *jour*]). In French alone of all the Romance languages. k and g became *sh* and zh also before a, nhich, if stressed. became ie (*caballum* > *cheval; caput* > chtef [Mod Fr. *chef,* borroned into English while in its O F. form]). Initial *qu,* although unchanged in spelling, lost the *u* element (quando > *quand*) becoming k in sound. Initial *s* folloued by another consonant got a prothetic e, which remained while the *s* was dropped (*stella* > esteile > Ctoile).

In intervocalic position, voiceless consonants (produced without accompanying vibrations of the vocal cords) generally became voiced (produced with accompanying vibrations of the vocal cords) in late spoken Latin. In Old French they, as also the original voiced consonants, tended to become fricatives or to be dropped (*videre* > *veeir* [Mod. Fr. voir]; vita > vie; jaba > *fève; ripa* > *rive;* plaga > *plaie; securum* > *seür* [Mod. Fr. *sûr*]; *placere* > *plaisir*). Double medial consonants except *ss* and *rr* became simple, although in Modern French the etymological spelling may be resumed without effect upon the pronunciation (*cappa* > *chape;* gutta > gote [Mod. Fr. goutte]; belle > bele [Mod. Fr. belle]; *flamma* > *flame* [Mod. Fr. *flamme*]; terra > *terre; missa* > *messe*). The cluster *mn* became m (*dom(i)na* > *dame*).

Final consonants were largely retained in Old French but were dropped later in pronunciation, though not necessarily in spelling. Final *m* was dropped early in Latin speech, except in monosyllables, where in French it appeared as n (*rem* > *rien*). Final *s* lasted through the Old French period. Voiced finals tended to become unvoiced and eventually were lost, together with the original ones; for example, *quand(o)* > *quant,* then the t was dropped. Modern French qztand shows restoration of the etymological d in spelling but not in pronunciation.

Morphology. — The most important consonantal phonemic signals in the Latin declensional system, that is, the so-called case endings, are *m* and s. Final *-m* disappeared early. Also the vocalic declensional signals lost their significance, because of the loss or blurring of older quantitative and qualitative distinctions in the unstressed vowels. With many cases thus bereft of significant markers. the whole paradigmatic system was doomed. But as long as Old French retained the final *s*, the cases ending in *s* (mostly nominative singular and accusative plural) could be distinguished from others without *s*. According to this new paradigm. *s* was often added by analogy even to forms that had none in Latin, and was dropped from forms nhere it had become disturbing. The new device, however. was capable of continuing not six cases. as in Latin. but only a two-case declension — one subject and one nonsubject case. When the latter fulfilled other than direct object (accusative) functions. it was generally preceded by a preposition. Once final *s* also had become silent, the majority of the subject-nonsubject distinctions could no longer be formally signaled. Prepositional phrases became indispensable, except for the subject-direct object relation, in which rigid word order (subject — verb — direct object) became the rule.

It is difficult, however, to be sure exactly which came first. the phonetic decay of case endings or their functional replacement by these other devices. The two tendencies probably occurred together and reinforced one another. In general (but there are exceptions) Modern French continues the nonsubject case in both singular and plural. Acoustically, the difference between singular and plural. though shown in spelling, resides in most cases in the accompanying article (la table — les tables; une table — des tables). Only the pronouns still retain audible vestiges of case distinctions (le, *lui, les, leur,* je, me, *tu,* te, etc.).

The three genders of Latin were reduced to two. neuters being transferred into either of the other genders (the plural in -a often becoming a French feminine singular). Not all nouns retained their Latin gender.

Adjectives developed in a manner similar to nouns as regards cases and genders. The comparison of adjectives and the formation of the adverb were accomplished through composition rather than inflection: *calidum, calidius, calidissimum, calide* appear as *chaud, plus chaud,* le *plus chaud, chaudement* < *calida mente* (literally "with a warm mind"). There are few remnants of older nays in Modern French. more in Old French (*meliorem* > *meilleur; peius* > pis; *maiorem* > *majeur; fortiorem* > O. F. *forzor; pessimum* > O. F. *pesme*).

The morphology of the verb partook of all changes that the conjugational system underwent in late spoken Latin (see ROMANCE LANGUAGES). The most striking of them and of later ones in French itself were (1) replacement of several simple tense forms by compositions (some forms still being felt as compounds: il a donne'; others again as simple forms: *donare* habeo > *donare* aio > je *donnerai;* colloquially often replaced by a new compound: je vais donner); (2) the loss of all simple passive forms (*amafur* > *il* est aime'); (3) the reduction of subjunctive forms in number and frequency of use; (4) the formation of a conditional mood (*donare habebat* > *il donnerait*).

Of the four Latin conjugational types (infinitives in -are, -ere, -ĕre, -ire) only three remain (but four infinitives *-er, -oir, -re, -ir*); not all verbs. however. stay in their original classes (rire < *ridēre* not *ridĕre;* choir < *cadēre* not *cadĕre*). Some irregular Latin infinitives become regular on the analogy of the main types (*pouvoir* < *potere* for posse, *vouloir* < *volēre* for *velle, être* < essere for esse). But such analogical leveling which pervades the whole verbal system, is capricious; it can be described and classified, but not predicted.

Syntax. — Many of the changes from Latin to French syntax are explained through phonological and morphological history. French is not as highly inflected as Latin, and, therefore, certain functions of Latin inflection must be expressed by other means in French: prepositional phrase, word order, subject pronoun (*chante, chantes, chante,* chantent sound alike without pronoun). In Old French. with vestiges of Latin inflection still remaining, word order was freer, and the use of the subject pronoun was optional. Also, the grammatical rules of Latin mere applied with laxness while the new language had not yet been rigidly codified. Hence one gets the impression of irregularity and lawlessness. but in truth there were just different rules. It must not be claimed that the syntactical development from Latin to French implies either improvement (greater logic, economy or orderliness) or deterioration (greater rigidity of word order, reduction of distinctions or loss of wealth of inflections). There is merely change, each stage of the language using the material available.

The most important changes of the Middle and Modern French periods have already been indicated in the preceding sections: monophthongization of diphthongs; end of the two-case system; regularization of word order; regularization of the use of definite, indefinite and partitive articles (derived from the Latin demonstrative pronoun. the numeral "one," and the preposition de plus the demonstrative pronoun. respectively); obligatory use of the subject pronoun; codification and stabilization of grammar. By the beginning of the 17th century the language had essentially attained its modern stage in structure. and the literature of the period can be read easily by one who knows Modern French.

In conclusion. a few words may be said on the often vaunted logic. clarity and general superiority of French over other languages. This idea was expressed as early as the 13th century by Brunetto Latini; it was dogmatized and enshrined by Rivarol in his *Discours sur l'universalité* de *la langue française* (1784); and it has since been endlessly reiterated (even in some books cited in the bibliography below). "What is not clear is not French; what is not clear is still English, Italian, Greek, or Latin." says Rivarol. What is not clear is not good French, true: nor is it good anything else. Clarity, logic, skill and all other linguistic excellence reside not in the language but in the user. Language is a mere instrument which can be employed in such a way as to fulfill any linguistic task at the bidding of the user, and he can use it well or ill. Statements on linguistic quality almost invariably refer to style and not to language structure. Style is the individual linguistic behavior of the user superimposed upon the systematic pattern of language. Viewing the performance of the many excellent practitioners of French who have produced over many centuries a great literature, linguistically uninformed persons have ascribed some of this excellence to the language itself (thereby unwittingly detracting from the authors' onn merits). If French was, for a long time, the vehicle of international diplomacy and of elegant discourse among international society. this mas due not to the excellence of the language. but to the intellectual and political role which Frenchmen played in these domains. and to the skill (learned in school) nith nhich they employed their own language. That French has lost some of its international currency to English and Russian is no more due to a deterioration of the language than its ascendency was due to an intrinsic superiority; it is, rather, the consequence of new political. cultural and economic alignments.

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FRENCH LAW AND INSTITUTIONS. In the historical evolution of French institutions, those of the Celts of Gaul are of little importance. None of them are known to have survived in later law. It was Roman rule which really formed Gaul. The institutions of Roman Gaul became identical with those of the Roman empire, provincial and municipal government undergoing the same evolution as in the other parts of the empire. The law for the Gallo-Romans was that which was administered by the *conventus* of the magistrate; there were only a few peculiarities, mere Gallicisms, resulting from usage, which were pointed out by Roman jurisconsults of the classical age.

The administrative reforms of Diocletian and Constantine applied to Gaul as to the rest of the empire. The Gallo-Romans became Christian with the other subjects of the empire; the church extended thither its organization framed on the administrative model, each *civitas* having a bishop. just as it had a *curia* and municipal magistrates. The church had the right of acquiring property; of holding councils, subject to the imperial authority; and of the free election of bishops. But only the first germs of ecclesiastical jurisdiction are to be traced in the bishop's powers of arbitration and in his disciplinary supervision of the morals of clergy and laity. After the fall of the western empire. there was left to the Gallo-Romans a body of written law which consisted of the imperial constitutions and the writings of the five jurists Gaius, Papinian. Julius Paulus, Ulpian and Herennius Modestinus (*see* ROMAN LAW).

THE FRANKISH MONARCHY

The invasions and settlements of the barbarians opened a new period. The various barbarian kingdoms in Gaul were established under different conditions. Under the Burgundians and Visigoths, the owners of the great estates, which had been the prevailing form of landed property in Roman Gaul. suffered partial dispossession, according to a regular system. It is doubtful whether a similar process took place in the case of the Frankish settlements, for their first conquests in the north and east seem to have led to the extermination or total expulsion of the Gallo-Roman population. In each case, however, the barbarian king wished to use rather than destroy the existing Roman administrative systems. The kings of the Visigoths and Burgundians were at first actually representatives of the western empire, and Clovis himself was ready to accept from the emperor Anastasius the title of consul.

The **Merovingians.**—The first administrative change which folloued the Merovingian conquest was the replacement of the *provincia* by the *civitas* as the fundamental unit. The *civitas*, generally known under the name *pagus*, was placed under a count (*comes*), and several *pagi* could be united under a *dux*. The *pagus* was generally divided into "hundreds" (*centenae*). But the Roman administrative machinery was too delicate to be handled by barbarians. Thus the Merovingians tried to levy the same direct taxes as the Romans had done, but the levies ceased to be imposts reassessed periodically and became fixed annual taxes on lands or persons. They disappeared at last as general imposts, continuing to exist only as personal or territorial dues. In the same way the Roman municipal organization survived for a considerable time under the Merovingians but was used only for the registration of written deeds; under the Carolingians it disappeared, and with it the old senatorial nobility. The administration of justice seems to have been organized on a system borrowed partly from Roman and partly from Germanic institutions. Justice was administered by the count (*comes*) or his deputy (*centenarius* or *vicarius*), but on the verdict of notables called *boni homines* or *rachimburgii*. This took place in an assembly, the *mallus*, which every free man was bound to attend a certain number of times a year, and in which were promulgated the general acts emanating from the king. The latter could issue commands or prohibitions, the violation of which entailed a fine of *60 solidi;* he also administered justice, assisted by the officers of his household, his jurisdiction being unlimited and undefined. He could hear all causes but was not bound to hear any. except, apparently, accusations of deliberate failure of justice and breach of trust on the part of the *rachimburgii*.

But what proved the great disturbing element in Gallo-Roman society was the fact that the conquerors were all warriors. whose normal state was that of war. It is true that under the Roman empire all the men of a *civitas* had been obliged, in case of necessity, to march against the enemy, and under the Frankish monarchy the count still called together his *pagenses* for this object. But the condition of the barbarian was very different; he lived essentially for fighting. Moreover, this military class, though not an aristocracy (for among the Franks the royal race alone was noble), was to a large extent independent, and the king had to attach these *leudes* or *fideles* to himself by gifts and favours. At the same time the authority of the king gradually assumed the personal character which, among the Germans, marked most of the relations between men. The household of the king gained in political importance. because the chief officers in the palace became also high public officials; and the king's bodyguard, the *antrustions,* remained a class apart.

The Frankish monarch had also the power of making laws (*decreta, edicta*), after consulting the chief men of the kingdom, both lay and ecclesiastical, in *placita*, meetings apparently modelled on the councils of the church. But throughout the kingdom in many places the direct authority of the king over the people ceased to make itself felt. The *immunitates,* granted chiefly to the great ecclesiastical landowners, limited this authority in a curious way by forbidding public officials to exercise their functions in the precinct of land which was *immunis*. Judicial and fiscal rights frequently passed to the landowner, who became of necessity the intermediary between the supreme power and the people. Other principles contributed toward the weakening of the royal power. The monarch had all the rights of the Roman emperor, whose place he had taken; but whereas the emperor had represented the state, the barbarian king considered the kingdom as his property. administered under the rules of private law. Hence the Frankish king could grant concessions of royal rights to individuals. and this principle justified the partition of the kingdom between the sons of the king, as in the division of an inheritance in land. This proved one of the chief weaknesses of the Merovingian monarchy.

In order to rule the Gallo-Romans, the barbarians had sought the help of the church. the representative of Roman civilization. Further, the Merovingian monarch and the Catholic Church had come into close alliance in their struggle with the Arians. The church therefore gained new privileges, but at the same time became to a certain extent dependent.

Under the Merovingians the election of the bishop by clergy and people was only valid if it obtained the assent of the king, who often directly nominated the prelate. But the church retained its full right of acquiring property, and its jurisdiction was partially recognized. It not only exercised more freely than ever a disciplinary jurisdiction, but the bishop, in place of the civil power, administered civil and criminal justice over the clergy. The councils had for a long time forbidden the clergy to cite one another before secular tribunals; they had also, in the 6th century, forbidden secular judges under pain of excommunication to cite before them and judge the clergy, without permission of the bishop. A decree of Clotaire II (*614*) acknowledged, if only partially. the validity of these claims.

The Carolingian Period. — The Merovingian dynasty perished amid increasing anarchy. The crown passed, with the approval of the papacy, to an Austrasian mayor of the palace and his family. Under these conditions there developed a number of institutions which were the direct precursors of feudalism. One was the royal benefice (*beneficium*) of which the church provided both the model and, in the first instance, the material. The model was the *precaria,* a form of concession by which it was customary for the church to grant the possession of its lands to free men; this practice the church itself had copied from the five-year leases granted by the Roman exchequer. Gradually, however, the *precaria* had become a grant made, in most cases, freely and for life. As regards the material, when the Austrasian mayors of the palace wished to secure the support of the *fideles* by fresh benefits, the royal treasury being exhausted, they turned to the church and took lands from it to give to their warriors. In order to disguise the robbery it was decided that these lands should be held as *precariae* from the church which had furnished them. Later, uhen the royal treasury was reorganized, grants of land made by the kings naturally took a similar form, the *beneficium,* as a free grant for life. The *beneficium* inevitably crystallized into a perpetual and hereditary right. Another institution akin to the *beneficium* was the *senioratus.* By the *commendatio,* a form of solemn contract, a man swore absolute fidelity to another man. who became his *senior.* It became the generally accepted idea that it was natural and normal for every free man to have a *senior.* At the same time a benefice was never granted unless accompanied by the *commendatio* of the beneficiary to the grantor. As the most important *seniores* were thus bound to the king and received from him their benefices, he expected through them to command their men; but in reality the king disappeared little by little in the *senior.* The capitulary of Kiersy-sur-Oise (877) clearly recognized this. The king granted as benefices not only lands, but also public offices such as those of count or *dux,* which thus became possessions, held first for life and later as hereditary properties.

Charlemagne, while sanctioning these institutions, reorganized the administration of justice, fixing the respective jurisdictions of the count and the *centenarius,* substituting for the *rachimburgii* permanent *scabini,* chosen by the count in the presence of the people, and defining the relations of the count, as the representative of the central authority, with the *advocati* or *judices* of *immunitates* and *potestates.* He reorganized the army, determining the obligations and the military outfit of free men according to their means. Finally, he established those regular inspections by the *missi dominici* (*q.v.*) and founded two general assemblies in the year, one in the autumn, the other in the spring, which mere attended by the chief officials, lay and ecclesiastical. It was in these assemblies that the capitularies (*see* CAPITULARY) and all important measures were first drawn up and then promulgated. The revenues of the Carolingian monarch consisted chiefly in the produce of the royal lands. There were also the free gifts which the great men were bound, according to custom, to bring to the *conventus;* the regular personal or territorial dues into which the old taxes had resolved themselves; the profits arising from the courts; and numberless requisitions in kind, a usage which had without doubt existed continuously since Roman times. The church added a fresh prerogative to its former privileges. namely, the right of levying a real tax in kind, the tithe. Since the 3rd century the church had tried to exact the payment of tithes from the faithful, and from the reign of Pippin the Short onward the civil law recognized and sanctioned this obligation. Ecclesiastical jurisdiction extended farther and farther, but Charlemagne, the protector of the papacy, maintained firmly his authority over the church. He nominated its dignitaries, both bishops and abbots, who were true ecclesiastical officials, parallel with the lay officials. In each *pagus,* bishop and count owed each other mutual support, and the *missi* on the same circuit were ordinarily a count and a bishop. In the first collection of capitularies, that of Ansegisus, two books out of four were devoted to ecclesiastical capitularies.

Criminal and Private Law.—What then, was the private and criminal law of this Frankish monarchy which had come to embrace so many different races? Men of Roman descent remained under Roman law, and the conquerors could not hope to impose their customs upon them. As to the barbarians. they had hitherto had nothing but customs, and these customs, of which the type nearest to the original is to be found in the oldest text of the *Lex Salica,* were nothing more than a series of tariffsof compensations, that is to say, sums of money due to the injured party or his family in case of crimes committed against individuals. They also introduced barbarous systems of trials, that by compurgation (*i.e.,* exculpation by the oath of the defendant supported by a certain number of *cojurantes*) and that by ordeal, later called *judicium Dei.* In each new kingdom the barbarians naturally kept their own laws, and when these men of different races all became subject to the Frankish monarchy, there evolved a system (called the *personnalité des lois*) by which every subject had, in principle, the right to be tried by the law of the race to which he belonged. When the two adversaries were of different race, the law of the defendant had to be applied. The customs of the barbarians had been drawn up in Latin. At this period only these written documents bore the name of "law" (*lex, leges*), and at least the tacit consent of the people seems to have been required for these collections of laws, in accordance with an axiom laid down in a later capitulary: *lex fit consensu populi et constitutione regis.* It is noteworthy, too, that in the process of being drawn up in Latin, most of the *leges barbarorum* were very much romanized.

In the midst of this diversity, a certain number of causes tended to produce a partial unity. The capitularies, which had themselves the force of law, when there was no question of modifying the *leges,* constituted a legislation which was the same for all; often they inflicted corporal punishment for grave offenses. which applied to all subjects without distinction. The Gallo-Romans and even the church itself, to a certain extent, adopted the barbarous methods of trial introduced by the Germans. On the other hand, written acts became prevalent among the barbarians. and at the same time they assimilated a certain amount of Roman law; for these acts continued to be drawn up in Latin, after Roman models. During this period, too, the Gallican Church adopted the collection of councils and decretals by Dionysius Exiguus, which was sent to Charlemagne in 774 by Pope Adrian I.

All the subjects of the Frankish monarchy were not of equal status. There was, strictly speaking, no nobility. both the Roman and the Germanic nobility having died out; but slavery continued to exist. The church, however, was transforming the slave into the serf, by giving validity to their marriages, at least when the master had approved of them, and by protecting the slave's *peculium.* But between the free man and the slave lay many persons of intermediate status. There was, to begin with, the Roman colonist (*colonus*), a class of which there is no clear mention in the laws before the 4th century; he and his children after him were attached perpetually to a certain piece of land, which they were allowed to cultivate on payment of a rent. There were, further, the *liti,* a similar class of Germanic origin. Many free men who had fled to the great landowners for protection accepted a similar position. Under the Merovingian regime and especially under the Carolingians, the occupation of land tended to assume the character of tenure; but free ownership of land continued to exist under the name of *alod,* and the capitularies contain numerous complaints and threats against the counts, who endeavoured by the abuse of their power to obtain the surrender of small properties held by free men.

THE EARLY CAPETIANS

The Rise of Feudalism.—The 10th and 11th centuries were a period of profound anarchy, during which feudalism took a more definite shape. The first Carolingians had striven to re-establish the king's authority, but the power of the state had again collapsed in the face of invasions from outside the kingdom. The sovereigns no longer made laws, the old capitularies and *leges* fell into disuse, and in their place territorial customs arose which were at first ill defined and strictly local. Apart from the influence of the church, government rested on brute force. No longer protected by the sovereign, men adopted new principles for their security, setting up a hierarchy of protection and submission depending on the possession of land; and a system of tenures came to replace the old system of ownership. The centre of the feudal nucleus was a chief, around whom gathered men capable of bearing arms, who commended themselves to him according to the old form of vassalage. They owed him fidelity. assistance and the support of their arms; he owed them protection. Some of them lived in his castle or fortified house, receiving their equipment only and eating at his table; others received lands from him! which became the fiefs of a later time. The fief was generally held for life and did not become universally hereditary till the second half of the 11th century. All these conditions had existed previously in much the same form; but that the chief was no longer merely an intermediary between his men and the royal power was a new development. The group had become in effect independent, so organized as to be socially and politically self-sufficient. It constituted a small army. led, naturally, by the chief and composed of his feudatories, supplemented in case of need by the *rustici*. It also formed an assembly in which common interests were discussed, the lord, according to custom, being bound to consult his feudatories and they to advise him to the best of their power. It also formed a court of justice. in which the feudatories gave judgment under the presidency of their lord: and all of them claimed to be subject only to the jurisdiction of this tribunal composed of their peers. Generally they also judged the villeins (*villani*) and the serfs dependent on the group, except in the rare cases where the latter obtained as a favour judges of their own status. Under these conditions a nobility was formed, those men becoming nobles who were able to devote themselves to the profession of arms; and this nobility could be indefinitely recruited by the granting of fiefs and admission to knighthood.

The state of anarchy was by now so far advanced that the custom of private war arose. Every man claimed the right of making war to defend his rights or to avenge his wrongs. Later on. this was a privilege of the noble, but the texts defining the limits which the church endeavoured to set to this abuse, namely. the Peace of God and the Truce of God, show that at the outset it was a power possessed by men of all classes. Even a man who had appeared in a court of law and received judgment had the choice of refusing to accept the judgment and of making war instead.

In this state of political disintegration each part of the country which had a homogeneous character tended to form itself into a higher unit. In this unit there arose a powerful lord, generally a duke, a count or a viscount, either a former official of the monarchy. whose function had become hereditary, or a usurper. He laid claim to an authority other than that conferred by the possession of real property: his court of justice was held in the highest honour, and to it were referred the most important affairs, More or less powerful lords with as yet no particular feudal title might commend themselves to him by doing homage.

Yet the kingship continued to exist. By the end of the Carolingian period it had in fact become elective. as is shown by the elections of Odo and Robert before that of Hugh Capet. The electors were the chief lords and prelates of the *regnum Francorum*. Each king during his lifetime secured the coronation of his eldest son; so that the first of the Capetians revived the principle of heredity in favour of the eldest son while establishing the hereditary indivisibility of the kingdom. But the only real authority of the king lay where his own possessions were, or where there had not arisen a duke. a count or a lord to compete with him. He maintained, however. a court, the jurisdiction of which seems to have been universal: though the parties in a suit could accept or reject the judgment given. The king dispensed justice surrounded by the officers of his household. who formed a permanent council. Periodically, at the great yearly festivals. he called together the chief lords and prelates of his kingdom, thus carving on the tradition of the Carolingian *placita* or *conventus;* but little by little the character of the gathering changed: it was no longer an assembly of officials but of independent lords. This was the origin of the *curia regis*.

The Growth of the Church.—While the power of the state was almost disappearing. that of the church continued to grow. Not only was the privilege of clergy, by which accused clerks were brought under jurisdiction of the church, almost absolute. but it had cognizance of a number of causes in which laymen only were concerned: marriage and everything nearly or remotely affecting it, wills, crimes and offenses against religion, and even contracts when the two parties wished it or when the agreement was made on oath. The church, moreover, remained in close connection with the crown, while the royal prerogatives with regard to the election of bishops were maintained more successfully than other rights of the crown. though in many of the great fiefs they nonetheless passed to the count or the duke. It was at this time too that the church tried to break the remaining connections which still kept it more or less dependent on the civil power (*see* INVESTITURE).

Final Organization of Feudalism.—The period of the true feudal monarchy is embraced by the 12th and 13th centuries. It was at this time that the crown again assumed real strength and authority. but so far it had no organs and instruments save those which were furnished by feudalism. now organized under a regular hierarchy. of which the king was the head. This new position of affairs was the result of three great factors: the revival of Roman law. the final organization of feudalism and the rise of the privileged towns. Roman law spread rapidly in the French schools and universities, except that of Paris, which was closed to it by the papacy; and the influence of this study was so great that it transformed society. It contributed largely to the reconstitution of the royal power, modelling the rights of the king on those of the Roman emperor; and it wrought a no less profound change in private law. From this time dates the division of France into the *pays de droit écrit* (the southern provinces), where Roman law, as codified by Justinian, was received as the ordinary law; and the *pays de coutume* (the northern provinces), where it played only a secondary part, being generally valid only as *ratio scripta* and not as *lex scripta*. In this period the customs also took definitive form, and over and above the local customs properly so called there were formed customs known as *general*, which held good through a whole province or *bailliage* and were based on the jurisprudence of the higher jurisdictions. (For the privileged towns *see* COMMUNE [MEDIEVAL].)

In the final organization of feudalism, the chief lord. the duke or count, had beneath him a whole hierarchy and was himself a part of the feudal system of France (*see* **FEUDALISM**). Doubtless in the case of lords like the dukes of Brittany and Burgundy, the king could not actually demand the strict fulfilment of feudal obligations; but the principle was established. Free and absolute property, the ancient *allodium*, continued to exist in most districts, though by way of exception. In the administration of justice, the feudal hierarchy had absolute sway. The fiefs themselves became hereditary, and the rules of succession were established. The most salient features of feudal succession were the right of primogeniture and the preference given to male heirs; but from the 13th century onward the right of primogeniture, which had at first involved the total exclusion of the younger members of a family, tended to be modified. except in the case of the chief lords, the eldest son obtaining the preponderant share or *préciput*. Nonnoble (*roturier*) tenancies followed a similar development, except that in their case there was no right of primogeniture nor any privilege of males.

The King's Government, 12th–13th Centuries.—The chief instruments of the crown in government were its great officers, the seneschal, butler. constable and chancellor; who were to become irremovable officials. At the end of the 12th century, however, one finds also the title of peers of France. applied to the king's principal vassals and to certain dignitaries of the church; but the regulation of the peerage did not take place till later, when this description no longer fitted it. Originally there had been six lay peerages and six ecclesiastical; but the latter proved to be the only stable ones, the lay peerages continually changing as time went on. In so far as it took part in the business of government, the court of the peers was a court of justice and, as such, was soon dominated by lawyers. Indeed, in this sense it was not separate from the *curia regis*, nor yet, later. from the *parlement* of Paris, of which the peers of France were by right members. From this time, too, dates the institution of the *maîtres des requêtes*.

The legislative power of the crown again began to be exercised during the 12th century, and in the 13th century had full authority over all the territories subject to the crown. The kings of this century were able narrowly to limit the custom of private war. But the most appreciable progress took place in the administrative and judicial institutions. Under the first Capetians the royal domain had been administered by *prévôts;* but as this system came to be corrupted by abuses Philip Augustus appointed *baillis (see* BAILIFF AND BAILIE) and seneschals above the *prévôts* as the king's representatives in the provinces and as superior judges. At the same time the form of the feudal courts tended to change, as they began more and more to be influenced by the Romano-canonical law. Saint Louis had striven to abolish trial by combat, and the Lateran council in 1216 condemned other forms of ordeal. Of the seignorial jurisdictions there soon remained only the *hautes* or *basses justices* (in the 14th century arose an intermediate grade, the *moyenne justice),* all of which were considered to be delegations of the royal power. As a result of the application of Roman and canon law, there arose the practice of appeal from seignorial justice to the royal court. In the 13th century too appeared the theory of crown cases *(cas royaux)* which were reserved for the royal court. Finally, the *curia regis* was gradually transformed into a regular court of justice, the *parlement* (*q.v.*), as it was already called in the second half of the 13th century. At this time the king no longer appeared in it regularly, and before each session (for it was not yet a permanent body) a list of properly qualified men was drawn up in advance to form the *parlement,* only those whose names were on the list being capable of sitting in it. Its main function had come to be that of a final court of appeal. At the various sessions, which were regularly held at Paris. appeared the *baillis* and seneschals, who were called upon to answer for the cases they had judged and also for their administration. The accounts were received by members of the *parlement* at the Temple and this was the origin of the *chambre des comptes.*

At the end of this period the nobility became an exclusive class. It became an established rule that a man had to be noble in order to be made a knight and even in order to acquire a fief; but in this latter respect the king made exceptions in the case of *roturiers,* who were licensed to take up fiefs, subject to a payment known as the *droits de franc fief.* The church maintained its privileges; a few attempts only were made to restrain the abuse, not the extent, of its jurisdiction. This jurisdiction was during the 12th century to a certain extent regularized, the bishop nominating a special functionary to hold his court; this was the *officialis* (Fr. *official*), whence the name of *officialité* later applied in France to the ecclesiastical jurisdictions. On one point, however, the former rights of the church were diminished. It preserved the right of freely acquiring personal and real property, but though it could still acquire feudal tenures, it could not keep them; it must alienate the property again within a year and a day. The reason for this new rule was that the church is a proprietor who does not die and in principle does not surrender its property; consequently, the lords had no longer the right of exacting payments on the alienations of those tenures which it acquired. In this period the form of the episcopal elections underwent a change, the electoral college coming to consist only of the canons composing the chapter of the cathedral church.

During the same period criminal law was profoundly modified. Under the influence of Roman law a system of arbitrary penalties replaced those laid down by the customs, which had usually been fixed and cruel. The criminal procedure of the feudal courts had been based on the right of accusation vested only in the person wronged and his relations; for this was substituted the inquisitorial procedure which had developed in the canon law at the end of the 12th century and was to become the *procédure à l'extraordznaire* of the *ancien régime,* which was conducted in secret and without free defense and debate. Of this procedure torture came to be an ordinary and regular part.

The customs, which at that time contained almost the whole of the law for a great part of France, were not fixed by being written down. In that part of France which was subject to customary law *(la France coutumière*) they were defined when necessary by the verdict of a jury in what was called the *enquête par turbes;* some of them, however, were, in part at least, authentically recorded in seignorial charters. *chartes de ville* or *chartes de coutume.* Their rules were also recorded by experts in private works or collections called *livres coutumiers,* or simply *coutumiers* (customaries). The most notable of these are *Les Coutumes de Beauvoisis* of Philippe de Beaumanoir; the *Très ancien coutumier de Normandie* and the *Grand coutumier de Normandie;* the *Conseil à un ami* of Pierre des Fontaines; the *Établissements de Saint Louis;* and the *Livre de jostice et de plet.* At the same time the clerks of important judges began to collect in registers notable decisions; thus the old decisions of the exchequer of Normandy and the *Olim* registers containing the earliest decisions of the *parlement* of Paris are still extant.

THE LIMITED MONARCHY OF THE VALOIS

The 14th and 15th centuries were the age of the limited monarchy. In this period certain rules for the succession to the throne were fixed by precedents: the exclusion of women and of male descendants in the female line and the principle that a king could not by an act of will change the succession of the crown. The former *curia regis,* with its universal jurisdiction, was divided into sections, each competent in its own sphere: the *parlement,* for matters of justice; the *chambre des comptes,* for finance; and the *conseil du roi,* an administrative and governing council, not at all of a feudal character. The number of members of the *conseil* was at first small, but soon the brevet of *conseiller du roi en ses conseils* was given to numerous representatives of the clergy and nobility, the great officers of the crown becoming members by right. Side by side with these officials, whose power was then at its height, there were gradually evolved more subservient ministers who could be dispensed with at will. From the 14th century *clercs du secret* and *secre'taires des finances* were descended the 15th-century *secre'taires des commandements du roi,* who in the 16th century developed into the *secre'taires d'e'tat.* The college of peers of France was continually being changed as the great fiefs were annexed to the crown. While the six ecclesiastical peerages remained unalterable, Philip the Fair raised the duchies of Brittany and Anjou and the countship of Artois to the rank of peerages of France; eventually the peerage, considered as a title of honour, ceased to be attached to the major fiefs, and there was a constant increase in the numbers of lay peers.

The Rise of the States General.—At the beginning of the 14th century appeared the states-general *(états ge'ne'raux),* the origin of which can be traced to the assemblies of barons. prelates and bourgeois which used to meet in the vicinity of the *curia regis* to offer the king "counsel" and "help" *(aide).* Their power reached its height at the crisis of the Hundred Years' War during the reign of King John II. Then they were frequently convened, to vote the subsidies that the king needed for the war; and they sought to establish their control over the government. With the return of peace, they were no longer summoned; indeed they were not convened at all between 1484 and 1560. As their powers were never defined, they remained an instrument devoid of authority to which the government turned in times of stress. At the same time there arose the provincial estates, which were in miniature for each province what the states-general were for the whole kingdom. Later it became a privilege for a province to have its own assembly; those which did so were never rightfully subject to the royal *taille* and kept, at least formally, the right of sanctioning, by means of the assembly, the subsidies which took its place. Hence it became the endeavour of the crown to suppress these provincial assemblies, which in the 14th century were to be found everywhere; from the outset of the 15th century they began to disappear in central France.

Royal Taxation.—The most characteristic feature of this period was the institution of universal taxation by the crown. Hitherto, the king's sole revenues were those which he exacted in his capacity of feudal lord together with the income arising from certain crown rights which he had preserved or regained. But these revenues, known later as the income of the royal domain and later still as the *finances ordinaires,* became insufficient in proportion as the royal power increased; it became a necessity for the monarch to be able to levy imposts throughout the whole extent of the provinces annexed to the crown, even upon the subjects of the different lords. This he could only do by means of the cooperation of those lords, lay and ecclesiastical, who alone had the right of taxing their subjects; the co-operation of the privileged towns, which had the right to tax themselves, was also necessary. It was in order to obtain this consent that the states-general, in most cases, and the provincial assemblies, in all cases, were convoked. In some cases, however, the king adopted different methods; for instance, he sometimes utilized the principle of the feudal aids. In cases where his vassals owed him, as overlord. a pecuniary aid, he substituted for the sum paid directly by his vassals a tax levied by his own authority on their subjects. It is in this way that for 30 years the necessary sums were raised. without any vote from the states-general, to pay the ransom of King John II. But in principle the taxes were sanctioned by the states-general in the 14th century. Whatever form they took, they were given the general name of *aides* or *auxilia* and were considered as occasional and extraordinary subsidies, the king being obliged in principle to "live of his own." Certain *aides,* it is true, tended to become permanent in the reign of Charles VI; but the taxes were at first the sole resource of Charles VII. With the consent of the states-general, an *aide* was levied, from 1435, on the sale of certain consumer goods (particularly wine) and also a *taille,* from 1439, for the maintenance of a regular army. These imposts continued to be levied in peacetime, and Louis XI, far from suppressing them, augmented them so powerfully that they became the treasury's chief resource up to the end of the *ancien re'gime.*

Together with the taxes there was evolved the system of their administration. For the administration of the subsidies which they granted, the states-general nominated from among their own numbers *surintendants généraux* or *généraux des finances* and further, for each diocese or equivalent district, *e'lus.* Both had judicial as well as fiscal powers. the latter constituting courts of first instance and the former courts of final appeal. After 1360 both *généraux* and *e'lus* were nominated by the king. The *e'lus,* or *officiers des élections,* only existed in districts which were subject to the royal *taille;* hence the division, so important in old France, into *pays d'élections* and *pays d'états.*

This dual system of financial administration. for revenue from the royal domain *(finances ordinaires)* and for imposts *(finances extraordinaires),* led to the creation of two distinct administrative bodies: for the former, there was that of the *receveurs du domaine* under four *trésoriers de France* and a *changeur du trésor;* for the latter, there were the *élus,* seconded by the *receveurs des tailles,* with four *généraux des finances* and four *receveurs généraux.* The *trésoriers* and the *généraux des finances* formed a kind of ministry of finance to the 1 jth-century monarchy. Their subordinates had both administrative and judicial functions; but two courts of law, the *cour du trésor* for the domain and the *cour des aides* for imposts, dealt with contentious matters at a higher stage.

The New Army. — The army also was reorganized. Moreover, the military service attached to the fiefs was transformed for the profit of the king. who alone had the right of making war; it became the *arrière-ban,* a term which had formerly applied to the *levée en masse* of all the inhabitants in times of national danger. Before the 14th century the king had only had the power of calling upon his own immediate vassals for service; henceforth all possessors of fiefs owed him, whether within the kingdom or on the frontiers, military service without pay and at their own expense. Charles VII's army comprised the *,francs-archers* furnished by the parishes, a militia which was only summoned in case of war, and companies of *gendarmerie* or heavy cavalry which were called *compagnies d'ordonnance.*

The new army led to the institution of the governors of provinces, who were to command the troops quartered there. At first they were only appointed for the frontiers and fortified places, but later the kingdom was divided into *gouvernements généraux.* There were at first 12 of these, which were called in the middle of the 16th century the *douze anciens gouvernenzents.* Although strictly speaking. they had only military powers, the governors. always chosen from among the great lords. became in the provinces the direct representatives of the king and caused the *baillis* and seneschals to take a secondary place.

The Courts Under the **Valois.**—The courts of law continued to develop on the lines already laid down. The *parlement,* which had come to be a judicial committee nominated every year, but always consisting in fact of the same persons, changed in the course of the 14th century into a body of magistrates who mere permanent but as yet subject to removal *(see* PARLEMENT). The provincial *parlements* had arisen after and in imitation of that of Paris and had for the most part taken the place of some superior jurisdiction which had formerly existed in the same district when it had been independent (like Provence) or when it had formed one of the great fiefs (like Normandy or Burgundy). It was during this period also that the *parlements* acquired the right of opposing the registration (that is to say. the promulgation) of laws. of revising them and of making representations to the king when they refused registration. The other royal jurisdictions were completed *(see* CHÂTELET). Beside them arose another of great importance, which was of military origin, but later came to include all citizens under its authority. This was that of the provosts of the marshals of France *(prévôts des mare'chaux de France),* who were officers of the *maréchaussée* (the gendarmerie of the time); they exercised criminal jurisdiction without appeal over crimes committed by vagabonds and by fugitives from justice and over a number of crimes of violence, whatever the rank of the offender. Further, another class of officers came gradually into being in connection with the lam courts: the "king's men" *(gens du roi),* the *procureurs* and *avocats du roi,* who were at first simply those lawyers who represented the king in the law courts or pleaded for him when his interests were involved. From the 14th century onward the *procureurs du roi* had full control over public prosecutions. In this period, too, appeared what was afterward called *justice retenue,* that is to say. the justice which the king administered, or was supposed to administer, in person. It was based on the idea that, since all justice and all judicial power reside in the king, he could not deprive himself of them by delegating their exercise to his officers and to the feudal lords. Consequently he could. if he thought fit, take the place of the judges and call up a case before his own council. He could reverse even the decisions of the courts of final appeal and, in some cases, used this means of appealing against the decrees of the *parlements.* In these cases the king was supposed to judge in person; in reality they were examined by the *maîtres des requêtes* and submitted to the *conseil du roi,* at which the king was always supposed to be present and which had in itself no power of giving a decision. For this purpose there was soon formed a special committee of the council, which was called the *conseil privé* or *de jzcstice.* The king frequently. by means of *lettres de justice,* intervened in the procedure of the courts, by granting *bénéfices,* by which rules which were too severe were modified, and judgments were given in cases not covered by the common law. By *lettres de grâce* he granted reprieve or pardon in individual cases. The most extreme form of royal intervention was made by means of *lettres de caclzet* *(q.v.),* which ordered a subject to go without trial into a state prison or into exile. In other cases the king. as supreme judge, would set up extraordinary judicial commissions to hear suits in which his own interests were involved.

The Ecclesiastical Settlement. — The condition of the church changed greatly during this period. The jurisdiction of the *officialités* was very much reduced. even over the clergy. The development of jurisprudence gradually removed from the *officialités* causes of a purely secular character in which laymen only were concerned, such as wills and contracts; and in matrimonial cases their jurisdiction was limited to those in which the *foedzcs matrimonii* was in question. For the acquisition of real property by ecclesiastical establishments the consent of the king was always necessary.

In ecclesiastical patronage, from the 14th century onward the papacy encroached more and more upon the rights of the bishops over the inferior benefices, and of the electors, who usually conierred the superior benefices; at the same time it exacted from newly appointed incumbents heavy dues, which were included under the generic name of annates *(q.v.).* During the Great Schism these abuses grew. until by a series of edicts, promulgated with the consent and advice of the *parlement* and the clergy, the Gallican Church was restored to the possession of its former liberties, under the royal authority. Thus France was ready to accept the decrees of reform issued by the council of Basel (*q.v.*), which it did, with a few modifications, in the Pragmatic Sanction of Charles VII, adopted after a solemn assembly of the clergy and nobles at Bourges and registered by the *parlement* of Paris in 1438. It suppressed the annates and most of the means by which the popes disposed of the inferior benefices. For the choice of bishops and abbots, it restored election by the chapters and convents. The Pragmatic Sanction. however, nas never recognized by the papacy, nor was it consistently and strictly applied by the kings.

THE ABSOLUTE MONARCHY

From the 16th century to the Revolution was the period of the absolute monarchy. The reigns of Francis I and Henry II clearly laid down the principle of the absolute power of the crown. The states-general were not assembled under these two reigns. though they reappeared in the second half of the 16th century thanks to the political disturbances of the period: they were summoned in 1560 at Orléans, in 1561 at Pontoise, and in 1576 and 1588 at Blois; and the League even convoked them once at Paris in 1593. But the states-general of the 16th century in spite of their good intentions and the great talents which were at their service. were no more effective than their predecessors. They were. however, to be called together yet again, as a result of the troubles that followed the death of Henry IV; but their dissentions and powerlessness were again strikingly exemplified, and they did not reappear until 1789. Other bodies, however, created by the royal power, were to carry on the struggle against it. There were the *parlements,* the political rivals of the states-general. Thanks to the principle according to which no law came into effect so long as it had not been registered by them, they had won the right of refusing registration, explaining their reasons to the king by means of the *remonstrances.* Before the end of the 17th century they had lost this power. The ordinance of 1667 on civil procedure and. above all. a declaration of 1673 ordered the *parlement* to register the laws as soon as it received them and without any modification. It was only after this registration that they were allowed to draw up *remonstrances,* which were henceforth futile. The nobles. as a body, had also become politically impotent. At the same time the central government underwent changes. The great officers of the crown disappeared one by one. Of those in the first rank only the chancellor survived till the Revolution. Apart from him, the king's real ministers were the secretaries of state. generally four in number, who were always removable and were not chosen from among the great nobles. For purposes of internal administration, the provinces were divided between them, each of them corresponding by despatches with the areas which were assigned to him. Any other business (except legal affairs. which belonged to the chancellor, and finance) was divided among them according to convenience. At the end of the 16th century. however, were evolved two regular departments. those of war and foreign affairs. From the time of Francis I, the administration of the finances underwent many changes. The control exercised over it by the *trésoriers de France* and the *généraux des finances* jointly was suppressed, and new systems were set up instead. For a time there was a *trésorier de l'Épargne;* then he was superseded by the *surintendant des finances.* Meanwhile the *trésoriers de France* and the *généraux des finances* were becoming provincial officers. and their powers were distributed among several officers with equal authority. These constituted the *bureaux des finances* which were responsible for large areas known as *généralités.* The fall of Nicolas Fouquet led to the suppression of the office of *surintendant;* but Jean Baptiste Colbert soon again became practically a minister of finance, under the name of *contrôleur général des finances,* both title and office remaining until the Revolution.

The *conseil du roi* was an important organ of the central government. and for a long time included among its members representatives of the nobility and clergy. Besides the councillors of state (*conseillers d'e'tat),* its ordinary members. the great officers of the crown and secretaries of state, princes of the blood and peers of France were members of it by right. Further, the king was accustomed to grant the brevet of councillor to a great number of the nobility and clergy who could be called upon to sit in the council and give an opinion on matters of importance. But in the 17th century the council tended to differentiate its functions, forming three principal sections. one for political, one ior financial and the third for questions of administration and justice. Under Louis XIV it took a definitely professional, administrative and technical character. The *conseillers à brevet* were all suppressed in 1673, and the peers of France ceased to be members of the council. The political council, or *conseil d'en haut,* had no *ex officio* members, not even the chancellor; the secretary of state for foreign affairs, horrever. necessarily had entry to it: it also included a small number of persons chosen by the king and bearing the title of ministers of state (*ministres d'e'tat).* The other important sections of the *conseil du roi* mere the *conseil des finances,* organized after the fall of Fouquet, and the *conseil des dépêches,* in which sat the four secretaries of state, dealing with everything concerned with internal administration (except finance), including the legal business connected with this administration.

The chief authority in the provincial administration belonged in the 16th century to the governors of the provinces. But at the end of that century commissioners were charged with temporary duties there: and these commissioners became regular. in the 17th century. under the name of *intendants.* The *intendants,* after a period of conflict with the governors and the *parlements,* became absolute masters of the administration wherever there were no provincial estates. Each one was at the head of a *généralité,* enjoying full administrative authority. (*See* INTENDANT.)

The towns having a municipal organization preserved in the 16th century a fairly wide autonomy. Under Louis XIV their independence rapidly declined. They were placed under the tutelage of the *intendants,* whose sanction or that of the *conseil du roi* was necessary for all acts of any importance. In the closing years of the 17th century. the municipal officials ceased, even in principle, to be elective. Their functions ranked as offices which were, like royal offices: saleable and heritable.

The Sale of Offices.—The sale of royal offices is one of the characteristic features of the *ancien régime.* In the 16th century, under Francis I at the latest. the crown itself began officially to sell offices. taking a fee from those upon whom they were conferred. In the judicial system, the practice had a favourable result, assuring security of office to the judges; for the king could not reasonably dismiss an official arbitrarily without refunding the fee which he had paid. On the other hand. it contributed to the development of the dues paid by litigants to the judges. The system was extended to all official functions. even to financial posts. It was completed by the recognition of the rights in the sale of offices as hereditary; the right of resigning the office on payment of a fee. either in favour of a competent descendant or of a third party, passed to the heirs of an official who had died without having exercised this right himself. Through this development there arose a class of men who, though bound in many ways to the crown, were actually independent. Hence the tendency in the 18th century to create new and important functions under the form. not of offices, but of simple commissions, as had been done in the case of the *intendants* in the 17th.

Public Law in the 16th Century.— In this period the essential principles of public law were defined. There were, in the first place. the fundamental laws of the realm, which were true constitutional principles, considered as binding the king himself: so that. although he was sovereign, he could neither abrogate nor modify nor violate them. There was, however, some discussion as to what rules actually came under this category, except in the case of two series about which there was no doubt: those which dealt with the succession to the crown and forbade the king to change its order: and those which proclaimed the inalienability of the royal domain against which no title by prescription was valid. This last principle admitted only two exceptions: the formation of appanages, and the sale of land to meet the necessities oi war. with a perpetual option of redemption and the ever-present possibility that the transaction would be revoked by the king. as in many instances it was.

There was in the second place the theory of the rights, franchises and liberties of the Gallican Church. This body of doctrine rested chiefly on three principles: firstly, that the temporal power was absolutely independent of the spiritual power; secondly, that the pope had authority over the clergy of France in temporal matters and matters of discipline only by the consent of the king; thirdly, that the king had authority over and could legislate for the Gallican Church in temporal matters and matters of discipline. The old public law provided a safeguard against the violation of these rules in the process known as the *appel comme d'abus,* definitely established during the 16th century. It was heard before the *parlenzents,* but could, like every other case, be evoked before the royal council. Its effect was to annul any act of the ecclesiastical authority due to abuse or contrary to French law. The Pragmatic Sanction had been abrogated and replaced by the concordat of 1516, which preserved many of the enactments of the Pragmatic Sanction, notably those which protected the collation of the inferior benefices from the encroachments of the papacy; on the other hand the greater benefices. bishoprics and abbeys were in the king's gift and were awarded as he pleased (this power weighed heavily on clerical life up to the end of the *ancien rkgime).* The *parlement* of Paris was unwilling to register the concordat, but the crown easily overcame its resistance.

In the 16th century also, contributions to the public services drawn from the immense possessions of the clergy were regularized. Since the second half of the 12th century at least, the kings had in times of urgent need asked for subsidies from the church, and ever since the Saladin tithe of Philip Augustus this contribution had assumed the form of a tithe. Such tithes were fairly frequently granted by the clergy of France. After the conclusion of the concordat. Leo X granted the king a tithe *(ddcime)* under the pretext of a projected war against the Turks. The concession was several times renewed until, by force of custom, the levying of these tithes became permanent. But in the middle of the 16th century the system changed. The crown was heavily in debt, and its needs had increased. The property of the clergy having been threatened by the states-general of 1j60 and 1561. the king proposed to them to remit the bulk of the tithes and other dues in return for the payment by them of a sum equivalent to the proceeds of the taxes which he had mortgaged A formal contract to this effect was concluded at Poissy in 1j61 between the king and the clergy of France. In 1580 a new assembly of the clergy renewed the agreement, which was henceforward always renewed every ten years. Thus every ten years a great elective assembly of the clergy became necessary. There were two stages in the election, a preliminary one in the dioceses and a further election in the ecclesiastical provinces, each province sending four deputies to the general assembly, two of the first rank. that is to say, chosen from the episcopate, and two of the second rank. which included all the other clergy. The *dons gratuits* (benevolences) voted by the assembly comprised a fixed sum equivalent to the old tithes together with supplementary sums levied for some particular occasion. The church, on its side, profited by this arrangement in order to obtain the commutation or redemption of the taxes affecting ecclesiastics considered as individuals. This settlement only applied to the "clergy of France." that is to say, to the clergy of those districts which were united to the crown before the end of the 16th century. The provinces annexed later, called *pays étrangers,* or *pays conquis,* had in this matter, as in many others, an arrangement of their own.

At the end of the 16th century a reasonable balance had been established among the Christians of France. The Edict of Nantes. in 1598, granted the Protestants full civil rights and liberty of public worship in many places and notably in all the royal *bailliages,* though restrictive clauses made it possible to regard it as a temporary concession: a measure of tolerance, the edict did not proclaim the right to freedom of conscience. The Catholics, whose religion was essentially a state religion, had never accepted this arrangement as final, and at last. in 1685, under Louis XIV, the edict was revoked and the Protestant pastors expelled from France. Their followers were forbidden to leave the country, but many succeeded nevertheless in escaping abroad. The position of those who remained behind was peculiar. Laws passed in 1715 and 1724 established the legal theory that there were no longer any Protestants in France. but only *vieux catholiques* and *nouveaux convertis.* The result was that henceforth they had no longer any regular civil status, the registers containing the lists of Catholics enjoying civil rights being kept by the Catholic clergy.

The Parlements, 1715–89.—The form of government established under Louis XIV was preserved without any fundamental modification under Louis XV. The *parlements* had regained their ancient rights in consequence of the *parlement* of Paris having. in 171j, set aside the will of Louis XIV as being contrary to the fundamental laws of the kingdom, in that it laid down rules for the composition of the council of regency and limited the power of the regent. This newly revived power they exercised freely, and all the more so since they were the last surviving check on the royal authority. They became at this period the avowed representatives of the nation; they contested the validity of the registration of laws in the *lits de justice,* asserting that laws could only be made obligatory when the registration had been freely endorsed by themselves. Before the registration of edicts concerning taxation they demanded a statement of the financial situation and the right of examining the accounts. Finally, by the theory of the *classes,* which considered the various *parlements* of France as parts of one and the same body, they established among them a political union. These pretensions the crown refused to recognize. Louis XV solemnly condemned them in a *lit de justice* of Dec. 1770, and in 1771 the chancellor René Maupeou took drastic measures against them. The magistrates of the *parlement* of Paris were removed, and a new *parlement* was constituted, including the members of the *grand conseil,* which had also been abolished. The *cour des aides* of Paris, which had made common cause with the *parlement,* was also suppressed and many of the provincial *parlements* were reorganized. These actions, the coup d'état of the chancellor Maupeou, as they were called, produced an immense sensation.

Organization of the Army.—The permanent army was further developed. The *gendarmerie* or heavy cavalry was continuously increased in numbers. On the other hand, the *francs archers* fell into disuse after Louis XI; and, after a fruitless attempt had been made under Francis I to establish a national infantry, a system of voluntary enlistment was introduced. The system of purchase underlay the uhole military organization. Each regiment was the property of a great lord; the captain was. so to speak, owner of his company, or rather a contractor, who, in return for the sums paid him by the king, recruited his men and gave them their uniforms, arms and equipment. Up to the end of the 17th century, the army had consisted exclusively of mercenary volunteers. Then a far-reaching change was made with the introduction of compulsory recruiting, on which the organization of the militia (*milices*) was based. Thereafter the two systems existed side by side. Each parish had to furnish one recruit to the militia, but the force was very rarely raised from the towns. The purpose for which these men were employed varied from time to time. Sometimes, as under Louis XIV, they were formed into special active regiments. Under Louis XV and Louis XVI they were formed into *régiments provinciaux,* which constituted an organized reserve. But their chief use was during the war, when they were individually incorporated into various regiments to fill up the gaps.

Under Louis XV, the duc de Choiseul suppressed what he called the "farming of companies" *(compagnie-ferme)*; recruiting became a function of the state, and voluntary enlistment a contract between the recruit and the state. Arms, uniforms and equipment were furnished by the king. Choiseul also equalized the numbers of the military units, and his reforms, together with a few others effected under Louis XVI, produced the army which fought the first campaigns of the Revolution.

Taxation, 17th–18th Centuries.—One of the most distinctive features of the *ancien régime* was excessive taxation. The taxes imposed by the king were numerous, and, moreover, hardly any of them fell on all parts of the kingdom. To this territorial inequality was added the inequality arising from privilege. Ecclesiastics, nobles and many of the crown officials were exempted from the heaviest imposts. In the 17th and 18th centuries certain important new taxes were established: between 1695 and 1698 the *capitation,* and in 1710 the tax of the *dixième,* which became under Louis XV the tax of the *vingtièmes.* These two imposts had been intended to affect every subject in proportion to his income; but so strong was the system of privilege, that as a matter of fact the chief burden fell upon the *roturiers.* The income of a *roturier* who was not exempt was thus subject in turn to three direct imposts, the *taille,* the *capitation* and the *vingtikmes,* and the apportioning or assessment of these was extremely arbitrary. In addition to indirect taxation strictly so called, France under the *ancien re'gime* was subject to the *traites,* or customs, which were not only levied at the frontiers on foreign trade, but also included many internal customhouses for trade between different provinces. Their origin mas generally due to historical reasons; thus, among the *provinces reputées étrangères* were those which in the 14th century had refused to pay the *aides* for the ransom of King John II, also certain provinces which had refused to allow customs offices to be established on their foreign frontier. Colbert had tried to abolish these internal duties, but had only succeeded to a limited extent.

The indirect taxes, the *traites* and the revenues of the royal domain were farmed out by the crown. At first a separate contract had been made for each impost in each *élection,* but later they were combined into larger blocks, as is shown by the name of one of the customs districts, *l'enceinte des cinq grosses fermes.* From the reign of Henry IV the levying of each indirect impost was farmed en bloc for the whole kingdom, a system known as the *fermes générales;* but the real *ferme ge'ne'rale,* including all the imposts and revenues which were farmed in the whole of France, was only established under Colbert. The *ferme générale* was a powerful company, employing a vast number of men, most of whom enjoyed various privileges. Besides the royal taxes, seigniorial imposts survived under the form of tolls and market dues. The lords also often possessed local monopolies or *banalités; e.g.,* the right of the common bakehouse *(four banal).*

Decline of the Ecclesiastical Courts. — The ecclesiastical jurisdictions survived to the end of the *ancien re'gime,* but with diminished scope. A series of ingenious legal theories had gradually deprived them of most of the cases which they had formerly entertained. In the 18th century civil suits in which the clergy were defendants were normally taken before secular tribunals, and ever since the first half of the 17th century, for all grave offenses, the royal judge could pronounce a sentence of corporal punishment on a guilty cleric without this necessitating his previous degradation. The inquiry into the case was, it is true, conducted jointly by the royal and the ecclesiastical judge, but each of them pronounced his sentence independently. All cases concerning benefices came before the royal judges. Finally, the *officialités* only possessed a very limited jurisdiction over laymen, even in the matter of marriage. The parish priests, however, continued to enter declarations of baptisms, marriages and burials in registers kept according to the civil laws.

Law and Legislation. — The general customs of the *pays coutumiers* were almost all officially recorded in the 16th century. Drafts were prepared by the officials of the royal courts in the chief town of the district and were then submitted to the government. The king then appointed commissioners to visit the district and promulgate the customs on the spot. For the purpose of this *publication* the lords, lay and ecclesiastical, of the district, with representatives of the towns and of various bodies of the inhabitants, were summoned for a given day to the chief town. In this assembly each article was read. discussed and put to the vote. Those which were approved by the majority were thereupon decreed *(décrétés)* by the commissioners in the king's name; those which gave rise to difficulties were put aside for the *parlement* to settle when it registered the *coutume.* The *coutumes* in this form became practically written law; henceforward their text could only be modified by a formal revision carried out according to the same procedure as the first version.

Legislation by *ordonnances, édits, déclarations* or *lettres patentes,* emanating from the king, became more and more frequent; but the character of the *grandes ordonnances,* which were of a far-reaching and comprehensive nature, underwent a change during this period. In the 14th, 15th and 16th centuries they had been mainly *ordonnances de réformation* (*i.e.,* revisions of previous laws), which were most frequently drawn up after a sitting of the states-general, in accordance with the suggestions submitted by the deputies. The last of this type was the ordinance of 1629, promulgated after the states-general of 1614 and the assemblies of notables which had followed it. In the 17th and 18th centuries they became essentially *codifications,* comprising a systematic and detailed statement of the whole branch of law. The first series of codifying ordinances under Louis XIV, inspired by Colbert and carried out under his direction, included the ordinance of 1667 on civil procedure; that of 1670 on the examination of criminal cases; that of 1673 on the commerce of merchants; and that of 1681 on the regulation of shipping (the last two form between them a complete code of commerce by land and sea). The second series, under Louis XV, due to the chancellor d'Aguesseau, led chiefly to the regulation, by the ordinances of 1731, 1735 and 1747, of deeds of gift between living persons, wills and property left in trust. Under Louis XVI some mitigation was made of the criminal law, notably the abolition of torture.

Land Tenure. — The system of land tenure which prevailed in the 18th century preserved many features of feudalism. The fief, although it still implied homage from the vassal, no longer involved any service on his part (excepting that of the *arridre-ban* due to the king); but when a fief changed hands the Iord still exacted his *profits.* Tenures held by *roturiers* were generally subject to periodical and fixed contributions for the profit of the lord. Serfdom had disappeared from most of the provinces of the kingdom; among all the *coutumes* which were officially codified, not more than ten or so still recognized this institution. An edict of Louis XVI of 1779 abolished serfdom on crown lands and mitigated the condition of the serfs who still existed on the domains of individual lords. By 1789 the number of serfs in the kingdom was insignificant.

THE FRENCH REVOLUTION

The Revolution destroyed the *ancien re'gime.* The Constituent Assembly suppressed nobility and forbade any one to bear its titles, emblems and arms. The Legislative Assembly eliminated, without indemnity, all feudal rights for which the original deed of concession could not be produced. The Convention entirely abolished all feudal rights. though it maintained, subject to redemption, those tenures and charges which were solely connected with landed property and not feudal.

Administrative Reorganization. — The Constituent Assembly gave to France a new administrative division, into departments, districts, cantons and communes; and this division, which mas intended to make the old provincial distinctions disappear, had to serve all purposes, the department being the unit for all public services. Apart from certain changes in detail, this settlement was definitive and exists to the present day. But there was a peculiar administrative organism depending on this arrangement. The constitution of 1791, it is true, made the king the titulary head of the executive power; but the internal administration of the kingdom was not actually in his hands. It was deputed, under his orders, to bodies elected in each department, district and commune. The municipal bodies were directly elected by citizens duly qualified; other bodies were chosen by the method of double election. Each body consisted of two parts: a council, for deliberative purposes, and a *bureau* or *directoire* chosen by the council from among its numbers to form the executive. These were the only instruments for the general administration and for that of the direct taxes. The king could, it is true, annul the illegal acts of these bodies, but not dismiss their members; he could merely suspend them from exercising their functions, but the matter then went before the Legislative Assembly, which could maintain or remit the suspension as it thought fit. The king had not a single agent chosen by himself for general administrative purposes. This was a reaction, though a very exaggerated one, against the excessive centralization of the *ancien re'gime,* and resulted in an absolute administrative anarchy. The organization of the revolutionary government partly restored the central authority; the councils of the departments were suppressed; the Committee of Public Safety and the "representatives of the people on mission" were able to remove and replace the members of the elected bodies; and also, by an ingenious arrangement, national agents were established in the districts. The constitution of the year III continued on these lines, simplifying the organization established by the Constituent Assembly, while maintaining its principle. The department had an administration of five members, elected as in the past. but having executive as well as deliberative functions. The district was suppressed. The communes retained only a municipal agent elected by themselves; the actual municipal body, the importance of which was considerably increased, was removed to the canton, and consisted of the municipal agents from each commune and a president elected by the duly qualified citizens of the canton. The Directory was represented in each departmental and communal administration by a commissary appointed and removable by itself and could dismiss the members of these administrations.

Judicial System.—The Constituent Assembly decided on the complete reorganization of the administration of justice. This was accomplished on a very simple plan, which realized that ideal of the two degrees of justice which we have noticed under the *ancien régime*. In the lower degrees it created in each canton a justice of the peace *(juge de paix)*, the idea and name of which were borrowed from England, but which differed very much from the English justice of the peace. He judged, both with and without appeal, civil cases of small importance; and, in cases which did not come within his competency, it mas his duty to try to reconcile the parties. In each district was established a civil court of five judges. For cases coming under the district court, the assembly had preserved the right of appeal in cases involving sums above a certain figure.

With regard to criminal prosecutions, there was in each department a court which judged crimes with the assistance of a jury; it consisted of judges borrowed from district courts and had its own president and public prosecutor. Correctional tribunals, composed of *juges de paix*, dealt with misdemeanours. The assembly preserved the commercial courts, or consular jurisdictions, of the *ancien re'gime*. There was a *tribunal de cassation*, the purpose of which was to preserve the unity of jurisprudence in France; it dealt with matters of law and not of fact, considering appeals based on the violation of law, whether in point of matter or of form, and if such violation were proved. sending the matter before another tribunal of the same rank for retrial. All judges were elected for a term of years. The Constituent Assembly required proof of professional qualifications from all judges except the *juges de paix*. But the system was really the same as that of the administrative organization. The king appointed the *commissaires du roi* attached to the district courts, criminal tribunals and the court of cassation but could not revoke an appointment once made. The Convention did not change this general organization; but it suppressed the professional guarantees required in the case of candidates for a judgeship, so that henceforth all citizens were eligible; and it also caused new elections to take place. Moreover, the Convention not infrequently removed and replaced judges without further election. The constitution of the year III preserved this system, but introduced one considerable modification. It suppressed the district courts and in their place created in each department a civil tribunal of 20 judges.

The Army.—The Constituent Assembly suppressed the militia and maintained the standing army, essentially according to the old type. The assembly proclaimed, however, the principle of compulsory and personal service, under the particular form of the national guard, to which all qualified citizens belonged and in which almost all ranks were conferred by election. This institution, with many successive modifications and long periods of inactivity, lasted till 1871. For purposes of war the Convention, in addition to voluntary enlistments and the resources furnished by the national guard and apart from the forced levy of 300,000 men in 1793, decided to call on the communes to furnish men, thus reviving the principle of the militia. The Directory's law of 6 Fructidor, year VI, established compulsory military service for all, under a strict form of conscription: Frenchmen aged from 20 to 25 *(de'fenseurs conscrits)* were divided into five classes, each including the men born in the same year, and were liable until they were 25 years old to be called up for active service, the whole period of service not exceeding four years; no class was called upon until the younger classes had been exhausted, and the sending of substitutes was forbidden. This law, with a few later modifications, provided for the French armies up to the end of the empire.

Taxation.—The Constituent Assembly abolished nearly all the taxes of the *ancien re'gime* except the stamp duty and that on the registration of acts (the old *contrôle* and *centième denier*). The customs were maintained only at the frontiers for foreign trade. One change was thought to be extremely important: imposts sanctioned by the sovereign power were now described as "contributions," to mark each citizen's desire to share in the state's expenditure. But this purely formal modification made no difference' to the way in which public liabilities were distributed. In the establishment of new taxes the assembly did away with indirect taxation on objects of consumption and made the principal direct tax the tax on land. Next in importance were the *contribution personnelle et mobilière* and the *patentes*, which, though considerably modified later, are still essentially the basis of the French system of direct taxation. Under the Directory there was a partial reappearance of indirect taxation in the *octrois* of the towns, which had been suppressed by the Constituent Assembly.

Religious Liberty.—The Constituent Assembly gave the Protestants liberty of worship and full rights; it also gave Jews the status of citizen and political rights. With regard to the Catholic Church, the assembly first abolished tithes and then nationalized the church lands, at the same time providing salaries for the clergy. Next it suppressed the religious orders, granting pensions to their former members. Finally, however, it enacted the civil constitution of the clergy, setting up an entirely new system for the organization of the church. Under this, the departments were taken as the chief regional units in the place of the old dioceses; and the bishops were elected by the electoral assembly of the department and the *cure's* by the electoral assembly of the district. This unfortunate piece of legislation, together with the civic oath imposed on the clergy, was a source of endless troubles. The constitutional church was, however, abolished as a state institution by the Convention. The laws of the years III and IV, in proclaiming the liberty of worship, declared that the republic neither endowed nor recognized any form of worship.

Civic and Criminal Law.—The assemblies of the Revolution, besides the laws which, by abolishing feudalism, altered the character of real property, passed many others concerning civil law. The most important are those of 1792, passed by the Legislative Assembly, which organized the registers of the *état civil* kept by the municipalities and laid down rules for marriage as a purely civil contract. Divorce was admitted to a practically unlimited extent; it was possible not only for causes determined by law and by mutual consent, but also for incompatibility of temper and character proved, by either husband or wife, to be of a persistent nature. Next came the laws of the Convention as to inheritance, imposing perfect equality among the natural heirs and endeavouring to ensure the division of properties. Illegitimate children were considered by these laws as on the same level with legitimate children. In criminal law their work was still more important. In 1791 the Constituent Assembly gave France its first penal code. It was inspired by humanitarian ideas, still admitting capital punishment, though accompanied by no cruelty in the execution; but none of the remaining punishments was for life. Long imprisonment with hard labour was introduced. Finally, as a reaction against the former system of arbitrary penalties, there came a system of fixed penalties determined. both as to its assessment and its nature, for each offense, which the judge could not modify. The Constituent Assembly also reformed the procedure of criminal trials and, taking English law as model, introduced the jury, with the double form of *jury d'accusation* and *jury de jugement*.

THE CONSULATE AND THE EMPIRE

The constitutional changes of the consulate and empire, though all, either in their full text or in principle, were submitted to popular vote by means of a *plébiscite,* had all the same object: to assure absolute poner to Napoleon, while preserving the forms and appearance of liberty. Popular suffrage became universal; but the citizens in effect merely nominated the candidates, and it was the senate which chose from among them the members of the various so-called elected bodies, even those of the political assemblies. According to the constitution of the year VIII, the first consul possessed the executive power in the widest sense of the word, and he alone could initiate legislation. There were three representative assemblies in existence. but one of them, the *corps législatif,* passed laws without discussing them and without the power of amending the suggestions of the government. The tribunate, on the contrary. discussed them, but its vote was not necessary for the passing of the law. The senate was the guardian and preserver of the constitution; its chief function was to annul laws and acts submitted to it by the tribunate as being unconstitutional. This original organization was naturally modified during the course of the consulate and the empire; and a whole body, the tribunate, which was the only one which could preserve some independence, disappeared, without resort to a plebiscite. The importance of another body, on the contrary, the *conseil d'e'tat,* which consisted of members appointed by Napoleon, continually increased. It was this body which really prepared and discussed the laws; and it was its members who advocated them before the *corps législatif,* to which the tribunate also sent orators to speak on its behalf. The ministers, who had no relation with the legislative power, were merely the agents of the head of the state, freely chosen by himself. Napoleon, however, found these powers insufficient and arrogated to himself others: thus he frequently declared war upon his own authority, in spite of the provisions to the contrary made by the constitution of the year VIII; and similarly, under the form of *dkcrets,* he made what were really laws. These were afterward called *décrets-lois,* and those that were not indissolubly associated with the political regime of the empire, and survived it, were subsequently declared valid by the court of cassation, on the ground that they had not been submitted to the senate as unconstitutional.

Administrative Changes. — The period saw the rise of a whole new series of great organic laws. For administrative organization, the most important was that of 28 Pluviôse, year VIII. It established as chief authority for each department a prefect, and side by side with him a *conseil général* for deliberative purposes; for each *arrondissement* (nearly corresponding to the old *district)* a subprefect (*sous-préfet*) and a *conseil d'arrondissement;* and for each *commune,* a mayor and a municipal council. But all these officials, both the members of the councils and the individual agents, were appointed by the head of the state or by the prefect, so that centralization was restored more completely than ever. Together with the prefect there was also established a *conseil de préfecture,* having administrative functions and generally acting as a court of the first instance in disputes and litigation arising out of the acts of the administration; for the Constituent Assembly had removed such cases from the jurisdiction of the civil tribunals and referred them to the administrative bodies themselves. The final appeal in these disputes was to the *conseil d'e'tat.* In 1807 was created another great administrative jurisdiction, the *cour des comptes,* after the pattern of the *chambre des comptes* of the *ancien régime.*

Judicial Changes. — Judicial organization had also been fundamentally altered. The system of election was preserved for a time in the case of the *juges de paix* and the members of the court of cassation, but finally disappeared there, even where it had already been no more than a form. The magistrates were in principle appointed for life, but under the empire a device was found for evading the rule of irremovability. For the judgment of civil cases there was a court of first instance in every *arrondzssement,* and above these a certain number of courts of appeal, each of which had within its province several departments. The separate criminal tribunals and the *jury d'accusation* were abolished in 1809 by the *Code d'Instruction Criminelle,* and the right of pronouncing the indictment was transferred to a chamber of the court of appeal. The correctional tribunals were amalgamated with the civil tribunals of the first instance. The *tribunal de cassation,* which took under the empire the name of *cour de cassation,* consisted of magistrates appointed for life and still kept its powers. The *ministère public* (consisting of imperial *avocats* and *procureurs)* was restored in practically the same form as under the *ancien régime.*

The former system of taxation was preserved in principle, but with one considerable addition: Napoleon re-established indirect taxation on articles of consumption, which had been abolished by the Constituent Assembly; the chief of these were the duties on liquor *(droits réunis,* or excise) and the monopoly of tobacco.

The Concordat. — The concordat concluded by Napoleon with the papacy on 26 Messidor, year IX, re-established the Catholic religion in France as the form of worship recognized and endowed by the state. It was in principle drawn up on the lines of that of 1516 and assured to the head of the French state in his dealings with the papacy the same prerogatives as had formerly been enjoyed by the kings; the chief of these was that he appointed the bishops, who afterward had to ask the pope for canonical institution. The territorial distribution of dioceses was preserved practically as it had been left by the civil constitution of the clergy. The state guaranteed the payment of salaries to bishops and *cure's;* and the pope agreed to renounce all claims referring to the appropriation of the goods of the clergy made by the Constituent Assembly. Later on, a decree restored to the *fabriques* (vestries) such of their former possessions as had not been alienated, and the churches which had not been alienated were restored for the purposes of worship. The law of 18 Germinal, year X, ratifying the concordat. reasserted, under the name of *articles organiques du culte catholique,* all the main principles contained in the old doctrine of the liberties of the Gallican Church. The concordat did not include the restoration of the religious orders and congregations; Napoleon sanctioned by decrees only a few establishments of this kind.

The University. — One important creation of the empire was the university. The Revolution had suppressed the old universities and the teaching congregations; the constitution of the year III had proclaimed liberty of instruction and commanded that public schools, both elementary and secondary, should be established; and the Directory had set up in each department an *école centrale,* in which all branches of human knowledge were taught. Napoleon, by laws and decrees of 1806, 1808 and 1811, founded the Université de France, which provided and organized higher, secondary and primary education; this was to be the monopoly of the state, carried on by its *facultés, lyckes* and primary schools. No private educational establishment could be opened without the authorization of the state.

The Codes. — Chief among the documents dating from this period are the codes, which are still in force in France. These are the *Code Civil* oi 1804, the *Code de Proce'dure Civile* of *1806.* the *Code de Commerce* of 1807, the *Code d'lnstrziction Criminelle* of 1809, and the *Code Pénal* of 1810. These monumental works, in the elaboration of which the *conseil d'e'tat* took the chief part, contributed, to a greater or less extent, toward the fusion of the old law of France with the laws of the Revolution. It was in the case of the *Code Civil* that this task presented the greatest difficulty *(see* CODE NAPOLÉON). The *Code de Commerce* was scarcely more than a revised and emended edition of the *ordonnances* of 1673 and 1681; while the *Code de Proce'dure Civile* borrowed its chief elements from the *ordonnance* of 1667. In the case of the *Code d'Instruction Criminelle* a distinctly new departure was made. While the procedure introduced by the Revolution into courts where judgment was given remained public and oral, with full liberty of defense. the preliminary procedure before the examining court *(juge d'instruction* or *chambre des mises en accusation)* was borrowed from the *ordonnance* of 1670; it was the procedure of the old law, without its cruelty, but secret and written, and generally not in the presence of both parties. The *Code Pénal* maintained the principles of the Revolution but increased the penalties. It substituted for the system of fixed penalties, in cases of temporary punishment, a maximum and a minimum, between the limits of which judges could assess the amount. Even in the case of misdemeanours, it admitted the system of extenuating circumstances, which allowed them still further to decrease and alter the penalty.

THE RESTORED MONARCHY

The Restoration and the monarchy of July, though separated by a revolution, form one period in the history of French institutions. It was a period of constitutional monarchy, with a parliamentary body consisting of two chambers, a system imitated from England. The revolution of 1830 took place in defense of the charter granted by Louis XVIII in 1814, which Charles X had violated by the *ordonnances* of July. The two chambers then acquired the initiative in legislation, which had not been recognized as theirs under the Restoration but from this time on belonged to them equally with the king. The sittings of the house of peers were henceforth held in public; but this chamber underwent another and more fundamental transformation. The peers were nominated by the king, with no limit of numbers, and according to the charter of 1814 their appointment could be either for life or hereditary. Under Louis XVIII, during the Restoration they were always appointed under the latter condition, but under the July monarchy their tenure of office was for life, and the king had to choose them from among 22 classes of notables fixed by law. The franchise for the election of the chamber of deputies had been limited by a system of money qualifications; but while, under the Restoration, it had been necessary, in order to be an elector, to pay 300 fr. in direct taxation, this sum was reduced in 1831 to 200 fr., while in certain cases even a smaller amount sufficed. In order to be elected as a deputy under the charter of 1814, it was necessary to pay 1,000 fr. in direct taxation; under that of 1830, only 500. From 1817 onward there was direct suffrage, the electors directly electing the deputies. The charter of 1814 had been framed to give the chief influence to the great landed proprietors; that of 1830 to give it to the middle and lower-middle classes.

In another respect also the Restoration and the July monarchy were at one, viz. in maintaining in principle the civil, legal and administrative institutions of the empire. The preface to the charter of 1814 sanctioned and guaranteed most of the legal rights won by the Revolution; even the alienation of national property was confirmed. Judicial and administrative organization, the system of taxation, military organization, the relations of church and state remained the same, and the university also continued to exist. The government did. it is true, negotiate a new concordat with the papacy in 1817, but did not dare even to submit it to the chambers. The most important reform was that of the law concerning recruiting for the army. The charter of 1814 had promised the abolition of conscription, in the form in which it had been created by the law of the year VI. The law of March 10, 1818, established a new system. The contingent voted by the chambers for annual incorporation into the standing army was divided up among all the cantons; and, in order to furnish it, lots were drawn among all the men of a certain class, that is to say, among the young Frenchmen who arrived at their majority that year. Those who were not chosen by lot were definitely set free from military service. The sending of substitutes, a custom which had been permitted by Napoleon, was recognized. This was the type of all the laws on recruiting in France up to 1867.

The Restoration produced a code, the *Code Forestier* of 1827, for the regulation of forests *(eaux et forêts)*. In 1816 a law had abolished divorce, making marriage indissoluble, as it had been in the old law. But the best laws of this period were those on finance. Now, for the first time, was introduced the practice of drawing up regular budgets, voted before the year to which they applied and divided since 1819 into the budget of expenditure and budget of receipts.

Together with other institutions of the empire, the Restoration had preserved the exaggerated system of administrative centralization established in the year VIII. It was only relaxed under the July monarchy. The municipal law of March 21, 1831, made the municipal councils elective and extended widely the right of voting in the elections for them; the *maires* and their assistants continued to be appointed by the government, but had to be chosen from among the members of the municipal councils. The law of June 22, 1833, made the general councils of the departments also elective and brought the *adjonction des capacités* into effect for their election. The powers of these bodies were enlarged in 1838, and they gained the right of electing their president. In 1833 was granted another liberty, that of primary education; but in spite of violent protestations, coming especially from the Catholics. secondary and higher education continued to be a monopoly of the state. A law of June 11, 1842, established the great railway lines. In 1832 the *Code Pénal* and *Code d'Instruction Criminelle* were revised, with the object of lightening penalties; the system of extenuating circumstances, as recognized by a jury, was extended to the judgment of all crimes. There was also a revision of Book III of the *Code de Commerce*, treating of bankruptcy. Finally, from this period date the laws of May 3, 1841, on expropriation for purposes of public utility, and of June 30, 1838, on the treatment of the insane. Judicial organization remained substantially unaltered.

THE SECOND REPUBLIC

From the point of view of constitutional law, the second republic and the second empire were each in a certain sense a return to the past. The former revived the tradition of the assemblies of the Revolution; the latter was obviously and avowedly an imitation of the consulate and the first empire.

Republican Constitution of 1848.—The provisional government set up by the revolution of Feb. 24, 1848. proclaimed universal suffrage, and by this means was elected a constituent assembly, which sat till May 1849 and passed the republican constitution of Nov. 4, 1848. This constitution gave the legislative power to a single permanent assembly, elected by direct universal suffrage and entirely renewed every three years. The executive authority, with very extensive powers, was given to a president of the republic, also elected by the universal and direct suffrage of the French citizens. On the other hand, the president was not immediately eligible for re-election on giving up his office. Now Louis Napoleon, who was elected president on Dec. 10, 1848, by a huge majority, wished to be re-elected. The result was the coup d'état of Dec. 2, 1851.

A detail of some constitutional importance is to be noticed in this period. The *conseil d'e'tat,* which had remained under the Restoration and the July monarchy an administrative council and the supreme arbiter in administrative trials, acquired new importance under the second republic. The ordinary *conseillers d'e'tat (en service ordinaire)* were elected by the legislative assembly, and consultation with the *conseil d'e'tat* was often insisted on by the constitution or by law. During its short existence the second republic produced many important laws. It abolished the penalty of death for political crimes and suppressed Negro slavery in the colonies. The election of *conseillers généraux* was thrown open to universal suffrage, and the municipal councils were allowed to elect the *maires* and their colleagues. The law of March 15, 1850, established the liberty of secondary education, but it conferred certain privileges on the Catholic clergy, a clear sign of the spirit of social conservatism which was the leading motive for its enactment. Certain humanitarian laws were passed, applying to the working classes.

Constitution of 1852.—With the coup d'état of Dec. 2, 1851, began a new era of constitutional plebiscites and disguised absolutism. The proclamations of Louis Napoleon on Dec. 2 contained a criticism of parliamentary government and formulated the wish to restore to France the constitutional institutions of the consulate and the empire. Napoleon asked the people for the powers necessary to draw up a constitution on these principles; the plebiscite issued in a vast majority of votes in his favour, and the constitution of Jan. 14. 1852, was the result. It bore a strong resemblance to the constitution of the first empire after 1807. The executive power was conferred on Louis Napoleon for ten years, with the title of president of the republic and very extended powers. Two assemblies were created. The conservative senate was charged with the task of opposing the promulgation of unconstitutional laws and of receiving the petitions of citizens; it had also the duty of providing everything not already provided but necessary for the proper working of the constitution. The second assembly was the *corps législatif,* which was elected by direct universal suffrage for six years and passed the laws, the government having the initiative in legislation. Its powers were very limited, and it could only discuss and put to the vote amendments approved by the *conseil d'e'tat;* the ministers did not in any way come into contact with it and could not be members of it, being responsible only to the head of the state, and only the senate having the right of accusing them before a high court of justice. The *conseil d'état* was composed in the same way and had the same authority as it had possessed from the year VIII to 1814; and it was the members of it who supported projected laws before the *corps ltgislatif.* To this was added a Draconian press legislation; press offenses were judged not by a jury but by the correctional tribunals: and political papers could not be founded without an authorization. They were subject to a regular administrative discipline and could be warned. suspended or suppressed without a trial by a simple act of the administration. The constitution of Jan. 1852 was still republican in name, though less so than that of the year VIII. The period corresponding with the consulate was also shorter in the case of Louis Napoleon. The year 1852 had not come to an end before a *senatus consulte,* that of Kov. 10, ratified by a plebiscite, re-established the imperial rank in favour of Napoleon III.

(J. P. E.; R. DT.)

THE SECOND EMPIRE

Numerous legislative reforms were introduced by the second empire, aiming at the development of commerce, industry and agriculture and the material prosperity of the country in general. Such were the decrees and laws of 1852 and 1853 relating to landbanks *(établissements de crédit foncier),* that of 1857 on trademarks, that of 1858 on general stores *(magasins généraux)* and warrants, those of 1863 and 1867 on commercial companies, that of 186; on cheques and that of 1866 on the mercantile marine. Economic treaties were also concluded by the emperor with foreign powers, the chief of these being concluded with Great Britain on Jan. 23, 1860. In another direction, the law of May 25. 1864, recognized for the first time the right of strikes among workmen and employees, while the superannuation fund *(caisses des retraites pour la vieillesse)* created by the law of June 18, 1850, was reorganized and perfected, and a law of July 11, 1868, established, under the guarantee of the state, two funds for voluntary insurance, one in case of death, the other against accidents occurring in industrial or agricultural employment.

Criminal law was the subject of important legislation. Thus the total loss of civil rights which hitherto accompanied condemnation to imprisonment for life was abolished in 1854, and in the same year transportation to the colonies was substituted for the system of convict prisons in France. The law of July 17, 1856, increased the power of independence of the *juges d'instruction,* and useful improvements were introduced by the laws of 1856 and 186j as regards precautionary detention and provisional release with or without bail. Finally a general revision of the *Code Pénal* took place in 1863.

In civil legislation may be noted the law of March 23, 1855, on mortgages; that of July 22, 1857, which abolished seizure of the person *(contrainte par corps)* for civil and commercial debts; and finally the law of July 14, 1866, on literary copyright.

The system of taxation was hardly modified at all, except for the establishment of a tax on the income from investments (shares and bonds of companies) in 1857 and a tax on carriages (1862). In Feb. 1868 an important military law was promulgated which asserted the principle of universal compulsory military service in time of war, but preserved the system of drawing lots to determine the annual contingent to be incorporated in the standing army. The term of service was fixed at five years, and it was still permissible to send a substitute. Able-bodied men who were not included in the annual contingent formed a reserve force, called the *Garde Nationale Mobile.*

The "Liberal Empire."—The constitution of 1852 underwent certain changes before the fall of the empire. Reforms of detail were made from 1860 onward and to a considerable extent transformed the character of the institutions affected. In the hope of disarming the liberal opposition, Napoleon III promulgated decrees that gave the *corps législatif* a larger share in the business of government: parliamentary debates were to be in public and uninhibited; ministers could be criticized; and more direct participation in voting the budget was conceded. The result was that in 1870 a ministry could be set up that was both collectively responsible and answerable to the parliament; the empire had, in fact, become a parliamentary regime.

THE THIRD REPUBLIC

The third republic had at first a provisional government set up by the people of Paris. But immediately after the capitulation of the capital and in order to treat with Germany, a national assembly was elected in accordance with the electoral law of 1849, which had been revived for the occasion with a few modifications, and met at Bordeaux on Feb. 13, 1871. Its majority was frankly monarchist, though divided as to the choice of a monarch, and pending a settlement of this question it ruled the country until 1875, with one man elected by it as head of the executive power. Louis Adolphe Thiers was the first to be elected in 1871; after his fall on May 24, 1873, he was succeeded by Marshal Patrice de MacMahon, on whom the assembly conferred, in November, the position of president of the republic for seven years when it was clearly no longer possible to restore the monarchy. However, the recognition of the republic by the assembly did not become definitive until Jan. 30, 1875, when an amendment was adopted providing for the election of an indefinite succession of presidents of the republic.

For the constitution of 1875 *see* the detailed account of its origin, of its provisions and of its modifications in the article *FRANCE: Hzstory: The Third Republic, to 1914.* Of the reforms of public law subsequently carried out, it is necessary here to mention only those of a really organic character, made to safeguard and to regulate the freedom of the individual. The law of June 30, 1881, modified by that of March 28, 1907, established the right of holding public meetings, whether for ordinary or for electoral purposes. without preliminary authorization; they were not to be held, however, in the public highway, but in an enclosed space. The law of July 29, 1881, on the press, as subsequently modified in 1882, 1889, 1895, 1908 and 1919, was one of the most liberal in the world. by it, all offenses committed by any kind of publication were submitted to a jury, and only slander, libel, defamation, incitement to crime and, in certain cases, the publication of false news, were punishable. The law of July 1, 1901, established the right of forming associations, the objects of which were not contrary to law or to public order or morality; on the condition of a simple declaration to the administrative authority, it granted them a civil status in a wide sense of the term. Religious congregations on the other hand, unless authorized by a law, were forbidden by this law.

The "Secular State."—A law passed in 1875 established the liberty of higher education; that of primary education was confirmed and reorganized by the law of Oct. 30, 1886, which simply deprived the clergy of the privileges granted them by the law of 1850, though the latter remained in force with regard to the liberty of secondary education. The law of March 22, 1882, made primary education obligatory, though it alloued parents to send their children either to private schools or to those of the state; the law of June 16, 1881, established secular *(laique)* education in the case of the latter. Secondary education was also organized for girls in *lycdes* or special colleges (*collèges* de *filles*). Finally, a law of July 10, 1896, dealing with higher education and the faculties of the state, reorganized the universities as distinct bodies enjoying a fairly wide autonomy.

A law of Dec. 19. 1905, abrogating that of 18 Germinal, year X, which had sanctioned Napoleon's concordat. proclaimed the separation of the church from the state. It is based on the principle of the secular state *(dtat lazque)* which recognizes no form of religion, though it respects the right of every citizen to worship according to his beliefs; and it aimed at organizing associations of citizens, the object of which was to collect the funds and acquire the property necessary for the maintenance of worship, under the form of *associations cultuelles,* differing in certain respects from the associations sanctioned by the law of July 1, 1901, and having a wider scope. It also handed over to these regularly formed associations the property of the ecclesiastical establishments formerly in existence. while taking precautions to ensure their proper application, and allowed the associations the free use of the churches and places of worship belonging to the state, the departments or the communes. If no *association cultuelle* was founded in a parish, the property of the former *fabrique* should devolve to the commune. But this lam, was condemned by the papacy, as contrary to the church hierarchy; and almost nowhere were *associatzons cultuelles* formed, except by Protestants and Jews. After many incidents but no church closures, a new law of Jan. 2, 1907, was enacted. It permitted the public exercise of any cult, by means of ordinary associations regulated by the law of July 1, 1901, and even of public meetings summoned by individuals. Failing all associations, either *cultuelles* or otherwise, churches, with their ornaments and furniture, were left to the disposition of the faithful and ministers for the purpose of exercising the religion; and, on certain conditions, the long use of them could be granted as a free gift to ministers of the religion.

Administrative Organization.—Among the organic laws concerning administrative affairs, that of Aug. 10, 1871, on the *conseils généraux,* considerably increased the powers and independence of these elective bodies, which subsequently became important deliberative assemblies; this law also created a new administrative organ for the departments, the *commission départementale* elected by the *conseil général* of the department and associated with the administration of the prefect. The municipal lam of April 5, 1884, effected a widespread decentralization; the *maires* and their adjoints were to be elected by the municipal council.

Military Service.—The war of 1870–71 had necessarily led to a modification of the military organization. The law of July 25, 1872, established the principle of compulsory service for all, first in the standing army, the period in which was fixed at five years, then in the reserve and finally in the territorial army. However, the system of conditional engagement for a year allowed young men for the purposes of study or apprenticeship to their professions to serve only a year with the active army. A new law of July 15, 1889, reduced the term of service in the active army to three years, while at the same time reducing the number of men liable for only one year's service. Later, the law of March 21, 1905, reduced the term of service in the active army to two years but made it equal for all, admitting of no exemption but allowing only certain facilities as to the age at which it had to be accomplished. In 1913, the chamber voted the return to the former term of service of three years; this was just being put into force when World War I broke out. After the war, the law of April 1, 1923, reduced the term in the active army to $1\frac{1}{2}$ years, and a law of July 14, 1927, completely reorganized the army for time of peace and for time of mar.

Judicial and Fiscal Systems.—In 1883 the judicial personnel was reorganized and reduced in number, and except for a few modifications the main lines of judicial organization remained the same until the law of Sept. 3, 1926, mhich, for purposes of economy, suppressed a large number of *tribunaux d'arrondissement.*

The system of taxation remained practically unaltered until 1914, with the exception of the financial law of 1901 which rearranged and increased the transfer fees and established a system of progressive taxation. A law of July 1j, 1914, created income tax; after the war, a tax on turnover and a tax on commercial and industrial profits were also imposed, while the rate of the taxes themselves and stamp duties were increased all around. In view of the rapid growth of fiscal legislation it was felt necessary to codify the various texts, which was done through a decree of Dec. 28. 1926.

Labour Legislation, to World War I.—Labour laws, which generally partook of the nature both of public and of private law, were very numerous under the third republic. The most notable of those passed before 1900 were the law of March 21, 1884, on professional syndicates, which introduced the liberty of association in matters of this kind before it became part of the common law; the law of Dec. 22, 1892, on conciliation and arbitration in the case of collective disputes between employers and workmen; that of June 29, 1893, on the hygiene and safeguarding of workers in industrial establishments, and the laws which regulate the work of children and women in factories; that of July 1j, 1893, on free medical attendance; and that of April 9, 1898, on the liability for accidents incurred during work, with those which have completed it. On Dec. 30, 1910, a *Code du Travail et de la Pre'voyance Sociale* was promulgated, codifying the previous legislation, dealing particularly with contracts for work, imposing special rules and regulations as to conditions of work, Sunday rest, precautions to be taken for the safety of workmen, industrial diseases, etc., and creating work inspectors. A law of June 21, 1924, added a new part to this code, reorganizing the long-standing system of *conseils de prud'hommes,* to which disputes between employers and workmen were to be referred.

Criminal Law.—As to criminal law, there were more than 50 enactments (mostly involving important modifications resulting from modern theories of penology), as a result of which it was almost entirely recast. For instance, separate systems were applied in cases of preventive detention and in those of imprisonment for short periods; liberation before the expiry of the term of sentence was introduced, subject to the condition that no fresh offense be committed within a given time; habitual offenders were transported to the colonies; the penalty was remitted in the case of first offenders; greater facilities were given for the rehabilitation of condemned persons; and the law of Dec. 8, 1897, made the examination before the *juge d'instruction* a real hearing on both sides, and the appearance of counsel for the defense practically compulsory.

Private Law.—As to private law, both civil and commercial, hundreds of laws were passed between 1871 and 1940 modifying it, sometimes profoundly. Among the more important there was the law of July 27, 1884, and those which re-established divorce, prohibited since 1816, but only permitted it for certain definite causes determined by law. On the other hand the law of Feb. 6, 1893, increased the liberty and independence of a woman who was simply judicially separated, in order to encourage separation as opposed to divorce, when the conditions allowed it. The law of March 25, 1896, on the succession of illegitimate children who were recognized by the parents, did not treat them in the same way as legitimate children but gave them the title of heirs in the succession of their father and mother together with much greater rights than they had hitherto possessed under the *Code Civil.* The law of July 24, 1899, on the protection of children who were ill-treated or morally neglected, also modified some of the provisions of the law as applied to the family with a view to greater justice and humanity. The formalities of marriage were simplified and marriage itself made easier through the laws of June 20, 1896, and July 1, 1914. The law of Dec. 30, 1915, made the legitimation of adulterine children possible; that of March 20, 1917, allowed women, who had hitherto been debarred from so doing, to act as guardians of infant children. Consent to marriage was facultative by the law of Feb. 28, 1922, and under the law of April 28, 1922, ceased to be required for parties above 25 years of age. The law of Aug. 10, 1927, codified the various dispositions concerning acquisition and loss of French nationality and permitted French women marrying foreigners to retain their nationality of origin instead of acquiring as heretofore that of their husbands.

Commercial Law.—The law as to cheques was altered by laws of Dec. 30, 1911, and Aug. 12, 1926; a law of July 4, 1914, completed that of July 10, 1885, on maritime mortgage. A law of March 18, 1919, created a commercial registry *(registre du commerce),* reinforcing the existing measures of publicity imposed on traders, and that of Aug. 25, 1919, created the *Office Nattonal du Commerce Extérieur.* Finally life-insurance companies were regulated and placed under strict supervision on the part of the state (law of March 17, 1905, as modified by that of May 21, 1921). (F. AL.; R. DT.)

Economic and Social Legislation, 1919–39.—The political and social upheavals that followed World War I caused a series of reforms to be enacted in the last years of the third republic. The increasing influence of Socialist parties and the trend toward state intervention in economic affairs and ton-ard a controlled economy induced the legislature to re-examine earlier measures on particular aspects of the questions involved with a view to establishing a general principle. This tendency was especially marked in the 1930s, under the combined stress of economic difficulties and of political pressure reacting against the threat of dictatorship; it was intensified from 1936 onward, in the iace of the epidemic of strikes and after the iormation of the Popular Front.

Great changes were made in social legislation. The law of March 11, 1932, reorganized the system of iamily allowances, which since 1920 had been eclectic and futile in its operation. Henceiorth all employers were obliged to subscribe to it, all workers with a family to support getting increased wages. Maternity allowances were added, to check the fall in the birth rate.

The iarthest-reaching changes were those made by the laws of 1936: the law of June 21 reduced the working week to 40 hours in all industrial and trading establishments; that of June 20 instituted yearly holidays with pay for all employees and workers, including domestic and agricultural wage earners; that of June 24 gave universal validity to the system of collective bargaining contracts; and that of Dec. 31, an especially forceful example of state intervention, prescribed how labour disputes had to be settled by arbitration, with representatives of the state taking part. The application of these laws, together with the increased activity oi the trade unions, was transforming the conditions of liie in France when World War II broke out. In 1940 the third republic mas overthrown. It must be remarked, however, that the democratic and representative character of the third republic had already been compromised for some years by the use of *décrets-lois* instead of the normal machinery for legislation.

THE "FRENCH STATE" AND THE PROVISIONAL GOVERNMENTS

Hardly had the armistice with Germany been signed when the republic itself was eliminated and Marshal Pétain, by what must be described as a coup d'état, secured a practical dictatorship for himself, which lasted throughout the four years of German occupation. The very name of "republic" was abandoned for that of "French state," which was vague enough to cover the absence of any definite regime. Supposed to be drawing up a constitution for the nation to ratify, Pétain instead merely issued from Vichy his 12 "constitutional acts," settling certain details and not constituting any real system of government. At the same time, being radically hostile to 19th-century liberal individualism and anxious moreover to win the adhesion of the working classes, the new regime gave signs of readiness to complete its predecessor's labour legislation by setting up a system oi co-operation, based on professional organizations, in the place of the old conflict of interests. This was the significance of the *Charte du Travail* of 1941.

The Vichy regime, however, was challenged from the outset by the rival system that set itself up in London in 1940 under the name of "Free French committee," later changed to "French national committee" (1941). This committee moved to Algiers in June 1943 and provided itself with a consultative assembly; then, being equipped with all the necessary organs, it took the style of "provisional government'of the republic" on June 3, 1944. Transferred to Paris on the liberation, it forthwith annulled Pétain's "constitutional acts" and proclaimed the lawful regime to be that of the third republic.

However, the revival of the constitution of 1875 was submitted to a referendum (Oct. 23, 1945), in which women were for the first time allowed to vote. This extension of the franchise, which raised the electorate to 25,000,000, was permanent. The result was against the revival of the old constitution, and a constituent assembly was elected to draw up a new document. Its proposals were likewise rejected in a new referendum (May 5, 1946), and a second such assembly was elected. An emended iorm of the previous draft was accepted in a referendum and promulgated on Oct. 27, 1946. This was the constitution of the fourth republic.

THE FOURTH REPUBLIC

The legislation of the fourth republic was even more markedly concerned with social questions than that of its predecessors had been. It put increased emphasis on the policy of maintaining a controlled economy, as was natural in a critical period and particularly so in view of the devaluation of the currency, which would otherwise have brought chaos into the wage-and-price structure It nationalized several private industries—banks, mines and the production of pas and of electricity. Finally it fixed the price of certain primary products, wheat, milk and beets. A corollary of this legislation was that the government should grant subsidies, give priority to exports and purchase surplus commodities irom producers (whose organizations occasionally brought pressure to bear with the threat of unrest.)

Labour legislation was completed with the fixing of minimum wages (which was in iact a means of fixing prices) and with the ruling that employees should be represented on the executive of all industrial and commercial undertakings (*ordonnance* of Feb. 22, 1945). (R. DT.)

THE FIFTH REPUBLIC

In May 1958 revolt broke out in Algeria, and France was threatened by civil war. On June 2 Gen Charles de Gaulle obtained full powers from the national assembly, restored calm and pushed through a new constitution under which the assembly could overthrow the government by a vote of censure, but only by an absolute majority of the members If such a motion were defeated, its sponsors could not introduce another at the same session The fifth republic constitution provided that French overseas territories could decide their own status *See* FRANCE; FRENCH COMMUNITY. (X)

FRENCH LICK, a resort town of Orange county, in southern Indiana, U S., 50 mi N. of Louisville. Ky. Natural resources and agricultural products include coal. sandstone mineral water, corn and livestock. A buffalo trail which passed the mineral springs in the present town was used by early travelers. including George Rogers Clark in 1786 Evidence indicates that he named the area French Lick for land by that name in Tennessee. In 1835 William A. Bomles built the first hctel and in 1857 he platted the tonn. Thomas Taggart (1856–1929), later chairman of the Democratic national committee, purchased the hotel in 1901. Through his efforts French Lick became a popular year-round health resort and convention centre. The resident population in the 1960s was about 2,000. (R. W. HA.)

FRENCH LITERATURE. Literature proper began to be cultivated in France, in the vernacular, during the 10th and 11th centuries. The earliest writings are *cantilenae,* or songs in the vulgar language (*e g.,* on St. Eulalia), a *Life of St. Leger* and a *Life of St. Alexis* (perhaps about 1050), but the first real monument of French literature is the *Chanson de Roland,* which remains the greatest achievement of that literature until the Renaissance. The *Chanson de Roland* is the masterpiece of a flourishing type of epic poetry, the *chansons de geste,* of which we possess about 100 specimens.

Chansons de Geste.—These deal with subjects of traditional French history. The line generally used is of 10 syllables, and in later poems of 12; there is a regular caesura. The lines are arranged in *laisses* or *tirades* of very irregular numbers. The earlier poems are assonanced, only the vowel sound of the last syllables being identical. Later the poems are rhymed in a regular manner. In subject matter there are three chief groups: one dealing with Charlemagne, one with Doon of Mayence, one with Garin de Monglane. There are other groups on the Lorrainers, on the crusades, etc.

The earliest versions alone of the various poems would amount to more than 300,000 lines. The successive development of the *chansons de geste* may be illustrated by the fortunes of *Huon de Bordeaux,* one of the most lively. varied and romantic of the older epics, and one which is interesting from the use made of it by Shakespeare, Wieland and R'eber. In the oldest form now extant, though even this is probably not the original, *Huon* consists of more than 10,000 lines. A subsequent version contains 11.000 more, and lastly, in the 14th century, a later poet amplified the legend to the extent of 30.000 lines. When this point had been reached *Huon* began to be turned into prose, being, with many of its fellows, published and republished during the subsequent centuries and retaining, in popular forms and garbs, the favour of the country districts. But the best period of the *chanson de geste* was the 11th and 12th centuries. The *Chanson de Roland* is the earliest we possess and belongs in its present form to the early 12th century. Two classes of persons are chiefly associated with the *chansons de geste.* There was the *trouvère,* who composed them, and the *jongleur,* who carried them about in manuscript or in his memory from castle to castle and sang them intermixing frequent appeals to his audience for silence, declarations of the novelty and the strict copyright character of the *chanson,* revilings of rival minstrels and frequent requests for money in plain words.

Not a few of the manuscripts that exist today appear to have been actually used by the *jongleurs.* But the names of the authors are known only in very few cases, the names of copyists, continuators and mere owners of manuscripts having often been mistaken for them.

The characters of a *chanson* of the older style are somewhat uniform. There is the hero who is unjustly suspected of guilt or sore beset by Saracens, the heroine nho falls in love with him, the traitor who accuses him or delays help. There are friendly paladins and the subordinate traitors. There is Charlemagne, in the later *chansoizs* an incapable and venal dotard, in the earlier still the great emperor; and with Charlemagne the Duke Naimes of Bavaria, invariably wise, brace, loyal and generous. In the *Chanson de Roland* the love interest does not appear at all except in the incident of Aude's death when she hears of Roland's fall. Even in the later *chansons* the love interest is very little marked. Fighting, counsels and religion hold the literary field. In a few *chansons* appears a very interesting class: the man of low birth or condition who rescues the high-born hero from his enemies. Thus, Rainvart in *Aliscans,* Gautier in *Gaydon*, Robastre in *Gaufrey,* etc. The subjects are handled with great uniformity and even monotony of style, with constant repetitions. But the verse is generally harmonious and often stately. Some passages rise to high poetry. The most remarkable of the *chansons* are *Roland, Aliscans, Gérard de Roussillon, Ami et Amile, Raoul de Cambrai, Garin le Loherain, Les Qzcatre Fils Aymon, Les Saisnes.* The series of *Le Chevalier au Cygne* deals with the first crusaders, and a remarkable group centres round William of Orange, dealing with the defense of the south of France against Mohammedan invasion.

Arthurian Romances. — The second class of early French epics consists of the Arthurian cycle, the *Matière de Bretagne,* the earliest-known compositions of which are at least a century junior to the earliest *chanson de geste* but which soon succeeded the *chansons* in popular favour and obtained a vogue both wider and far more enduring. It is not easy to conceive a greater contrast in form, style. subject and sentiment than is presented by the two classes. In both the religious sentiment is prominent, but the religion of the *chansons* is of the simplest, not to say of the most savage character. To pray to God and to kill his enemies constitutes the whole duty of man. In the romances the mystical element becomes on the contrary prominent and furnishes, in the Holy Grail, one of the most important features. In the Carlovingian knight the courtesy and clemency which we have learned to associate with chivalry are almost entirely absent. The *gentix ber* contradicts, jeers at and execrates his sovereign and his fellows with the utmost freedom. He thinks nothing of striking his *cartoise moullier* so that the blood runs down her *cler vis.* If a servant or even an equal offends him, he will throw the offender into the fire. knock his brains out or set his whiskers ablaze. The Arthurian knight is far more of the modern model in these respects. But his chief difference from his predecessor is undoubtedly in his amorous devotion to his beloved. who, if not morally superior to Bellicent, Floripas. Esclairmonde and the other Carlovingian heroines, is somewhat less forward. Even in minute details the difference is strongly marked. The romances are in octosyllabic couplets or in prose, and their language is different from that of the *chansons* and contains fewer of the usual epic repetitions and stock phrases. The earliest romances, the *Saint Graal,* the *Quite du Saint Graal, Joseph d'Arimathie* and *Merlin* bear the names of Walter Map and Robert de Borron. *Artus* and part at least of *Laizcelot du Lac* appear to be the work of unknown authors. *Tristan* came later and has a stronger mixture of Celtic tradition. At the same time as Walter Map, or a little later, Chrétien (or Chrestien) de Troyes turned the legends of the Round Table into octosyllabic verse of a singularly spirited and picturesque character. The chief poems attributed to him are the *Chevalier au Lyon* (Sir Ewain of Wales), the *Chevalier à la Charette* (one of the episodes of *Laizcelot)* and *Erec, Tristan* and *Percivale.* These poems, independently of their merit, which is great, had an extensive literary influence. They were translated by the German minnesingers Wolfram von Eschenbach, Gottfried of Strasbourg and others.

With the romances to which we have already referred, Chrétien's poems complete the earlier forms of the Arthurian story and supply the matter of it as it is best known to English readers in Sir Thomas Malory's book. Nor does that book, though far later than the original forms, convey a very false impression of the characteristics of the older romances. Indeed: the Arthurian knight. his character and adventures. are so much better known than the heroes of the Carlovingian *chansons* that there is less need to dwell upon them.

The romances had, as has been already pointed out, great influence upon their rivals, and their comparative fertility of invention, the much larger number of their *drainatis personae* and the greater variety of interests to which they appealed sufficiently explain their increased popularity. The ordinary attractions of poetry are also more largely present in them than in the *chansons;* there is more description, more life and less of the mere chronicle. They have been accused of relaxing morality, and there is perhaps some truth in the charge. But the change is after all one rather of manners than of morals, and what is lost in simplicity is gained in refinement and the beginnings of a sense of literary form.

Romances of Antiquity. — There is yet a third class of early narrative poems, differing from the two former in subject but agreeing, sometimes with one, sometimes with the other, in form. These are the classical romances — the *matière de* Rome — which are not much later than those of Charlemagne and Arthur. The chief subjects mere the conquests of Alexander and the siege of Troy, though other classical stories come in. The most remarkable of all is the romance of *Alixandre* by Lambert le Tort and Alexander of Bernay.

Alexander is made in many respects a prototype of Charlemagne. He is regularly knighted. he has 12 peers, he holds tournaments, he has relations with Arthur and comes in contact with fairies, he takes flights in the ai , dives in the sea and so forth. There is perhaps more avowed imagination in these classical stories than in either of the other divisions of French epic poetry. Some of their authors even confess to the practice of fiction. while the *trouvères* of the *chansons* invariably assert the historical character of their facts and personages.

The *chansoizs de geste* had shown the creative power and independent character of French literature. There is. at least about the earlier ones, nothing borrowed, traditional or scholarly. They smack of the soil, and they rank France among the very few countries which. in this matter of indigenous growth. have yielded more than folk songs and fireside tales. The Arthurian romances. less independent in origin, exhibit a wider range of view, a greater knowledge of human nature and a more extensive command of the sources of poetical and romantic interest. The classical epics superadd the only ingredient necessary to an accomplished literature; *i.e.,* the knowledge of what has been done by other peoples and other literatures already, and the readiness to take advantage of the materials thus supplied.

Romans **d'Aventures.**—There remain to be mentioned a considerable number of narrative poems, written after the 13th century, which cannot be brought into any one of the three previous categories. As literary taste spread, *romans* were written about any possible subject, and in many various forms. Thus *Guillaume de Palerme* deals with the adventures of a Sicilian prince who is befriended by a werewolf; *Le Roman de l'escoufle* with a heroine whose ring is carried off by a sparrow hawk; *Guy of Warwick, Meraugis de Portlèguez, Cléomadès, Partenopeu de Blois* and *Floire et Blanchefleur* are among the best known. To this category may be added a number of early romances and fictions in prose. *Aucassin ef Nicolette* (13th century) is written partly in prose and partly in verse and is called a *chantefable.*

Such was the literature produced for the enjoyment of the higher classes from the 11th to the 13th century. The habit of private wars and of insurrection against the sovereign supply the motives of the *chanson de geste,* the love of gallantry, adventure and foreign travel those of the romances, Arthurian and miscellaneous. On the other hand, the gradual spread of learning, inaccurate and ill-digested perhaps, but still learning, not only opened up new classes of subjects but opened them to new classes of persons. The thousands of students who flocked to the schools of Paris nere not all princes or nobles.

Hence there arose two new classes of literature. The first consisted of the embodiment of learning of one kind or other in the vulgar tongue. The other, one of the most remarkable developments of sportive literature which the world has seen, produced the second indigenous literary growth of which France can boast, namely, the fabliaux. and the almost more remarkable work which is an immense conglomerate of fabliaux, the great beast epic of the *Roman de Renart*.

Fabliaux.—There are few literary products which have more originality and at the same time more diversity than the fabliau. The epic and the drama, even when they are independently produced, are similar in their main characteristics all the world over. But there is nothing in previous literature which exactly corresponds to the fabliau. The story is the first thing, the moral the second. and the latter is never suffered to interfere with the former. These observations apply only to the fabliaux, properly so called, but the term has been used with considerable looseness. The collectors of those interesting pieces, *Barbazan, Méon, Le Grand d'Aussy*, have included in their collections large numbers of miscellaneous pieces such as *dits* (rhymed descriptions of various objects, the most famous known author of which was Baudouin de Condé, 13th century) and *débats* (discussions between two persons or contrasts of the attributes of two things), sometimes even short romances, farces and mystery plays. Not that the fable proper—the prose classical beast story of Aesop—was neglected.

Marie de France—the poet to be mentioned again for her more strictly poetical work—is the most literary of not a few writers who composed what were often, after the mysterious original poet, named *Ysopets*. Aesop, Phaedrus, Babrius were translated and imitated in Latin and in the vernacular by this class of writer, and some of the best known of "fablers" date from this time. The fabliau, on the other hand, according to the best definition of it yet achieved, is "the recital, generally comic, of a real or possible incident occurring in ordinary human life." The comedy, it may be added, is usually of a satiric kind, and occupies itself with every class and rank of men, from the king to the villein. There is no limit to the variety of these lively verse tales, which are invariably written in eight-syllabled couplets. Now the subject is the misadventure of two Englishmen, whose ignorance of the French language makes them confuse donkey and lamb; now it is the fortunes of an exceedingly foolish knight, who has an amiable and ingenious mother-in-law; now the deserved sufferings of an avaricious or ill-behaved priest; now the bringing of an ungrateful son to a better mind by the wisdom of babes and sucklings.

Not a few of the *Canterbury Tales* are taken directly from fabliaux; indeed, Chaucer, with the possible exception of Matthew Prior, is the nearest approach to a fabliau writer in England. At the other end of Europe the prose novels of Boccaccio and other Italian tale tellers are largely based upon fabliaux. But their influence in their own country was the greatest. They were the first expression of the spirit which thereafter animated the most national and popular developments of French literature. Simple and unpretending as they are in form, the fabliaux announce not merely the *Cent nouvelles nouvelles* and the *Heptameron, L'Avocat Patelin* and *Pantagruel*, but also *L'Avare* and the *Roman comique, Gil Blas* and *Candide*. They indeed do more than merely prophesy the spirit of these great performances—they directly lead to them. The prose tale and the farce are the direct outcomes of the fabliau, and the prose tale and the farce once given, the novel and the comedy inevitably follow.

The special period of fabliau composition appears to have been the 12th and 13th centuries. It signifies on the one side the growth of a lighter and more sportive spirit than had yet prevailed, on another the rise in importance of other and lower orders of men than the priest and the noble, on yet another the consciousness on the part of these lower-orders of the defects of the two privileged classes and of the shortcomings of the system of polity under which these privileged classes enjoyed their privileges. There is, however, in the fabliau proper not so very much of direct satire, this being indeed excluded by the definition given above and by the thoroughly artistic spirit in which that definition is observed. The fabliaux are so numerous and so various that it is difficult to select any as specially representative. We may, however, mention, both as good examples and as interesting from their subsequent history, *Le Vair palefroi*, treated in English by Leigh Hunt and by T. L. Peacock; *Le Vilain Mire*, the original consciously or unconsciously followed in *Le Médecin malgré lui; Le Roi d'Angleterre et le jongleur d'Eli; La Houce partie; Le Sot chevalier*, an indecorous but extremely amusing story; *Les Deux bordeors ribaus*, a dialogue between two *jongleurs* of great literary interest, containing allusions to the *chansons de geste* and romances most in vogue; and *Le Vilain qui conquist paradis par plait*.

Roman de **Renart.**—If the fabliaux are not remarkable for direct satire, that element is supplied in more than compensating quantity by an extraordinary composition which is closely related to them. *Le Roman de Renart*, or *History of Reynard the Fox*, is a poem, or rather series of poems, which. from the end of the 12th century to the middle of the 14th, served the citizen poets of northern France not merely as an outlet for literary expression but also as a vehicle of satirical comment—now on the general vices and weaknesses of humanity, now on the usual corruptions in church and state, now on the various historical events which occupied public attention from time to time. The enormous popularity of the subject is shown by the long vogue which it had and by the empire which it exercised over generations of nriters who differed from each other widely in style and temper. Nothing can be further from the allegorical erudition, the political diatribes and the sermonizing moralities of the authors of *Renart le contrefait* than the sly naïveté of the writers of the earlier branches. Yet these and a long and unknown series of intermediate bards the fox-king pressed into his service, and it is scarcely too much to say that, during the tno centuries of his reign, there was hardly a thought in the popular mind which, as it rose to the surface. did not find expression in an addition to the huge cycle of *Renart*.

The French poems which we possess on the subject amount in all to nearly 100 000 lines, independently of mere variations but including the different versions of *Renart le contrefait*. The separate branches are the work of different authors, hardly any of whom are known, and. but for their community of subject and to some extent of treatment, might be regarded as separate poems. The history of Renart, his victories over Isengrim the wolf Bruin the bear and his other unfortunate rivals. his family affection. his outwittings of King Noble the Lion and all the rest are nell knonn. It is perhaps in the subsequent poems, though they are far less known and much less amusing, that the hold which the idea of Renart had obtained on the mind of northern France, and the ingenious uses to which it was put, are best shown. The first of these is *Le Couronnement de Renart*, a poem of betneen 3,000 and 4,000 lines, attributed, on no grounds whatever. to the poet Marie de France, and describing how the hero by his ingenuity got himself crowned king. This poem already shows signs of direct moral application and generalizing. These are still more apparent in *Renart le nouvel*, a composition of about 8.000 lines, finished in the year 1288 by the Fleming Jacquemart Gelée. Here the personification, of which, in noticing the *Rornun de la rose*, we shall soon have to give extended mention, becomes evident. Instead of or at least besides the lively personal Renart who used to steal sausages. set Isengrim fishing with his tail or make use of Chanticleer's comb for a purpose for which it was certainly never intended, we have *Reaardie*, an abstraction of guile and hypocrisy, triumphantly prevailing over other and better qualities. Lastly, as the *Roman de la rose* of Guillaume de Lorris is paralleled by *Renart le nouvel*, so its continuation by Jean de Meung is paralleled by the great miscellany of *Renart le contrefait*, which, even in its existing versions, extends to fully 50,000 lines. Here me have, besides floods of miscellaneous erudition and discourse, political argument of the most direct and important kind. The wrongs of the lower orders are bitterly urged.

Early Lyrics.—The song literature of mediaeval France is extremely abundant and beautiful. From the 12th century to the 15th it received constant accessions, some signed, some anonymous, some purely popular in their character, some the work of more learned writers, others again produced by members of the aristocracy. Of the latter class it may fairly be said that the catalogue of royal and noble authors boasts few if any names superior to those of Thibaut de Champagne, king of Navarre at the beginning of the 13th century, and Charles d'Orléans. the father of Louis XII, at the beginning of the 15th. Although much of this lyric poetry is anonymous, the most popular part of it almost entirely so, yet we are able to enumerate hundreds of French *ckansonniers* between the 11th century and the 13th.

The earliest song literature is mainly sentimental in character. The collectors divide it under the two heads of romances and *pastourelles,* the former being usually the celebration of the loves of a noble knight and maiden and recounting how Belle Doette or Eglantine or Oriour sat at her windows or in the tourney gallery, or embroidering silk and samite in her chamber, with her thoughts on Gerard or Guy or Henry, the latter somewhat monotonous but nai've and often picturesque recitals, very often in the first person, of the meeting of an errant knight or minstrel with a shepherdess and his cavalier but not always successful wooing. With these, some of which date from the 12th century, may be contrasted, at the other end of the mediaeval period, the more varied and popular collection dating in their present form from the 15th century and published in 1875 by Gaston Paris. In both alike, making allowance for the difference of their age and the state of the language, may be noticed a charming lyrical faculty and great skill in the elaboration of light and suitable metres. Especially remarkable is the abundance of refrains of an admirably melodious kind. It is said that more than 500 of these exist.

Among the lyric writers of these four centuries whose names are known may be mentioned Audefroi le Bastard (12th century), the author of the charming song of *Belle Idoine* and others no way inferior, Quesnes de Béthune, the ancestor of Sully. whose song writing inclines to a satirical cast in many instances, the vidame de Chartres, Charles d'Anjou, King John of Brienne, the châtelain de Coucy, Gace Buslé and Colin Muset; while not a few writers mentioned elsewhere—Guyot de Provins, Adam de la Hale. Jean Bodel and others—were also lyrists. But none of them, except perhaps Audefroi, can compare with Thibaut IV (1201–53), nho by his possessions and ancestry had a connection with the north and the south and who employed the methods of both districts but used the language of the north only. Thibaut was supposed to be the lover of Blanche of Castille, the mother of St. Louis, and a great deal of his verse is concerned with his love for her. But while knights and nobles were thus employing lyric poetry in courtly and sentimental verse, lyric forms were being freely employed by others, of both high and low birth, for more general purposes. Blanche and Thibaut themselves came in for contemporary lampoons, and both at this time and in the times immediately following a number of writers composed light verse, sometimes of a lyric, sometimes of a narrative kind, and sometimes in a mixture of both. By far the most remarkable of these is Rutebeuf (*q.v.*).

Rutebeuf is among the earliest French writers who tell us their personal history and make personal appeals. But he does not confine himself to these. He discusses the history of his times, he composes pious poetry too, and in at least one poem takes care to distinguish between the church which he venerates and the corrupt churchmen whom he lampoons. Besides Rutebeuf the most characteristic figure of his class and time (about the middle of the 13th century) is Adam de la Hale, commonly called the Hunchback of Arras. The earlier poems of Adam are of a sentimental character, the later ones satirical and somewhat ill-tempered; such, for instance, is his invective against his native city. But his chief importance consists in his *jeux,* the *Jeu de la feuillée,* the *Jeu de Robin et Marion,* dramatic compositions which led the way to the regular dramatic form. Indeed the general tendency of the 13th century is to satire, fable and farce even more than to serious or sentimental poetry. We should perhaps except the *lais,* the chief of which are known under the name of Marie de France. These *lais* are exclusively Breton in origin, though not in application, and the term seems originally to have had reference rather to the music to which they were sung than to the manner or matter of the pieces.

The subjects of the *lais* are indifferently taken from the Arthurian cycle, from ancient story and from popular tradition, and, at any rate in Marie's hands, they give occasion for some passionate and in the modern sense really romantic poetry. The most famous of all is the *Lay of the Honeysuckle,* traditionally assigned to Sir Tristram.

Roman de la Rose.—A work of very different importance from all these, though with seeming touches of the same spirit, a work which deserves to take rank among the most important of the middle ages, is the *Roman de la rose.* The author of the earlier part was Guillaume de Lorris, who lived in the first half of the 13th century; the author of the later part was Jean de Meung, who mas born about the middle of that century and whose part in the *Roman* dates at least from its extreme end. This great poem exhibits in its two parts very different characteristics which yet go to make up a not inharmonious nhole. It is a love poem, and yet it is satire. But both gallantry and raillery are treated in an entirely allegorical spirit. The lover meets all sorts of obstacles in his pursuit of the rose. though he has for a guide the metaphorical personage Bel-Accueil. The early part, which belongs to Guillaume de Lorris, is remarkable for lts gracious and fanciful descriptions. Forty years after Lorris's death, Jean de Meung completed it in an entirely different spirit. He keeps the allegorical form, and indeed introduces two new personages of importance, Nature and Faux-semblant. In the mouths of these personages and of another, Raison, he puts the most extraordinary mixture of erudition and satire. At one time we have the history of classical heroes, at another theories against the hoarding of money, about astronomy, about the duty of mankind to increase and multiply. Accounts of the origin of loyalty, nhich would have cost the poet his bead at some periods of history, and even communistic ideas, are also to be found here. In Faux-semblant we have a real creation of the theatrical hypocrite. All this miscellaneous and apparently incongruous material in fact explains the success of the poem. There are to be found in the *Roman de la rose* the characteristics of the later middle age, its gallantry, its mysticism, its economic and social troubles and problems, its scholastic methods of thought. its naive acceptance as science of everything that is written and at the same time its shrewd and embracing criticism of much that the age of criticism has accepted without doubt or question. The *Roman de la rose,* as might be supposed, set the example of an immense literature of allegorical poetry, which flourished more and more until the Renaissance.

Satiric and Didactic Work. — Direct satire began early in the 13th century with Guyot de Provins and Hugues de Brégy. Travesties of the romances of chivalry were written in which the chief heroes and situations were mercilessly parodied. The disputes of Philippe le Bel with the pope and the Templars had an immense literary influence. partly in the concluding portions of the *Renart,* partly in the *Roman de la rose* and partly in other satiric allegories of which the chief is the romance of *Fauvel,* attributed to François de Rues. The hero of this is an allegorical personage, half man and half horse, signifying the union of bestial degradation with human ingenuity and cunning. Fauvel (the name, it may be worth while to recall, occurs in Langland) is a divinity in his may. All the personages of state, from kings and popes to mendicant friars, pay their court to him. The abuse of usury at the time, and the exactions of the Jews and Lombards, were severely felt, and Money itself, as personified, figures largely in the popular literature.

An example of early didactic verse is the *Bestiary* of Philippe de Thaun. a Norman *trouvkre* who lived and wrote in England during the reign of Henry Beauclerc. Besides the *Bestiary,* which from its dedication to Queen Adela has been conjectured to belong to the third decade of the 12th century, Philippe wrote also in French a *Liber de creaturis,* both works being translated from the Latin. These works of mystical and apocryphal physics and zoology became extremely popular in the succeeding centuries and were frequently imitated. A moralizing turn was also given to them, which was much helped by the importation of several miscellanies of oriental origin, partly tales, partly didactic in character, the most celebrated of which is the *Roman des sept sages,* which, under that title and the variant of *Dolopathos,* received repeated treatment from French writers both in prose and verse. Art, too, soon demanded exposition in verse, as well as science. The favourite pastime of the chase was repeatedly dealt nith, notably in the *Roi Modus* (1325), mixed prose and verse; the *Déduits de la chasse* (1387) of Gaston de Foix, prose; and the *Trésor de vénerie* of Jean Hardouin (1394), verse.

Very soon didactic verse extended itself to all the arts and sciences. Vegetius and his military precepts had found a home in French octosyllables as early as the 12th century; the end of the same age saw the ceremonies of knighthood solemnly versified, and *napes* (maps) *du monde* also soon appeared. In 1245 Gautier of Metz translated from various Latin works into French verse a sort of encyclopaedia, while another incongruous work, known as *L'Image du monde,* exists from the same century. Profane knowledge was not the only subject which occupied didactic poets at this time. Religious handbooks and commentaries on the Scriptures were common in the 13th and following centuries. and, under the titles of *castoiements, enseignements* and *doctrinaux,* moral treatises became common. The most famous of these. the *Castoiement d'un père à sons fils,* falls under the class of works attributable to oriental influence, being derived from the Indian *Panchatantra.*

In the 14th century the influence of the *Roman de la rose* helped to render moral verse common and popular. The same century, moreover, which witnessed these developments of well intentioned if not always judicious erudition witnessed also a considerable change in lyrical poetry. Hitherto such poetry had chiefly been composed in the melodious but unconstrained forms of the romance and the *pastozirelle.* In the 14th century the writers of northern France subjected themselves to severer rules. In this age arose the forms which for so long a time were to occupy French singers — the ballade, the rondeau. the rondel, the triolet, the *chant royal* and others. These received considerable alterations as time went on. We possess not a few *Artes poeticae,* such as that of Eustache Deschamps at the end of the 14th century and that of Thomas Sibilet in the 16th. giving particulars of them, and these particulars show considerable changes. The earliest poets who appear to have practised them extensively nere born at the close of the 13th century and the beginning of the 14th. Of these, Guillaume de Machault (*c.* 1300–80) is the oldest. He left about 80.000 verses. Eustache Deschamps (*c.* 1340–*c.* 1410) was nearly as prolific. Jean Froissart the historian (1338–1410?) was also an agreeable and prolific poet. Less known but not less noteworthy, and perhaps the earliest of all. is Jehannot de Lescurel, whose personality is obscure and most of whose works are lost but whose fragments are full of grace. Froissart appears to have had many countrymen in Hainaut and Brabant who devoted themselves to the art of versification; and the *Livre des cent ballades* of Jean Boucicault (*c.* 1366–1421) and his friends — c. 1390 — shows that the French gentleman of the 14th century was as apt at the ballade as his Elizabethan peer in England was at the sonnet.

Beginnings of Drama. — The mysteries (subjects taken from the sacred writings) and miracle plays (subjects taken from the legends of the Saints and the Virgin) are of very early date. The mystery of the *Foolish Virgins* (partly French, partly Latin), that of *Adam* and perhaps that of *Daniel* are of the 12th century, though the work of unknown authors. Jean Bodel and Ruteheuf, already mentioned, gave, the one that of *Saint Nicolas* at the confines of the 12th and 13th, the other that of *Théophile* later in the 13th itself. But the later moralities, *soties* and farces seem to be also in part a very probable development of the simpler and earlier forms of the fabliau and of the *tenson* or *jeu parti,* a poem in simple dialogue. Of the *jeux partis* there are many examples, varying from very simple questions and answers to something like regular dramatic dialogue; even short romances, such as *Aucassin et Nicolette,* were easily susceptible of dramatization. But the *Jeu de la feuillie* (or *feuillée*) of Adam de la Hale seems to be the earliest piece. profane in subject, containing something more than mere dialogue. The poet has not indeed gone far for his subject. for he brings in his own wife, father and friends, the interest being complicated by the introduction of stock characters (the doctor, the monk, the fool) and of certain fairies — personages already popular from the later romances of chivalry. Another piece of Adam's the *Jeu de Robin et Marion,* also already alluded to, is little more than a simple throwing into action of an ordinary *pastourelle* with a considerable number of songs to music. Nevertheless later criticism has seen, and not unreasonably, in these two pieces the origin in the one case of farce, and thus indirectly of comedy proper, in the other of comic opera.

For a long time, however, the mystery and miracle plays remained the mainstay of theatrical performance, and until the 13th century actors as well as performers were more or less taken from the clergy. It has, indeed. been well pointed out that the offices of the church were themselves dramatic performances and required little more than development at the hands of the mystery writers. The occasional festive outbursts, such as the Feast of Fools, that of the Boy Bishop and the rest, helped in the development. The variety of mysteries and miracles was very great. A single manuscript contains 40 miracles of the Virgin, averaging from 1,200 to 1,500 lines each, written in octosyllabic couplets, and at least as old as the 14th century, most of them perhaps much earlier.

The mysteries proper, or plays taken from the Scriptures, are older still. Many of these are exceedingly long. There is a *Mystère de l'Ancien Testament* which must have taken weeks to act in its entirety. The *Mystère de la Passion,* though not quite so long, took several days and recounts the whole history of the Gospels. The best apparently of the authors of these pieces, which are mostly anonymous, were two brothers, Arnoul and Simon Gréban (authors of the *Actes des apôtres,* and in the first case of the *Passion), c.* 1450; and a certain Jean Michel (d. 1493) is credited with having continued the *Passion* from 30 000 lines to 50 000. But these performances. though they held their ground until the middle of the 16th century and extended their range of subject from sacred to profane history — legendary as in the *Destruction de Troie,* contemporary as in the *Siège d'Orléans* — were soon rivalled by the more profane performances of the moralities, the farces and the *soties.* The palmy time of all these three kinds is the 15th century, while the Confrérie de la Passion itself, the special performers of the sacred drama, obtained the licence constituting it only by an ordinance of Charles VI in 1402. In order to take in the whole of the mediaeval theatre at a glance. however, we may anticipate a little. The Confraternity was not itself the author or performer of the profaner kind of dramatic performance. This latter was the work of two other bodies, the clerks of the Bazoche and the Enfants sans Souci. As the Confraternity was chiefly composed of tradesmen and persons very similar to Peter Quince and his associates, so the clerks of the Bazoche were members of the legal profession of Paris, and the Enfants sans Souci were mostly young men of family. The morality was the special property of the first. the *sotie* of the second. But as the moralities were sometimes decidedly tedious plays, and by no means brief, they were varied by the introduction of farces, of nhich the *peux* already mentioned nere the early germ and of which *L'Avocat Patelin,* dated by some about 14€j and certainly about 200 years subsequent to Adam de la Hale, is the most famous example.

The morality was the natural result on the stage of the immense literary popularity of allegory in the *Roman de la rose* and its imitations. The *sotie* was directly satirical and assumed the guise of folly only as a stalking horse for shooting wit. It was more Aristophanic than any other modern form of comedy and, like its predecessor, it perished as a result of its political application. Encouraged for a moment as a political engine at the beginning of the 16th century, it was soon absolutely forbidden and put down and had to give place in one direction to the lampoon and the prose pamphlet, in another to forms of comic satire more general and vague in their scope.

The farce, on the other hand, having neither moral purpose nor political intention, was a purer work of art, enjoyed a wider range of subject and was in no danger of any permanent extinction. Farcical interludes were interpolated in the mysteries themselves: short farces introduced and rendered palatable the moralities, and the *sotie* was itself but a variety of farce; all the kinds were sometimes combined in a sort of tetralogy. It was a short composition, 500 verses being considered sufficient, whereas the morality might run to at least 1,000 verses, the miracle play to nearly double that number and the mystery to 40.000 or 50,000.

Of the pieces represented, one only, that of *Maître Patelin,* is now much known; but many are almost equally amusing. *Patelin* itself has an immense number of versions and editions. Other farces are too numerous to attempt to classify; they bear, however, in their subjects as in their manner, a remarkable resemblance to the fabliaux, their source. Conjugal disagreements, the unpleasantness of mothers-in-law, the shifty or, in the earlier stages, clumsy valet and chambermaid, the mishaps of too loosely given ecclesiastics, the abuses of relics and pardons, the extortion, violence and sometimes cowardice of the seigneur and the soldiery, the corruption of justice, its delays and its pompous apparatus, supply the subjects. The treatment is rather narrative than dramatic in most cases, as might be expected, but makes up by the liveliness of the dialogue for the deficiency of elaborately planned action and interest. All these forms, it will be observed, are directly or indirectly comic.

Tragedy in the middle ages is represented only by the religious drama, except for a brief period toward the decline of that form when the "profane" mysteries referred to above came to be represented. These were, however, rather "histories," in the Elizabethan sense, than tragedies proper.

History. — For a time the French chroniclers contented themselves with Latin prose or with French verse, after the fashion of Robert Wace and the Belgian Philippe Mousket (1215–83). These, after a fashion universal in mediaeval times, began from fabulous or merely literary origins; and just as Andrew of Wyntoun later carries back the history of Scotland to the terrestrial paradise, so does Mousket start that of France from the rape of Helen. But soon prose chronicles, first translated, then original, became common. Then came French selections and versions from the great series of historical compositions undertaken by the monks of St. Denys, the so-called *Grandes chroniques de France* from the date of 1274, when they first took form in the hands of a monk styled Primat, to the reign of Charles V, when they assumed the title just given. But the first really remarkable author who used French prose as a vehicle of historical expression is Geoffroy de Villehardouin, marshal of Champagne, who was born about the middle of the 12th century and died in Greece in 1213. Under the title of *Conquête de Constantinople* Villehardouin has left a history of the fourth crusade. The *Conquête de Constantinople* has been well called a *chanson de geste* in prose, and indeed in the surprising nature of the feats it celebrates, in the abundance of detail and in the vivid and picturesque poetry of the narration it equals the very best of the *chansons.* But it is now felt that Villehardouin was putting up a specious plea for one of the worst misdeeds of the middle ages, the wrecking of the Byzantine empire, and he was one of the chief criminals.

The rhymed chronicles of Philippe Mousket and Guillaume Guiart belong to the next half-century; and in prose the most remarkable works are the *Chronique de Reims,* a well-written history having the interesting characteristic of taking the lay and popular side, and the great compilation edited (in the modem sense) by Baudouin d'Avesnes (1213–89). Jean Joinville (1224?–1317), whose special subject is the life of St. Louis, is shrewd, practical, has political ideas and antiquarian curiosity, and his descriptions are often very creditable pieces of deliberate literature.

What Villehardouin is to the 12th and Joinville to the 13th century, so Froissart is to the 14th. His picture is the most famous as it is the most varied of the three, but it has special drawbacks as well as special merits. Society is still to him all knights and ladies, tournaments, skirmishes and feasts. He depicts these, not like Joinville, still less like Villehardouin, as a sharer in them, but with the facile and picturesque pen of a sympathizing literary onlooker. As the comparison of the *Conquête de Constantinople* with a *chanson de geste* is inevitable, so is that of Froissart's *Chronique* with a *roman d'aventure.*

Poetry in the 15th Century. — Christine de Pisan (1364–c. 1430) was the daughter of an Italian astrologer who was patronized by Charles V. She was born in Italy but brought up in France, and she enriched the literature of her adopted country with much learning, good sense and patriotism. She wrote history, devotional works and poetry; and though her literary merit is not of the highest, it is very far from despicable. Alain Chartier (*c.* 1385–*c.* 1430), best known to modern readers by the story of *Margaret of Scotland's Kiss,* was a writer of somewhat similar character.

A very different person is Charles d'Orléans (1394–1465), one of the greatest of *grands seigneurs,* for he was the father of a king of France and heir to the duchies of Orléans and Milan. Charles was an admirable poet. He is the best-known and perhaps the best writer of the graceful poems in which an artificial versification is strictly observed and helps by its recurrent lines and modulated rhymes to give to poetry something of a musical accompaniment even without the addition of music properly so called. His ballades are certainly inferior to those of François Villon, but his rondels are unequalled.

To François Villon (1431–63?), as to other great single writers, no attempt can be made to do justice in this place. His remarkable life and character especially lie outside our subject. But he is universally recognized as the most important single figure of French literature before the Renaissance. His work is very strange in form, the undoubtedly genuine part of it consisting merely of two compositions, known as the *Great* and *Little Testament,* written in stanzas of eight lines of eight syllables each, with lyrical compositions in ballade and rondeau form interspersed. Nothing in old French literature can compare with the best of these, such as the "Ballade des dames du temps jadis." the "Ballade pour sa mère," "La Grosse Margot," "Les Regrets de la belle Heaulmière" and others; while the whole composition is full of poetical traits of the most extraordinary vigour, picturesqueness and pathos. "L'Epitaphe Villon" deserves special notice. Toward the end of the century the poetical production of the time became very large. The artificial measures already alluded to and others far more artificial and infinitely less beautiful were extensively practised. The combination of these drifts in verse writing produced a school known in literary history as the *grands rhétoriqueurs.*

15th-Century Prose. — This period produced, indeed, no prose writer of great distinction, except Philippe de Comines; but it witnessed serious, if not entirely successful, efforts at prose composition. Christine de Pisan and Alain Chartier were at least as much prose writers as poets; and the latter, while he, like Jean de Gerson, dealt much with the reform of the church, used in his *Quadriloge invectif* really forcible language for the purpose of spurring on the nobles of France to put an end to its sufferings and evils. These moral and didactic treatises were but continuations of others, which for convenience's sake we have hitherto left unnoticed. Though verse was in the centuries prior to the 15th the favourite medium for literary composition, it was by no means the only one, and moral and educational treatises already existed in pedestrian phrase. Certain household books *(livres de raison)* have been preserved, some of which date as far back as the 13th century. These contain not merely accounts but family chronicles, receipts and the like.

Accounts of travel, especially to the Holy Land, culminated in the famous *Voyage* of Sir John Mandeville, which, though it has never been of so much importance in French as in English, perhaps first took vernacular form in the French tongue. Of the 14th century, we have a *Menagier de Paris,* intended for the instruction of a young wife, and a large number of miscellaneous treatises of art, science and morality, while private letters, mostly as yet unpublished, exist in considerable numbers and are generally of the moralizing character; books of devotion, too, are naturally frequent.

Froissart had been followed as a chronicler by Enguerrand de Monstrelet (*c.* 1400–1453) and by the historiographers of the Burgundian court, Georges Chastellain (1404–75), whose *Chronique de Jacques de Lalaing* is much the most attractive part of his work, and Olivier de la Marche. The memoir and chronicle writers, who were to be of so much importance in French literature, also begin to be numerous at this period. Juvenal des Ursins (1388–1473), author of the *Chronique scandaleuse,* may be mentioned as presenting the characteristic of minute observation and record which has distinguished the class ever since. Jean Lemaire de Belges (1473–c. 152j) was historiographer to Louis XII and wrote *Illustrations* des Gaules. But Philippe de Comines (1445–1509) is no imitator of Froissart or of anyone else. The last of the quartette of great French mediaeval historians, he does not yield to any of his three predecessors in originality or merit, but he is very different from them. He fully represents the passion of the time for statecraft, and his book has long ranked with that of Niccolo Machiavelli as a manual of the art, though he has not the absolutely nonmoral character of the Italian. His memoirs, considered merely as literature, show a style well suited to their purport— not, indeed, brilliant or picturesque, but clear, terse and thoroughly well suited to the expression of the acuteness, observation and common sense of their author.

The best prose of the century, the nearest yet to being an acceptable literary medium, was employed for the telling of romances in miniature. The *Cent nouvelles* noucelles is undoubtedly the first work of prose belles-lettres in French and the first, moreover, of a long and most remarkable class of literary work, the short prose tale of a comic character. The subjects of the *Cent nouvelles* noucelles are by no means new. They are simply the old themes of the fabliaux treated in the old way. The novelty is in the application of prose to such a purpose and in the crispness, the fluency and the elegance of the prose used. These tales have been attributed to Antoine de la Salle (1388–1462). La Salle's one acknowledged work is the story of Petit *Jehan de Saintré*, a short romance exhibiting great command of character and abundance of delicate draughtsmanship. Another masterpiece of the period, Les Quinze *joyes de mariage*, has also been assigned to him.

THE 16TH CENTURY

While the Renaissance in Italy had mainly exhausted its effects by the middle of the 16th century, while in Germany those effects only paved the nay for a national literature and did not themselves greatly contribute thereto, while in England it was not till the extreme end of the period that a great literature was forthcoming, in France almost the whole century was marked by the production of capital works in every branch of literary effort. There arose a great number of prose writers and poets: John Calvin, St. Francis de Sales, the seigneur de Montaigne, Guillaume du Vair, Jean Bodin, Théodore Agrippa d'Aubigné, the authors of the Sative *Ménippée*, the seigneur de Montluc, the seigneur de Brantôme, Étienne Pasquier, François Rabelais, Bonaventure des Périers, Nicolas de Herberay des Essarts, Jacques Xmyot, Robert Garnier, Clément Marot, Pierre de Ronsard and the rest of the Pléiade and, finally, Mathurin Régnier.

The first note of the new literature was sounded by Clément Marot (1496/7–1544). The son of an older poet, Jean des Mares, called Marot (1463–1523), Clément at first wrote, like his father's contemporaries, allegorical and mythological poetry, afternard collected in a volume nith a charming title, *L'Adolescence Clémentine*. It was not till he was nearly 30 years old that his work became really remarkable. From that time till his death he was much involved in the troubles and persecutions of the Huguenot party to which he belonged; nor was the protection of Marguerite d'Angoulême, the chief patroness of Huguenots and men of letters, always efficient. But his troubles, so far from harming, helped his literary faculties, and his epistles, epigrams, *blasons* (descendants of the mediaeval dits) and *coq-à-l'âne* became remarkable for their easy and polished style, their light and graceful wit and a certain elegance which had not as yet been even attempted in French.

Around Marot arose a whole school of disciples and imitators, such as Victor Brodeau (1470?–1540), the authority on rondeaus, Maurice Scève, a fertile author of *blasons*, Hugues Salel, Marguerite d'Angoulême, queen of Navarre (1492–1549), a religious as well as amorous poet (*Les Marguerites de la Marguerite*), and Mellin de Saint Gelais (1491–1j58). But the inventive vigour of the age was so great that one school had hardly become popular before another pushed it from its stool, and even of the blarotists just mentioned Scève and Salel are often regarded as chief and member respectively of a Lyonnese coterie?intermediate between the schools of Marot and of Ronsard, containing other members of repute such as Antoine Heroët, Charles Fontaine and Louise Labé.

The Pléiade.—Pierre de Ronsard (1524–8j) was the chief poet of the period. At first a courtier and a diplomatist, physical disqualifications made him change his career. He began to study the classics under Jean Daurat (1508–88), and with his master and five other writers, Étienne Jodelle (1532–73), Rémy Belleau (1528–77), Joachim du Bellay (1j22–60), Jean Antoine de Baïf (1532–89) and Pontus de Tyard (1j21–160j), bishop of Châlons-sur-Saône, composed the famous "Pléiade." The object of this band was to bring the French language, in vocabulary, constructions and application, on a level with the classical tongues by borrowings from the latter. They would have imported the Greek licence of compound words, though the genius of the French language is but little adapted thereto; and they wished to reproduce in French the regular tragedy, the Pindaric and Horatian ode, the Virgilian epic, etc. Both in Bellay's famous manifesto: the *Défense et illustration de la langue française*, and in Ronsard's own work, caution and attention to the genius and the tradition of French are insisted upon. Being all men of the highest talent, and not a few of them men of great genius, they achieved much that they designed; and even where they failed exactly to achieve it, they very often indirectly produced results as important as and more beneficial than those which they intended. Doubtless they went too far and provoked to some extent the reaction which François de, Malherbe led. Their importations mere sometimes unnecessary. It is almost impossible to read the *Françiade* of Ronsard, and not too easy to read the tragedies of Jodelle and Garnier, fine as the latter are in parts. But the best of Ronsard's sonnets and odes, the finest of Bellay's *Antiquités de Rome* (translated into English by Edmund Spenser), the exquisite *Vanneur* of the same author and the *Avril* of Belleau, even the finer passages of D'Aubigné and the seigneur du Bartas, are not only admirable in themselves but also of a kind not previously found in French literature. Their work as a whole suffers from the fact that the French language is not yet a satisfactory instrument of literary expression nor is French taste fully formed.

The effort of the Pléiade proper was continued and shared by a considerable number of minor poets, some of them, as has been already noted, belonging to different groups and schools. Olivier de Magny (d. 1560) and Louise Labé (b. 1526) were poets and lovers, the lady deserving far the higher rank in literature. There is more depth of passion in the writings of "La Belle Cordière," as this Lyonnese poet nas called, than in almost any of her contemporaries. Jacques Tahureau (1527–55) is more than a minor poet. There is less than the usual hyperbole in the contemporary comparison of him to Catullus, and he reminds an Englishman of the school represented nearly a century later by Richard Carew, Thomas Randolph and Sir John Suckling. The title of a part of his poem—*Mignardises amoureuses de l'admirée*—is characteristic both of the style and of the time. Jean Doublet (c. 1528–c. 1580), Amadis Jamyn (c. 1530–85) and Jean de la Taille (1540–1608) deserve mention at least as poets, but two other writers require a longer description. Guillaume de Salluste, seigneur du Bartas (1544–go), was partly a disciple and partly a rival of Ronsard. His poem of *Judith* was eclipsed by his better-known La Divine *sepmaine* or epic of the Creation. Théodore Agrippa d'Aubigné (1552–1630), like Du Bartas, was a Calvinist. His genius was of a more varied character. He wrote sonnets and odes as became a Ronsardist, but his chief poetical work is the satirical poem of Les *Tragiques*, in which the author brands the factions, corruptions and persecutions of the time, and in which there are to be found alexandrines of a strength, vigour and original cadence hardly to be discovered elsewhere, save in Corneille and Victor Hugo. Toward the end of the century, Philippe Desportes (1546–1606) and Jean Bertaut (1552–1611), with much enfeebled strength but with a certain grace, continue the Ronsardizing tradition. Among their contemporaries must be noticed Jean Passerat (1534–1602), a writer of much wit and vigour and rather resembling Marot than Ronsard, and Vauquelin de la Fresnaye (1536–1607), the author of a valuable Ars *poëtica* and of the first French satires which actually bear that title. Jean le Houx (fl. c. 1600) continued, rewrote or invented the *vaux de vire,* commonly known as the work of Olivier Basselin.

The nephew of Desportes, Mathurin Régnier (1573–1613), descendant at once of the older Gallic spirit of Villon and Marot in virtue of his consummate acuteness, terseness and wit, of the school of Ronsard by his erudition, his command of language and his scholarship, marks the end of the poetry of the century.

16th-Century Drama.—The change which dramatic poetry underwent during the 16th century was at least as remarkable as that undergone by poetry proper. The first half of the period saw the end of the religious mysteries, the licence of which had irritated both the parliament and the clergy. Under the patronage of Louis XII were produced the chief works of Pierre Gringore or Gringoire (*c.* 1480–1547), by far the most remarkable writer of this class of composition. His *Prince des sots* and his *Mystère de St. Louis* are among the best of their kind. An enormous volume of composition of this class was produced between 1500 and 1550. One morality by itself, *L'Homme juste et l'homme mondain,* contains about 36,000 lines. But in 1548, when the Confraternity was formally established at the Hôtel de Bourgogne, leave to play sacred subjects was expressly refused it. Moralities and *soties* dragged on under difficulties till the end of the century, and the farce, which is immortal, continually affected comedy. But the effect of the Renaissance was to sweep away all other vestiges of the mediaeval drama, at least in the capital. An entirely new class of subjects, entirely new modes of treatment and a different kind of performers were introduced. The change naturally came from Italy.

In the close relationship with that country which France had during the early years of the century, Italian translations of the classical masterpieces were easily imported. Soon French translations were made afresh of the *Electra,* the *Hecuba,* the *Iphigenia in Aulis,* and the French humanists hastened to compose original tragedies on the classical model, especially as exhibited in Seneca. It was impossible that the Pléiade should not eagerly seize such an opportunity of carrying out its principles, and one of its members. Jodelle, devoting himself mainly to dramatic composition, fashioned at once the first tragedy, *Cléopâtre,* and the first comedy, *Eugène,* thus setting the example of the style of composition uhich for two centuries and a half Frenchmen were to regard as the highest effort of literary ambition. *Cléopâtre* was followed by *Didon,* which, unlike its predecessor, is entirely in alexandrines and observes the regular alternation of masculine and feminine rhymes.

Robert Garnier (1534–90) chose his subjects indifferently from classical, sacred and mediaeval literature. While tragedy clings closely to antique models, comedy, as might be expected in the country of the fabliaux, is more independent. Italy had already a comic school of some originality, and the French farce was too vigorous and lively a production to permit of its being entirely overlooked. The first comic writer of great merit was Pierre Larivey (*c.* 1550–*c.* 1612), an Italian by descent.

16th-Century Prose Fiction.—Great as is the importance of the 16th century in the history of French poetry, its importance in the history of French prose is greater still. There can be no doubt of the precedence, in every sense of the word, of François Rabelais (*c.* 1490–1553), with *Gargantua* and *Pantagruel.* With an immense erudition representing almost the whole of the knowledge of his time, with an untiring faculty of invention, with the judgment of a philosopher and the common sense of a man of the world, with an observation that let no characteristic of the time pass unobserved and with a tenfold portion of the special Gallic gift of good-humoured satire, Rabelais reaches a height of speculation and depth of insight and a vein of poetical imagination rarely found in any writer, but altogether portentous when taken in conjunction with his other characteristics. His great work has been taken for an exercise of transcendental philosophy, for a concealed theological polemic, for an allegorical history of this and that personage of his time, for a merely literary utterance, for an attempt to tickle the popular ear and taste. It is all of these, and it is none—all of them in parts, none of them in deliberate and exclusive intention. It may perhaps be called the exposition and commentary of all the thoughts, feelings, aspirations and knowledge of a particular time and nation put forth in attractive literary form by a man who for once combined the practical and the literary spirit, the power of knowledge and the power of expression.

In 1558 appeared two works of high literary and social interest. These are the *Heptaméron* of the queen of Navarre and the *Contes et joyeux devis* of Bonaventure des Périers (c. 1500–44). The *Heptaméron* is composed on the model of Boccaccio, but its tone and character are entirely different, and it has a very individual charm. The *Tales* of Des Périers are shorter, simpler and more homely; there is more wit in them and less refinement. His *Cymbalum Mundi* (1538) is a violent attack on Christianity.

16th-Century Historians.—As in the case of the tale tellers, so in that of the historians, the writers of the 16th century had traditions to continue. It is doubtful indeed whether any of them can risk comparison as artists with the great names of Villehardouin and Joinville, Froissart and Comines. The 16th century, however, set the example of dividing the functions of the chronicler, setting those of the historian proper on one side and of the anecdotemonger and biographer on the other. The efforts at regular history made in this century were not of the highest value. But on the other hand the practice of memoir writing, in which the French were to excel every nation in the world, and of literary correspondence, in which they were to excel even their memoirs, was solidly founded.

There are four collections of memoirs concerning this time which far exceed all others in interest and importance. The turbulent dispositions of the time, the loose dependence of the nobles and even the smaller gentry on any single or central authority, the rapid changes of political situations and the singularly active appetite, both for pleasure and for business, for learning and for war, which distinguished the French gentleman of the 16th century, place the memoirs of François de Lanoue (1531–91), Blaise de Montluc (*c.* 1502–77), Théodore Agrippa d'Aubigné and Pierre de Bourdeille, seigneur de Brantôme (1540–1614), almost at the head of the literature of their class. The name of Brantôme is known to all who have the slightest acquaintance with French literature, and the works of the others are not inferior in interest, and perhaps superior in spirit and conception, to the *Dames galantes,* the *Grands capitaines* and the *Hommes illustres.* The commentaries of Montluc, which Henri IV is said to have called the soldier's Bible, are exclusively military and deal with affairs only. Montluc was governor in Guienne, where he repressed the savage Huguenots of the south with a savagery worse than their own. He was, however, a partisan of order, not of Catholicism. He hanged and shot both parties with impartiality and refused to have anything to do with the massacre of St. Bartholomew. Though he was a man of no learning, his style is excellent, being vivid, flexible and straightforward. Lanoue, who was a moderate in politics, has left his principles reflected in his memoirs. D'Aubigné gives the extreme Huguenot side as opposed to the royalist partisanship of Montluc and the *via media* of Lanoue. Brantôme, on the other hand, is quite free from any political or religious prepossessions and, indeed, troubles himself very little about any such matters. He is the shrewd and somewhat cynical observer, moving through the crowd and taking note of its ways, its outward appearance, its heroisms and its follies.

16th-Century Theologians; **Montaigne.**—The great textbook of the French Reformation is John Calvin's *Institutes* of *the Christian Religion,* a book equally remarkable in matter and in form, in circumstances and in result. It is the first really great composition in argumentative French prose. Its severe logic and careful arrangement had as much influence on the manner of future thought, both in France and the other regions whither its widespread popularity carried it, as its style had on the expression of such thought. It was the work of a man of only 27, when hardly any models of French prose existed-except tales and chronicles which required and exhibited totally different qualities of style. It is indeed probable that had not the *Institutes* been first written by its author in Latin, and afterward translated by him, it might have had less dignity and vigour; but it must at the same time be remembered that this process of composition was at least equally likely, in the hands of any but a great genius, to produce a heavy and pedantic style neither French nor Latin in character. Something like this result was actually produced in some of Calvin's minor works, and still more in the works of many of his followers, whose lumbering language gained for itself, in allusion to their exile from France, the title of *style refugié*. Nevertheless, the use of the vulgar tongue on the Protestant side, and the possession of a work of such importance written therein, gave the reformers an immense advantage which their adversaries were some time in neutralizing. Even before the *Institutes,* Lefkvre d'Etaples (1455–1537) and Guillaume Farel (1489–1565) saw and utilized the importance of the vernacular. Calvin (1 jog–64) was much helped by Pierre Viret (1511–71), who wrote a large number of small theological and moral dialogues and of satirical pamphlets, designed to captivate as well as to instruct the lower orders. The more famous Beza (Théodore de Bèze) (1519–1605) wrote chiefly in Latin, but he composed in French an ecclesiastical history of the Reformed churches and some translations of the Psalms. Marnix de Sainte Aldegonde (1530–93), a gentleman of Brabant, followed Viret as a satirical pamphleteer on the Protestant side. On the other hand, the Catholic champions at first affected to disdain the use of the vulgar tongue, and their pamphleteers, when they did attempt it, were unequal to the task.

Toward the end of the century wider outlook was achieved by Philippe du Plessis Mornay (1549–1623) on the Protestant side, whose work is at least as much directed against freethinkers and enemies of Christianity in general as against the dogmas and discipline of Rome. His adversary, the redoubtable Jacques Cardinal du Perron (1556–1618), who, originally a Calvinist: went over to the other side, employed French most vigorously in controversial works, chiefly with reference to the Eucharist. Du Perron was celebrated as the first controversialist of the time, and obtained dialectical victories over all comers. At the same time the bishop of Geneva, St. Francis de Sales (1567–1622), supported the Catholic side, partly by controversial works but still more by his devotional writings, the chief of which is the *Introduction to a Devout Life,* still a popular classic.

Literature was to receive one of its principal accessions in the famous essays of Michel Eyquem, seigneur de Montaigne (1533–92). It would be a mistake to imagine the existence of any sceptical propaganda in this charming and popular book. Its principle is not scepticism but egotism; and, the author being by nature sceptical, this quality automatically rather than intentionally appears. It expresses the mental attitude of the latter part of the century as completely as Rabelais expresses the mental attitude of the early part. There is considerably less vigour and life in this attitude. Inquiry and protest have given way to a placid conviction that, there i͵ not much to be found out and that it does not much matter; the erudition though abundant is less indiscriminate; exuberant drollery has given way to quiet irony; and though neither business nor pleasure is decried, both are regarded rather as useful pastimes incident to the life of a man than with the eager appetite of the Renaissance. From the purely literary point of view, the style is remarkable for its absence of pedantry in construction and yet for its rich vocabulary and picturesque brilliancy. It is one of the best-loved books in the French language throughout the whole world; its mood and contents are often in tune with the mind of the really civilized people in all ages. Montaigne is an infinite source of pleasure, to be read at leisure, by small or large sections, to be put down and taken up again at will. His friend Pierre Charron (1591–1603) is himself no mean essayist (*Traité de la sagesse).*

The greatest political writer of the age is Jean Bodin (1530–96), whose *République* is founded partly on speculative considerations like the political theories of the ancients, and partly on an extended historical inquiry. Bodin, like most lawyers who have taken the royalist side, is for unlimited monarchy. but, notwithstanding this, he condemns religious persecution and is against slavery. In his speculations on the connection between forms of government and natural causes, he resembles both Aristotle and the great Montesquieu. A large number of writers adopt opposite conclusions. Étienne de la Boétie (1530–63), the friend of Rlontaigne's youth. composed the *Contre un* or *Discours de la servitude volontaire,* a protest against the monarchical theory.

The foremost work against the Holy League, political party of the Catholics, was the famous *Satire Ménippée* (1594), from a literary point of view one of the most remarkable of political books. The *Ménippée* nas the work of no single author, but was the result, it is said, of the collaboration of five, Pierre Leroi, who has the credit of the idea, Jacques Gillot, Florent Chrétien, Nicholas Rapin (1541–96) and Pierre Pithou (1539–96), with some assistance in verse from Jean Passerat and Gilles Durand. The book is a kind of burlesque report of the meeting of the states-general. called for the purpose of supporting the views of the League in 1593. It gives an account of the procession of opening, and then we have the supposed speeches of the principal characters—the duc de Mayenne, the papal legate, the rector of the university (a ferocious Leaguer) and others. But by far the most remarkable is that attributed to Claude d'Aubray, the leader of the *tiers état,* and said to be nritten by Pithou. in which all the evils of the time and the malpractices of the leaders of the League are exposed and branded. The satire is extraordinarily strong and yet perfectly good-humoured.

16th-Century Savants.—One more division, that of scientific and learned nriters pure and simple, remains. Much of the work of this kind during the period was naturally done in Latin, the normal tongue of the learned. But in France, as in other countries. the study of the classics led to a vast number of translations, and Amyot, one of the translators, deserves as a prose mriter a rank among the highest. Many of the authors already mentioned contributed to the literature of translation. Des Périers translated Plato's *Lysis,* La Boétie some works of Xenophon and Plutarch Du Vair the *De corona,* the *In Ctesiphontem* and the *Pro Milone.* Salel attempted the *Iliad,* Belleau the false *Anacreon,* Baïf some plays of Plautus and Terence. Besides these Lefkvre d'Etaples gave a version of the Bible. Pierre Saliat one of Herodotus and Louis Leroi (1510–77), not to be confounded with the part author of the *Ménippée,* many works of Plato. Aristotle and other Greek writers. Jacques Xmyot (1513–93), bishop of Auxerre, takes rank as a French classic by his translations of Plutarch. Ldngus and Heliodorus. The admiration which Amyot excited in his onn time was immense. Montaigne declares that it was thanks to him that his contemporaries knew how to speak and to write, and the academy in the next age, though not too much inclined to honour its predecessors, ranked him as a model. His Plutarch, which had an enormous influence at the time and coloured perhaps more than any classic the thoughts and writings of the 16th century, both in French and English. was considered his masterpiece.

On the other hand, Claude Fauchet (1530–1601) in two antiquarian works, *Antiquités gauloises et françoises* and *L'Origine de la langue et de la poésie française,* displays a remarkable critical faculty in sweeping away the fables which had encumbered history. Fauchet had the (for his time) wonderful habit of consulting manuscripts, and we owe to him literary notices of many of the *trouvères.* At the same time François Grudé. sieur de la Croix du hlaine (1552–92), and Xntoine Duverdier (1544–1600) founded the study of bibliography in France. Pasquier's *Recherches* carries out the principles of Fauchet independently, and, besides treating the history of the past in a true critical spirit, supplies us with voluminous and invaluable information on contemporary politics and literature. He has, moreover, the merit, which Fauchet had not, of being an excellent writer. Henri Estienne (Stephanus) (1528–98) also deserves notice in this place, both for certain treatises on the French language. full of critical crotchets, and also for his curious *Apologie pour Hérodote.* The famous potter Bernard Palissy (1510–90) was not much less skilful as a fashioner of words than as a fashioner of pots. and his description of the difficulties of his experiments in enamelling, which lasted 16 years, is well known. The great surgeon Ambroise Paré (*c.* 1517–90) was also a mriter, and his descriptions of his military experiences at Turin, Metz and elsewhere have all the charm of the 16th-century memoir.

The only other writers who require special mention are Oliver de Serres (1539–1619), who composed, under the title of *Théâtre d'agriculture,* a complete treatise on the various operations of rural economy, and Jacques du Fouilloux (1521–80), who wrote on hunting (La Ve'nerie). Both became extremely popular and were frequently reprinted.

THE 17TH CENTURY

We now come to the triumph of French literature, with tragedies in verse, comedies in verse and in prose and a great variety of works in prose. Among them the Fables of Jean de la Fontaine stand as a unique achievement. It is not sufficiently realized that French "classical" literature is the result of many European tendencies. Europe had produced, with Dante Alighieri, William Shakespeare, Miguel de Cervantes, Luis de Camoens, greater literature than the French were to produce; but as yet it had, in literature, no form of art of its own. The French, arriving later than some other nations to the highest zone of literature, created a European ideal. The realism of Boccaccio and of Chaucer comes to full fruition in Molière and La Fontaine. The supreme triumph of Shakespeare admitted of many faults which were realized by Ben Jonson. Corneille and Jean Racine follow up, unknown to themselves, the tendencies evident in Ben Jonson and, quite consciously, follow Spanish and Italian models. Blaise Pascal is a triumph of European Christianity, not only of French religion; he is not at all at his ease in France, any more than is René Descartes. In fact, the literature of France in the 17th century in no way follows from the French middle ages or the French Renaissance; it despised deliberately and consciously all previous French literature and admired Tasso rather than Ronsard. Molière is the successor of Italian comedy and has no French predecessors worth mentioning. Petrarch is the direct ancestor of both Chimène and Bérénice; premarital love reigns in the Cid as in Britannicus.

The establishment of the absolute monarchy created the favourable conditions for this literature, which presupposes aluays a complete acceptance of religion and kingship. Louis XIV was reaily a monarch with Spanish ideals on the French throne. quite unlike Henri IV or Louis XIII, but following the ideals of Philip II, whose great-grandson he was. He had been brought up by a Spanish mother in love with Spanish etiquette and ideas so far unknown in France.

Thus, in France one side of Europe came to fruition—the side based on classical antiquity, religion and absolute monarchy. Hence, we have the universal success of the French for a while; not a mere matter of fashion, but the recognition all over Europe that Molière, Racine and—to a great extent, barring the Protestant element—Jacques Bossuet spoke for Europe. Hence, also, we have the downfall of that school at the end of the 18th century, when the whole of Europe—not France alone—abandoned those ideals. But not only Nicolas Boileau-Despréaux fell; Alexander Pope, a greater writer, also fell when Samuel Taylor Coleridge and William Wordsworth came forward. Pope cannot be explained by French influence only; he is also a European writing in English. But by 1800 Europe had lost consciousness of its own religious, political and cultural history, and the rebellion seemed to all a rebellion against the French, because the French of the 17th century had best given expression to that former Europe.

Poetry in the 17th Century.—Yet in all this greatness of the French, one thing is strangely absent—poetry proper has disappeared. Between Ronsard (d. 1585) and the rise of Alphonse de Lamartine (1820) there is not one major poet. There is, of course, great poetry in the prose of Pascal and of Bossuet, and some poetry, of a kind, in Corneille and Racine, but it remains fragmentary and occasional, an illustration to thought rather than poetry for its own sake. Superior rhetoric would be a better designation.

Yet a few names of talented writers in verse must be remembered: François de Malherbe (1555–1628) had a great reputation as the first French author who wrote in a disciplined manner, but it is absurd to give him the credit of founding a school in which Corneille and Molière would be disciples. He was totally devoid of genius and is now largely unreadable and unread. Honoré de Bueil, marquis de Racan (1589–1670), Jean Chapelain (1595–1674) and many more were signal failures in the grand manner; Théophile de Viau, Gérard de Saint-Amant and Paul Scarron are still names referred to by historians. A learned assembly of ladies, the Précieuses, have been much written about; Molière made them immortal by his first good play, Les *Précieuses ridi*cules. The real classics were their enemies and ridiculed their pet authors, Vincent Voiture, Isaac de Benserade and Georges de Scudéry, now quite unread. It has long been the fashion to say that these ladies gave order to the French language. But as Voltaire asserts rightly, great prose was written first in French by Pascal, a genius on the world scale, and it is difficult to see how his French owed anything to the Précieuses.

The French academy was founded unofficially by Valentin Conrart in 1629, received official standing six years later, and continued the tradition of Malherbe in attempting constantly to school and correct, as the phrase went, the somewhat disorderly instincts of the early French stage. Even the Cid was formally censured for irregularity by it.

17th-Century Drama.—We have already seen how the mediaeval theatre was formed and how in the second half of the 16th century it met with a formidable rival in the classical drama of Jodelle and Garnier. In 1588 mysteries had been prohibited, and with the prohibition of the mysteries the Confrérie de la Passion lost the principal part of its reason for existence. The other bodies and societies of amateur actors had already perished, and at length the Hôtel de Bourgogne itself, the home of the Confraternity, had been handed over to a regular troop of actors, while companies of strollers, whose life has been vividly depicted in the Roman comique of Scarron and the Capitaine Fracasse of Théophile Gautier, wandered all about the provinces. The old farce was for a time maintained or revived by Tabarin (Antoine Girard), a remarkable figure in dramatic history, of whom but little is known.

The great dramatic author of the first. quarter of the 17th century was Alexandre Hardy (1569–1631), who surpassed even Thomas Heywood in fecundity and very nearly approached the portentous productiveness of Lope de Vega. From Hardy to Rotrou is, in point of literary interest, a great step, and from Rotrou to Corneille a greater. Jean de Rotrou (1609–50) has been called the French Marlowe, and there is a curious likeness and yet a curious contrast between the two poets. The best parts of Rotrou's two best plays, Venceslas and *St. Genest,* are quite beyond comparison in respect of anything that preceded them, and the central speech of the last-named play will rank with anything in French dramatic poetry.

The fertility of France at this moment in dramatic authors was immense; nearly 100 are enumerated in the first quarter of the century. The early plays of Pierre Corneille (1606–84) had all the faults of his contemporaries combined with merits to which none of them except Rotrou, and Rotrou himself only in part, could lay claim. His first play was *Mélite,* a comedy, and in Clitandre, a tragedy, he soon produced what may perhaps be not inconveniently taken as the typical piece of the school of Hardy. A full account of Corneille may be found elsewhere. It is sufficient to say here that his importance in French literature is quite as great in the way of influence and example as in the way of intellectual excellence. The *Cid* and the *Menteur* are, respectively, the first examples of French tragedy and comedy which can be called great literature.

Beginning with mere farces of the Italian type, and passing from these to comedies still of an Italian character, it was in Les *Précieuses* ridicules, acted in 1659, that Molière (Jean Baptiste Poquelin) (1622–73), in the words of a spectator, hit at last on "la bonne *comédie.*" The next 15 years comprise the whole of his best-known work, the finest achievement of a certain class of comedy that any literature has produced. The tragic masterpieces of Jean Racine (1639–99) were not far from coinciding with the comic masterpieces of Molière, for, with the exception of the remarkable aftergrowth of Esther and *Athalie,* they were produced chiefly between 1667 and 1677. Both Racine and Moliere are writers who require separate mention.

Among the immediate successors and later contemporaries of the three great dramatists we do not find any who deserve high rank as tragedians, though there are some whose comedies are more than competent. It is at least significant that the restrictions imposed by the academic theory on the comic drama were far less severe than those which tragedy had to undergo. Only Thomas Corneille (1625–1709), the inheritor of an older tradition and of a great name, deserves to be excepted from the condemnation to be passed on the lesser tragedians of this period. He was unfortunate in possessing his brother's name, and in being, like him, too voluminous in his compositions; but *Camma, Ariane, Le Comte d'Essex* are not tragedies to be despised. On the other hand, the names of Jean de Campistron (1656–1723) and Nicolas Pradon (1632–98) mainly serve to point injurious comparisons; Joseph Franqois Duché (1668–1704) and Antoine la Fosse (1653–1708) are of still less importance, and the tragedies of Philippe Quinault (1635–88) are chiefly remarkable because he had the good sense to give up writing them and to take to opera. The general excellence of French comedy, on the other hand, was sufficiently vindicated. Besides the splendid sum of Molière's work, the two great tragedians had each, in *Le Menteur* and *Les Plaideurs,* set a capital example to their successors, which was fairly followed. David Augustin de Brueys (1640–1723) and Jean Palaprat (1650–1721) brought out once more the ever new *Avocat Patelin,* besides the capital *Grondeur.* Philippe Quinault and Jean Galbert de Campistron wrote fair comedies. Florent Carton Dancourt (1661–1725), Charles Rivikre Dufresny (1648–1724) and Edmond Boursault (1638–1701) were all comic writers of considerable merit. But the chief comic dramatist of the latter period of the 17th century was Jean Franqois Regnard (1655–1709), whose *Joueur* and *Légataire* are comedies almost of the first rank.

La Fontaine and **Boileau.**—Jean de la Fontaine (1621–95) and Nicolas Boileau-Despréaux (1636–1711) belong to no category. In the 17th century there is only one *fabulzste* and only one *critique achevé.* Yet the spirit of the century is nowhere seen more clearly than in those two. La Fontaine began with licentious *contes* imitated from Boccaccio but out of place in the *grand siècle* and not so very amusing. Then he rose to the *Fables,* a masterpiece so unique that no other literature can boast of anything like it. Never has the French language been handled so deftly as in some of these little masterpieces. The Greek poems that inspire most of them are, by comparison, rough and obvious. As for Boileau, in his *Satires* and his *Art poétique,* he is the master of a kind of versified prose which is supreme of its kind—not being poetry at all. But in his maxims as to what literature really is, he not only expresses the ideas of his time but is nearly always universally in the right. He is probably the one real literary critic that Europe has produced; Pope, who imitates him frequently and often has much more bite and power, is far below him in universal truth.

17th-Century Fiction.—In the department of literature which comes between poetry and prose, that of romance writing, the 17th century, excepting one remarkable development, was not very fertile. *Polexandre* and *Cléopâtre, Clélie* and the *Grand Cyrus* have been too heavy for all the industry and energy of literary antiquarians. The nearest ancestry which can be found for them is the romances of the *Amadis* type. The *Carte de Tendre,* which originally appeared in *Clélie,* is well known, as are the shepherds and shepherdesses who figure in the *Astrée* of Honoré d'Urfé (1568–1625), on the banks of the Lignon; but here general knowledge ends, and there is perhaps no reason why it should go much further. It is sufficient to say that Madeleine de Scudéry (1607–1701) principally devotes herself in the books above mentioned to laborious gallantry and heroism; Gauthier de Costes de la Calprénède (1610–63), in *Cassandre et Cléopâtre,* to something which might have been the historical novel if it had been constructed on a less preposterous scale; and Marin le Roy de Gomberville (1600–47), in *Polexandre,* to moralizings.

The form uhich the prose tale took at this period was that of the fairy story. Charles Perrault (1628–1703) and Madame d'Aulnoy (*c.* 1650–1705) composed specimens of this kind which have never ceased to be popular. Anthony Hamilton (1646–1720), the author of the well-known *Mémoires du comte de Gramont,* wrote similar stories of extraordinary merit in style and ingenuity. There is yet a third class of prose writing which deserves to be mentioned. It also may probably be traced to Spanish influence, to the picaresque romances which the 16th and 17th centuries produced in Spain in large numbers. The most remarkable example of this is the *Roman comique* of the burlesque writer Scarron. The *Roman bourgeois* of Antoine Furetikre (1619–88) also deserves mention as a collection of pictures of the life of the time, arranged in the most desultory manner but drawn with great vividness, observation and skill.

A remarkable writer who had great influence on Molikre has also to be mentioned in this connection rather than in any other. This is Cyrano de Bergerac (1620–55), who, besides composing doubtful comedies and tragedies, writing political pamphlets and exercising the task of literary criticism in objecting to Scarron's burlesques, produced in his *Histoires comiques des états et empires de la lune et du soleil,* half romantic and half satirical compositions.

One other work, and in literary influence perhaps the most remarkable of its kind in the century, remains. Marie de la Vergne, comtesse de la Fayette (1634–93), the friend of La Rochefoucauld and of Madame de Sévigné, though she did not exactly anticipate the modern novel, showed the way to it in her stories, the principal of which are *Zai'de* and still more *La Princesse de Clèves.* The latter, though a long way from *Manon Lescaut, Clarissa* or *Tom Jones,* is a longer way still from *Polexandre* or the *Arcadia.* The novel becomes in it no longer a more or less fictitious chronicle, but an attempt at least at the display of character. *La Princesse de Clèves* has never been a widely popular work outside its own country, nor perhaps does it deserve such popularity, for it has more grace than strength; but as an original effort in an important direction its historical value is considerable.

17th-Century Prose.—French prose now attained the strength and perfection for which it is still pre-eminent. The prose Malherbe of French literature was Jean Louis Guez de Balzac (1594–1654). The writers of the 16th century had practically created the literary language of prose, but they had not created a prose style. The charm of Rabelais, of Amyot, of Montaigne and of the numerous writers of tales and memoirs whom we have noticed was a charm of exuberance, of naïveté, of picturesque effect—in short, of a mixture of poetry and prose rather than of prose proper.

Sixteenth-century French prose is a delightful instrument in the hands of men and women of genius, but in the hands of those who have not genius it is full of defects and indeed is nearly unreadable. Now, prose is essentially an instrument of all work. The poet who has not genius had better not write at all; the prose writer often may and sometimes must dispense with this qualification. Jean Louis Guez de Balzac is perhaps the first, in France, to give an example of well-ordered prose. He himself produced no great work, his principal writings being letters, a few discourses and dissertations and a work entitled *Le Socrate chre'tien,* a sort of treatise on political theology.

Voiture seconded Balzac. His prose style, also chiefly contained in letters, is lighter than that of his contemporary.

17th-Century History.—In historical composition, especially in the department of memoirs, this period was exceedingly rich. At last there was written, in French, an entire history of France. The author was François Eudes de Mézeray (1610–83), whose work, though not exhibiting the perfection of style at which some of his contemporaries had already arrived and though still more or less uncritical, yet deserves the title of history. At the end of the period comes the great ecclesiastical history of Claude Fleury (1640–1723), a work which perhaps belongs more to the section of erudition than to that of history proper. Three small treatises, however, composed by different authors toward the middle of the century, supply remarkable instances of prose style in its application to history. These are the *Conjurations du comte de Fiesque,* written by Paul de Gondi Cardinal de Retz (1614–79), whose memoirs are a major literary masterpiece, the *Conspiration* de *Walstein* of Jean Sarasin and the *Conjuration des Espagnols contre Venise,* composed in 1672 by the abbé de Saint-Réal (1639–92), the author of various historical and critical works deserving less notice. Both this and earlier times found chronicle in the singular *Historiettes* of Gédéon Tallemant des Réaux (1619–90), a collection of anecdotes, frequently scandalous. reaching from the times of Henri IV to those of Louis XIV, to which may be joined the letters of Guy Patin (1602–76).

The queen of letter writers is Madame de Sévigné (1626–96), on whom, as on most of the great and better-known writers whom we have had and shall have to mention, it is impossible here to dwell at length. The last half of the century produced crowds of similar but inferior writers. The memoirs of Roger de Bussy-Rabutin (1618–93) (author of a kind of scandalous chronicle called *Histoire amoureuse des Gaules*) and of Madame de Maintenon (1635–1719) perhaps deserve notice above the others. Memoir writing became the occupation not so much of persons who made history, as was the case from Comines to Retz, as of those who, having culture, leisure and opportunity of observation, devoted themselves to the task of recording the deeds of others. The efforts of Balzac and the academy supplied a suitable language and style; and the increasing tendency toward epigrammatic moralizing, which reached its acme in La Rochefoucauld (1613–80) and Jean de la Bruybre (1645–96), added in most cases point and attractiveness to their writings.

17th-Century Philosophers and **Theologians.**—René Descartes (1596–1650) was at once a master of prose style, the greatest of French philosophers and one of the greatest metaphysicians, not merely of France and of the 17th century but of all countries and times. Even before Descartes there had been considerable and important developments of metaphysical speculation in France. The first eminent philosopher of French birth was Pierre Gassendi (1592–1655). Gassendi devoted himself to the maintenance of a modernized form of the Epicurean doctrines, but he wrote mainly, if not entirely, in Latin. Another sceptical philosopher of a less scientific character was the physicist Gabriel Naudé (1600–53), who, like many others of the philosophers of the time, was accused of atheism. But as none of these could approach Descartes in philosophical power and originality, so also none has even a fraction of his importance in the history of French literature. Descartes stands with Plato, and possibly George Berkeley and Nicolas Malebranche, at the head of all philosophers in respect of style; and in his case the excellence is far more remarkable than in others. inasmuch as he had absolutely no models and was forced in a great degree to create the language which he used. The *Discours de la méthode* is not only one of the epoch-making books of philosophy, it is also one of the epoch-making books of French style. Utmost clarity of expression was also achieved by Blaise Pascal (1623–62) and the school of Port Royal, who will be noticed presently. The very genius of the Cartesian philosophy was intimately connected with this clearness, distinctness and severity of style; and there is something more than a fanciful contrast between these literary characteristics of Descartes, on the one hand, and the elaborate splendour of Francis Bacon, the knotty and crabbed strength of Thomas Hobbes and the commonplace and almost vulgar slovenliness of John Locke. Of the followers of Descartes, by far the most distinguished, both in philosophy and in literature, is Nicolas Malebranche (1638–1715). His *Recherche* de *la vérité,* admirable as it is for its subtlety and its consecutiveness of thought, is equally admirable for its elegance of style. Malebranche cannot indeed, like his great master, claim absolute originality. But his excellence as a writer is as great as if not greater than that of Descartes, and the *Recherche* remains to this day the one philosophical treatise of great length and abstruseness which, merely as a book, is delightful to read.

Yet, for all this, philosophy hardly flourished in France. It was too intimately connected with theological and ecclesiastical questions, and especially with Jansenism, to escape suspicion and persecution. Descartes himself chose to spend much of his life in Holland and Sweden; and though the unquestionable orthodoxy of Malebranche, the strongly religious cast of his works and the remoteness of the abstruse region in which he sojourned from that of the controversies of the day protected him, other followers of Descartes were not so fortunate. Holland, indeed, became a kind of city of refuge for students of philosophy, though even in Holland they were by no means entirely safe from persecution.

By far the most remarkable of French philosophical exiles in Holland was Pierre Bayle (1647–1706), a name not perhaps of the first rank in respect of literary value, but certainly of the first as regards influence. Bayle, after oscillating between the two confessions, nominally remained a Protestant in religion. In philosophy he in the same manner oscillated between Descartes and Gassendi, finally resting in an equally nominal Cartesianism. Bayle was, in fact, both in philosophy and in religion, merely a sceptic. His style is hardly to be called good, being diffuse and often inelegant. But his great dictionary, though one of the most heterogeneous and unmethodical of compositions, exercised an enormous influence. It may be called the Bible of the 18th century and contains in the germ all the desultory philosophy, the ill-ordered scepticism and the critical but negatively critical acuteness of the *Aufklärung.*

Cornelius Jansen himself, though a Dutchman by birth, passed much time in France, and it was in France that he found most disciples. These disciples consisted in the first place of the members of the society of Port Royal des Champs, a coterie after the fashion of the time, but one which devoted itself not to sonnets or madrigals but to devotional exercises, study and the teaching of youth. This coterie early adopted the Cartesian philosophy, and the Port Royal *Logic* was the most remarkable popular handbook of that school. In theology they adopted Jansenism and were in consequence soon at daggers drawn with the Jesuits, according to the polemical habits of the time. The most distinguished champions on the Jansenist side were Jean Duvergier de Hauranne, abbé de St. Cyran (1581–1643), and Antoine Arnauld (1560–1619), but by far the most important literary results of the quarrel were the famous *Provinciales* of Pascal. Their literary importance consists not merely in their grace of style but in the application to serious discussion of the polished and devastating irony of which Pascal is the greatest master the world has ever seen. Pascal set the example of combining the use of the most terribly effective weapons with good humour, good breeding and a polished style. The example was largely followed, and the manner of Voltaire and his followers in the 18th century owes at least as much to Pascal as their method and matter do to Bayle. The Jansenists, attacked and persecuted by the civil power, which the Jesuits had contrived to interest, were finally suppressed. But the *Provinciales* had given them an unapproachable superiority in matter of argument and literature. Their other literary works were inferior, though still remarkable. Antoine Arnauld (the younger, often called "the great") (1612–94) and Pierre Nicole (1625–95) managed their native language with vigour if not exactly with grace.

17th-Century Preachers. — When we think of Gallican theology during the 17th century, it is always the famous pulpit orators who come first to the mind. Nor is this unjust, for though the most prominent of them all, Jacques Bénigne Bossuet (1627–1704), was remarkable as a writer of matter intended to be read, not merely as a speaker of matter intended to be heard, this double character is not possessed by most of the orthodox theologians of the ,time; and even Bossuet, great as is his genius, is rather a rhetorician than a philosopher or a theologian.

No country has ever been able to show a more magnificent concourse of orators, sacred or profane, than that formed by Bossuet, François de Satagnac de la Mothe de Fénelon (1651–171j), Esprit Fléchier (1632–1710), Jules Mascaron (1634–1703), Louis Bourdaloue (1632–1704) and Jean Baptiste Massillon (1663–1742), to whom may be justly added the Protestant divines Jean Claude (1619–87) and Jacques Saurin (1677–1730). The characteristics of all these were different. Bossuet, the earliest and certainly the greatest, was also the most universal. He was not merely a preacher; he was, as we have said, a controversialist, indeed somewhat too much of a controversialist, as his battle with Fénelon proved. He was a philosophical or at least a theological historian, and his *Discours sur l'histoire universelle* is equally remarkable from the point of view of theology, philosophy, history and literature. Turning to theological politics: he wrote his *Politique tirée de l'écriture sainte,* to theology proper his *Méditations sur les évangiles* and his *Elévations sur les mystères.* But his best literary work is in his *Oraisons funèbres.*

While Bossuet made himself chiefly remarkable in his sermons and in his writings by an almost Hebraic grandeur and strength, the more special characteristics of Christianity, largely alloyed with a Greek and Platonic spirit, displayed themselves in Fénelon. In pure literature he is not less remarkable than in theology, politics and morals. His practice in matters of style was admirable, as the universally known *Télémaque* sufficiently shows to those who know nothing else of his writing. But his taste, in his famous *Lettre à l'Académie,* is perhaps more admirable still. Despite Malherbe, Balzac, Boileau and the traditions of nearly a century, he dared to speak favourably of Ronsard, and plainly expressed his opinion that the practice of his own contemporaries and predecessors had cramped and impoverished the French language quite as much as they had polished or purified it.

The two Protestant ministers of great fame, though inferior to their rivals, yet deserve honourable mention among the ecclesiastical writers of the period. Claude engaged in a controversy with Bossuet, in which victory is claimed for the invincible eagle of Meaux. Saurin, by far the greater preacher of the two, long continued to occupy and indeed still occupies in the libraries of French Protestants the position given to Bossuet and Massillon on the other side.

17th-Century Moralists. — The interests of many different classes of persons were concentrated upon moralizings, which took indeed very different forms in the hands of Pascal and other grave and serious thinkers of the Jansenist complexion in theology, and in those of literary courtiers as, for example, Saint-fivremond and La Rochefoucauld, whose chief object was to depict the motives and characters prominent in the brilliant and not altogether frivolous society in which they moved. Both classes, however, were more or less tempted by the cast of their thoughts and the genius of the language to adopt the tersest and most epigrammatic form of expression possible and thus to originate the *pensée,* in which, as its greatest later writer, Joseph Joubert, has said, "the ambition of the author is to put a book into a page, a page into a phrase, and a phrase into a word." Pascal, who is more fully noticed under his own name, became accidentally the greatest of writers of *pensées,* his great book having remained in a state of fragments. For sheer genius, both in thought and in style, and for depth of feeling, Pascal is possibly the greatest figure in French literature.

There arose only a little later a very different group of moralists. whose writings have been as widely read and who have had as great a practical and literary influence as perhaps any other class of authors. The earliest to be born and the last to die of these was Charles de Saint-Denis, seigneur de Saint-fivremond (1610 – I) Saint-Évremond was long known rather as a conversational wit, some of whose good things were handed about in manuscript, or surreptitiously printed in foreign lands, than as a writer, and this is still to a certain extent his reputation. He was at least as cynical as his still better-known contemporary La Rochefoucauld, if not more so, and he had less intellectual force and less nobility of character. But his wit was very great, and he set the example of the brilliant societies of the next century.

In direct literary value, however, no comparison can be made between Saint-fivremond and the author of the *Sentences et maximes morales.* François de la Rochefoucauld (1613–80) has other literary claims besides those of this famous book. His *Mémoires* were very favourably judged by his contemporaries, and they are still held to deserve no little praise even among the numerous and excellent works of the kind which that age of memoir writers produced. But while the *Mémoires* thus invite comparison, the *Sentences et maximes* stand alone. Even allowing that the mere publication of detached reflections in terse language was not absolutely new, it had never been carried, perhaps has never since been carried. to such a perfection. Beside La Rochefoucauld all other writers are diffuse, vacillating, unfinished, rough. Not only is there in him never a word too much, but there is never a word too little. The thought is always fully expressed, not compressed. Frequently as the metaphor of minting or stamping coin has been applied to the art of managing words, it has never been applied so appropriately as to the maxims of La Rochefoucauld. The form of them is almost beyond praise, and its excellencies, combined with their immense and enduring popularity, have had a very considerable share in influencing the character of subsequent French literature. Of hardly less importance in this respect, though of considerably less intellectual and literary individuality, was the translator of Theophrastus and the author of the *Caractères,* Jean de la Bruyère, but though frequently epigrammatic, he did not aim at the same incredible terseness as the author of the *Maximes.*

17th-Century Scholars. — The institution of the academy led to various linguistic works. One of the earliest of these was the *Remarques* of the Savoyard Claude Favre de Vaugelas (1595–1650), afterward re-edited by Thomas Corneille. Paul Pellisson wrote a history of the academy itself when it had as yet but a brief one. The famous *Examen du Czd* was an instance of the literary criticism of the time which was afterward represented by René Rapin (1621–87), Dominique Bouhours (1628–1702) and René le Bossu (1631–80); and Adrien Baillet (1649–1706) collected the largest thesaurus of the subject in his *Jugements des savants.* Boileau set the example of treating such subjects in verse, and in the latter part of the century *reflexions, discours, observations* and the like on particular styles, literary forms and authors became exceedingly numerous. In earlier years France possessed a numerous band of classical scholars of the first rank, such as Joseph Scaliger and Isaac Casaubon, who did not lack followers.

The famous quarrel between the Ancients and the Moderns, of Italian origin, was mainly started in France by Charles Perrault (1628–1703), who thereby rendered much less service to literature than by his charming fairy tales. The opposite side was taken by Boileau, and the fight was afterward revived by Antoine Houdar de la Motte (1672–1731), a writer of little learning but much talent in various ways, and by the celebrated Madame Anne Lefèvre Dacier (1654–1720). The discussion was conducted. as is well known, without very much knowledge or judgment among the disputants on the one side or on the other. But at this very time there were in France students and scholars of the most profound erudition. Fleury is only the last and the most popular of a race of omnivorous and untiring scholars, whose labours have ever since. until the modern method of first-hand investigations came in, furnished the bulk of historical and scholarly references and quotations. To this century belong Sébastien le Nain de Tillemont (1637–98), whose enormous *Histoire des empereurs* and *Mémoires pour servir à l'histoire ecclésiastique* served Gibbon and a hundred others as quarry; Charles Dufresne, seigneur de Ducange (1614–88), whose well-known glossary was only one of numerous productions; Jean Mabillon (1632–1707), one of the most voluminous of the voluminous Benedictines; and Bernard de Montfaucon (1655–1741).

THE 18TH CENTURY

The beginning of the 18th century is among the dead seasons of French literature. Fénelon and Malebranche still survived, but they were emphatically men of the last age. as was Massillon, though he lived till nearly the middle of the century. The characteristic literary figures of the opening years of the period are Henri François d'Aguesseau, Fontenelle, Louis de Rouvroy, duc de Saint-Simon, personages in many ways interesting and remarkable but purely transitional in their characteristics. Bernard le Bovier de Fontenelle (1657–1757) is, indeed, perhaps the most typical figure of the time. He was a dramatist, a moralist, a philosopher, physical and metaphysical, a critic, a historian, a poet and a satirist. The manner of his work is always easy and graceful, and their matter rarely contemptible.

18th-Century Poetry. — The dispiriting signs shown during the 17th century by French poetry proper received entire fulfilment in the following age. The two poets who were moat prominent at the opening of the period were the abbé Guillaume Xmfrye de Chaulieu (1639–1720) and the marquis de la Fare (1644–1712), poetical or rather versifying twins who are always quoted together. They were followed. however, by the one poet who succeeded in producing something resembling poetry in this artificial style. J. B. Rousseau (1671–1741).

Rousseau, nho in some respects was nothing so little as a religious poet, was nevertheless strongly influenced, as Marot had been, by the Psalms of David. His *Odes* and his *Cantates* are perhaps less destitute of that spirit than the work of any other poet of the century excepting André de Chénier. Rousseau was also an extremely successful epigrammatist, having in this respect, too, resemblances to Marot.

The universal talent of Voltaire (François Marie Arouet) (1694–1778) showed itself in his poetical productions no less than in his other works, and it is perhaps not least remarkable in verse. It is impossible nowadays to regard the *Henriade* as anything but a highly successful prize poem, but the burlesque epic of *La Pucelle,* discreditable as it may be from the moral point of view, is remarkable enough as literature. The epistles and satires are among the best of their kind, the verse tales are in the same way admirable, and the epigrams. impromptus and short miscellaneous poems generally are the *ne plus ultra* of verse mhich is not poetry.

André de Chénier (1762–94) stands far above the art of his century, though the strong chain of custom and his early death by the guillotine prevented him from breaking finally through the restraints of its language and its versification. Chénier was half a Greek by blood. The manner of his verses, the very air which surrounds them and which they diffuse are different from those of the 18th century, and his poetry is probably the utmost that its language and versification could produce. To do more, the revolution which followed a generation after his death was required.

18th-Century Drama. — The results of the cultivation of dramatic poetry at this time were even less individually remarkable than those of the attention paid to poetry proper. Here again the astonishing poner and literary aptitude of Voltaire gave value to his attempts. There is no doubt that no work of Voltaire's comes up to *Polyeucte* and *Rodogune,* as certainly no single passage in any of his plays can approach the best passages of *Cinna* and *Les Horaces.* But the remaining tragic writers of the century, with the single exception of Crébillon *père,* are scarcely third-rate. Prosper Jolyot de Crébillon (1674–1762) himself had talent, and there are to be found in his work evidences of a real tragic spirit, the last flickers of classical energy and taste.

Very early in the century Alain René le Sage (1668–1747), in the admirable comedy of *Turcaret,* produced a work not unworthy to stand by the side of all but his master's best. Philippe Destouches (1680–1754) was also a fertile comedy writer in the early years of the century, and in *Le Glorieux* and *Le Philosophe marié* achieved considerable success. As the age aent on, comedy, always apt to lay hold of passing events, devoted itself to the great struggle betneen the Philosophes and their opponents. Curiously enough, the party nhich engrossed almost all the wit of France had the worst of it in this dramatic portion of the contest, if in no other.

The *Méchant* of J. B. L. Gresset and the *Métromanie* of Alexis Piron (1689–1773) were far superior to anything produced on the other side, and the *Philosophes* of Charles Palissot de Montenoy (1730–1814), though scurrilous and broadly farcical, had a great success.

On the other hand, it was to a Philosophe that the invention of a new dramatic style was due, and still more the promulgation of certain ideas on dramatic criticism and construction, which, after being filtered through the German mind, were to return to France and to exercise the most powerful influence on its dramatic productions. This was Denis Diderot (1713–84), fhe most fertile genius of the century, but also the least productive in finished and perfect work. His chief dramas, the *Fils naturel* and the *Père de famille,* are certainly not great successes; the shorter plays, *Est-il bon? est-il méchant?* and *La Pièce et le prologue,* are better. But it was his follower Michel Jean Sédaine (1719–97) who, in *Le Philosophe sans le savoir* and other pieces, produced the best examples of the bourgeois as opposed to the heroic drama. Diderot is sometimes credited or discredited with the invention of the *comédie larmoyante,* a title which indeed his own plays do not altogether refuse. but this special variety seems to be, in its invention, rather the property of Pierre Claude Nivelle de la Chaussée (1692–1754). The most original dramatist of the century is perhaps Pierre de Marivaux (1688–1763), whose *Jeu de l'amour et du hasard,* for delicacy of style and feeling, is one of the permanent masterpieces of the comic stage. He reaches at times to an astonishing modernity of tone and sensibility.

At the extreme limit of this period there appears the remarkable figure of Pierre Caron de Beaumarchais (1732–99). The *Mariage de Figaro* and the *Barbier de Séville* are well known as having had attributed to them no mean place among the literary causes and forerunners of the Revolution. Their dramatic and literary value would itself have sufficed to obtain attention for them at any time, though there can be no doubt that their popularity was mainly the result of their political appositeness. The most remarkable point about them, as about the school of comedy of which Congreve was the chief master in England at the beginning of the century, was the abuse and superfluity of wit in the dialogue, indiscriminately allotted to all characters alike.

18th-Century **Fiction.**—Le Sage in his *Diable boiteux* and *Gil Blas* went to Spain not merely for his subject but also for his inspiration and manner, following the lead of the picaresque romance of Rojas and Scarron. Like Fielding. however, whom he much resembles, Le Sage mingled with the romance of incident the most careful attention to character and the most lively portrayal of it, while his style and language are such as to make his work one of the classics of French literature. The novel of character was really founded in France by the abbé Antoine François Prévost (1697–1763), the author of *Cleaeland* and of the incomparable *Manon Lescaut.*

The popularity of this style was much helped by the immense vogue in France of the works of Samuel Richardson. Side by side with it, however, and for a time enjoying still greater popularity, there flourished a very different school of fiction, of which Voltaire, whose name occupies the first or all but the first place in every branch of literature of his time, gave the most brilliant specimens. This was a direct development of the earlier *conte,* and consisted usually of the treatment, in a humorous, satirical and not always overdecent fashion, of contemporary foibles. beliefs, philosophies and occupations. These tales are of every rank of excellence and merit both literary and moral, and range from the astonishing wit, grace and humour of *Candide* and *Zadig* to the book which is Diderot's one hardly pardonable sin. and the similar but more lively efforts of Claude Prosper Crébillon *fils* (1707–77).

A third class of 18th-century fiction consists of attempts to return to the humorous *fatrasie* of the 16th century, attempts which were as much influenced by Laurence Sterne as the sentimental novel was by Richardson. The *Homme aux quarante écus* of Voltaire has something of this character, but the most characteristic work of the style is the *Jacques le fataliste* of Diderot, which shows it nearly at its best.

The great vogue and success of *Télémaque* produced a certain number of didactic works in which moral or historical information was sought to be conveyed under a more or less thin guise of fiction. Such was the *Voyage du jeune Anacharsis* of Jean Jacques Barthélemy (1716–95); such the *Numa Pompilius* and *Gonzalve de Cordoue* of Jean de Florian (1755–94), who also deserves notice as a writer of pastorals, fables and short prose tales; such the *Bélisaire* and *Les Incas* of Jean François Marmontel (1723–99). Between this class and that of the novel of sentiment may perhaps be placed *Paul et Virginie* and *La Chaumière indienne;* though Bernardin de Saint-Pierre (1737–1814) should more properly be noticed after Rousseau and as a disciple. Diderot's fiction writing has already been referred to, but his *Religieuse* deserves mention here as a powerful specimen of the novel both of analysis and of polemic; while his undoubted masterpiece, the *Neveu de Rameau,* though very difficult to class, comes under this head as well as under any other. There are, however, two of the novelists of this age, and of the most remarkable, who have yet to be noticed, and these are the author of *Marianne* and the author of *Julie.* We do not mention Pierre de Marivaux (1688–1763) in this connection as the equal of Jean Jacques Rousseau (1712–78), but merely as being in his nay almost equally original and equally remote from any suspicion of school influence. Gray's definition of happiness, "to lie on a sofa and read endless novels by Marivaux," is well known, and the production of mere pastime by means more or less harmless has since become so well recognized a function of the novelist that Marivaux, as one of the earliest to discharge it, deserves notice. The name, however, of Jean Jacques Rousseau is of far different importance. His two great works, the *Nouvelle Héloïse* and *Émile,* are as far as possible from being perfect as novels. But no novels in the world have ever had such influence as these. To a great extent this influence was a result mainly of their attractions as novels, imperfect though they may be in this character, but it was beyond dispute also because of the doctrines which they contained and which were exhibited in novel form. In the other works oi Rousseau, especially in the Confessions, there is not merely shown passion as fervid though perhaps less unaffected than that of Mademoiselle de Lespinasse—there appear in them two literary characteristics which, if not entirely novel, were for the first time brought out deliberately by powers of the first order, being for the first time made the mainspring of literary interest and thereby set an example which was persistently followed and which produced some of the finest results of modern literature. The first of these was the elaborate and unsparing analysis and display of the motives, the weaknesses and the failings of individual character. This process, which Rousseau unflinchingly performed on himself, had been followed usually in respect to fictitious characters by his successors.

The other novelty was the feeling for natural beauty and the elaborate description of it, the credit for which latter must, it has been agreed by all impartial critics, be assigned rather to Rousseau than to any other writer. His influence in this direction was. however, soon taken up and continued by Bernardin de Saint-Pierre, the connecting link between Rousseau and Chateaubriand, some of whose works have been already alluded to. In particular the author of Paul *et* Virginie set himself to develop the example of description which Rousseau had set, and his word paintings, though less powerful than those of his model, are more abundant, more elaborate and animated by a more amiable spirit. The Liaisons dangereuses by Choderlos de Laclos (1741–1803) is probably the greatest novel of the century and has some strangely modern elements. It had a great influence on Stendhal.

18th-Century History, Memoirs and Letters.—The three principal works of Charles Secondat de Montesquieu (1689–1755) are all historical and at the same time political in character. In the Lettres *persanes* he handled, with wit inferior to the wit of no other writer even in that witty age, the corruptions and dangers of contemporary morals and politics. The literary charm of this book is very great, and its plan was so popular as to lead to a thousand imitations, of which all, except those of Voltaire and Goldsmith, only bring out the immense superiority of the original. Few things could be more different from this lively and popular book than Montesquieu's next work, the Grandezrr et dkcadence des *Romains,* in which the same acuteness and knowledge of human nature are united with considerable erudition and with a weighty though perhaps somewhat grandiloquent and rhetorical style. His third and greatest work, the Esprit des *lois,* is again different both in style and character. and such defects as it has are as nothing when compared with the merits of its fertility in ideas, its splendid breadth of view and the felicity with which the author, in a manner unknown before, recognizes the laws underlying complicated assemblages of fact. The style of this great work is equal to its substance; less light than that of the Lettres, less rhetorical than that of the Grandeur des *Romains,* it is still a marvellous union of dignity and wit. Around Montesquieu, partly before and partly after him, is a group of philosophical or at least systematic historians, of whom the chief are Jean Baptiste Dubos (1670–1742) and G. Bonnot de Mably (1709–85).

Montesquieu was followed by Anne Robert Jacques Turgot (1727–81), whose writings are few in number, and not remarkable for style, but full of original thought. Turgot in his turn was followed by Marie Jean Antoine Nicolas Caritat, marquis de Condorcet (1743–94), whose tendency is somewhat more sociological than directly historical. Toward the end of the period, too, a considerable number of philosophical histories were written, the usual object of which was, under cover of a kind of allegory, to satirize and attack the existing institutions and government of France. The most famous of these was the *Histoire* des *Indes,* nominally written by the abbé Guillaume Thomas Franqois Raynal (1713–96), but really the joint work of many members of the Philosophe party, especially Diderot. Side by side with this really or nominally philosophical school of history there existed another and less ambitious school, which contented itself with the older and simpler view of the science. The abbé René de Vertot (1655–1735) belongs almost as much to the 17th as to the 18th century. In the same class, too, far superior as his literary power, must be ranked the historical works of Voltaire, Charles *XII,* Pierre *le* Grand, *Histoire* du *Siècle* de Louis XIV.

The *Mémoires* of the duc de Saint-Simon (1675–1755) are an extraordinary series of pictures of the court of Louis XIV and the Regency, written in a powerful style, with something of the irregular excellence of the great 16th-century writers, and most striking in the sombre bitterness of its tone. The subsequent and less remarkable memoirs of the century are so numerous that it is almost impossible to select a few for reference and altogether impossible to mention all. Of those bearing on public history the memoirs of Marguerite Delaunay, baronne de Staal (1684–1750), of Pierre Louis de Voyer, marquis d'Argenson (1694–1757), of Charles Pinot Duclos (1704–72), of Stephanie Félicité de Saint-Aubin, Madame de Genlis (1746–1830), of Pierre Victor, baron de Bésenval de Bronstatt (1722–91), of Jeanne Louise Campan (1752–1822) and of Franqois Joachim Cardinal de Bernis (1715–94) may be selected for mention; of those bearing on literary and private history, the memoirs of Louise d'Epinay (1726–83), those of Mathieu Marais (1664–1737), the so-called *Mémoires* secrets of Louis Petit de Bachaumont (1690–1770) and the innumerable writings having reference to Voltaire and to the Philosophe party generally. Here, too, may be mentioned a remarkable class of literature, consisting of purely private and almost confidential letters, which were written at this time with very remarkable literary excellence. As specimens may be selected those of Mademoiselle Aissé (1694–1757), which are models of easy and unaffected tenderness, and those of Julie de Lespinasse (1732–76) the companion of the marquise du Deffand de la Lande and afterward of Jean Le Rond d'Alembert. These latter, in their extraordinary fervour and passion, not merely contrast strongly with the generally languid and frivolous gallantry of the age, but also constitute one of its most remarkable literary monuments. It has been said of them that they "burn the paper," and the expression is not exaggerated. Madame du Deffand's (1697–1780) own letters, many of which were written to Horace Walpole, are noteworthy in a very different way. Of lighter letters the charming correspondence of Diderot with Sophie Voland deserves special mention.

18th-Century Philosophy.—The Philosophes, as a general rule, have but little claim to their title. There were some who manifested, however, an aptitude for purely philosophical argument, and one who confined himself strictly thereto. Among these the most remarkable are Julien Offroy de la Mettrie (1709–51) and Denis Diderot. La Mettrie in his works *L'Homme machine, L'Homme plante,* etc., applied a lively and vigorous imagination, a considerable familiarity with physics and medicine and a brilliant but unequal style to the task of advocating materialistic ideas on the constitution of man. Diderot, in a series of early works, Lettre *sur* les *aveugles,* Promenade *d'un sceptique, Pen*skes *philosophiques,* etc., exhibited a good acquaintance nith philosophical history and opinion and gave sign in this direction, as in so many others, of a far-reaching intellect.

But the least mediocre metaphysician of the period is Étienne Bonnot, abbé de Condillac (1714–SO), almost the only writer of the time in France who succeeded in keeping strictly to philosophy without attempting to pursue his system to its results in ethics, politics and theology. In the Tmitk des *sensations,* the Essai *sur l'origine* des *connaissances humaines* and other works Condillac elaborated and continued the imperfect sensationalism of Locke.

It has never been at all accurately decided how far what may be called the scoffing school of Voltaire represents a direct revolt against Christianity and how far it was merely a kind of guerrilla warfare against the clergy. Voltaire was not an atheist, and he did not approve of atheism. But his *Dictionnaire philosophique,* which is typical of a vast amount of contemporary and subsequent literature, consists of a heterogeneous assemblage of articles directed against various points of dogma and ritual and various characteristics of the sacred records. From the literary point of view, it is one of the most characteristic of all Voltaire's works, though it is perhaps not entirely his. The desultory arrangement, the light and lively style. the extensive but not always accurate erudition and the somewhat captious and quibbling objections are intensely Voltairian. But there is little seriousness about it and certainly no kind of rancorous or deep-seated hostility. With many of Voltaire's pupils and younger contemporaries, however, the case was altered. They were distinctively atheists and antisupernaturalists. The atheism of Diderot, unquestionably the greatest of them all, has been keenly debated; but in the case of Étienne Damilaville (1723–68), Jacques André Naigeon (1738–1810), Paul Heinrich Dietrich, baron d'Holbach, and others there is no room for doubt. By these writers a great mass of atheistic and anti-Christian literature was composed and set afloat. The characteristic work of this school, its last word indeed, is the famous *Système de la nature,* attributed to Holbach (1723–89) but known to be, in part at least, the work of Diderot. In this remarkable work, the climax of the metaphysical materialism or rather nihilism of the century, the atheistic position is clearly stated.

As the Revolution approached, and the victory of the Philosophe party was declared, there appeared for a brief space a group of cynical and accomplished phrase makers presenting some similarity to that of which, 100 years before, Saint-Evremond was the most prominent figure. The chief of this group were Nicolas Chamfort (1747–94) on the republican side and Antoine Rivarol (1753–1801) on that of the royalists. Like the older writer to whom they have been compared, neither can be said to have produced any one work of eminence, and in this they stand distinguished from moralists like La Rochefoucauld. The floating sayings, however, which are attributed to them, or which occur here and there in their miscellaneous work. yield in no respect to those of the most famous of their predecessors in wit and a certain kind of wisdom, though they are frequently more personal than aphoristic.

18th-Century Moralists and Politicians.— Not the least part of the energy of the period in thought and writing was devoted to questions of a directly moral and political kind, however. With regard to morality proper the favourite doctrine of the century was what is commonly called the selfish theory, the only one indeed which was suitable to the sensationalism of Condillac and the materialism of Holbach. The pattern book of this doctrine was the *De l'esprit* of Claude Adrien Helvétius (1715–71), the most amusing book perhaps which ever pretended to the title of a solemn philosophical treatise. There is some analogy between the principles of this work and those of the *Système de la nature.*

Luc de Clapiers, marquis de Vauvenargues (1715–47), produced maxims and reflections of considerable mental force and literary finish. He was a worthy friend of Voltaire and not unworthy to be compared with Saint-Bvremond. Between the moralists and the politicians may be placed Rousseau, who in his novels and miscellaneous works is of the first class, in his famous *Contrat social* of the second. All his theories, whatever their originality and whatever their value, were made novel and influential by the literary beauties of their form.

Political economy and administrative theories received much attention. The earliest writer of eminence on these subjects was the great engineer Sébastien le Prestre, marquis de Vauban (1633–1707), whose *Oisivetés* and *Dîme royale* exhibit both great ability and extensive observation. A more utopian economist of the same time was Charles Irénée Castel, abbé de Saint-Pierre (1658–1743), not to be confounded with the author of *Paul et Virginie.* Soon political economy in the hands of François Quesnay (1694–1774) took a regular form, and toward the middle of the century a great number of works on questions connected with it, especially that of free trade in grain, on which Ferdinand Galiani (1728–87), André Morellet (1727–1819), both abbés, and above all Turgot, distinguished themselves.

18th-Century Criticism and Periodical Literature.— Literary criticism assumes in this century a sufficient importance to be treated under a separate heading. Contributions were made to it of many different kinds and from many different points of view. Periodical literature. the chief stimulus to its production, began more and more to come into favour. Even in the 17th century the *Journal des savants,* the Jesuit *Jownal de Trévoux* and other publications had set the example of different kinds of it.

Just before the Revolution the *Gazette de France* was in the hands of J. B. A. Suard (1734–1817), a man who was nothing if not a literary critic. Perhaps, however, the most remarkable contribution of the century to criticism of the periodical kind was the *Feuilles de Grimm,* a circular sent for many years to the German courts by Friedrich Melchior, baron von Grimm (1723–1807), the comrade of Diderot and Rousseau, and containing a *compte rendu* of the ways and works of Paris, literary and artistic as well as social.

The most characteristic critic of the mid-century was the abbé Charles Batteux (1713–So), who illustrated a tendency of the time by beginning with a treatise on *Les Beaux arts réduits à un même principe* (1746); reduced it and others into *Principes de la littérature* (1764) and added in 1771 *Les Quatres poktiques* (Aristotle, Horace, Vida and Boileau). Batteux is a very ingenious critic, and his attempt to conciliate "taste" and "the rules," though inadequate, is interesting. Works on the arts in general or on special divisions of them were not wanting, as, for instance, that of Dubos. the *Essai sur la peinture* of Diderot and others. Critically annotated editions of the great French writers also came into fashion. Of these Voltaire's edition of Corneille was the most remarkable, and his annotations, united separately under the title of *Commentaire sur Corneille,* form not the least important portion of his works.

The method of much of the literary criticism of the close of this period was indeed deplorable enough. Jean François de la Harpe (1739–1803), who though a little later in time as to most of his critical productions is perhaps the most representative figure, shows criticism in one of its worst forms. La Harpe lays it down distinctly that a beauty, however beautiful, produced in spite of rules is a "monstrous beauty" and cannot be allowed.

18th-Century Savants.— In science and general erudition the 18th century in France was at first much occupied with the mathematical studies for which the French genius is so peculiarly adapted, which the great discoveries of Descartes had made possible and popular and which those of his supplanter Newton only made more popular still. Voltaire took to himself the credit, which he fairly deserves, of first introducing the Newtonian system into France, and it was soon widely popular, even ladies devoting themselves to the exposition of mathematical subjects, as in the case of Gabrielle de Breteuil, marquise du Chbtelet (1706–49), Voltaire's "divine Emilie." Indeed ladies played a great part in the literary and scientific activity of the century, by actual contribution sometimes, but still more by continuing and extending the tradition of "salons." The duchesse du Maine, Mesdames de Lambert, de Tencin, Geoffrin, du Deffand, Necker and, above all, the baronne d'Holbach (whose husband, however, was here the principal personage) presided over coteries which became more and more "philosophical." Many of the greatest mathematicians of the age, such as Abraham de Moivre and Pierre Simon, marquis de Laplace, were French by birth, while others such as Leonhard Euler belonged to French-speaking nationalities and wrote in French. The physical sciences were also ardently cultivated, the impulse to them being given partly by the generally materialistic tendency of the age, partly by the Newtonian system and partly also by the extended knouledge of the world provided by the circumnavigatory voyage of Louis Antoine de Bougainville (1729–1811) and other travels. P. L. Moreau de Maupertius (1698–1759) and C. M. de la Condamine (1701–74) made long journeys for scientific purposes and, duly recorded their experiences. D'Alembert, a great mathematician and a writer of considerable. though rather academic excellence, is principally known from his connection with and introduction to the *Encyclopédie,* discussed below. Chemistry was also assiduously cultivated, the baron d'Holbach, among others, being a devotee thereof and helping to advance the science to the point where, at the conclusion of the century, it was illustrated by Claude Louis Berthollet and Antoine Lavoisier.

During all this devotion to science in its modern acceptation, the older and more literary forms of erudition were not neglected, especially by the illustrious Benedictines of the abbey of St. Maur. Dom Augustin Calmet (1672–1757), the author of the well-known Dictionary of the Bible, belonged to this order, and to them also (in particular to Dom Rivet) was attributable the beginning of the immense *Histoire* litte'raire de la France, a work interrupted by the Revolution and long suspended, but diligently continued after the middle of the 19th century. The immense Natural History of Georges Louis Leclerc, comte de Buffon (1717–88), though not entirely his own, is a remarkable monument of the union of scientific tastes with literary ability. As has happened in many similar instances, there is in parts more literature than science to be found in it, yet many fruitful scientific ideas and theories are here propounded for the first time.

The *Encyclopédie,* unquestionably on the whole the most important French literary production of the century, if we except the works of Rousseau and Voltaire, was conducted for a time by Diderot and D'Alembert, afterward by Diderot alone. It numbered among its contributors almost every Frenchman of eminence in letters. It had, besides a considerable theological and political influence, an immense share in diffusing and gratifying the taste for general information.

1789–1820 — General Sketch. — The period which elapsed between the outbreak of the Revolution and the accession of Charles X has often been considered a sterile one in point of literature. Casimir Delavigne (1793–1843), the author of Les *Messéniennes,* is a writer of very great talent, and, according to the measure of J. B. Rousseau and Lebrun (Ponce Denis Ecouchard), no mean poet. It is usual to reckon Delavigne as transitionary between the classical and romantic schools, but in strictness he must be counted with the classicists. Dramatic poetry exhibited somewhat similar characteristics. Jean Franqois Ducis (1733–1816), who passes with Englishmen as a feeble reducer of Shakespeare to classical rules, passed with his contemporaries as an introducer into French poetry of strange and revolutionary novelties.

Comedy, on the other hand, fared better, as indeed it had always fared. Philippe Franqois Nazaire Fabre d'Eglantine (1755–94), the companion in death of Georges Jacques Danton, Jean Franqois Collin d'Harleville (1755–1806), Franqois G. J. S. Andrieux (1759–1833), Louis Benoît Picard, Alexandre Duval and Népomucène Lemercier (1771–1840) (the most vigorous of all as a poet and a critic of mark) were the comic authors of the period. Perhaps the most remarkable work in point of originality of the time was Xavier de Maistre's (1763–1852) Voyage *autour* de *ma chambre*, an attempt in quite a new style, which was happily followed up by other writers.

The chief philosophical writers were Pierre Paul Royer Collard (1763–1845), F. P. G. Maine de Biran (1776–1824) and Théodore Simon Jouffroy (1796–1842). Their influence on literature, however, was altogether inferior to that of the conservative school, of whom Louis Gabriel, vicomte de Bonald (1754–1840), and Joseph de Maistre (1754–1821) were the great leaders. As Bonald is royalist and aristocratic, so Maistre is the advocate of a theocracy pure and simple, with the pope for its earthly head and a vigorous despotism for its system of government. Joseph Joubert (1754–1824) is the most illustrious successor of Pascal and Vauvenargues, certainly above Vauvenargues in breadth and depth of thought. In pure literary criticism more particularly, Joubert, though exhibiting some inconsistencies because of his time. is astonishingly penetrating and suggestive. Étienne Pivert de Sénancour (1770–1846), with Obermann (1804). had an extraordinary influence on his own and the next generation in the direction of melancholy moralizing.

We have already alluded to some of the beginnings of periodical and journalistic letters in France. For some time, in the hands of Pierre Bayle, Jacques Basnage, P. des Maizeaux and Pierre Jurieu, periodical literature consisted mainly of a series, more or less disconnected, of pamphlets, with occasional extracts from forthcoming works, critical *adversaria* and the like. Of a more regular kind were the often-mentioned Journal *de Trévoux* and *Mercure* de France, and later the *Année littéraire* of Louis Marie Stanislas Fréron and the like. The Correspondance of Grimm also, as has been pointed out, bore considerable resemblance to a modern monthly review, though it was addressed to a very few persons. Of political news there was, under a despotism, naturally very little. The year 1789, however, saw a vast change in this respect. An enormous efflorescence of periodical literature at once took place and a few of the numerous journals founded in that year or soon afterward survived for a considerable time.

A whole class of authors arose who pretended to be nothing more than journalists, while many writers distinguished for more solid contributions to literature took part in the movement, and not a few active politicians contributed. Thus to the original staff of the *Moniteur,* or, as it was at first called, La Gazette nationale, La Harpe, Jean Charles Dominique de Lacretelle, Franqois Guillaume Jean Stanislas Andrieux, Dominique Joseph Garat (1749–1833) and Pierre Ginguené (1748–1815) were attached. Among the writers of the *Journal* de Paris André Chénier had been ranked. Louis de Fontanes contributed to many royalist and moderate journals. Franqois Pierre Guillaume Guizot and André Morellet, representatives, respectively, of the 19th and the 18th century, shared in the *Nouvelles politiques,* while Louis Franqois Bertin, Joseph Fievée and Julien Louis Geoffroy (1743–1814), a critic of peculiar acerbity, contributed to the Journal de *l'empire,* afterward turned into the famous Journal des de'bats. With Geoffroy, François Benoît Hoffman (1760–1828), Franqois Joseph Dussault (1769–1824) and Charles Marie Dorimond, abbé de Féletz (1765–1850), constituted a quartet of critics sometimes spoken of as "the *Débats* four," though they were by no means all friends. Of active politicians Jean Paul Marat (*L'Ami* du *peuple*), Honor6 Gabriel Riqueti, comte de Mirabeau (Courrier de Provence), Bertrand Barère de Vieuzac (Le Point *dü* jour), Jacques Pierre Brissot (Patriote *français*), Jacques René Hébert (*Père* Duchesne), Maximilien Franqois Marie Isidore de Robespierre (*Défenseur* de la constitution) and Jean Lambert Tallien (La Sentinelle) were the most remarkable who had an intimate connection with journalism. On the other hand, the type of the journalist pure and simple is Camille Desmoulins (1760–94), one of the most brilliant, from a literary point of view, of the short-lived celebrities of the time. Of the same class were Charles Durozoir (1790–1844), Elisée Loustalot (1762–90) and Jacques Coretin Royou (1745–1828). As the immediate daily interest in politics drooped, there were formed periodicals of a partly political and partly literary character. Such had been the De'cade *philosophique,* which counted Pierre Jean Georges Cabani Chénier and Antoine Louis Claude Destutt, comte de Tracy, among its contributors, and this was followed by the Revue *française* at a later period, which was in its turn succeeded by the Revue des deux mondes. On the other hand, parliamentary eloquence was even more important than journalism during the early period of the Revolution. Mirabeau naturally stands at the head of orators of this class, and next to him may be ranked the well-known names of Pierre Victor Malouet among constitutionalists; of Robespierre, Marat and Danton, the triumvirs of the Mountain; of Jean Siffrein Maury, Jacques Antoine Marie de Cazalès and André Boniface Louis Riqueti, vicomte de Mirabeau, among the royalists; and above all of the Girondist speakers Antoine Pierre Joseph Marie Barnave, Pierre Victurnien Vergniaud and Jean Denis, comte Lanjuinais. The last-named survived to take part in the revival of parliamentary discussion after the Restoration. But the permanent contributions to French literature of this period of voluminous eloquence are, as frequently happens in such cases, by no means large.

The union of the journalist and the parliamentary spirit produced, however, in Paul Louis Courier a master of style. Courier spent the greater part of his life, tragically cut short, in translating the classics and studying the older writers of France, in which study he learned thoroughly to despise the pseudoclassicism of the 18th century. It was not till he was past 40 that he took to political writing, and the style of his pamphlets and their wonderful irony and vigour at once placed them on the level of the very best things of the kind. Benjamin Constant de Rebecque (1767–1830), though mainly a politician and an orator, lives in literature by his *Adolphe* (1815), a model of the analytical pseudo-biographical novel.

Madame de Staël (1766–1817) on the other hand, as became a daughter of Necker, retained a great deal of the Philosophe character and the traditions of the 18th century, especially its liberalism, its *sensibilitd* and its thirst for general information; to these, however, she added a cosmopolitan spirit and a readiness to introduce into France the literary and social, as well as the political and philosophical, peculiarities of other countries. Her early writings were of the critical kind, half aesthetic, half ethical, of which the 18th century had been fond and which their titles, *Lettres sur J. J. Rousseau, De l'influence des passions, De la littérature considérée dans ses rapports avec les institutions sociales,* sufficiently show. Her romances, *Delphine* and *Corinne,* had immense literary influence at the time. Still more was this the case with *De l'Allemagne,* which practically opened up to the rising generation in France the till then unknown quantities of literature and philosophy which during the most glorious half century of its literary history Germany had, sometimes on hints taken from France itself, been accumulating. The literary importance of François René, vicomte de Chateaubriand (1768–1848), is far greater, while his literary influence can hardly be exaggerated. Chateaubriand's literary father was Rousseau, and his voyage to America helped to develop the seeds which Rousseau had sown. In *René* and other works of the same kind, the nature worship of Rousseau received a still further development. But it was not in mere description that Chateaubriand was to find his most fertile and most successful theme. It was, on the contrary, in the rehabilitation of Christianity as an inspiring force in literature. This theme he develops with the most splendid language and with every conceivable advantage of style in the *Génie du Christianisme* and the *Martyrs.* His *Mémoires d'outre-tombe,* however, are his lasting masterpiece; in power of style, in psychological penetration and even occasionally in depth of thought they rank among the very best things in the French language.

THE 19TH CENTURY

The literary work of the 19th century and of the great romantic movement which began in its second quarter was to repeat on a far larger scale the work of the 16th, to break up and discard such literary forms as had become useless or hopelessly stiff, to give strength, suppleness and variety to such as were retained, to invent new ones where necessary, to enrich the language by importations, inventions and revivals and, above all, to bring into prominence the principle of individualism. Authors and even books, rather than groups and kinds, demand principal attention.

The result of this revolution is naturally most remarkable in the belles-lettres and the kindred department of history. Poetry, not dramatic, was revived; prose romance and literary criticism were brought to a perfection previously unknown; and history produced works more various and more remarkable than at any previous stage of the language.

Before the accession of Victor Hugo, three new writers were of remarkable eminence. These three were Pierre Jean de Béranger (1780–1857), Alphonse de Lamartine (1790–1869) and Hugues Félicité Robert de Lamennais (1782–1854). The first belongs definitely in manner, despite his striking originality of nuance, to the past. He has remnants of the old periphrases, the cumbrous mythological allusions, the poetical "properties" of French verse. His astonishing popularity makes it necessary to mention him, but very little of value remains of his work. Béranger's talent was still too much a matter of individual genius to have great literary influence, and he formed no school. It was different with Lamartine, who was, nevertheless, like Béranger, a typical Frenchman. The *Me'ditations* and the *Harmonies* exhibit a remarkable transition between the old school and the new. In going directly to nature, in borrowing from her striking outlines, vivid and contrasted tints, harmony and variety of sound, the new poet showed himself an innovator of the best class. In using romantic and religious associations and expressing them in affecting language, he was the Chateaubriand of verse. But with all this he retained some of the vices of the classical school. His versification, harmonious as it is, is monotonous, and he does not venture into the bold lyrical forms which true poetry loves. He has still the horror of the *mot propre;* he is always spiritualizing and idealizing, and his style and thought have a double portion of the feminine and almost flaccid softness which had come to pass for grace in French.

The last of the trio, Lamennais, represents an altogether bolder and rougher genius. Strongly influenced by the Catholic reaction, Lamennais also shows the strongest possible influence of the revolutionary spirit. His earliest work, the *Essai sur l'indifférence en matière de religion* (1817 and 1818) was a defense of the church on curiously unecclesiastical lines. It was written in an ardent style, full of illustrations and extremely ambitious in character.

In Lamennais's prose, especially as afterward developed in the apocalyptic *Paroles d'un croyant* (1839), are to be discerned many of the tendencies of the romantic school, particularly its hardy and picturesque choice of language and the disdain of established and accepted methods which it professed. The signs of the Revolution itself were, as was natural, first given in periodical literature. The feudalist affectations of Chateaubriand and the legitimists excited a sort of aesthetic affection for Gothicism, and Walter Scott became one of the favourite authors in France Soon was started the periodical *La Muse française,* in which the names of Hugo, Vigny, Deschamps and Madame de Girardin appear. Almost all the writers in this periodical were eager royalists, and for some time the battle was still fought on political grounds. There could, however, be no special connection between classical drama and liberalism; and the liberal journal, the *Globe* with no less a person than Sainte-Beuve among its contributors, declared definite war against classicism in the drama. The chief "classical" organs were the *Constitutionnel,* the *Journal des de'bats* and, after a time and not exclusively, the *Revue des deux mondes.* Soon the question became purely literary, and the romantic school proper was born in the famous *cénacle* or clique in which Hugo was chief poet, Sainte-Beuve chief critic and Gautier, Gérard de Nerval, the brothers Émile (1791–1871) and Antony (1800–69) Deschamps, Petrus Borel (1809–59) and others were officers. Alfred de Vigny and Alfred de Musset stand somewhat apart, and so does Charles Nodier (1780–1844), a versatile and voluminous writer, the very variety and number of whose works have somewhat prevented the individual excellence of any of them from having justice done to it. The objects of the school were, briefly stated, the burning of everything which had been adored and the adoring of everything which had been burned. They would have no unities. no arbitrary selection of subjects, no restraints on variety of versification, no academically limited vocabulary, no considerations of artificial beauty and, above all, no periphrastic expression. The *mot propre*, the calling of a spade a spade, was the great commandment of romanticism; but it must be allowed that what was taken away in periphrase was made up in adjectives. The performance of *Hernani* in 1830 was the culmination of the struggle, and during a great part of the reign of Louis Philippe almost all the younger men of letters in France were romantics. The performance of the *Lucrèce* of François Ponsard (1814–67) in 1843 is often quoted as the herald or sign of a classical reaction.

Romantic Drama and Poetry. — Although the immediate subject on which the battles of classics and romantics arose was dramatic poetry, the dramatic results of the movement have not been those of greatest value or most permanent character. The principal effect in the long run has been the introduction of a species of play called *drame,* as opposed to regular comedy and tragedy, admitting of much freer treatment than either of these two as previously understood in French and lending itself in some measure to the lengthy and disjointed action, the multiplicity of personages and the absence of stock characters which characterized the English stage in its palmy days. All Victor Hugo's dramatic works are of this class, and each, as it was produced or published *(Cromwell, Hernani, Marion Delorme, Le Roi s'amuse, Lucrèce Borgia, Marie Tudor, Ruy Blas* and *Les Burgraves),* was a literary event and excited the most violent discussion — the author's usual plan being to prefix a prose preface of a very militant character to his work. A still more melodramatic variety of *drame* was that chiefly represented by Alexandre Dumas (1802–70), whose *Henri III* and *Antony,* to which may be added later *La Tour de Nesle* and *Mademoiselle de Belleisle,* were almost as much rallying points for the early romantics as the dramas of Hugo, despite their inferior literary value. Alfred de Vigny's *Chatterton* is perhaps the best single drama produced by the romantic movement.

A special variety of drama of some literary importance was also cultivated under the title of *sc*è*nes* or *proverbes,* slight dramatic sketches in which the dialogue and style are of even more importance than the action. The best of all of these are those of Alfred de Musset (1810–57), whose *Il faut qu'une porte soit ouverte ou fermée, On ne badine pas avec l'amour,* etc., are models of grace and wit.

In poetry proper, as in drama, Victor Hugo showed the way. In him all the romantic characteristics were expressed and embodied — disregard of arbitrary critical rules, free choice of subject, variety and vigour of metre, splendour and sonorousness of diction, abundant "local colour" and that irrepressible individualism which is one of the chief, though not perhaps the chief, of the symptoms. A deficient sense of the ludicrous which characterized many of the romantics was strongly apparent in their leader, as was also an equally representative grandiosity and a fondness for the introduction of foreign and unfamiliar words. especially proper names, which occasionally produces an effect of burlesque. Victor Hugo's earliest poetical works, his chiefly royalist and political *Odes,* were cast in the older and accepted forms, but already displayed astonishing poetical qualities. But it was in the *ballades* (*e.g.,* the splendid *Pas d'armes du roi Jean,* written in verses of three syllables) and the *orientales* (of which may be taken for a sample the sixth section of *Navarin,* a perfect torrent of outlandish terms poured forth in the most admirable verse, or *Les Djinns,* where some of the stanzas have lines of two syllables each) that the grand provocation was thrown to the believers in alexandrines, careful caesuras and strictly separated couplets. *Les Feuilles d'automne, Les Chants du crépuscule, Les Voix intérieures, Les Rayons et les ombres,* the productions of the next 20 years, were quieter in style and tone but no less full of poetical spirit. The revolution of 1848, the establishment of the empire and the poet's exile brought about a fresh concentration of his genius on lyrical subjects. *Les Châtiments* and *La Légende des siècles,* the one political, the other historical, reach perhaps the high-water mark of French verse; and they were accompanied by the philosophical poems *Dieu, La Fin de Satan* and by *Les Contemplations,* and followed by the lighter *Chansons des rues et des bois,* the *Année terrible,* the second *Le'gende des siècles,* etc. The literary productiveness of Victor Hugo himself has been the measure and sample of the whole literary productiveness of France on the poetical side. At 25 he was acknowledged as a master, at 75 he was a master still. He is the one single universal literary genius whom France can recognize as its representative, and to be set in world literature on the level of Dante, Cervantes, Shakespeare and Goethe. By his highest achievements, in such poems as *Dieu* and *La Fin de Satan,* he takes his place among the religious prophets of mankind.

Hugo's poetical influence has been represented in different schools, from which very few of the poetical writers of the century can be excluded. Alfred de Musset, a writer of great talent, felt part of the romantic inspiration very strongly, but was on the whole unfortunately influenced by Byron, and partly out of wilfulness, partly from a natural want of persevering industry and vigour, allowed himself to be careless and even slovenly in composition. Notwithstanding this, some of his lyrics are among the finest poems in the language, and his verse, careless as it is, has extraordinary natural grace. Auguste Barbier (1805–82), whose *Iambes* shows an extraordinary command of nervous and masculine versification, also comes in here. Alfred de Vigny (1799–1865) is a great poet of little bulk and somewhat over-fastidious, but possessing one of the strongest styles to be found in French with a curious restrained passion and a complicated originality, rising to the greater heights of philosophical poetry. Madame hckermann (1813–90) is the philosophical poetess of the romantic period; but for actual poetical powers, Marceline Desbordes-Valmore (1786–1859) perhaps excelled her, though in a looser and more sentimental fashion. Théophile Gautier (1811–72) is one of the best poets in point of form that France has produced. The *Comédie de la mort,* the *Poésies diverses* and still more the *Emaux et camées* display a distinctly classical tendency — classical, that is to say, not in the party and perverted sense, but in its true acceptation. The tendency to the fantastic and horrible may be taken as best shown by Petrus Borel (1809–59), a writer of singular power almost entirely wasted. Gérard de Nerval (Labrunie) (1808–55) adopted a manner also fantastic but more idealistic than Borel's and distinguished himself by his oriental travels and studies and by his attention to popular ballads and traditions; and his style has an exquisite but unaffected strangeness hardly inferior to Gautier's. Théodore de Banville (1823–91), adopting the principles of Gautier and combining with them a considerable satiric faculty, composed a large amount of verse, faultless in form, delicate and exquisite in shades and colours but so entirely neutral in moral and political tone that it has found fewer admirers than it deserved. Charles Marie René Leconte de Lisle (1818–94) (*Poèmes antiques, Poèmes barbares, Poèmes tragiques*), carrying out the principle of ransacking foreign literature for subjects, went to Celtic, classical or even oriental sources for his inspiration, and despite a science in verse not much inferior to Banville's, and a far wider range and choice of subject, diffused an air of erudition, not to say pedantry, over his work which tried some readers and a pessimism which displeased others, but has left poetry inferior only to that of the greatest of his countrymen. Charles Baudelaire (1821–67) in *Les Fleurs du mal* gives the first poems in which the "modern" note is struck. His influence on the 20th century was greater than Victor Hugo's, and perhaps even than that of Mallarmé. He revealed the inner beauty of things — and feelings — until then accounted ugly or sinful. His verse often reaches unprecedented felicity of vocabulary and rhythm, but unfortunately never stays for very long at its highest. Hugo, whom he revered, aptly and generously described him as having discovered a *frisson nouveau.* Many critics see in him the greatest and the most human of all French poets. Ohe cannot judiciously go so far, but he is undoubtedly one of the finest.

Postromantic Poetry. — In 1866 a collection of poems, entitled after an old French fashion *Le Parnasse contemporain,* appeared. It included contributions by some of the poets just mentioned, but the mass of the contributors were previously unknown to fame. A similar collection appeared in 1869 and was interrupted by the German war but continued after it, and a third in 1876.

The first *Parnasse* had been projected by Xavier de Ricard (1843–1911) and Abraham Catulle Mendès (1841–1909) as a sort of manifesto of a school of young poets; but its contents were largely coloured by the inclusion among them of work by representatives of older generations — Gautier, Laprade, Leconte de Lisle, Banville, Baudelaire and others. The continuation, however, of the title in the later issues, rather than anything else, led to the formation and promulgation of the idea of a *Parnassien* or an *Impassible* school nhich was supposed to adopt as its watchword the motto of "Art for art's sake," to pay especial attention to form and also to aim at a certain objectivity. As a matter of fact the greater poets and the greater poems of the *Parnasse* admit of no such restrictive labelling, which can be regarded only as mischievous, though (or very mainly because) it has been continued. Another school, arising mainly in the later '80s and calling itself that of symbolism, has been supposed to indicate a reaction against Parnassianism and even against the main romantic tradition generally, with a throwing back to Lamartine and perhaps Chénier. This idea of successive schools (decadents, naturists, etc.) has even been reduced to such an *absurdum* as the statement that "France sees a new school of poetry every 15 years." Those who have studied literature sufficiently widely, and from a sufficient elevation. know that these systematizings are alnays more or less delusive. Parnassianism. symbolism and the other things are merely phases of the romantic movement itself—as may be proved to demonstration by the simple process of taking, say, Hugo and Verlaine on the one hand, Delille or Escouchard Lebrun on the other, and comparing the two first mentioned with each other·and with the older poet. The differences in the first case will be found to be differences at most of individuality, in the other of kind.

We shall not try to list the so-called schools but simply give the names and mention the chief works of the important poets of the period. Among the most remarkable were Sully Prudhomme (1839–1907), François Coppée (1842–1908) and Paul Verlaine (1844–96). The first *(Stances et poèmes,* 1865; *Vaines tendresses,* 1875; *Bonheur,* 1888; etc.) is a philosophical and rather pessimistic poet, the second *(La Grève des forgerons,* 1869; *Les Humbles,* 1872; *Contes et vers,* 1881–87; etc.) a dealer with more generally popular subjects in a more sentimental manner and the third *(Sagesse,* 1881; *Parallèlement,* 1889; *Poèmes saturniens,* including early work, 1867–90), by far the most original and remarkable poet of the three. starting with Baudelaire and pushing further the fancy for forbidden subjects, but treating both these and others with wonderful command of sound and image suggestion. Verlaine in fact (he was actually well acquainted with English) endeavoured and to a small extent succeeded in the endeavour to communicate to French the vague suggestion of visual and audible appeal which has characterized English poetry from Blake and Coleridge onward.

Arthur Rimbaud (1854–91), an extraordinary personality who gave up writing before he was 20, must be mentioned for his influence, which ranks with that of Baudelaire and Verlaine. His *Le Bateau ivre* is a short masterpiece. Stéphane Mallarmé (1842–98), afterward chief of the symbolists, was a great poet in his way, though somewhat barren. His technique and his ideals dominated the best in all later poetry not only in France, but all over the world, down to Paul Valéry and T. S. Eliot. This movement, started by Baudelaire, Rimbaud and Mallarmé, was helped later by the influence of three peculiar writers, all of whom suffered from bad health and died young. Isidore Ducasse, nho adopted the title of comte de Lautréamort, died at 24 in 1870 and his *Chants de Maldoror* became famous only in the 20th century; Tristan Corbiere (1845–75) acquired a late reputation after 1890 with *Les Amours jaunes;* Jules Laforgue (1860–87) brought into the Symbolist movement a German metaphysical element. José Maria de Hérédia (1842–1905) was a very exquisite practitioner of the sonnet but with perhaps more art than matter in him. A. Villiers de l'Isle-Adam was another eccentric with but a spark of genius; Léon Dierx, after producing even less than Mallarmé, succeeded him as symbolist chief.

Yet another flight of poets may be grouped as specially representing the last quarter of the century and (whether Parnassian, symbolist or what not) the latest development of French poetry. Verlaine and Mallarmé were in a manner the leaders of these. The whole tendency of the period was to relax the stringency of French prosody. Albert Samain (1859- goo), a musical versifier; Jean Moréas (Papadiamantopoulos) (1856–1910), who began with a volume called *Les Syrtes* in 1884; Laurent Tailhade (1854–1919) and others are more or less symbolist, and contributed to the symbolist periodical (one of many such since the beginning of the romantic movement which would almost require an article to themselves), the *Mercure de France.* Jean Richepin (1849–1926) harked back somewhat to the type of early romanticism—*La Chanson des gueux, Les Blasphèmes,* etc. Edmond Rostand brilliantly revived the romantic drama in verse in *Cyrano de Bergerac* (1897) and other plays. Henri de Régnier (1864–1936) received very high praise for work in *Lendemains* (1886) and other volumes such as *Les Jeux rustiques et divins* (1897) and *Les Médailles d'argile* (1900). His later writings cover a larger field.

Fiction After 1830.—The novel during this period took two different directions—the first that of the novel of incident, the second that of analysis and character. The first was that which, as was natural when Scott was the model, was formerly most trodden; the second. because of the genius of George Sand, of Balzac and of Stendhal, became predominant. The novels of Victor Hugo are novels of incident, with a strong infusion of purpose and considerable but rather ideal character drawing. They are in fact lengthy prose *drames* rather than romances proper, and they have found no imitators. They display. however, the powers of the master at their fullest. On the other hand, Alexandre Dumas originally composed his novels in close imitation of Scott, and they are much less dramatic than narrative in character. The best of them, such as *Les Trois mousquetaires, Vingt ans aprds, La Reine Margot,* are probably the best specimens extant of their kind. Of somewhat the same kind, but of a far lower stamp, are the novels of Eugène Sue (1804–57). Dumas and Sue were accompanied and followed by a vast crowd of companions, independent or imitative. Alfred de Vigny had already attempted the historical novel in *Cinq-Mars.*

By degrees, however, the taste for the novel of incident. at least of a historical kind, died out till it was revived in another form, and with an admixture of domestic interest, by Erckmann-Chatrian. The last and one of the most splendid instances of the old style was *Le Capitaine Fracasse,* which Théophile Gautier began early and finished late as a kind of *tour de force.* The last-named writer in his earlier days had modified the incident novel in many short tales, a kind of writing for which French has always been famous and in which Gautier's sketches are masterpieces. His only other long novel, *Mademoiselle de Maupin,* belongs rather to the class of analysis. With Gautier, as a writer whose literary characteristics excel even his purely tale-telling powers, may be classed Prosper Mérimée (1803–70), one of the most exquisite 19th-century masters of the language. Already, however, in 1830 the tide was setting strongly in favour of novels of contemporary life and manners.

The great master of the novel of character and manners as opposed to that of history and incident is Honoré de Balzac (1799–1850). With him George Sand and Stendhal must be studied. Henri Beyle (1798–1865), who wrote under the nom de plume of Stendhal, stands by himself. His chief books in the line of fiction are *La Chartreuse de Pavme* and *Le Rouge et le noir,* exceedingly powerful novels of the analytical kind, and he also composed a considerable number of critical and miscellaneous works. Of little influence at first (though he had great power over Mérimée), he exercised ever-increasing authority as a master of pessimistic analysis. Indeed much of his work was never published till toward the close of the century. George Sand (1804–76) began with books strongly tinged with the spirit of revolt against moral and social arrangements, and she sometimes diverged into very curious paths of pseudophilosophy, such as was popular in the second quarter of the century. At times, too, as in *Lucrezia Floriani* and some other works, she did not hesitate to draw largely on her own personal adventures and experiences. But later on she devoted herself rather to sketches of country life and manners and to novels involving bold if not very careful sketches of character and more or less dramatic situations. She was one of the most fertile of novelists, continuing to the end of her long life to pour forth fiction at the rate of many volumes a year. Of her different styles may be mentioned as fairly characteristic *Lélia, Lucrezia Florinni, Consuelo, La Mare au diable, La Petite Fadette, François le champi* and *Mademoiselle de la Quintinie.* In view of the shorter length of his life the productiveness of Balzac was almost more astonishing, especially if we consider that he left great stores of fragments and unfinished sketches. His early work was worse than unsuccessful, it was positively bad. After more than a score of unsuccessful attempts, *Les Chouans* at last made its mark, and for 20 years from that time the astonishing productions compoiing the so-called *Comédie humaine* were poured forth successively. The subtitles which Balzac imposed upon the different batches. *Scènes de la vie parisienne, de la vie de province, de la vie intime,* etc., show like the general title, a deliberate intention on the author's part to cover the whole ground of human, at least of French, life. Such an attempt could not succeed wholly; yet the amount of success attained is astonishing. Balzac has, however. with some justice been accused of creating the world which he described, and his personages, wonderful as is the accuracy and force with which many of the characteristics of humanity are exemplified in them, are sometimes not altogether human. Balzac stands as the foremost novelist of France, and in the opinion of many as the greatest of all novelists.

The so-called realist side of Balzac was developed (but, as he himself acknowledged, with a double dose of intermixed if somewhat transformed romanticism) by Gustave Flaubert (1821–SO), who showed culture, scholarship and a literary poaer over the language inferior to that of no writer of the century. No novelist of his generation attained a higher literary rank than Flaubert. *Madame Bovary* and *L'Éducation sentimentale* are studies of contemporary life; in *Salammbô* and *La Tentation de Saint Antoine* erudition and antiquarian knowledge furnish the subjects for the display of the highest literary skill. Eugéne Fromentin (1820–76), best known as a painter. wrote a novel, *Dominique,* which is highly appreciated by good judges.

The "naturalists" proper chiefly developed or seemed to develop one side of Balzac, but almost entirely abandoned his romantic element. They aimed first at exact and almost photographic delineation of the incidents of modern life and second at still more uncompromising nonsuppression of the essential features and functions of that life which are usually suppressed. This school may be represented in chief by four novelists (really three, as two of them nere brothers who wrote together till the rather early death of one of them), Émile Zola (1840–1903), Alphonse Daudet (1840–97) and Edmond (1822–97) and Jules (1830–70) de Goncourt. The first. of Italian extraction and Marseillais birth, began with work of undecided kinds and was alnays a critic as well as a novelist. Of this first stage *Contes à Ninon* (1864) and *Thérèse Raquin* (1867) deserve to be specified. But after 1870 Zola entered upon a huge scheme (suggested no doubt by the *Comédie humaine*) of tracing the fortunes in every branch, legitimate and illegitimate, and in every rank of society of a family, *Les Rougon-Macquart,* and carried it out in a full score of novels during more than as many years. He followed this with a shorter series on places, *Paris, Rome, Lourdes,* and lastly by another of strangely apocalyptic tone. *Fécondité, Travail, Vérité,* the last a story of the Dreyfus case, retrospective and. as it proved, prophetic. Between Flaubert and Proust. Zola emerges (with only Anatole France as a possible competitor) as the most important and influential of French novelists. *L'Assommoir* (1877) and *Germinal* (188;) are generally considered his best novels. His pessimistic realism is tempered by a powerful sympathy for human suffering. moral as well as physical.

The Goncourts. besides their work in naturalist (they would have preferred to call it "impressionist") fiction, devoted themselves especially to study and collection in the fine arts and produced many volumes on the historical side of these, volumes distinguished by accurate and careful research. This quality they carried, and the elder of them after his brother's death continued to carry into novel writing (*Renée Mauperin, Germinie Lacerteux, Chérie,* etc.), nith the addition of an extraordinary care for peculiar and. as they called it, "personal" diction. On the other hand. Alphonse Daudet (who with the other three, Flaubert to some extent. and the Russian novelist Ivan Sergeyevich Turgenev formed a sort of *cénacle* or literary club) mixed with some naturalism a far greater amount of fancy and wit than his companions alloned themselves or could perhaps attain; and in the *Tartarin* series (dealing with the extravagances of his fellow Provençaux) added not a little to the gaiety of Europe. His other novels (*Fromont jeune et Risler aîné, Jack, Le Nabab,* etc.), also very popular, have been variously judged. there being something strangely like plagiarism in some of them. and in others in fact in most an excessive use of that privilege of the novelist which consists in introducing real persons more or less under disguise. It should be observed in speaking of this group that the Goncourts, or rather the survivor of them, left an elaborate *Journal* of much importance for the appreciation of the personal side of French literature during the last half of the century.

Barbey d'Aurevilly (1808–1889) with *L'Ensorcelée* and *Le Chevalier Destouches* has a place of his own and many passionate admirers. He is in his own way a master of fiction and a master of prose. The tales of Villiers de l'Isle-Adam (1838–89) also deserve to be at least mentioned. Léon Bloy (1846–1917) in *Le Désespéré* and *La Femme pauvre* reaches a violent and unequal but real kind of genius.

In 1880 Zola, who had by this time formed a regular school of disciples. issued with certain of them a collection of short stories, *Les Soire'es de Médan,* which contains one of his own best things. "L'Attaque du moulin," and also the capital story "Boule de suif" by Guy de Maupassant (1850–93), who in the same year published poems, *Des Vers,* of very remarkable if not strictly poetical quality. Maupassant developed great powers in a series of longer novels (*Une Vze, Bel-Ami, Pierre et Jean, Fort comme la mort*) and shorter stories (*Monsieur Parent, Les Soeurs Rondoli, Le Horla*), but they were distorted by pessimism. J. K. Huysmans (1848–1907), also a contributor to *Les Soirées de Médan,* who began a little earlier nith *Marthe* (1876) and other books, gave his most characteristic work in 1884 with *A Rebours* and in 1891 with *Ld-bas,* stories of exaggerated and "satanic" pose. Afterward, by an obvious reaction, he returned to Catholicism. Of about the same date as these two were two other novelists of note, Julien Viaud ("Pierre Loti") (1850–1923), a naval officer who embodied his experiences of foreign service with a faint dose of story and character interest. a far larger one of description and chiefly of lyrism in a series of books (*Aziyadé, Le Mariage de Loti, Madanze Chrysanthème,* etc.), and Paul Bourget (1852–1935), an important critic as well as novelist—*Crztelle Énigme* (1885), *Le Disciple, La Terre promise, Cosmopolis.* As a contrast or complement to Bourget's "psychological" novel may be taken the "ethical' novel of Edouard Rod (1857–1910)—*La Vie privée de Michel Teissier* (1893), *Le Sens de la vie, Les Trois coeurs.*

Contemporary nith these as a novelist, though a much older man and occupied at different times of his life with verse and with criticism, came Anatole France (1844–1924; real name Jacques Anatole Thibault), who in *Le Crime de Sylvestre Bonnard, La Rôtisserie de la reine Pédauque, Le Lys rouge, Les Dieux ont soif, La Révolte des anges* and others made a kind of novel as different from the ordinary styles as Pierre Loti's, and of the highest appeal in its wit, its subtle fancy and its perfect French. Maurice Barrès (1862–1923), famous already in the 19th century (*Le Jardin de Bérénice*), like Anatole France, wrote his masterpieces in the 20th *La Colline enspirée* (1913) and *Un jardin sur l'Oronte* (1922).

Periodical Literature After **1830:** Criticism.—One of the causes which led to this extensive composition of novels was the great spread of periodical literature in France and the custom of including in almost all periodicals, daily, weekly or monthly, a *feuilleton* or instalment of fiction. Of the contributors to these periodicals who were strictly journalists and almost political journalists only, the most remarkable after Armand Carrel were his opponent in the fatal duel, Émile de Girardin, Lucien A. Prévost-Paradol (1829–70), Jean Hippolyte Cartier, called De Villemessant (1812–79), and, above all, Louis Veuillot (1815–83), the most violent and unscrupulous but by no means the least gifted of his class.

The same spread of periodical literature, together with the increasing interest in the literature of the past. led also to a very great development of criticism, and the most distinguished of the critics was Charles Augustin Sainte-Beuve (1804–69). Sainte-Beuve's first distinguished work (his poems and novels we may leave out of consideration) was the sketch of 16th-century literature which he contributed to the *Globe.* But it was not till later that his style of criticism became fully developed and accentuated. During the first decade of Louis Philippe's reign his critical papers, united under the title of *Critiques et portraits littéraires,* show a gradual advance. During the next ten years he was mainly occupied with his studies of the writers of the Port Royal school. His *Histoire de Port Royal* is considered by a large public as Sainte-Beuve's main title to fame. But it was during the last 20 years of his life, when the famous *Causeries du lundi* appeared weekly in the columns of the *Constitutionnel* and the *Moniteur,* that his most remarkable productions came out. Sainte-Beuve's style of criticism (which is the key to so much of French literature of the last half of the 19th century that it is necessary to dwell on it at some length), excellent and valuable as it is, lent itself to two corruptions. There is, in the first place, in making the careful investigations into the character and circumstances of each writer which it demands, a danger of paying too much attention to the man and too little to his work, and of substituting for a critical study a mere collection of personal anecdotes and traits, especially if the author dealt with belongs to a foreign country or a past age. The other danger is that of connecting the genius and character of particular authors too much with their conditions and circumstances, so as to regard them as merely so many products of the age.

These faults, and especially the latter, were very noticeable in many of Sainte-Beuve's successors, particularly perhaps in Hippolyte Taine (1828–93), who, however, besides his work on English literature, did much of importance on French, and has been regarded as the first critic who did thorough honour to Balzac in his own country. Beginning with philosophical studies, and always maintaining a strong tincture of philosophical determinism. he applied himself later, first to literary history and criticism in his famous *Histoire de la litte'rature anglaise* (1864), and then to history proper in his still more famous *Origines de la France contemporaine* (1876).

Edmond Scherer (181j–89) and Paul de Saint-Victor (1827–1881) represent different sides of Sainte-Beuve's style in literary criticism, Scherer combining with it a martinet and somewhat prudish precision, while Saint-Victor, with great powers of appreciation, is the most flowery and "prose-poetical" of French critics. In theatrical criticism Francisque Sarcey (1827–99), an acute but somewhat severe and limited judge, succeeded to the good-natured sovereignty of Jules Gabriel Janin. The criticism of the *Revue des deux mondes* played a sufficiently important part in French literature to deserve separate notice in passing. Founded in 1829, the *Revue,* after some vicissitudes, soon attained, under the direction of François Buloz, the character of being one of the first of European critical periodicals. Its style of criticism, on the whole, inclined rather to the classical side; *i.e.,* to classicism as modified by, and possibly after, the romantic movement. Besides some of the authors already named, its principal critical contributors were Gustave Planche (1808–57), an acute but somewhat truculent critic, Saint-René Taillandier (1817–79) and Émile Montégut (182 5–95).

Not only did the critical work in various ways of Renan, Taine, Sarcey and others continue during the latter part of the century, but a new generation, hardly in this case inferior to the old, appeared. The chiefs of this were Anatole France, fimile Faguet (1847–1916), Ferdinand Brunetiiire (1849–1906) and Jules Lemaître (1853–1914). The last, however, though a brilliant writer, was but an "interim" critic, beginning with poetry and other matters, and after a time turning to yet others, while, brilliant as he was, his criticism was often ill-formed. So too Anatole France, after compiling four volumes of *La Vie littéraire* in his own inimitable style and with singular felicity of appreciation, also turned away.

Philosophy and History: 1830–90.—In philosophy proper France has been more remarkable for attention to the historical side of the matter than for the production of new systems; and the principal exception among French philosophical writers, Auguste Comte (1793–1857), besides inclining, as far as his matter went, to the political and scientific rather than to the purely philosophical side (which indeed he regarded as antiquated), was not very remarkable merely as a man of letters. Victor Cousin (1792–1867), on the other hand, almost a brilliant man of letters and for a time regarded as something of a philosophical apostle preaching "eclecticism," betook himself to biographical and other miscellaneous writings. Similar phenomena, not so much of inconstancy to philosophy as of a tendency toward the applied rather than the pure branches of the subject, are noticeable in Edgar Quinet (1803–75), in Charles de Rémusat (1797–1875) and in Ernest Renan (1823–92), the first of whom began by translating Herder while the second and third devoted themselves early to scholastic philosophy, De Rémusat dealing with Abélard (1845) and Anselm (1856), Renan with Averroes (1852). Renan is one of the greatest of prose writers of all time, for purity, elegance and fluidity. Outside his historical work, his *Souvenirs* and his *Drames* and *Dialogues philosophiques* are imperishable masterpieces. His original ideas are best expressed in *L'Avenir de la science.* More single-minded devotion to at least the historical side was shown by Jean Philibert Damiron (1794–1862), who published in 1842 a *Cours de philosophie* and many minor works at different times; but the inconstancy recurs in Jules Simon (1814–96), who, in the earlier part of his life a professor of philosophy and a writer of authority on the Greek philosophers (especially in *Histoire de l'école d'Alexandrie,* 1844–45), began before long to take an active and, toward the close of his life work, all but a foremost part in politics.

Political philosophy and its kindred sciences naturally received a large share of attention. Toward the middle of the century there was a great development of socialist and fanciful theorizing on politics, with which the names of Claude Henri, comte de Saint-Simon (1760–1825), Charles Fourier (1772–1837), fitlenne Cabet (1788–1856) and others are connected. As political economists Frédéric Bastiat (1801–50), L. G. L. Guilhaud de Lavergne (1809–So), Louis Auguste Blanqui (1805–81) and Michel Chevalier (1806–79) may be noticed. In Alexis de Tocqueville (1805–59) France produced a political observer of a remarkably acute, moderate and reflective character.

The brothers Thierry devoted themselves to early French history, Amédée Thierry (1797–1873) producing a *Histoire des Gaulois* and other works concerning the Roman period, and Augustin Thierry (1795–1856) the well-known history of the Norman conquest, the equally attractive *Récits des temps mérovingiens* and other excellent works. Philippe de Ségur (1780–1873) wrote a history of the Russian campaign of Napoleon and some other works chiefly dealing with Russian history. The voluminous *Histoire de France* of Henri Martin (1810–83) is an impartial work dealing in detail with the whole subject. A. G. P. Brugiiire, baron de Barante (1782–1866), after beginning with literary criticism, turned to history and in his *Histoire des ducs de Bourgogne* produced a work of capital importance. As was to be expected, many of the most brilliant results of this devotion to historical subjects consisted of works dealing with the French Revolution. No series of historical events has ever perhaps received treatment at the same time from so many different points of view and by writers of such varied literary excellence. among whom it must, however, be said that the purely royalist side is hardly at all represented. One of the earliest of these histories is that of François Mignet (1796–1884), a sober and judicious historian of the older school, also well known for his *Histoire de Marie Stuart.*

About the same time was begun the brilliant if not extremely trustworthy work of Adolphe Thiers (1797–1877) on the Revolution, which established the literary reputation of the future president of the French republic and was at a later period completed by the *Histoire du consulat et de l'empire.* The passing of the July monarchy and the early years of the empire witnessed the publication of several works of the first importance on this subject. Barante contributed histories of the Convention and the Directory, but the three books of greatest note were those of Lamartine, Jules Michelet (1798–1874) and Louis Blanc (1811–82). Lamartine's *Histoire des Girondins* is written from the constitutional-republican point of view and is sometimes considered to have had much influence in producing the events of 1848. It is, perhaps, rather the work of an orator and poet than of a historian. The work of Michelet is of a more original character. Besides his history of the Revolution, Michelet wrote an extended history of France, and a very large number of smaller works on historical, political and social subjects. His imaginative powers are of the highest order, and his style stands alone in French for its strangely broken and picturesque character. its turbid abundance of striking images and its somewhat sombre magnificence, qualities which, as may easily be supposed, found full occupation in a history of the Revolution. Edgar Quinet (1803–75), like Louis Blanc a devotee of the republic and an exile for its sake, brought to this subject a mind and pen long trained to literary and historical studies; but *La Révolution* is not considered his best work. And Taine, after distinguishing himself, as has been mentioned, in literary criticism, and attaining less success in philosophy *(De l'intelligence).* turned in *Les Origines de la France moderne* to an elaborate discussion of the Revolution, its causes. character and consequences. Franqois Pierre Guillaume Guizot (1787–1874), like his rival Thiers, devoted himself much to historical study. His earliest works were literary and linguistic, but he soon turned to political history, and for the last half century of his long life his contributions to historical literature were almost incessant and of the most various character. The most important are the histories *Des Origznes du gouvernement représentatif, De la révolutzon d'Angleterre, De la civilisation en France* and a *Histoire de France,* which he was writing at the time of his death.

In the last quarter of the century, under the department of history. the most remarkable names were still those of Taine and Renan. Indeed it may be here proper to remark that Renan, in the kind of elaborated semipoetic style which most characterized the prose of the 19th century in all countries of Europe, takes preeminence among French writers even in the estimation of critics who are not enamoured of his substance and tone. The chief work of his life is the *Histoire des origines du Christianisme,* which includes the celebrated *Vie de Jésus.* But. under the influence of Taine to some extent and of a general European tendency still more. France during this period attained or recovered a considerable place for what is called "scientific" history—the history which while, in some cases. though not in all, not neglecting the development of style attaches itself particularly to "the document," on the one hand, and to philosophical arrangement on the other. The chief representatives of the school were probably Albert Sorel (1842–1906) and Fustel de Coulanges (1830–89) *(La* Cite' *antique, Histoire des institutions de l'ancienne France).*

(D. S.; X.)

THE 20TH CENTURY

The first half of the 20th century was a period of considerable production and immense diversity. Schools and movements followed each other in rapid succession, but none of them changed the whole course of literature, as Romanticism had done roo years earlier. Surrealism and existentialism, the two most important, represented attitudes to life rather than a conception of literature. Literary groupings were replaced to an increasing extent by philosophical or political affiliations, but personal convictions often counted for more than formal attachments to any school of thought. The term "existentialist," for instance, could be applied to different persons holding the most divergent views, and the many Catholic writers prominent throughout the period varied considerably in outlook.

During the early years of the century, no significant tendency prevailed, except a fairly general reaction against naturalism. The influence of symbolism was felt for some time, chiefly in poetry and drama, but also in fiction. Paul Bourget, Anatole France and Pierre Loti remained in high esteem, but declined in reputation from the 1920s onward, perhaps too sharply. Maurice Barrbs, however, continued to attract many followers, in right-wing circles particularly. It seemed characteristic of the age to turn to certain writers for leadership, and various authors in turn established an ascendancy in different sections of opinion. Charles Maurras dominated right-wing nationalism for many years; Henri Bergson, in an entirely opposite direction, helped to create the philosophic atmosphere in which many writers grew up. Alain (Émile Chartier; 1868–1951) was a humanist, essayist and moralist who exercised a remarkable hold over several generations of Frenchmen. Charles Péguy, killed in action in 1914, was later to become a symbol of the integrity and vision which had characterized his life and writings; Antoine de Saint-Exupéry, who lost his life in an air mission in 1944, was another writer whose spiritual influence grew with the years. André Gide, André Malraux and Jean Paul Sartre all left a considerable mark on the outlook of their contemporaries.

The intellectual curiosity of the age was reflected in many branches of literature. One sign of this activity was the starting of an unparalleled number of periodicals, expressing every shade of opinion. Péguy founded the first of these reviews with his famous *Cahiers de la Quinzaine* (1900–14), in which he waged a ceaseless battle against materialism, corruption and injustice, opening his columns to various authors then unknown. The *Nouvelle Revue Française,* in which much of the new writing of the century was to appear, was founded by Gide, with Jean Schlumberger and Jacques Copeau, in 1909; two gifted editors, Jacques Rivière and Jean Paulhan, were in charge of it from 1919 to 1925 and from 192j to 1940 respectively.

French literature in the 50 years from 1900 tended more and more to reflect the problems and uncertainties of the time. Men of letters took an increasing part in public affairs and in the discussion of conflicting ideologies.

Fiction.—The range of the novel was constantly being extended, but many of its characteristics were developments of earlier tendencies rather than complete innovations.

Few authors limited themselves to fiction alone: Jean Giraudoux and Henry de Montherlant gained a second reputation in the theatre when already well-known as novelists. Autobiographical works of various kinds, including, in some cases, extensive collections of correspondence, throw considerable light on the authors concerned. The *Cahiers* of Maurice Barrbs, the *Journal* of Gide and those of Jules Renard; of Franqois Mauriac and of Julien Green are particularly noteworthy.

Biographies and works of criticism were produced by many novelists. The generous ideals and lofty internationalism of Romain Rolland (1866–1944) found expression in his lives of Tolstoy, Gandhi, Péguy, etc., and especially in his major work, *Beethoven: les grandes époques cre'atrices* (7 vol., 1927–46). These uritings complement his masterpiece in fiction, *Jean Christophe,* a novel-cycle of a composer of genius (published in Péguy's *Cahiers,* 1904–12). Many other works could be cited which help to illustrate the attitude of the novelists in question—for instance Marcel Proust's translations of John Ruskin, Gide's *Dostoïevski,* Mauriac's biographies of Racine and St. Margaret of Cortona, etc.

For some time, vast novel-cycles were in favour. Marcel Proust (1871–1922) wrote the finest of these, *A la recherche du temps perdu* (1913–28). He created a world of unforgettable characters, but gave considerable emphasis to the portrayal of anomalies in human nature. A merciless exposure of fashionable society, it is the work of a poet with an acute sense of comedy. Increasingly an invalid, Proust sought to recapture his youthful happiness before it vanished from his mind. He made time present and time remembered appear simultaneous, elaborating these themes with an infinity of parenthesis and a beauty of cadence which make his style unique. *Jean Santeuil,* an earlier draft of this work, discovered long after Proust's death, was published in 1952; a series of critical essays, entitled *Contre Sainte-Beuve,* appeared in 1954. Both these works aroused considerable interest.

Georges Duhamel (1884–) served as an army doctor in World War I. In *La Vie des martyrs* (1917) and *Civilisation* (1922) he stressed the suffering and futility of war. He will also be remembered for his Salavin chronicles (1920–32) and for the *Chronique des Pasquier* (1933–44). He does not resort to easy optimism, but regards humanity with sympathy and understanding. Roger Martin du Gard (1881–) wrote an excellent novel, *Jean Barois* (1913) on the effects of the Dreyfus case. His clear-sighted, dispassionate observation is also apparent in *Les Thibault* (1922–40), a family cycle reflecting the social history of France from the later decades of the 19th century up to World War I.

Jules Romains (Louis Farigoule; 1885–), a novelist of considerable descriptive power, based much of his writing on the theory of "unanimism," the idea that one unifying principle may be found in all human activities. His panorama, Les *Hommes* de bonne *volonté* (1932–47), ranges over many aspects of life in France between 1908 and 1933. Novel-cycles were also written by René Behaine, Paul Vialar and Henri Troyat, the last-named giving a picture of revolutionary Russia from 1888 onward. The "proletarian" novel, militantly left-wing in character, was represented by Charles Plisnier and Louis Aragon; Jean Richard Bloch wrote Et *Cie* (1913), a powerful Jewish story; Louis-Ferdinand Céline, author of Voyage au bout de la *nuit* (1932), went on to develop vehemently anti-Semitic opinions; Louis Guilloux foreshadowed existentialism in Le Sang noir (1935).

The lower levels of society were depicted by Charles Louis Philippe (1874–1909; La *Mère* et l'enjant, 1900; Marie *Donadieu,* 1904). Pierre Hamp, André Thérive, Léon Lemonnier, Eugène Dabit, Maxence Van der Meersch and Jean Prévost (1901–44) described industrial scenes or working-class conditions. Prévost was also an excellent literary critic. Philippe Hériat (Raymond-Gérard Payelle; 1898–) described French middle-class life (La Famille Boussardel, 1947). André Maurois (Émile Herzog; 1885–) wrote many kinds of fiction. essays and other miscellaneous works. His light-hearted sketches of British army life in World War I, followed by his lives of Shelley, Disraeli, etc., brought him considerable popularity. His more searching biographies of Proust, George Sand and Victor Hugo added greatly to his reputation.

André Chamson (1900–) showed himself to be a sincere, thoughtful writer with faith in the essential decency of human nature. He began as a regional novelist and widened his range to discuss many pressing topics of the day (*L'Année* des *vaincus,* 1934; La Neige et la *fleur,* 1951; etc.). C. F. Ramuz gave authentic descriptions of Vaud in Switzerland; Jean Giono admirably conveyed the atmosphere of Provence, but after World War II adopted a new style of writing (*Un* de Baumugnes, 1929; Regain, 1930; *Que* ma joie demeure, 1935; Le Hussard sur le *toit,* 1951).

Many authors made their own corner of France part of the literary scene: Alphonse de Chateaubriant (La *Brière,* 1923), Maurice Genevoix (Raboliot, 1927), Henri Bosco (Le *Mas* Thkotime, 1945), etc. Louis Hémon's Maria Chapdelaine (1916) is a moving story of French Canada. The restless cosmopolitanism of the 1920s was represented by Paul Morand; the brothers Jérôme and Jean Tharaud, writing in partnership, were skilled in descriptive travel-fiction. Lighthearted novels were rare, but Gabriel Chevallier's Clochemerle (1934) was a riotous skit on village politics. Other amusing writers were Pierre Mille in his colonial novels, Henri Duvernois in his descriptions of Paris, and Raymond Queneau in a number of books. The sardonic humour and the fantasy of Marcel Aymé (1902–) made him a highly individual observer of the social scene. He was successful both in novels and short stories (La Jument verte, 1933; Uranus, 1948; Le *Passe*-muraille, 1943). The revival of the short story was a feature of the period, with Marcel Arland, Jean Cassou, Elsa Triolet, "Vercors" (Jean Bruller), Pierre Courtade, Marc Blancpain and Jules Supervielle. Supervielle, Saint-Exupéry, Aymé and Maurois also wrote stories for children.

Colette (Sidonie-Gabrielle Colette; 1873–1954) stands preeminent among woman writers. Her novels, which inculcate no doctrine, are largely concerned with the pleasures and pains of love and the senses. She recalls her childhood in a countryside astir with life in its minutest forms, recorded with fidelity and affection in a rich and faultless prose (Chkri, 1920; La *Maison* de Claudine, 1922; Sido, 1928; *Duo,* 1934; etc.). Jean Giraudoux (1882–1944) also belonged to no literary school. He blended poetry, humour, fantasy and reality in a very personal style (Simon *le* pathktique, 1918; Siegfried et le Limousin, 1922).

Individual problems and emotional conflicts—traditional themes in French fiction—were much discussed. Highly personal issues were raised by André Gide (1869–1951). Impatient of constraints in life, he subjected his art to rigorous discipline, attaining a style of classical lucidity. From the 1920s onward, he was recognized as one of the leading figures of the century (Les *Nourritures* terrestres, 1897; La Porte dtroite, 1909; Les Faux-Monnayeurs, 1926). His influence was seen in Valery Larbaud (1881–1957; *Journal d'A. O.* Barnabooth, 1913) and in Jean Schlumberger (1877– ; Saint-Saturnin, 1931).

Analytical novels, in great variety, were written by Jacques Chardonne, Jacques de Lacretelle, Émile Henriot, Jean Cassou, Marcel Arland. Pierre Bost and Raymond Radiguet; and later by Hervé Bazin, José Cabanis, Gilbert Cesbron, Jacques Lemarchand (Genevikve, 1944), Michel Mohrt, etc. The influence of modern psychological theories was often apparent; novelists were also indebted to Stendhal and to the 18th-century analysts. The novel of adolescence, a form characteristic of the period, was represented by two masterpieces in complete contrast, Le *Grand Meaulnes* (1912) by Alain-Fournier (Henri Alain Fournier; 1886–1914) and Le *Diable au* corps (1923) by Raymond Radiguet (1903–23). Jean Cocteau also wrote a distinguished novel of adolescence (Les Enfants *terribles,* 1929).

The position of the individual in the world of temporal or eternal values was constantly debated. Sin and redemption form the themes of the Catholic writers, among whom François Mauriac (1885–) is pre-eminent. His best stories are set in his native Bordelais. He conveys with intensity the oppressive atmosphere in which his characters live out their unhappy, withdrawn existence (Le Baiser *au lépreux;* 1922; Thdrkse Desqueyroux, 1927; Le Noeud de *vipères,* 1932; La Pharisienne, 1941). From 1944, he turned increasingly to political journalism, with the uncompromising independence that marked his prewar condemnations of fascism.

Georges Bernanos (1888–1948), like his predecessor Léon Bloy, was a visionary, for whom the forces of good and evil were real presences. The vehement integrity of his polemical writings (La *Grande Peur* des bien-pensants, 1931; Les Grands Cimetikres *sous* la lune, 1938) characterizes his novels *Sous le soleil* de Satan (1926) and Journal *d'un* curd de campagne (1936), his masterpiece. Julien Green (1900– ; of Anglo-American parentage) depicted characters obsessed by disquietude and irrational impulses, in a strangely nightmarish world (Adrienne Mesurat, 1927; *Minuit,* 1936; *Moïra,* 1950). Marcel Jouhandeau (1888–) mingled spirituality and emphatic realism in his stories about "Monsieur Godeau"—largely a self-portrait—and "Chaminadour," the name given to his native town of Guéret.

Other writers wrote from a humanistic standpoint, laying stress on individual attainment. Henry de Montherlant (1896–), a successor of Barrès, blended exaltation and cynicism: He showed a considerable command of language (Les *Bestiaires,* 1926; Les Cklibataires, 1934; Les Jeunes *Filles,* 1936–39).

The struggle for self-realization in a common cause is the theme of Andre Malraux (1901–), one of the major writers of the century. His experiences of revolution in the far east and of civil war in Spain give his novels a singularly authentic quality (La *Voie* royale, 1930; La Condition humaine, 1933, an outstanding work; Le Temps du *mépris,* 1935; and *L'Espoir,* 1937). After completing the first volume of Les Noyers de *l'Altenburg* (1945), Malraux embarked on a vast survey of art throughout the world, to show that humanity's greatest triumph lies in artistic achievement (Les Voix du silence, 1951).

Self-sacrifice and community of effort were also the ideals of Antoine de Saint-Exupéry (1900–44). Flying gave him an elevation of mind and a sense of poetry, expressed in works of a largely autobiographical character (*Courrier* sud, 1928; Vol de *nuit,* 1931; Terre des hommes, 1939). Pilote de guerre (New York, 1942) ranks among the best records of World War II. The Resistance movement produced Lettres *à un* ami *allemand,* by Albert Camus, Angleterre, by "Argonne" (Jacques Debu-Bridel), and *Le Silence* de la mer by "Vercors" (Jean Bruller).

Albert Camus (1913–1960), sometimes classed with the existentialists, parted company with them after publishing his essay, *L'Homme révolté* (1951). He emphasized the apparent absurdity of life, but also the need for common effort. *L'Étranger* (1942) and La Peste (1947) gave him first place among younger novelists.

From the 1930s, many French novels tended to emphasize the least prepossessing aspects of human nature. It was perhaps not surprising that there should be a new *mal* du *siècle,* more sombre and violent than that after the Napoleonic wars. The influence of Franz Kafka and of the modern American novelists accentuated this tendency. The writings of the existentialists showed many of these characteristics. The term existentialism covers two separate streams of thought: Christian existentialism, represented by Gabriel Marcel (see below, Drama); and atheistic existentialism, headed by J. P. Sartre (1905–). Sartre and his followers utilized many forms of literature to expound their views. They discussed what the individual should do to work out his salvation in an apparently purposeless world, unfettered by conventional morality: his decisions must be his own, but he assumes a responsibility to the community through them. At first Sartre's existentialism appeared to be compounded of negation and despair (La *Nausée,* 1938, followed by the short stories of Le Mur, 1939); but a more positive attitude seemed to be developing in his cycle Les *Chemins* de la *liberté* (1945 ff.). Simone de Beauvoir showed psychological insight in *L'Invitée,* 1943. and Lcs Mandarins, 1954; her essay Pour *une* morale de *l'ambiguïté* (1947) and her defense of feminism, Le *Deuxième* Sexe (1949), were also notable.

The circumstances arising from World War II were graphically described by many of the younger novelists, Francis Ambrière (Charles Letellier), Jean Louis Curtis (Les *Forêts* de la *nuit,* 1947), David Rousset, Pierre Gascar, Robert Merle, Romain Gary, Roger Vailland (*Drôle* de jeu, 1945), Roger Nimier, and others. Other talented novelists of the period were Emmanuel Robliis. Jean Malaquais, Jean-Jacques Gautier, Maurice Druon, Louis Parrot, Félicien Marceau, Roger Peyrefitte, Antoine Blondin and Béatrix Beck.

Maurice Blanchot, Julien Gracq, Henri Thomas and Raymond Queneau—all very different—were highly praised for their originality in theme or technique.

The story of adventure has flourished, with Claude Farrère, Pierre Benoît, Joseph Kessel, Pierre MacOrlan, Francis Carco, Blaise Cendrars, Edouard Peisson, Roger Vercel and others. Henri Barbusse and Roland Dorgelès are remembered for their accounts of World War I. Georges Simenon gave a new status to the "thriller" of crime and detection. Pierre Boulle, Jean Hougron—an excellent story-teller—and Pierre Courtade wrote stirring narratives of the far east. The historical novel, comparatively neglected. reached a high literary standard with Zoe Oldenbourg and Marguerite Yourcenar.

The Theatre and **Drama.**[1]—From the end of World War I, the French theatre showed considerable vitality. There had been little evidence of this in the first part of the century, except in comedy. Tristan Bernard (1866–1947) was a gay humorist, Georges Courteline (1860–1923) made more Frenchmen laugh at themselves than any dramatist since Molière, and Georges Feydeau (1862–1921) proved to be the best vaudevilliste of modern times. Many "problem" plays of the earlier period dated considerably; *e.g.,* those of Paul Hervieu, Eugène Brieux, Henry Bataille, Henri Bernstein, Georges de Porto-Riche and François de Curel. The works of Maurice Maeterlinck led on to the symbolism of Paul Claudel (1868–195j) and other later writers. Claudel's first two masterpieces, *L'Annonce* faite *à* Marie and *L'Otage,* were staged in 1912 and in 1914 respectively. The works that brought him to the height of renown, Le Soulier de satin and *Partage* de midi, were however not performed till 1943 and 1948, respectively, though both had been written much earlier.

From the 1920s onward, theatrical productions increased greatly in variety. There were comedies of every kind—the latest frivolity by Sacha Guitry; Le *Cocu magnifique* (1921) by F. Crommelynck; Dr. Knock (1923) by Jules Romains, an extremely successful satire on doctoring; Topaze and *Marius* in 1928, by Marcel Pagnol, both immensely popular; and works by Jacques Deval, Henri Duvernois, Édouard Bourdet, Jean Sarment (Jean Bellemiire) and Marcel Achard.

In the serious theatre new talents were coming into view. Plays relying on implication and suggestion rather than on outright statement were written by Charles Vildrac (Le Paquebot Tenacity, 1920), Paul Géraldy, Denys Amiel and Jean Jacques Bernard (Martine, 1922). The action in general was simple, the characters those of everyday life.

More vehement, often declamatory plays were written by H. R. Lenormand, Paul Raynal and Stève Passeur. Raynal made a stir with his play about a returning soldier, Le *Tombeau sous l'Arc* de *Triomphe* (1924), but achieved a much deeper note in Le *Matériel humain* (written 1935, produced 1948). Three very different authors who became increasingly well-known—Marcel, Salacrou and Cocteau—also began their careers in the theatre at this time.

Gabriel Marcel (1889–) was a philosopher more than a dramatist: the chief exponent of Christian existentialism, he introduced Soren Kierkegaard to France about 1925 and published some of the most substantial writing of the age in his Journal *métaphysique* (1928) and *Être* et avoir (1935). His best play was Le Dard (1936).

Armand Salacrou (1899–) developed increasing mastery from the mid-1930s in many different types of plays and came to stand, with Anouilh, in the front rank of postwar dramatists (*Atlas-Hôtel,* 1931; Une Femme *libre,* 1934; La Terre est ronde, 1938; Les *Nuits* de la *colère,* 1946, an outstanding play on the Resistance; *L'Archipel* Lenoir, 1947; etc.).

Jean Cocteau (1889–) produced dramatic entertainments of endless variety—adaptations of Shakespeare. mime, ballet, films (Orphe'e), versions of ancient myths (Antigone, La *Machine infernale,* etc.), a remarkable psychological study (Les Parents terrible~,1938) and much else besides.

The 1930s saw a renaissance in tragedy, with Claudel and Giraudoux pre-eminent. A typical feature was the use of classical legends or historical subjects with a bearing on contemporary events. Religious tragedy, particularly through the genius of Claudel, regained a place it had not known since Racine. Often unwieldy and not primarily suited to the theatre, Claudel's plays have a transcendental quality which makes them both lyrical and epic.

Giraudoux became a dramatist in 1928, with Siegfried, adapted from one of his own stories. His reputation mounted steadily (Amphitryon *38,* 1929; Intermezzo, 1933; La Guerre de Troie n'aura pas lieu, 1935; etc.). His technique was entirely original, blending poetic unreality or myth with urgent topical issues.

Jean Anouilh (1910–) was, like Salacrou, primarily a man of the theatre. Now flippant, now sardonic, he took disillusionment and frustration for his themes and treated them with acrid wit. Le Voyageur sans *bagages* was performed in 1937, and Anouilh came into full fame with *Antigone* (1942), followed by several other much discussed plays, *Ardèle* (1948), La *Valse* des *toréadors* (1952), *L'Alouette* (1953) and *Ornifle* (19jj).

Mauriac gained a reputation with his first play, *Asmodée,* in 1937; Les *Mal-Aimés* followed in 1945, but later dramatic works were less successful. Henry de Montherlant stood high among postwar dramatists, with a remarkable grasp of technique, construction and dialogue (La Reine morte, 1942; Le *Maître* de Santiago, 1948; Port-Royal, 1954).

The leading existentialists were prominent in the theatre. Sartre achieved fame in 1943 with Les *Mouches;* and *Huis-clos* (1944), Les Mains sales (1948), Le Diable et le Bon *Dieu* (1951), etc., all provoked controversy by their frank discussion of painful topics. Simone de Beauvoir with Les Bouches *inutiles* (1945) and Camus with Le *Malentendu* and *Caligula* (1944) added notably to the existentialist repertoire.

The problems of World War II and its aftermath were discussed by Emmanuel Robliis (Montserrat, 1948), Maurice Clavel, Thierry Maulnier and others.

During and after the war, serious plays predominated. *Sud* (1953) and *L'Ennemi* (1954) were two notable psychological studies by Julien Green, striking out on a new career as dramatist. Comedy, however, was not neglected. Jacques Audiberti (1899–) covered philosophical intentions under the guise of comic extravagance (Quoat-Quoat, Le *Mal* court); and André Roussin (1911–) wrote some very diverting plays (La Petite Hutte, Les *Oeufs* de *l'autruche,* etc.). Marcel Aymé made a success with *Clérambard* (1950). Henri Pichette (1924–) was

[1]All dates of plays given in this section refer to the first performances of the plays concerned, unless otherwise stated.

a lyrical surrealist of much promise *(Les Epiphanies,* 1947).

Poetry. — The first half of the 20th century was not an age of outstanding achievement. Present-day poetry has derived much of its inspiration from 19th-century authors, particularly from Charles Baudelaire, Paul Verlaine. Stephane Mallarmé, Jean Rimbaud, Gérard de Nerval and Lautréamont (Isidore Lucien Ducasse). The influence of poets from outside France- mile Verhaeren, Walt Whitman, Rainer Maria Rilke—was also frequently apparent.

Poetry during this period tended to live in a somewhat rarefied atmosphere and to be concerned with highly personal forms of self-expression, not always very accessible to the general reader.

Paul Valéry (1871–1945) was the chief discipline of Mallarmé in this respect. His *Introduction à la méthode de Léonard de Vinci,* published at the age of 24, was followed a year later by *Une soirée avec M. Teste:* these were prose essays, revealing his philosophical preoccupations and his great gifts for intellectual self-analysis. He published little for 20 years, then sprang into fame as a poet in 1917, with *La Jeune Parque. Le Cimetikre marin* followed in 1920 and a collection entitled *Charmes* in 1922. Thereafter Valéry reverted to prose, his Socratic dialogue *Eupalinos* (1923) and five volumes of essays entitled *Variété* (1924–44) being especially memorable.

In the first quarter of the century Claudel and Péguy were the other leading poets. The comtesse de Noailles (Anna Elisabeth de Brancovan, 1876–1933: *Le Coeur innombrable,* 1901; *L'Honneur de souffrir,* 1927) and P. J. Toulet *(Les Contrerimes,* 1921) were attractive but less notable writers. Paul Fort (1872–) was a popular poet who drew much of his material from provincial legend *(Ballades françaises,* 1897–1953) and printed his verse as if it were prose. The prose-poem was much in favour in different forms throughout the period. and there was a constant tendency to break further and further away from traditional forms of versification. Claudel showed the resources of prose-poetry in his *Connaissance de l'est* (1900). Péguy, Max Jacob, André Breton. Leon-Paul Eargue, René Char and Henri Michaux all used this form extensively.

Religious themes were especially prominent. Claudel was converted to Catholicism during a sudden mystical experience in 1886. His *Cinq grandes odes* (1910) reflect his fervent sense of the supernatural. Often diffuse or obscure, his writing combines lyrical power with a sometimes jovial humour. He invented a special *verset* of his own, based on the style of the Bible. Francis Jammes (1868–1938) returned to Catholicism through Claudel's influence. His poetry, with a simplicity not devoid of artifice, is often genuinely touching. Péguy also returned to Catholicism. His writing has something of the naïveté of mediaeval legend. It is prolix and repetitive but contains many lines of great beauty, especially those dealing with death and sacrifice *(Le Mystbre de la charité de Jeanne d'Arc,* 1910; *Le Porche du mystère de la deuxibme vertu,* 1911; *Eve,* 1913).

The change-over to what may be called "modern" poetry began before World War I and became particularly apparent in the works of the surrealists during the early 1920s. Surrealism often led to exaggeration and straining after novelty. It produced, perhaps, few masterpieces in its own right, but many poets were influenced by it. Some of its characteristics went back to 19th-century sources; a fiercely grotesque, antibourgeois farce called *Ubu-Roi* (1896) by Alfred Jarry (1873–1907) was also important. The surrealists, however, chiefly turned to Guillaume Apollinaire (Wilhelm Apollinaris de Kostrowitzki, of Polish-Italian descent; 1880–1918). Keenly interested in the cubist painters, especially Pablo Picasso, he showed in his poetry a brilliant, often artificial modernity, but his work also reflects genuine feeling *(Alcools,* 1913; *Calligrammes,* 1918). Max Jacob and Blaise Cendrars were associated with him. Léon-Paul Fargue (1876–1947) and Pierre Reverdy (1889–) were attached to no particular school. Their poetry, individual and sincere, prepared the way for many later developments.

Surrealism was founded by André Breton, with Philippe Soupault, Paul Cluard and Louis Aragon. Breton, its most staunch and persuasive advocate, had become acquainted with Freudian psychoanalysis during the war. Surrealism embodied these new themes of the subconscious—hence its insistence on "automatic" writing. Soon, however, various poets associated with this movement went their separate ways (*e.g.,* Cocteau). Several surrealists swung over to Communism, notably Aragon and also Éluard (Eugkne Grindel; 1895–1952), whose idealism, simplicity and depth of feeling make him one of the outstanding poets of the period. During World War II. they both took part in the Resistance and wrote poignant verse expressing the pent-up feelings of the time: Aragon was the author of *Le Crkve-coeur* and *Les Yeux d'Elsa,* while Éluard's poetry was collected under the title *Poésie et vérité* and *Au rendez-vous nllemand.* The outburst of poetic activity which took place during the war led many to believe that a revival was at hand. for the time being the widening gap between poets and the general reader was bridged by the expression of feelings in which both could share. This tendency did not long survive the war.

Pierre-Jean Jouve (1887–), a complex, pessimistic writer, strongly influenced in turn by unanimism, Freudism and Catholicism, exercised a considerable influence on such younger poets as Pierre Emmanuel (1916–), Jean Cayrol. Luc Estang and Patrice de la Tour du Pin (the three latter all born in 1911).

Two very original poets are Saint-John Perse (the diplomat Alexis Saint-Léger Léger; 1887–) and Jules Supervielle (1884–1960). Perse is an extremely intellectual writer; his poetry is highly disciplined, subtly contrived and rich in imagery. Supervielle, on the other hand, is deliberately uncomplicated: his qualities of observation, sentiment, wit and fantasy make his writings particularly attractive.

Among later poets, we may mention Jacques Prévert (1900–) and Raymond Queneau (1903–), both endowed with wit and verbal dexterity. Henri Michaux (1899–) and René Char (1907–) were both much discussed in the 1950s, showing considerable depth of thought and feeling.

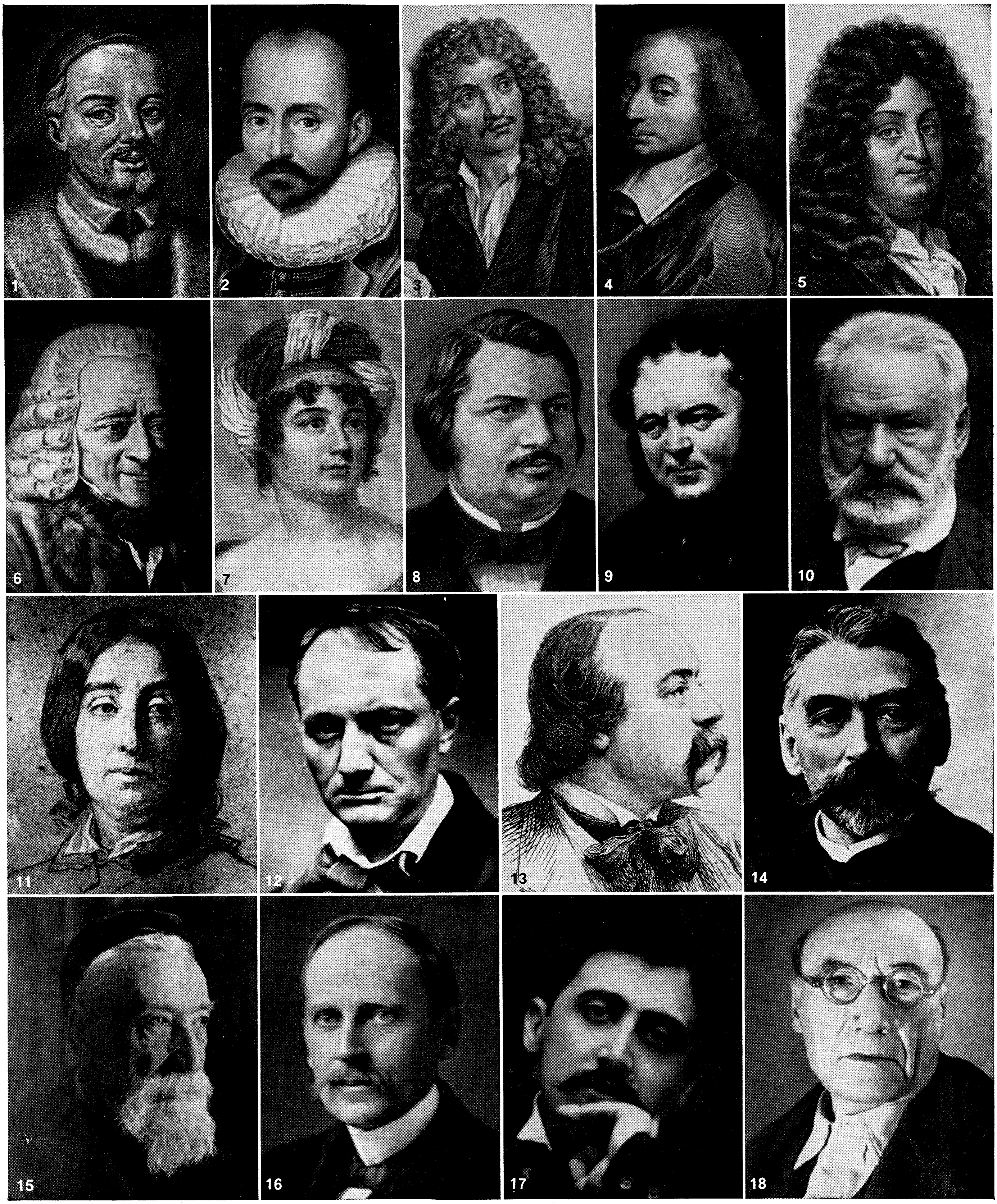
Philosophy and Scholarship. — Notable contributions were made in many sectors of these fields. Some of these have been mentioned earlier; here it is only possible to give a brief list.

Henri Bergson (1859–1941) held a foremost position in philosophy for many years *(Essai sur les données immédiates de la conscience,* 1889; *Les Deux Sources de la morale et de la religion,* 1932; etc.). He emphasized the importance of intuition and took his stand against the scientific determinism of the naturalists; his theory of time as a matter of personal experience rather than actual physical duration was also of much interest to literature. His views were countered by the rationalists Léon Brunschvicg and Julien Benda (1867–1956) and others. Sartre's major treatise of existentialism, *L'Être et le néant,* was published in 1943; so also was Camus' argument against suicide, *Le Mythe de Sisyphe.*

Noted Catholic writers were Léon Bloy (1846–1917); the philosopher Maurice Blonde1 (1861–1949); Jacques Maritain (1882–), interpreter of St. Thomas Aquinas; Étienne Gilson (1884–). a world authority on the Christian philosophy of the middle ages; the abbé Henri Bremond (1865–1933); Daniel-Rops (Henri Petiot; 1901–), author of *Jésus en son temps* (1945).

Political discussion occupied many writers. Charles Maurras (1868–1952) had gifts as poet and critic which are often overlooked in the animosities provoked by his violent nationalism. Jean Jaurès (1859–1914) voiced the ideals of international socialism. These were given a philosophic content by Léon Blum, also an acute moralist and literary critic *(Stmdhal et le heylirme.* etc.). Henri Lefebvre (1910–) began a Marxist survey of philosophy in 1947 Maurice Merleau-Ponty (1908–61) was a left-wing existentialist. André Siegfried (1875–1959), Raymond Aron (1905–) and Thierry Maulnier were prominent, in widely different directions, among those who studied the social. economic or political issues of the time. The events of World War II and the lessons to be learned from them provided material for many authors, Léon Blum's *A l'échelle humaine,* Marc Bloch's *L'Etrange défaite* and Gen. Charles de Gaulle's *Mémoires de guerre* (1954–56) being particularly noteworthy.

The leading historian was Ernest Lavisse (1842–1922). Other



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FRENCH AUTHORS

1. François Rabelais (c. 1495-1553). 2. Michel de Montaigne (1533-92). 3. Molière (Jean Baptiste Poquelin) (1622-73). 4. Blaise Pascal (1623-62). 5. Jean Racine (1639-99). 6. François Marie Arouet de Voltaira (1694-1778). 7. Madame de Stall (1766-1817). 8. Honor6 de Balzac (1799-1850). 9. Stendhal (Marie Henri Beyle) (1783-1842). 10. Victor Marie Hugo (1802-85). 11. George Sand (Amandine Dupin Dudevant) (1804-76). 12. Charles Pierre Baudelaire (1821-67). 13. Gustave Flaubert (1821-80). 14. Stéphane Mallarmé (1842-98). 15. Anatole France (Jacques Anatole Thibault) (1844-1924). 16. Romain Rolland (1866-1944). 17. Marcel Proust (1871-1922). 18. André Gide (1869-1951)

FRENCH REVOLUTION

LEADING FIGURES IN THE FRENCH REVOLUTION

1. Maximilien François Isidore de Robespierre **(1758-94)**
2. Georges Jacques Danton **(1759-94)**
3. Louis XVI, king of France **(1754-93)**
4. Marie Antoinette, queen of France (1755–93)
5. Jacques Necker **(1732-1804)**
6. Jeanne Manon Phlipon, Madame Roland **(1754-93)**
7. Jean Paul Marat **(1743-93)**
8. Honor6 Gabriel Victor Riqueti, comte de Mirabeau (1749-**1791)**
9. Jacques Pierre Brissot (1754–93)
10. Pierre Victurnien Vergniaud (1753–93)
11. Emmanuel Joseph Sieyes (Abbé) **(1748-1836)**
12. Lazare Nicolas Marguerite Carnot (1753–1823)
13. Général Louis Lazare Hoche **(1768-97)**
14. Charles Maurice de Talleyrand-Périgord, prince de Bénévent (1754–1838)
15. André Masséna, duc de Rivoli, prince d'Essling **(1756-1817)**
16. Faul Francois Jean Nicolas, vicomte de Barras **(1755-1829)**
17. Marie Joseph Motier, marquis de La Fayette **(1757-1834)**
18. François Christophe Kellermann, duc de Valmy (1735–1820)
19. Général Charles Francois Dumouriez (1739–1823)
20. General Jean Victor Marie Moreau **(1763-1813)**

notable historians were Lucien Febvre, Jacques Bainville, Charles Seignobos, Élie Halévy, Georges Lefebvre, Louis Madelin, Pierre Gaxotte and Marc Bloch. Émile Mâle wrote the standard work on French religious art; Élie Faure combined the study of art and civilization; Daniel Mornet and Paul Hazard surveyed 18th-century thought; P. Vidal de la Blache made geography literature; Ferdinand Brunot recorded the history of the French language.

Literary History and Criticism.—Gustave Lanson (1857–1934) brought a new discipline to the study of literary history. Many traditional assessments were revised in the course of the period. In literary criticism there was much diversity of opinion. Valéry, Gide and Péguy made criticism a notable part of their activity. Alain became famous for his *Propos*, short essays dealing with a great variety of topics; his longer works (*Avec Balzac*, 1937; etc.) were equally stimulating. Remy de Gourmont and Paul Souday were prominent in the first part of the century, and Albert Thibaudet (1874–1936) was the leading critic of his day (*Histoire de la littérature française de 1789 à nos jours*, 1936; *Réflexions*, 1938–41; etc.). Charles du Bos (1882–1939; *Approximations*, 1922–37; etc.), like Valery Larbaud, did much to make English authors known in France; Edmond Jaloux, Benjamin Crémieux and André Suarès were also gifted interpreters of foreign literature. Émile Henriot was an excellent guide to current literary production for more than 25 years (in his *Courrier littéraire*, etc.). Many different tendencies were expressed by other critics of repute: Pierre Abraham, Marcel Arland, Maurice Bardèche, Gérard Bauer, André Bellessort, André Billy, J. Boulenger, Roger Caillois, Ramon Fernandez, Yves Gandon, Jean Guéhenno, Daniel Halévy, Jean Hytier, Paul Léautaud, Thierry Maulnier, Henri Mondor, Léon Pierre-Quint, Marcel Raymond, André Rousseaux, J. Schlumberger, A. Thérive, Marcel Thiébaut and others. Among postwar writings, Georges Poulet's *Études sur le temps humain*, 2 vol. (1950–52), were outstanding. Other original critics of the later period were R. M. Albérès (*La Révolte des écrivains d'aujourd'hui*, 1949), Albert Béguin, Maurice Blanchot (*Faux-pas*, 1943; *La Part du feu*, 1949), Pierre de Boisdeffre (*Métamorphose de la littérature*, 2 vol., 1950–51), Armand Hoog, Robert Kanters, Claude-Edmonde Magny, Robert Mallet, Claude Mauriac, Maurice Nadeau, Gaëtan Picon and Pierre Henri Simon (*L'Esprit et l'histoire*, 1954). Dramatic criticism has been well represented by Robert Kemp, Gabriel Marcel, Jacques Lemarchand, Francis Ambrière and Jean-Jacques Gautier. Two well-known histories of modern French literature were written by René Lalou and Henri Clouard respectively; Pierre Brodin studied 47 contemporary authors with much discrimination in his *Présences contemporaines*, 2 vol. (1954–55). (*See* also biographical articles on various writers.)

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FRENCH OCEANIA: *see* PACIFIC ISLANDS.

FRENCH REPUBLICAN CALENDAR, a calendar substituted in France during the Revolution in place of the prevailing Gregorian system. Something of the sort had been suggested in 1785 by a certain Riboud, and a definite scheme had been promulgated by Pierre Sylvain Maréchal (1750–1803) in his *Almanach des honnêtes gens* (1788). The objects which the advocates of a new calendar had in view were to strike a blow at the clergy and to divorce all calculations of time from the Christian associations with which they were loaded, in short, to abolish the Christian year; and enthusiasts were already speaking of "the first year of liberty" and "the first year of the republic" when the national convention took up the matter in 1793. The business of drawing up the new calendar was entrusted to the president of

An II. 1793–94		An III. 1794–95	An IV. 1795–96	An V. 1796–97	An VI. 1797–98	An VII. 1798–99	An VIII. 1799–1800	An IX. 1800–01
1 Vendémiaire	22 Sept. 1793	22 Sept. 1794	23 Sept. 1795	22 Sept. 1796	22 Sept. 1797	22 Sept. 1798	23 Sept. 1799	23 Sept. 1800
1 Brumaire .	22 Oct. „	22 Oct. „	23 Oct. „	22 Oct. „	22 Oct. „	22 Oct. „	23 Oct. „	23 Oct. „
1 Frimaire .	21 Nov. „	21 Nov. „	22 Nov. „	21 Nov. „	21 Nov. „	21 Nov. „	22 Nov. „	22 Nov. „
1 Nivôse .	21 Déc. „	21 Déc. „	22 Déc. „	21 Déc. „	21 Déc. „	21 Déc. „	22 Déc. „	22 Déc. „
1 Pluviôse .	20 Janv. 1794	20 Janv. 1795	21 Janv. 1796	20 Janv. 1797	20 Janv. 1798	20 Janv. 1799	21 Janv. 1800	21 Janv. 1801
1 Ventôse .	19 Févr. „	19 Févr. „	20 Févr. „	19 Févr. „	19 Févr. „	19 Févr. „	20 Févr. „	20 Févr. „
1 Germinal .	21 Mars „	21 Mars „	21 Mars „	21 Mars „	21 Mars „	21 Mars „	22 Mars „	22 Mars „
1 Floréal .	20 Avr. „	20 Avr. „	20 Avr. „	20 Avr. „	20 Avr. „	20 Avr. „	21 Avr. „	21 Avr. „
1 Prairial .	20 Mai „	20 Mai „	20 Mai „	20 Mai „	20 Mai „	20 Mai „	21 Mai „	21 Mai „
1 Messidor .	19 Juin „	19 Juin „	19 Juin „	19 Juin „	19 Juin „	19 Juin „	20 Juin „	20 Juin „
1 Thermidor .	19 Juil. „	19 Juil. „	19 Juil. „	19 Juil. „	19 Juil. „	19 Juil. „	20 Juil. „	20 Juil. „
1 Fructidor .	18 Août „	18 Août „	18 Août „	18 Août „	18 Août „	18 Août „	19 Août „	19 Août „
1 Sans-culottides 6 „	17 Sept. 1794	17 Sept. 1795 22 „ „	17 Sept. 1796	17 Sept. 1797	17 Sept. 1798	17 Sept. 1799 22 „ „	18 Sept. 1800	18 Sept. 1801

An X. 1801–02		An XI. 1802–03	An XII. 1803–04	An XIII. 1804–05	An XIV. 1805
1 Vendémiaire . . .	23 Septembre 1801	23 Septembre 1802	24 Septembre 1803	23 Septembre 1804	23 Septembre 1805
1 Brumaire . . .	23 Octobre „	23 Octobre „	24 Octobre „	23 Octobre „	23 Octobre „
1 Frimaire	22 Novembre „	22 Novembre „	23 Novembre „	22 Novembre „	22 Novembre „
1 Nivôse	22 Décembre „	22 Décembre „	23 Décembre „	22 Décembre „	22 Décembre „
1 Pluviôse	21 Janvier 1802	21 Janvier 1803	22 Janvier 1804	21 Janvier 1805	
1 Ventôse	20 Février „	20 Février „	21 Février „	20 Février „	
1 Germinal . . .	22 Mars „	22 Mars „	22 Mars „	22 Mars „	
1 Floréal	21 Avril „	21 Avril „	21 Avril „	21 Avril „	
1 Prairial	21 Mai „	21 Mai „	21 Mai „	21 Mai „	
1 Messidor. . . .	20 Juin „	20 Juin „	20 Juin „	20 Juin „	
1 Thermidor . . .	20 Juillet „	20 Juillet „	20 Juillet „	20 Juillet „	
1 Fructidor . . .	19 Août „	19 Août „	19 Août „	19 Août „	
1 Sans-culottides . . 6 „ . .	18 Septembre 1802	18 Septembre 1803 23 „ „	18 Septembre 1804	18 Septembre 1805	

the committee of public instruction, Charles Gilbert Romme (1750–95), who was aided in the work by the mathematicians Gaspard Monge and Joseph Louis Lagrange, the poet Fabre d'Églantine and others. The result of their labours was submitted to the convention in September; it was accepted, and the new calendar became law on Oct. 5, 1793. The new arrangement was regarded as beginning on Sept. 22, 1792, because it was the day of the proclamation of the republic, and, in this year, the day of the autumnal equinox.

By the new calendar the year of 365 days was divided into 12 months of 30 days each, every month being divided into three periods of ten days, each of which were called *décades*, and the tenth, or last, day of each decade being a day of rest. It was also proposed to divide the day on the decimal system, but this arrangement was found to be highly inconvenient and it was never put into practice. Five days of the 365 still remained to be dealt with, and these were set aside for national festivals and holidays and were called *Sans-culottides*. They were to fall at the end of the year, *i.e.*, on the five days between Sept. 17 and 21 inclusive. and were called the festivals of virtue, of genius, of labour, of opinion and of rewards. A similar course was adopted with regard to the extra day which occurred once in every four years, but the first of these was to fall in the year III., *i.e.*, in 1795, and not in 1796, the leap year in the Gregorian calendar. This day was set apart for the festival of the Revolution and was to be the last of the *Sans-culottides*. Each period of four years was to be called a *Franciade*.

Some discussion took place about the nomenclature of the new divisions of time. Eventually this work was entrusted to Fabre d'Églantine. Beginning with the new year on Sept. 22, the autumn months were *Vendémiaire,* the month of vintage, *Brumaire,* the month of fog, and *Frimaire,* the month of frost. The winter months were *Nivôse,* the snowy, *Pluviôse,* the rainy, and *Ventôse,* the windy month; the spring months, *Germinal,* the month of buds, *Floréal,* the month of flowers, and *Prairial,* the month of meadows; the summer months, *Messidor,* the month of reaping, *Therrnidor,* the month of heat, and *Fructidor,* the month of fruit. To the days Fabre d'Églantine gave names which retained the idea of their numerical order, calling them Primedi, Duodi, etc., the last day of the ten, the day of rest, being named Décadi. The new order was soon in force in France and the new method was employed in all public documents, but it did not last many years. In Sept. 1805 it was decided to restore the Gregorian calendar, and the republican one was officially discontinued on Jan. 1, 1806.

The connecting link between the old and the new calendars is slight and the expression of a date in one calendar in terms of the other is a matter of some difficulty. A simple method of doing this, however, is afforded by the table on the preceding page, which is taken from the article by J. Dubourdieu in *La Grande Encyclopédie*.

Thus Robespierre was executed on 10 Thermidor An II., *i.e.*, July 28, 1794. The insurrection of 12 Germinal An III. took place on April 1, 1795. The famous 18 Brumaire An VIII. fell on Nov. 9, 1799, and the *coup d'état* of 18 Fructidor An V. on Sept. 4, 1797.

For a complete concordance of the Gregorian and the republican calendars *see* Stokvis, *Manuel d'histoire,* vol. iii. (Leyden, 1889); also G. Villain, "Le Calendrier républicain," in *La Révolution Française* for 1884–85.

FRENCH REVOLUTION, THE. There have been several revolutions in France, but when the French Revolution is spoken of without qualification it means the great revolutipn, by which, towards the close of the 18th century, the old order in France was overthrown. Though the Revolution passed through many phases and its beginnings must be set far back in the history of France, one event was from the first held to mark its decisive moment. When, on the afternoon of July 14, 1789, the Duc de La Rochefoucauld-Liancourt brought to King Louis XVI. at Versailles the news of the capture of the Bastille, the king exclaimed: "Why, thia is a revolt!" "No, Sire," replied the duke, "It is a revolution." Three days later the tidings reached Arthur Young at Nancy; he noted in his journal that he had just received the news of the "complete overthrow of the old order." To this day the anniversary of the fall of the Bastille, July 14, is celebrated by the French as the birthday of their national liberties.

It is not proposed here to explain why the capture by the populace of an old castle-prison, garrisoned by a handful of pensioners, was at once taken as marking the downfall of the old autocratic *régime* in France; an account of the Revolution which this heralded, of its antecedent causes, and of its later developments will be found in the article FRANCE: *History*. But the great Revolution was of epoch-making importance, not for France only, but for the whole world; for it set in motion those revolutionary forces—democracy, nationalism, socialism—which have changed the face of Europe and of the world, and are not yet spent. To say this, is not to belittle the importance of the American Revolution, which preceded the French Revolution and to a great extent inspired it. July 4, 1776, was certainly also an epoch-making date. The American Declaration of Independence first laid down the principle that governments derive their just powers from the consent of the governed, and so for the first time authoritatively proclaimed democracy as the only legitimate foundation of civil society. But the American Revolution was not so revolutionary as at first it seemed. Though a breach was made with England, no breach was made with English traditions of government and law. Of those who signed the Declaration of Independence but very few were democrats at heart. They subscribed to the revolutionary principles embodied by Jefferson in the preamble, but they had no idea of giving them a logical and universal application. That was reserved for the French. The Americans first established modern democracy. The French made it a militant creed.

There had been revolutions in Europe before 1789; but these revolutions had been strictly limited in their aims, and there had been no idea of setting up one form of constitution as absolutely superior to all others. Before 1789 the words "republic" and "democracy" conveyed no suggestion of revolutionary peril. Though Rousseau declared the ultimate sovereignty of the people to be inalienable, and all governments not established on this basis usurpations, he agreed with blontesquieu that republicanism and democracy were suitable only to small States, and were therefore peaceful in their tendencies. Even when a great new Republic was founded beyond the Atlantic, the monarchs watched its rise without misgiving, and even assisted in its foundation. "Time is necessary for the creation of a conquering people," said a contemporary diplomatic report, "It is more difficult to produce the spirit of conquest in a republic than in the head of a government which is entrusted to a single person."

This was an illusion which the history of the French Revolution should have dispelled, though it still persists. It serves partly to explain the apathy displayed at the outset by the Continental monarchs towards the troubles of their brother of France, which they even regarded as providential, since they prevented him from interfering with their plans for the final partition of Poland. It was only gradually that they awoke to the fact that the triumph of the Revolution in Paris had introduced a wholly new factor into international politics, and one very perilous to themselves. For the principles of the Revolution had an application far beyond the borders of France, since the doctrine of the sovereignty of the people as the only legitimate foundation of government challenged the right to exist of every State in Europe. This was the new thing which the crusading spirit of the Revolution revealed to the world: political idealism in arms, war waged, not in the name of the State for purposes of conquest, but in the name of humanity to set up everywhere on the ruins of the old order the theoretically perfect State. There were those, even at the time, who could read the meaning of the portent. Goethe was present when, at Valmy on Sept, 20, 1792, the ragged levies of the nascent French Republic withstood the attack of Brunswick's Prussian veterans. "From this place and this day," he noted in his diary, "dates a new epoch in the history of the world, and you will be able to say: I was there."

Characteristics of the Revolution.—The French Revolution, by the challenge thrown down to all the old world, had revealed itself as different to any revolution that had hitherto been.

In what did this difference consist? and what were its causes? The essential difference was that the French Revolution, increasingly as overturn succeeded overturn, represented not so much an effort to remedy admitted evils in the body politic, as an effort to recreate it on an ideal basis. "What does this mysterious science of government and legislation amount to?" said Robespierre, "To putting into the laws the moral truths culled from the works of the philosophers."

In holding this view Robespierre was not singular, though he was the most rigid in upholding it. Of the 1,200 deputies who met in the States-General at Versailles, in May 1789, but few had any experience of the practical problems of government, or had learned politics in any other school than the conversations of the *salons* and the writings of the philosophers. So far as they were not merely conservative, the champions of outworn prerogatives and privilege, they were for the most part—as Talleyrand was to put it—"builders of theories for an imaginary world." The voices of those who, like Mirabeau, realized the force of tradition in human affairs, and tried to hold fast what was good and useful in the old order, were soon silenced by the eloquence of the ideologues and—the roar of the Paris mob. And so, beginning with the "orgy" of Aug. 4, 1789, the old order was swept away before a new order was ready to take its place. The internal history of France during the Revolution is mainly that of successive attempts to build up an ideal order on the ruins.

Divergent Tendencies.—The process, of course, was not simple. The Revolutionists might agree on the principles embodied in the Declaration of the Rights of Man, but they differed about their application. The Constitution of 1791 was ostensibly an effort to apply them logically; but its framers tempered their logic with a *bourgeois* caution; for them "equality" meant at most equality before the law, not equality of opportunity, and they limited the franchise in the interests of the possessing classes. The Constitution was overthrown, with the monarchy, on Aug. 10, 1792; but the rift it had created in the revolutionary ranks continued, and widened, in the National Convention.

The struggle between the Girondins (*see* GIRONDISTS) and the Mountain (*q.v.*), as M. Albert Mathiez has now shown, was no mere struggle of rival groups for power, nor was it primarily a revolt of the provinces against the predominance of Paris and the Paris mob. Though the border-line between the factions was never very clearly marked, the essential difference between them was that the Girondins, though republicans and idealists, were champions of the rights of property, while the Mountain, which depended for its power on the organized mob of Paris, tended more and more in the direction of what is now called Socialism. It is a question how far this tendency was deliberate, or how far the socialistic laws (Law of the Maximum, etc.) put in force under the Terror were merely "war measures." But, at least in the case of Robespierre and his party, it now seems clear that they represented a conscious attempt to realize the ideal of the Socialist Republic. Socialists, from Buonarotti onwards, have claimed him, not without reason, as the apostle and protomartyr of their economic creed.

The Revolution and Nationalism.—If modern democracy, in its various developments, received its first great impulse from the Revolution, this is also true of nationalism, which during the 19th century was to prove the most powerful solvent of the established order. The principle of nationality was not, indeed, originally part of the revolutionary gospel, which was beautifully cosmopolitan. The orators of the Constituent Assembly held up the ideal of universal peace, and asserted with confidence that regenerated France would never again wage wars of conquest; and those who later, in the Legislative Assembly, clamoured for war spoke of carrying "liberty" to oppressed peoples. But already the mood was changing. The threat of foreign invasion had aroused in the French themselves an intense natiohal consciousness, and Danton was not alone in urging that the great object of the war should be to gain for France the frontiers "fixed by nature"—the Rhine, the Alps and the Pyrenees. And so, almost insensibly, the war of defence and revolutionary propaganda developed into a war of conquest, till in the end the rights of man were forgotten, blotted out by the splendour of the man, Napoleon, who had become the incarnation of a Revolution now identified with all the glories of France.

The sparks from the conflagration in Paris had meanwhile been carried far and wide, and had started fires even in places unexpected and remote, where they glowed under the surface, to burst into flame later. But though the agitations, which were in the end to lead to the rise of a whole series of new nations in eastern Europe, were sometimes inspired at the outset by French revolutionary doctrines, it was not so much these doctrines which gave its mighty impulse to the new spirit of nationality in Europe at large as the example of French nationalism, and the reaction against it when it became a conquering force. In Italy Napoleon, for his own purposes, deliberately awakened a national consciousness which had slumbered for a thousand years. In Germany, which like Italy had become little more than "a geographical expression," the humiliations he inflicted stirred up memories of ancient greatness and a new passion for national unity. When Spain set the example of national resistance, and with success, all Europe recognized that a new force had come into the world; that war was no longer a mere ordeal by battle, to be fought out according to fixed rules by professional armies, but a trial of strength between nations in arms. And so it was that, in their final struggle against the revolutionary doctrine of conquest, as embodied in Napoleon, the monarchs themselves appealed to the new-born national sentiment of the peoples, and not in vain. The battle of Leipzig, which practically sealed Napoleon's doom, is rightly known as "the Battle of the Nations."

The processes of national segregation and national expansion, then, which during the century that followed changed the face of Europe, received their first great impulse from the French Revolution. The result has been a complete change in the substance of the old order, even where the outward semblance has remained unaltered. Everywhere before the World War, except in the Austrian and Ottoman empires, sovereignty had ceased to be territorial and become national; even in Germany, where territorial sovereignties continued to exist, these were overshadowed by the power and prestige of the German emperor, whose title implied not a territorial but a national authority. The World War, a world-wide battle of the nations, completed the process, so far as the principle of national sovereignty is concerned; for Luxembourg, Liechtenstein and Monaco are insignificant exceptions which serve to emphasize the rule. Above all, the disappearance of the Habsburg monarchy, the last great purely territorial dominion, proclaimed the World War as the most stupendous phase of the Revolution which started with the capture of the Bastille. That it was the last phase cannot be said. In their internal affairs the nations are still experimenting in the application of the democratic principles proclaimed by the Revolution, except where—as in most Latin countries—the experiment has conspicuously broken down. As for the social revolution, dreamed of by Robespierre, this has to a large extent been realized even in countries reputed conservative—in universal free education, the duty of the State to provide work or the maintenance of those out of work, and so on. In the matter of international relations, too, some return has been made to the revolutionary ideal of the brotherhood of man; and the League of Nations represents an attempt to put into the laws the moral truths culled from the works of the philosophers. But the jealous and mutually exclusive sentiment of nationality remains the most fateful legacy of the Revolution, the forces of which for good or evil are not yet spent.

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FRENCH REVOLUTIONARY WARS (1792–1800), the general name for the first part of the series of French wars which went on continuously, except for some local and temporary cessations of hostilities, from the declaration of war against Britain in 1792 to the final overthrow of Bonaparte in 1815. The most important of these cessations—viz., the peace of 1801–03—

closes the "Revolutionary" and opens the "Napoleonic" era of land warfare, for which *see* NAPOLEONIC CAMPAIGNS, PENINSULAR WAR and WATERLOO CAMPAIGN. The naval history of the period is dated somewhat differently; the first period, treated below, is 1792–99; for the second, 1799–1815, *see* NAPOLEONIC CAMPAIGNS.

MILITARY OPERATIONS

France declared war on Austria on April 20, 1792. But Prussia and other pouers had allied themselves with Austria in view of war, and it was against a coalition and not a single power that France found herself pitted, at the moment when the "emigration," the ferment of the Revolution, and want of material and of funds had thoroughly disorganized her army. The first engagements were singularly disgraceful. Near Lille the French soldiers fled at sight of the Austrian outposts, crying *"Nous sommes trahis,"* and mur'dered their general (April 29). The commanders-in-chief of the armies that were formed became one after another "suspects"; and before a serious action had been fought, the three armies of Rochambeau, Lafayette and Liickner had resolved themselves into two commanded by Dumouriez and Kellermann. Thus the disciplined soldiers of the Allies had apparently good reason to consider the campaign before them a military promenade. On the Rhine, a combined army of Prussians, Austrians, Hessians and *émigrés* under the duke of Brunswick was formed for the invasion of France, flanked by two smaller armies on its right and left, all three being under the supreme command of the king of Prussia. In the Netherlands the Austrians were to besiege Lille, and in the south the Piedmontese also took the field The first step, taken against Brunswick's advice, was the issue (July 2j) of a proclamation which, couched in terms in the last degree offensive to the French nation, generated the spirit that was afterwards to find expression in the "armed nation" of 1793–94, and sealed the fate of Louis XVI. The duke, who was a model sovereign in his own principality, sympathized with the constitutional side of the Revolution, while as a soldier he had no confidence in the success of the enterprise. After completing its preparations in the leisurely manner of the previous generation, his army crossed the French frontier on Aug. 19. Longwy was easily captured; and the Allies slowly marched on to Verdun, which was more indefensible even than Longwy. The commandant, Col. Eeaurepaire, shot himself in despair, and the place surrendered on Sept. 3. Brunswick now began his march on Paris and approached the defiles of the Argonne. But Dumouriez, who had been training his raw troops at Valenciennes in constant small engagements, with the purpose of invading Belgium, now threw himself into the Xrgonne by a rapid and daring flank march, almost under the eyes of the Prussian advanced guard, and barred the Paris road, summoning Kellermann to his assistance from Metz. The latter moved but slowly, and before he arrived the northern part of the line of defence had been forced. Dumouriez, undaunted, changed front so as to face north, with his right wing on the Argonne and his left stretching towards Châlons, and in this position Kellermann joined him at St. Menehould on Sept. 19.

Valmy.—Brunswick meanwhile had passed the northern defiles and had then swung round to cut off Dumouriez from Châlons. At the moment when the Prussian manoeuvre was nearly completed, Kellermann, commanding in Dumouriez's momentary absence, advanced his left wing and took up a position between St. Menehould and Valmy. The result was the world-renowned cannonade of Valmy (Sept. 20, 1792). Kellermann's infantry, nearly all regulars, stood steady. The French artillery justified its reputation as the best in Europe, and eventually, with no more than a half-hearted infantry attàck, the duke broke off the action and retired. This trivial engagement was the turning-point of the campaign and a landmark in the world's history. Ten days later, without firing another shot, the invading army began its retreat. Dumouriez's pursuit was not seriously pressed; he occupied himself chiefly with a series of subtle and curious negotiations which, with the general advance of the French troops, brought about the complete withdrawal of the enemy from the soil of France.

Meanwhile, the French forces in the south had driven back the Piedmontese and had conquered Savoy and Nice. Another French success was the daring expedition into Germany made by Custine from Alsace. Custine captured Mainz itself on Oct. 21 and penetrated as far as Frankfurt. In the north the Austrian siege of Lille had completely failed, and Dumouriez now resumed his interrupted scheme for the invasion of the Netherlands. His forward movement, made as it was late in the season, surprised the Austrians, and he disposed of enormously superior forces. On Nov. 6 he won the first great victory of the war at Jemappes, near Mons, and, this time advancing boldly, he overran the whole country from Namur to Antwerp within a month.

Such was the prelude of what was called the "Great War" in England and the "Épopée" in France. Before going farther it is necessary to summarize the special features of the French army —in leadership, discipline, tactics, organization and movement—which made these campaigns the archetype of modern warfare.

The French Army **1792–1796.**—At the outbreak of the Revolution, the French army, like other armies in Europe, was a "voluntary" long-service army, augmented to some extent in war by drafts of militia. One of the first problems that the Constituent Assembly took upon itself to solve was the nationalization of this strictly royal and professional force, and as early as October 1789, the word "conscription" was heard in its debates. But it was decreed, nevertheless, that free enlistment alone befitted a free people, and the regular army was left unaltered in form. However, a national guard came into existence side by side with it, and the history of French army organization in the next few years is the history of the fusion of these two elements. The first step, as regards the regular army, was the abolition of proprietary rights, the serial numbering of regiments throughout the army, and the disbandment of the *Maison du roi*. The next was the promotion of deserving soldiers to fill the numerous vacancies caused by the emigration. Along with these, however, there came to the surface many incompetent leaders, favourites in the political clubs of Paris, etc., and the old strict discipline became impossible owing to the frequent intervention of the civil authorities in matters affecting it, the denunciation of generals, and especially the wild words and wild behaviour of "Volunteer" (embodied national guard) battalions.

When war came, it was soon found that the regulars had fallen too low in numbers and that the national guard demanded too high pay, to admit of developing the expected field strength. Arms, discipline, training alike were wanting to the new levies, and the repulse of Brunswick was effected by manoeuvring and fighting on the old lines and chiefly with the old army. The cry of *"La patrie en danger,"* after giving, at the crisis, the highest moral support to the troops in the front, dwindled away after victory, and the French Government contented itself with the half-measures that had, apparently, sufficed to avert the peril. More, when the armies went into winter quarters, the volunteers claimed leave of absence and went home. But in the spring of 1793, confronted by a far more serious peril, the Government took strong measures. Universal liability was asserted, and passed into law. Yet even now whole classes obtained exemption and the right of substitution as usual forced the burden of service on the poorer classes, so that of the 100,000 men called on for the regular army and 200,000 for the volunteers, only 180,000 men were actually raised. Desertion, quite usually regarded as the curse of professional armies, became a conspicuous vice of the defenders of the Republic, except at moments when a supreme crisis called forth supreme devotion.

Amalgamation and Universal Service.—While this unsatisfactory general levy was being made, defeats, defections and invasion in earnest came in rapid succession, and to deal with the almost desperate emergency, the ruthless Committee of Public Safety sprang into existence. "The levy is to be universal. Unmarried citizens and widowers without children of ages from 18 to 25 are to be called up first," and 450,000 recruits were immediately obtained by this single act. The complete amalgamation of the regular and volunteer units was decided upon. The white uniforms of the line gave place to the blue of the national guard *in all arms and services. The titles of officers were changed, and in fact every relic of the old régime, save the inherited solidity of the old regular battalions, was swept away. This rough combination of line and volunteers, therefore— for the "Amalgam" was not officially begun until 1794—must be understood when we refer to the French army of Hondschoote or of Wattignies. It contained, by reason of its universality and also because men were better off in the army than out of it— if they stayed at home they went in daily fear of denunciation and the guillotine— the best elements of the French nation. To some extent the political arrivistes had been weeded out, and though the informer, here as elsewhere, struck unseen blows, the mass of the army gradually evolved its true leaders and obeyed them. It was, therefore, an army of individual citizen-soldiers of the best type, welded by the enemy's fire, and conscious of its own solidarity in the midst of the revolutionary chaos. After 1794 the system underwent but little radical change until the end of the Revolutionary period. Its regiments grew in military value month by month and attained their highest level in the great campaign of 1796. In 1795 the French forces (now all styled national guard) consisted of 531,000 men, of whom 323,000 were infantry (100 3-battalion demi-brigades), 97,000 light infantry (30 demi-brigades), 29,000 artillery, 20,000 engineers and 59,000 cavalry. This novel army developed novel fighting methods, above all in the infantry. This arm had just received a new drill-book, as the result of a long controversy (see* INFANTRY*) between the advocates of "lines" and "columns," and this drill-book, while retaining the principle of the line, set controversy at rest by admitting battalion columns of attack, and movements at the "quick" (100–120 paces to the minute) instead of at the "slow" march (76). On these two prescriptions, ignoring the rest, the practical troop leaders built up the new tactics little by little, and almost unconsciously.*

Tactics.— The earlier battles were fought more or less according to the drill-book, partly in line for fire action, partly in column for the bayonet attack. But line movements required the most accurate drill, and what was attainable after years of practice with regulars moving at the slow march was wholly impossible for new levies moving at 120 paces to the minute. When, therefore, the line marched off, it broke up into a shapeless swarm of individual firers. This was the form, if form it can be called, of the tactics of 1793— "horde-tactics" as they have quite justly been called— and a few such experiences as that of Hondschoote sufficed to suggest the need of a remedy. This was found in keeping as many troops as possible out of the firing line. In other words, the bravest and coolest marksmen were let loose to do what damage they could, and the rest, massed in close order, were kept under the control of their officers and only exposed to the dissolving influence of the fight when the moment arrived to deliver, whether by fire or by shock, the decisive blow.

The cavalry underwent little change in its organization and tactics, which remained as in the drill-books founded on Frederick's practice. But except in the case of the hussars, who were chiefly Alsatians, it was thoroughly disorganized by the emigration or execution of the nobles who had officered it, and for long it was incapable of facing the hostile squadrons in the open

In artillery matters, this period, 1792–96, marks an important progress, due above all to Gribeauval (q.v.) and the two du Teils, Jean Pierre (1722–94) and Jean (1733–1820), who were Bonaparte's instructors. The change was chiefly in organization and equipment— the great tactical development of the arm was not to come until the time of the Grande Armée—and may be summarized as the transition from battalion guns and reserve artillery to batteries of "horse and field."

The engineers, like the artillery, were a technical and non-noble corps. They escaped, therefore, most of the troubles of the Revolution— indeed, the artillery and engineer officers, Bonaparte and Carnot amongst them, were conspicuous in the political regeneration of France— and the engineers carried on with little change the traditions of Vauban and Cormontaigne (see FORTIFICATION AND SIEGECRAFT*). Both these corps were, after the Revolution as before it, the best in Europe, other armies admitting their superiority and following their precepts.*

In all this the army naturally outgrew its old "linear" organization. Temporary divisions, called for by momentary necessities, placed under selected generals and released from the detailed supervision of the commander-in-chief, soon became, though in an irregular and haphazard fashion, permanent organisms, and by 1796 the divisional system had become practically universal. The next step, as the armies became fewer and larger, was the temporary grouping of divisions; this, too, in turn became permanent as the army corps.

New System of War.— This subdivision of forces was intimately connected with the general method of making war adopted by the "New French," as their enemies called them. What astonished the Allies most of all was the number and the velocity of the Republicans. These improvised armies had, in fact, nothing to delay them. Tents were unprocurable for want of money, untransportable for want of the enormous number of wagons that would have been required, and also unnecessary, for the discomfort that would have caused wholesale desertion in professional armies was cheerfully borne by the men of 1793–94. Supplies for armies of then unheard-of size could not be carried in convoys, and the French soon became familiar with "living on the country." Thus 1793 saw the birth of a new system of war— rapidity of movement, full development of national strength, bivouacs and requisitions, and force, as against cautious manoeuvring, small professional armies, tents and full rations, and chicane. The first represented the decision-compelling spirit, the second the spirit of risking a little to gain a little. Above all the decision-compelling spirit was reinforced by the presence of the emissaries of the Committee of Public Safety, the "representatives on mission" who practically controlled the guillotine. There were civil officials with the armies of the Allies too, but their chief function was not to infuse desperate energy into the military operations, but to see that the troops did not maltreat civilians. Such were the fundamental principles of the "New French" method of warfare, but it only reached maturity after a painful period of trial and error.

CAMPAIGNS IN THE NETHERLANDS

The year 1793 opened disastrously for the Republic. As a consequence of Jemappes and Valmy, France had taken the offensive both in Belgium, which had been overrun by Dumouriez's army, and in the Rhine countries. But the execution of Louis XVI. raised up a host of new and determined enemies. England, Holland, Austria, Prussia, Spain and Sardinia promptly formed the First Coalition. England poured out money in profusion to pay and equip her Allies' land armies, and herself began the great struggle for the command of the sea (see Naval Operations, below).

Neerwinden.—*In the Low Countries, while Dumouriez was beginning his proposed invasion of Holland, Prince Josias of Saxe-Coburg, the new Austrian commander on the Lower Rhine, advanced from the region of Cologne and drove in the various detachments that Dumouriez had posted to cover his right. The French general thereupon abandoned his advance into Holland, and, with what forces he could gather, turned towards the Meuse. The two armies met at Neerwinden (q.v.) on March 18, 1793. Dumouriez had only a few thousand men more than his opponent, instead of the enormous superiority he had had at Jemappes. Thus the enveloping attack could not be repeated, and in a battle on equal fronts the old generalship and the old armies had the advantage. Dumouriez was thoroughly defeated, the house of cards collapsed, and the whole of the French forces retreated in confusion to the strong line of border fortresses, created by Louis XIV. and Vauban.*[1] *Dumouriez, witnessing the failure of his political schemes, declared against the Republic and, after a vain attempt to induce his own army to follow his example, fled (April 5) into the Austrian lines. The leaderless Republicans streamed back to Valenciennes. There, however, they found a general. Picot (comte de) Dampierre was a regimental officer of the old army, who, in spite of his vanity and extravagance, pos-*

[1]For *following operations see map in* SPANISH *SUCCESSION, WAR OF THE.*

sessed real loyalty to the new order of things, and brilliant personal courage. At the darkest hour he seized the reins without orders and without reference to seniority, and began to reconstruct the force and the spirit of the shattered army by wise administration and dithyrambic proclamations.

France was, however, for a time defenceless, and the opportunity existed for the military promenade to Paris that the allied statesmen had imagined in 1792. But Coburg now ceased to be a purely Austrian commander, for one by one allied contingents, with instructions that varied with the political aims of the various governments, began to arrive. Soon the idea of restoring order in France became little more than a pretext for a general intrigue amongst the confederate powers, each seeking to aggrandize itself at France's expense. Coburg's plan of campaign was limited to the objects acceptable to all the Allies alike. He aimed at the conquest of a first-class fortress—Liile or Valenciennes—his reason being largely that he might gain a depot as near as possible to the front to save the customarily exorbitant hire of transport for supplies. As for the other governments which Coburg served as best he could, the object of the war was material concessions, and it would be easy to negotiate for the cession of Dunkirk and Valenciennes when the British and Austrian colours already waved there. The Allies, therefore, instead of following up their advantage over the Frehch field army and driving forward on the open Paris road, set their faces westward, intending to capture Valenciennes, Le Quesnoy, Dunkirk and Lille one after the other.

Dampierre meanwhile grew less confident as responsibility settled upon his shoulders. Quite unable to believe that Coburg would bury himself in a maze of rivers and fortresses when he could scatter the French army to the winds by a direct advance, he was disquieted and puzzled by the Austrian investment of Condé. And the result of skirmishes around Valenciennes gave him little confidence in the troops. But the representatives on mission bade him relieve Condé at all costs. On May 1, Coburg's positions west of Quiévrain were attacked. The French won some local successes by force of numbers and surprise, but the Allies recovered themselves, and drove the Republicans in disorder to their entrenchments. Dampierre's discouragement now became desperation, and, urged on by the representatives (who, be it said, had exposed their own lives freely enough in the action), he attacked Clerfayt, who was covering the siege of Condé, on the 8th at Raismes. The troops fought far better in the woods and hamlets west of the Scheldt than they had done in the plains to the east. But in the heat of the action Dampierre risked and lost his life in leading a storming party, and his men retired sullenly, though this time in good order, to Valenciennes. Another pause followed, Coburg awaiting the British conticgent under the duke of York, and the Republicans endeavouring to assimilate the reinforcements of conscripts, who now arrived. Mutiny and denunciations augmented the confusion in the French camp. Plan of campaign there was none, save a resolution to stay at Valenciennes in the hope of finding an opportunity of relieving Condé and to create diversions elsewhere. These came to nothing, and before they had even started, Coburg, resuming the offensive, had stormed the lines of Famars (May 24), whereupon the French army retired to Bouchain, leaving not only Condé, but also Valenciennes to resist as best they could. Here, surrounded by streams and marshes, the French generals thought that their troops were secure from the rush of the dreaded Austrian cavalry. Coburg refrained from a regular siege of Condé. He wished to gain possession of the fortress in a defensible state, intending to use it as his own depot later in the year. He therefore reduced it by famine. During the siege of Valenciennes the Allies appear to have been supplied from Mons.

Many Commanders.—Custine next took charge of the dispirited army, the fourth commander in two months. His first task was to institute a severe discipline, and his prestige was so great that his mere threat of death sentences for offenders produced the desired effect. As to operations, he wished for a concentration of all possible forces from other parts of the frontier towards Valenciennes, even if necessary at the cost of sacrificing his own conquest of Mainz. But the generals of the numerous other armies refused to give up their troops, and on June 17 the idea was abandoned in view of the growing seriousness of the Vendéan insurrection (see VENDÉE, WARS OF THE). Custine, therefore, could do no more than continue the work of reorganization. Coburg, who had all this time succeeded in remaining concentrated, now found himself compelled to extend leftwards towards Flanders, for Custine had infused some energy into the scattered groups of the Republicans in the region of Douai, Lille and Dunkirk—and during this respite the Paris Jacobins sent to the guillotine both Custine and his successor La Marlière before July was ended. Both were "ci-devant" nobles and, so far as is ascertainable, neither was guilty of anything worse than attempts to make his orders respected by his soldiers. By this time, owing to the innumerable denunciations and arrests, the confusion in the Army of the North was at its height, and no further efforts were made for the relief of Valenciennes and Condé. Condé, starved out as Coburg desired, capitulated on June 10, and Valenciennes, which held out bravely until the civil population began to plot treachery, on July 28. Shortly after this the wreck of the field army retired on Arras. By this they gave up the direct defence of the Paris road, but placed themselves in a "flank position" relatively to it. Thus ended the second episode of the campaign of 1793. Military operations were few and spasmodic, on the one side because the Allied statesmen were less concerned with the nebulous common object of restoring order in France than with their several schemes of aggrandizement, on the other owing to the almost incredible confusion of France under the *régime* of Danton and Marat. The third episode shows little or no change in the force and direction of the allied efforts, but a very great change in France. Thoroughly roused by disaster and now dominated by the furious and bloodthirsty energy of the Terrorists, the French people and armies at last set before themselves clear and definite objects to be pursued at all costs.

Jean Nicolas Houchard, the next officer appointed to command, had been a heavy cavalry trooper in the Seven Years' War. His bravery, his stature, his bold and fierce manner, his want of education, seemed all to betoken the ideal sans-culotte general. But he was incapable of leading an army, and knowing this, carefully conformed to the advice of his staff-officers, Berthelmy and Gay-Vernon, the latter of whom, an exceptionally capable officer, had been Custine's chief of staff and was consequently under suspicion. At one moment, indeed, operations had to be suspended altogether because his papers were seized by the civil authorities, and amongst them were all the confidential memoranda and maps required for the business of headquarters. It was the darkest hour. The Vendéans, the people of Lyons, Marseille and Toulon, were in open and hitherto successful revolt. Valenciennes had fallen and Coburg's hussar parties pressed forward into the Somme valley. Again the Allies had the decision of the war in their own hands. Coburg, indeed, thought an advance on Paris hazardous. But, hazardous or not, it would have been attempted but for the English. The duke of York had definite orders from his government to capture Dunkirk—at present a nest of corsairs which interfered with the Channel trade, and in the future, it was hoped, a second Gibraltar—and the English and Hanoverians marched away to besiege the coast fortress. Thereupon the king of Prussia in turn called off his contingent for operations on the middle Rhine. Coburg, therefore, was brought to a complete standstill, and the scene of the decision was shifted to the district between Lille and the coast.

Thither came Carnot, the engineer officer who was in charge of military affairs in the Committee of Public Safety and who is known to history as the "Organizer of Victory." He went no further than to recommend an inroad into Flanders on the ground that no enemy would be encountered there. This, however, in the event developed into an operation of almost decisive importance, for at the moment of its inception the duke of York was already on the march. Fighting *en route* a severe but successful action at Lincelles, to extricate the Dutch, the Anglo-Hanoverians entered the district—densely intersected with canals and morasses—around Dunkirk and Bergues on August 21 and 22.

On the right, by way of Furnes, the British moved towards Dunkirk and invested the east front of the weak fortress, while on the left the Hanoverian field-marshal von Freytag moved via Poperinghe on Bergues. The French detachments were easily dispersed. Houchard was in despair at the bad conduct of his troops. But one young general, Jourdan, anticipating Houchard's orders, had already brought a strong force from Lille to Cassel, whence he incessantly harried Freytag's posts. Carnot encouraged the garrisons of Dunkirk and Bergues, and caused the sluices to be opened. The morale of the defenders rose rapidly. Houchard prepared to bring up every available man of the Army of the North, and only waited to make up his mind as to the direction in which his attack should be made. The Allies themselves recognized the extreme danger of their position. It was cut in half by the Great Morass, stretches of which extended even to Furnes. Neither Dunkirk nor Bergues could be completely invested owing to the inundations, and Freytag sent a message to King George III. to the effect that if Dunkirk did not surrender in a few days the expedition would be a complete failure.

As for the French, they could hardly believe their good fortune. Generals, staff officers and representatives on mission alike were eager for a swift and crushing offensive. "'Attack' and 'attack in mass' became the shibboleth and the catch-phrase of the camps" (Chuquet), and fortresses and armies on other parts of the frontier were imperiously called upon to supply large drafts for the Army of the North. Gay-Vernon's strategical instinct found expression in a wide-ranging movement designed to secure the annihilation of the duke of York's forces. Beginning with an attack on the Dutch posts north and east of Lille, the army was then to press forward towards Furnes, the left wing holding Freytag's left wing in check, and the right swinging inwards and across the line of retreat of both allied corps. On Aug. 28, consequently, the Dutch posts were attacked and driven away by the mobile forces at Lille, aided by parts of the main army from Arras. But even before they had fired their last shot the Republicans dispersed to plunder and compromised their success. Houchard and Gay-Vernon began to fear that their army would not emerge successfully from the supreme test they were about to impose on it, and from this moment the scheme of destroying the English began to give way to the simpler and safer idea of relieving Dunkirk. The place was so ill-equipped that after a few days' siege it was in *extrcmis*, and the political importance of its preservation led not merely the civilian representatives, but even Carnot, to implore Houchard to end the crisis at once. An army of 37,000 men was left to watch Coburg and to secure Arras and Douai, and the rest, 50,000 strong, assembled at Cassel. Everything was in Houchard's favour could he but overcome the indiscipline of his own army. The duke of 170rk was more dangerous in appearance than in reality and Freytag's covering army extended in a line of disconnected posts from Bergues to Ypres.

Hondschoote.—Against the left and centre of this feeble cordon 40,000 men advanced in many columns on Sept. 6. A confused outpost fight, in which the various assailing columns dissolved into excited swarms, ended, long after nightfall, in the orderly withdrawal of the various allied posts to Hondschoote. The French generals were occupied the whole of next day in sorting out their troops, who had not only completely wasted their strength against mere outposts, but had actually consumed their rations and used up their ammunition. On the 8th, the assailants, having more or less recovered themselves, advanced again. They found the enemy entrenched on either side of the village of Hondschoote, the right resting on the great morass and the left on the village of Leysele. Houchard, now concerned more with the relief of Dunkirk than with the defeat of the enemy, had sent away one division to Dunkirk, another to Bergues, and a third towards Ypres, and left himself only some 20,000 men for the battle. The enemy, however, had only 13,000. Houchard despatched a column, guided by his staff officer Berthelmy, to turn the Hanoverians' left, but this column lost its way in the dense country about Loo. The centre waited motionless under the hre of the allied guns near Hondschoote. In vain the representative Delbrel implored the general to order the advance. Houchard was obstinate, and ere long the natural result followed. Though Delbrel posted himself in front of the line, conspicuous by his white horse and tricoloured sash and plume, to steady the men, the bravest left the ranks and skirmished forward from bush to bush, and the rest sought cover. Then the allied commander ordered forward one regiment of Hessians, and these, advancing at a ceremonial slow march, and firing steady rolling volleys, scattered the Republicans before them. At this crisis Houchard uttered the fatal word "retreat," but Delbrel overwhelmed him with reproaches and stung him into renewed activity. He hurried away to urge forward the right wing while Jourdan rallied the centre and led it into the fight again. Once more Jourdan awaited in vain the order to advance, and once more the troops broke. But at last the exasperated Delbrel rose to the occasion. "You fear the responsibility," he cried to Jourdan; "well, I assume it. My authority overrides the general's and I give you the formal order to attack at once!" Then, gently, as if to soften a rebuke, he continued, "You have forced me to speak as a superior; now I will be your aide-de-camp," and at once hurried off to bring up the reserves and to despatch cavalry to collect the fugitives. This incident, amongst many, serves to show that the representatives on mission were no mere savage marplots, as is too generally assumed. They were often wise and able men, brave and fearless of responsibility in camp and in action. Jourdan fell wounded, but Delbrel headed a wild irregular bayonet charge which checked the Hanoverians, and Houchard himself, in his true place as a cavalry leader, came up with 500 fresh sabres and flung himself on the Allies. The disciplined Hanoverians soon re-formed after the shock, but by this time the fugitives collected by Delbrel's troopers, reanimated by ne hopes of victory, were returning to the front in hundreds, and a last assault on Hondschoote met with complete success.

Hondschoote was a psychological victory. Materially, it was no more than the crushing of an obstinate rearguard at enormous expense to the assailants, for the duke of York was able to withdraw while there was still time. But it established the fact that the "New French" mere determined to win, at any cost and by sheer weight and energy. It was long before they were able to meet equal numbers with confidence, and still longer before they could freely oppose a small corps to a larger one. But the nightmare of defeats and surrenders was dispelled. Having missed the opportunity of crushing the English, Houchard turned his attention to the Dutch posts about Menin, which he overwhelmed (Sept. 12–13). After this engagement, won by immensely superior forces, Houchard pushed still further inland, but missed his target—the Austrian general, Beaulieu—while his own detachments suffered a series of pin-prick defeats. Houchard's offensive died away completely, and he halted at Gaverelle, half-way between Douai and Arras, a prey to conflicting rumours from which emerged the conclusion that Coburg was about to join the duke of York in a second siege of Dunkirk. In consequence he began to close on his left. But his conclusion was entirely wrong. The Allies were closing on *their* left inland to attack Maubeuge.

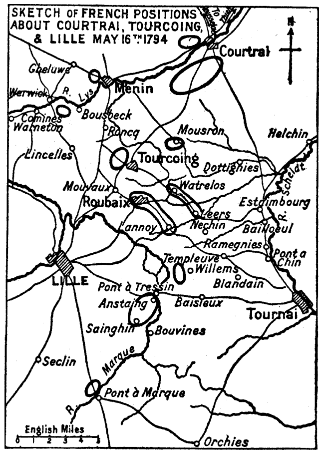
Houchard was now denounced and brought captive to Paris. Placed upon his trial, he offered a calm and reasoned defence of his conduct, but when the intolerable word "coward" was hurled at him by one of his judges he wept with rage, pointing to the scars of his many wounds, and then, his spirit broken, sank into a lethargic indifference, in which he remained to the end. He was guillotined on Nov. 16, 1793. After Houchard's arrest Jourdan accepted the command, though with many misgivings. The new levies, instead of filling up the depleted ranks of the line, were assembled in indisciplined and half-armed hordes at various frontier camps, under elected officers who had for the most part never undergone the least training. But an enthusiasm equal to that of Hondschoote, and similarly demanding a plain, urgent and recognizable objective, animated it, and although Jourdan and Carnot (who was with him) began to study the general strategic situation, the Committee brought them back to realities by ordering them to relieve Maubeuge at all costs.

Wattignies.—The Allies disposed in all of 66,000 men around the threatened fortress, but 26,000 of these were actually employed in the siege, and the remainder, forming the covering army, extended in an enormous semicircle of posts facing west, south and east. Thus the Republicans, as before, had two men to one at the point of contact (44,000 against 20,000) on Oct. 15, and though the Allies' right and centre held their ground, on their left the plateau of Wattignies (*q.v.*) was stormed on the second day, Carnot, Jourdan and the representatives leading the columns in person. Coburg, indeed, fell back in unbroken order, added to which the Maubeuge garrison had failed to co-operate with their rescuers by a sortie, and the duke of York had hurried up with all the men he could spare from the Flanders cordon. But the Dutch generals refused to ad ance beyond the Sambre, and Coburg broke up the siege of Maubeuge and retired whence he had come, while Jourdan, so far from pressing forward, was anxiously awaiting a counter-attack, and entrenching himself with all possible energy. The episode gives a perfect picture of the character, at once intense and spasmodic, of the "New French" warfare in the days of the Terror.

To complete the story of '93, it remains to sketch, very briefly, the principal events on the eastern and southern frontiers of France. It was not merely on the Sambre and the Scheldt, nor against one army of heterogeneous allies that the Republic had to fight for life, but against Prussians and Hessians on the Rhine, Sardinians in the Alps, Spaniards in the Pyrenees, and also (one might say, indeed, above all) against Frenchmen in Vendée, Lyons, Marseilles and Toulon. On the Rhine the advance of a Prussian-Hessian army, 63,000 strong. rapidly drove back Custine from the Main into the valleys of the Saar and the Lauter. An Austrian corps under Wurmser soon afterwards invaded Alsace. Here, as on the northern frontier, there was a long period of trial and error, of denunciations and indiscipline, and of wholly trivial fighting, before the Republicans recovered themselves. But in the end the ragged enthusiasts found their true leader in Hoche, and, though defeated by Brunswick at Pirmasens and Kaiserslautern, they managed to develop almost their full strength against Wurmser in Alsace. On Dec. 26 the latter was driven by main force from the lines of Weissenburg, after which Hoche advanced into the Palatinate and delivered Landau, and Pichegru moved on to recapture Mainz, which had surrendered in July. On the Spanish frontier both sides indulged in a fruitless war of posts in broken ground. The Italian campaign of 1793, equally unprofitable, will be referred to below. Far more serious than either was the insurrection of Vendée (*q.v.*) and the counter-revolution in the south of France, the principal incidents of which were the terrible sieges of Lyons and Toulon.

Campaign of 1794.—For 1794 Carnot planned a general advance of all the northern armies, that of the North (Pichegru) from Dunkirk-Cassel on Brussels, the minor Army of the Ardennes to Charleroi, and the Army of the Moselle (Jourdan) to Liége. He counted upon little as regards the two armies near the Meuse, but hoped to force on a decisive battle by the advance of the left wing towards Ypres. Coburg, on the other side, intended, if not forced to develop his strength on the Ypres side, to make his main effort against the French centre about Landrecies. This produced the siege of Landrecies, which need not concern us, a forward movement of the French to Menin and Courtrai which resulted in the battles of Tourcoing and Tournai, and the campaign of Fleurus, which, almost fortuitously, produced the long-sought decision. The first crisis was brought about by the advance of the left wing of the Army of. the North to Menin-Courtrai, where it found itself between two hostile masses, the main body of the allied right wing about Tournai and a secondary corps at Thielt. Common-sense, therefore, dictated a converging attack for the Allies and a series of rapid radial blows for the French. In the allied camp common-sense had first to prevail over routine, and the emperor's first orders were for a raid of the Thielt corps towards Ypres, which his advisers hoped would of itself cause the French to decamp. But the duke of York formed a very different plan, and Clerfayt, in command at Thielt, agreed to co-operate. Their proposal was to surround the French on the Lys with their'two corps, and by May 15 the emperor had decided to use larger forces in order to accomplish the same object.

On that day Coburg himself entered Tournai and took up the general command. Orders were promptly issued for a general offensive. Clerfayt's corps was to force its way, on the 16th, across the Lys at Werwick and connect with the main army. The main army was to advance in four columns. The first three, under the duke of York, were to move off, at daylight on the 17th, to the line Mouscron-Tourcoing-Mouvaux. The fourth and fifth under Kinsky and the archduke Charles, were to defeat the French corps on the upper Marque, and then, leaving Lille on their left, to march rapidly forward towards Werwick, thus completing the investing circle around Souham's and Moreau's isolated divisions. Picked volunteers to clear away the enemy's skirmishers were to precede the heads of the columns. Then came at the head of the main body the artillery with an infantry escort. All this might have been designed by the Japanese for the attack of some well-defined Russian position in the war of 1904. But in 1904 the Russians stood still, which was the last thing that the Revolutionary armies of 1794 would or could do. Souham, who commanded in the temporary absence of Pichegru, had formed his own plan. Finding himself with the major part of his forces between York and Clerfayt, he had decided to impose upon the former by means of a covering detachment, and to fall upon Clerfayt near Rousselaer with the bulk of his forces. But the appearance of fresh allied troops (Kinsky) on his right at once modified these arrangements. Divining Coburg's intentions from the arrival of the enemy near Pont-à-Marque and at Lannoy, he attempted a fresh concentration against the left flank of the columns on the move towards Tourcoing, which his weak centre (12,000 men at Tourcoing, Mouscron, Roubaix) was to stop by frontal defence. No rôle was as yet assigned to the principal mass (50,000 under hforeau) about Courtrai.



This second plan failed like the first, because the enemy's counter-will was not controlled—as Napoleon usually sought to ensure. All along the line Coburg's advance compelled the French to fight as they were without any redistribution. But the French were sufficiently elastic to adapt themselves readily to unforseen conditions, and at the end of the first day's operations, the "annihilation plan" of the Allies had already undergone a serious check. The archduke did not arrive at Orchies till dawn on the 17th, and had to halt there for rest and food. Thence, moving across country in fighting formation, he made his way no farther than Pont-&-Marque. Kinsky, after forcing the passage of the Marque at Bouvines, had made little headway in face of a French covering detachment. On the other flank, the right column (Hanoverians) under von dem Bussche, had been driven back from Mouscron. Only the duke of York and Otto had done their share in the centre, and they now stood at Mouvaux and Tourcoing respectively, isolated in the midst of the enemy's main body, with no hope of support from the other columns and no more than a chance of meeting Clerfayt, who had met an unexpected all-day check at Werwick. Coburg's entire force was, without deducting losses, no more than 53,000 for a front of 18m., and only half of the enemy's available 80,000 men had as yet been engaged. Matters did not, of course, present themselves in this light at Souham's headquarters, where the generals met in an informal council. The outposts, reinforced though they were from the main group, had everywhere been driven in, and the subordinate leaders sent in the most despondent reports. "Councils of war never fight" is an old maxim, justified in 99 cases in 100. But this council determined to do so, and with all possible vigour. The scheme was practically that which Coburg's first threat had produced and his first brusque advance had inhibited. Vandamme was to hold

Clerfayt, the garrison of Lille and a few outlying corps to occupy the archduke and Kinsky, and in the centre, Moreau and Bonnaud, with 40,000 effectives, were to attack the Tourcoing-Mouvaux position in front and flank at dawn with all possible energy.

Battle of **Tourcoing.**—The first shots were fired on the Lys, where Clerfayt's infantry had effected its crossing in the night. Vandamme's troops were, by the chance of a fatigue-enforced halt near Menin, massed on the flank of Clerfayt's subsequent line of advance. Vandamme used his advantage well. He attacked Clerfayt's columns as they moved on Lincelles with perhaps 12,000 men agninst 21,000. Clerfayt stopped at once, turned upon him and drove him towards Roncq and Menin. Still, fighting, rallying and fighting again, Vandamme's regiments managed to spin out time and to commit Clerfayt deeper and deeper to a false direction till it was too late in the day to influence the battle elsewhere. Von dem Bussche's column at Dottignies, still shaken from the day before, did nothing, and actually retreated to the Scheldt. On the other flank, Kinsky and the archduke Charles practically remained inactive. There remained the two centre columns, Otto's and the duke of York's. The orders of the emperor to the duke were that he should advance to establish communication with Clerfayt at Lincelles as a preliminary to a general advance to crush the French Courtrai group, thereby isolated. These airy schemes were destroyed at dawn on the 18th. One of Moreau's brigades carried Tourcoing at the first rush, another brigade swarmed round the duke of York's entrenchments at Mouvaux, while Bonnaud's mass from the side of Lille lapped round the flanks of the British posts at Roubaix and Lannoy. The duke had used up his reserves in assisting Otto, and by 8 A.M. the positions of Roubaix, Lannoy and Mouvaux were isolated from each other. But the Allies fought magnificently, and by now the Republicans were in confusion, excited to the highest pitch and therefore extremely sensitive to waves of enthusiasm or panic. Otto was able to retire gradually, though with heavy losses, to Leer , before he could be cut off, and thither the English fell back, not without confusion, to join him.

With the retreat of the two sorely tried columns and the suspension of Clerfayt's attack, the battle of Tourcoing ended. It was a victory of which the young French generals had reason to be proud. The main attack was vigorously conducted, and the two-to-one numerical superiority which the French possessed at the decisive point is the best testimony at once to Souham's generalship and to Vandamme's bravery. As for the Allies, those of them who took part in the battle at all, covered themselves with glory, but the inaction of two-thirds of Coburg's army was the bankruptcy declaration of the old strategical system. But Souham's victory, owing to his geographical position, had merely given him air. The Allies, except for the loss of some 5,500 men, were in no way worse off. The plan had failed, but the army as a whole had not been defeated, while the troops of the duke of York and Otto were far too well disciplined not to take their defeat as "all in the day's work." Souham was still on the Lys and midway between the two allied masses, able to strike each in turn or liable to be crushed between them in proportion as the opposing generals calculated time, space and endurance accurately. Souham, therefore, as early as the 19th, had left Bonnaud to hold the main body of the Allies on the side of Tournai, while he concentrated most of his forces towards Courtrai. This move had the desired effect, for Clerfayt retired without a contest, and on May 21 Souham issued his orders for an advance on Coburg's army, which, as he knew, had meantime been reinforced. Vandamme alone was left to face Clerfayt, and this time with outposts far out so as to ensure his chief, not a few hours', but two or three days', freedom from interference.

Pichegru now returned and took up the supreme command, Souham remaining in charge of his own and Moreau's divisions. On the extreme right, from Pont-à-Tressin, only demonstrations were to be made; the centre, between Baisieux and Estaimbourg, was to be the scene of the holding attack of Bonnaud's command, while Souham, in greater strength, delivered the decisive attack on the allied right by St. Leger and Warcoing. The battle opened in the early morning of the 22nd and was long and desperately contested. The demonstration on the French extreme right was soon recognized by the defenders to be negligible, and the allied left wing thereupon closed on the centre. There Bonnaud attacked with vigour, dislodging the Allies from Nechin. The defenders of Templeuve then fell back, and the attacking swarms—a dissolved line of battle—fringed the brook beyond Templeuve, on the other side of which was the Allies' main position, and even for a moment seized Blandain. Meanwhile the French at Nechin pressed on towards Ramegnies in concert with the main attack. Macdonald's and other brigades had forced the Espierre rivulet and driven von dem Bussche partly over the Scheldt, partly southward. The main front of the Allies was defined by the brook that flows between Templeuve and Blandain and empties into the Scheldt near Pont-&-Chin. Here, till close on nightfall, a fierce battle raged. Pichegru's main attack was still by his left, and Pont-&-Chin was taken and retaken by French, Austrians, British and Hanoverians in turn. Between Blandain and Pont-à-Chin Bonnaud's troops more than once entered the line of defence. But the attack was definitively broken off at nightfall and the Republicans withdrew slowly towards Lannoy and Leers. They had for the first time in a fiercely contested "soldier's battle" measured their strength, regiment for regiment, against the Allies, and failed, but by so narrow a margin that hencefor ward the Army of the North realized its own strength and solidity.

The Moselle Army.—But the actual strategic decision was destined by a process of evolution to be given by Jourdan's Army of the Moselle, to which we turn. The Army of the Moselle had been ordered to assemble a striking force on its left wing, whiie maintaining its cordon in Lorraine, and with this striking force to operate towards Liége and Namur. Its first movement on Arlon, in April, was repulsed, but early in May the advance was resumed though the troops were ill-equipped and ill-fed, and requisitions had reduced the civil population to semi-starvation and sullen bostility. At this moment the general situation east of the Scheldt was as follows: The Allies' centre under Coburg had captured Landrecies and now (May 4) lay around that place, about 65,000 strong, while the left under Kaunitz (27,000) was somewhat north of Maubeuge. Beyond these again were the detachment of Beaulieu (8,000) near Arlon, and another, 9,000 strong, around Trier. On the side of the French, the Army of the Moselle (41,000 effectives) was in cordon between Saargemünd and Longwy; the Army of the Ardennes (22,000) between Beaumont and Givet; of the Army of the North, the right wing (38,000) in the area Beaumont-Maubeuge and the centre (24,000) about Guise. In the aggregate the Allied field armies numbered 139,000 men, those of the French 203,000. Tactically the disproportion was sufficient to give the latter the victory, if, strategically, it could be made effective at a given time and place. But the French missed their opportunity, as Coburg had missed his in 1793. Pichegru's right was ordered to march on Mons, and his left to master the navigation of the Scheldt so as to reduce the Allies to wagon-drawn supplies, while Jourdan's task was to conquer the Liége or Namur country without unduly stripping the cordon on the Saar and the Moselle. Jourdan's orders and original purpose were to march through the Ardennes as rapidly as possible, living on what supplies he could pick up from the enemy or the inhabitants.

The movement began on May 21 from Longwy through Arlon towards Neufchbteau. Irregular fighting, sometimes with the Austrians, sometimes with the bitterly hostile inhabitants, marked its progress. On the 28th the French, after a vain détour made in the hope of forcing Beaulieu to fight, reached Ciney, and there heard that the enemy had fallen back to a strongly entrenched position on the east bank of the Meuse near Namur. Jourdan was preparing to attack them there, when considerations of quite another kind intervened to change his direction, and thereby to produce the drama of Charleroi and Fleurus—which military historians have asserted to be the foreseen result of the initial plan. At the same moment (29th) Jourdan received new orders from Paris—(a) to take Dinant and Charleroi and to clear the country between the Meuse and the Sambre, and (b) to attack Namur either by assault or by regular siege. From these orders and from the action of the enemy the campaign at last took a definite shape.

Charleroi.—When the Army of the Moselle passed over to the left bank of the Meuse, it was greeted by the distant roar of guns towards Charleroi and by news that the Army of the Ardennes, which had already twice been defeated by Kaunitz, was for the third time deeply and unsuccessfully engaged beyond the Sambre. The resumption of the march again complicated the supply question—for the system of "living on the country" had broken down in the Ardennes, and Jourdan had been dependent on intermittent convoys—and it was only slowly that the army advanced towards Charleroi. But at last, on June 3, the concentration of parts of three armies on the Sambre was effected. Jourdan took command of the united force (Army of the Sambre and Meuse) with a strong hand, the 40,000 newcomers inspired fresh courage in the beaten Ardennes troops, and in the sudden dominating enthusiasm of the moment pillaging and straggling almost ceased. Troops that had secured bread shared it with less fortunate comrades, and even the Liégois peasantry made free gifts of supplies. Meanwhile, Tourcoing and Tournai had at last convinced Coburg that Pichegru was his most threatening opponent, and he had therefore, though with many misgivings, decided to move towards his right, leaving the prince of Orange with not more than 45,000 men on the side of Maubeuge-Charleroi-Namur. Jourdan crossed the Sambre on June 12, practically unopposed. Charleroi was rapidly invested and the covering army extended in a semicircular position. Although forced to recross the Sambre on June 16, it was back again two days later, and this time the prince of Orange gave up the effort to interfere with his irrepressible antagonists.

Charleroi, garrisoned by less than 3,000 men, was intimidated into surrender (25th); thus the object of the first operations was achieved. As to the next, neither Jourdan nor the representatives seem to have had anything further in view than the capture of more fortresses. But within 24 hours events had decided for them. Coburg had quickly abandoned his intention of closing on his right wing, and (after the usual difficulties with his Allies on that side) had withdrawn 12,000 Austrians from the centre of his cordon opposite Pichegru, and made forced marches to join the prince of Orange. On June 24 he had collected 52,000 men at various points round Charleroi, and on the 25th he set out to relieve the fortress, of whose surrender he did not know until in the midst of the battle next day.

Fleurus.—On the 26th Jourdan's army (now some 73,000 strong) was still posted in a semicircle of entrenched posts, zom. in extent, round the captured town, but Coburg was still more widely extended. Inferior in numbers as he was, he proposed to attack on an equal front, and thus gave himself, for the attack of an entrenched position, an order of battle of three men to every two yards of front, all reserves included. The Allies were to attack in five columns, the prince of Orange from the west and north-west towards Trazegnies and Monceau wood, Quasdanovich from the north on Gosselies, Kaunitz from the north-east, the archduke Charles from the east through Fleurus, and finally Beaulieu towards Lambusart. The scheme was worked out in such minute detail and with so entire a disregard of the chance of unforeseen incidents, that once he had given the executive command to move, the Austrian general could do no more. If every detail worked out as planned, victory would be his; if accidents happened, he could do nothing to redress them, and unless these righted themselves (which was improbable in the case of the stiffly organized old armies) he could only send round the order to break off the action and retreat. In these circumstances the battle of Fleurus is the sum rather than the product of the various fights that took place between each allied column and the French division that it met. The prince of Orange attacked at earliest dawn and gradually drove in the French left wing to Courcelles, Roux and Marchiennes, but somewhat after noon, the French, under the direction for the most part of Kléber, began a series of counterstrokes which recovered the lost ground, and about five, without waiting for Coburg's instructions, the prince retired north-westward off the battlefield. The Quasdanovich column and part of Kaunitz's force pressed the French centre division back on Gosselies, but the brook west of Mellet was a serious obstacle to the rigid order of the Allies and had to be bridged before their guns could be got over, Kaunitz's column and Championnet's division met on the battlefield of 1690. The French were gradually driven in from the outlying villages to their main position between Heppignies and Wangenies. Here they were so hard pressed as to need the intervention of Jourdan's slender reserves, and the attackers only gave way to this counterstroke at the moment they received Coburg's orders for a general retreat.

On the allied left wing the fighting was closer and more severe than at any point. Beaulieu on the extreme left advanced upon Velaine and the woods to the south in several small groups of all arms. Here were the divisions of the Army of the Ardennes, markedly inferior in discipline and endurance to the rest, and only too mindful of their four previous reverses. For six hours, more or less, they resisted the oncoming Allies, but then, in spite of the example and the despairing appeals of their young general Marceau, they broke and fled, leaving Beaulieu free to combine with the archduke Charles, who carried Fleurus after obstinate fighting, and then pressed on towards Campinaire. Beaulieu took command of all the allied forces on this side about noon, and from then to 5 P.M. launched a series of terrible attacks on the French about Campinaire and Lambusart. The Austrians came on time after time over ground that was practically destitute of cover. Villages, farms and fields of corn caught fire. The French grew more and more excited—"No retreat to-day!" they called out to their leaders, and finally, clamouring to be led against the enemy, they had their wish. Lefebvre seized the psychological moment when the fourth attack of the Allies had failed, and (though he did not know it) the order to retreat had come from Coburg. The losses of the unit that delivered it were small, for the charge exactly responded to the moral conditions of the moment, but the proportion of killed to wounded (jj to 81) is good evidence of the intensity of the momentary conflict. So ended the battle. Coburg had by now learned definitely that Charleroi had surrendered, and while the issue of the battle was still doubtful—for though the prince of Orange was beaten, Beaulieu was in the full tide of success—he gave (towards 3 P.M.) the order for a general retreat. This was delivered to the various commanders between four and five, and these, having their men in hand even in the heat of the engagement, were able to break off the battle without undue confusion. The French were far too exhausted to pursue them (they had lost twice as many men as the Allies), and their leader had practically no formed body at hand to follow up the victory, thanks to the extraordinary dissemination of the army.

Tourcoing, Tournai and Fleurus represent the maximum result achievable under the earlier Revolutionary system of making war and show the men and their leaders at the highest point of combined steadiness and enthusiasm they ever reached—that is, as a "Sans-culotte" army. Fleurus was also the last great victory of the French, in point of time, prior to the advent of Bonaparte, and may therefore be considered as illustrating the general conditions of warfare at one of the most important points in its development. The sequel of these battles can be told in a few words. The Austrian government had, it is said, long ago decided to evacuate the Netherlands, and Coburg retired over the Meuse, practically unpursued, while the duke of York's forces fell back in good order, though pursued by Pichegru through Flanders. The English contingent embarked for home, the rest retired through Holland into Hanoverian territory, leaving the Dutch troops to surrender to the victors. The last phase of the pursuit reflected glory on Pichegru, for it was conducted in midwinter through a country bare of supplies and densely intersected with dykes and meres. The crowning incident was the dramatic capture of the Dutch fleet, frozen in at the Texel, by a handful of hussars who rode over the ice and browbeat the crews of the well-armed battleships into surrender. It was many years before a prince of Orange ruled again in the United provinces, while the Austrian whitecoats never again mounted guard in Brussels.

The Rhine campaign of 1794, waged chiefly by the Prussians, was not of great importance. Mollendorf won a victory at Kaiserslautern on May 23, but operations thereafter became spasmodic, and were soon complicated by Coburg's retreat over the Meuse. With this event the offensive of the Allies against the French Revolution came to an inglorious end. Poland now occupied the thoughts of European statesmen, and Austria began to draw her forces on to the east. England stopped the payment of subsidies and Prussia made the Peace of Basle on April j, 1795. On the Spanish frontier the French were successful in almost every encounter, and Spain, too, made peace. Only the eternal enemies, France and Austria, were left face to face on the Rhine, and elsewhere of all the Allies, Sardinia alone (see below under *The* War in Italy *1793–97*) continued the struggle in a half-hearted fashion. The operations of 1795 on the Rhine present no feature of the revolutionary wars that other and more interesting campaigns fail to show. Austria had two armies on foot under the general command of Clerfayt, one on the upper Rhine, the other south of the Main, while Mainz was held by an army of imperial contingents. The French, Jourdan on the lower, Pichegru on the upper, Rhine, had as usual superior numbers at their disposal. Jourdan combined a demonstrative frontal attack on Neuwied with an advance in force via Diisseldorf, reunited his wings beyond the river near Neuwied, and drove back the Austrians in a series of small engagements to the Main, while Pichegru passed at Mannheim and advanced towards the Neckar. But ere long both were beaten, Jourdan at Hochst and Pichegru at Mannheim, and the investment of Mainz had to be abandoned. This was followed by the invasion of the Palatinate by Clerfayt and the retreat of Jourdan to the Moselle. The position was further compromised by secret negotiations between Pichegru and the enemy for the restoration of the Bourbons. The meditated treason came to light early in the following year, and the guilty commander disappeared into the obscure ranks of the royalist secret agents till finally brought to justice in 1804.

THE CAMPAIGN OF 1796 IN GERMANY

The wonder of Europe now transferred itself from the drama of the French Revolution to the equally absorbing drama of a great war on the Rhine. France's policy was no longer defensive. She aimed at invading and "revolutionizing" the monarchies and principalities of old Europe, and to this end the campaign of 1796 was to be the great and conclusive effort. The "liberation of the oppressed" had its part in the decision, and the glory of freeing the serf easily merged itself in the glory of defeating the serf's masters. But a still more pressing motive for carrying the war into the enemy's country was the fact that France and the lands she had overrun could no longer subsist her armies. The Directory frankly told its generals, when they complained that their men were starving and ragged, that they would find plenty of subsistence beyond the Rhine. On her part, Austria, no longer fettered by allied contingents nor by the expenses of a far distant campaign, could put forth more strength than on former campaigns, and as war came nearer home and the citizen saw himself threatened by "revolutionizing" and devastating armies, he ceased to hamper or to swindle the troops. Thus the duel took place on the grandest scale then known in the history of European armies. Apart from the secondary theatre of Italy, the area embraced in the struggle was a vast triangle extending from Diisseldorf to Basle and thence to Ratisbon, and Carnot sketched the outlines in accordance with the scale of the picture. He imagined nothing less than the union of the armies of the Rhine and the Riviera before the walls of Vienna.

Jourdan and **Moreau.**—The scheme took shape only gradually. The first advance was made partly in search of food, partly to disengage the Palatinate, which Clerfayt had conquered in 1795. "If you have reason to believe that you would find some supplies on the Lahn, hasten thither with the greater part of your forces," wrote the Directory to Jourdan (Army of the Sambre-and-Meuse, 76,000) on March 29. He was to move at once, before the Austrians could concentrate, pass the Rhine at Dusseldorf and do his utmost to break them up completely. A fortnight later Moreau (Army of the Rhine-and-Moselle, 78,000) was ordered to take advantage of Jourdan's move, which would draw off the Austrian forces, to enter the Breisgau and Suabia. "You will attack Austria at home, and capture her magazines. You will enter a new country, the resources of which, properly handled, should suffice for the needs of the Army of the Rhine-and-Moselle." Jourdan, therefore, was to take upon himself the destruction of the enemy, Moreau the invasion of south Germany. Jourdan crossed at Ddsseldorf and reached the Lahn, but the Austrians, now commanded by the archduke Charles, concentrated against him very swiftly and he had to retire over the river. Still he enabled Moreau to cross at Strasbourg without much difficulty. On hearing of Moreau's progress, the archduke returned to the Neckar country with 20,000 men, leaving Wartensleben with 36,000 to observe Jourdan. In later years he admitted himself that his own force, weakened by the usual numerous detachments, was far too small to deal with Moreau, who, he probably thought, would retire after a few manoeuvres.

The Archduke's Plan. — But Carnot had indicated a decisive battle as the object. Jourdan was instructed, if the archduke turned on Moreau, to follow him up and bring him to action. Moreau, too, was not retreating but advancing. The two armies, Moreau's and the archduke's, met in a straggling and indecisive battle at Malsch on July 9, and soon afterwards Charles learned that Jourdan had recrossed the Rhine and was driving Wartensleben before him. He thereupon retired both armies from the Rhine valley into the interior, hoping that at least the French would detach large forces to besiege the river fortresses. Disappointed of this, he determined, in his own words: "to retire both armies step by step without committing himself to a battle, and to seize the first opportunity to unite them so as to throw himself with superior or at least equal strength on one of the two hostile enemies." This is the ever-recurring idea of "interior lines." It was not new, for C. Claudius Nero in the Metaurus campaign (207 B.C.) had given the earliest example, and Frederick the Great had used similar means in similar circumstances, as had Souham at Tourcoing and even Dampierre at Valenciennes. Nor was it differentiated, as were Bonaparte's operations in this same year, by the deliberate use of a small containing force at one point to obtain relative superiority at another. The point to be observed is not the expedient, which was dictated by the circumstances, but the courage of the young general, who, unlike Wartensleben and the rest of his generals, unlike, too, Moreau and Jourdan themselves, surmounted difficulties instead of lamenting them. On the other side, Carnot, of course, foresaw this possibility. He warned the generals not to allow the enemy to "use his forces sometimes against one, sometimes against the other, as he did in the last campaign," and ordered them to go forward respectively into Franconia and into the country of the upper Neckar, with a view to seeking out and defeating the enemy's army. But the plan of operations soon grew bolder. Jourdan was informed on July 21 that he was not to hesitate to advance to Ratisbon and even to Passau if the disorganization of the enemy admitted it, but in these contingencies he was to detach a force into Bohemia to levy contributions. "We presume that the enemy is too weak to offer a successful resistance and will have united his forces on the Danube; we hope that our two armies will act in unison to rout him completely. Each is, in any case, strong enough to attack by itself, and nothing is so pernicious as slowness in war." Evidently the fear that the two Austrian armies would unite against one of their assailants had now given place to something like disdain.

This was due in all probability to the rapidity with which Moreau was driving the archduke before him. Wartensleben was similarly falling back before Jourdan. Hitherto an independent leader, he resented the loss of his freedom of action, and beside lamentations opposed a dull passive resistance to all but the most formal orders of the prince. Many weeks passed before this was overcome sufficiently for his leader even to arrange for the contemplated combination, and in these weeks the archduke was being driven back day by day, and the German principalities were falling away one by one as the French advanced and preached the revolutionary formula. But their operating armies had seriously diminished in numbers, Jourdan disposing of not more than 45,000 and Moreau of about 50,000. The archduke had now, owing to the arrival of a few detachments from the Black Forest and elsewhere, about 34,000 men, Wartensleben almost exactly the same, and the former suddenly turned and fought a long, severe and straggling battle above Neresheim (Aug. 11). This did not, however, give him much respite, and on the 12th he began to retire over the Danube. At this date Wartensleben was about Amberg, almost as far away from the other army as he had been on the Rhine, owing to the necessity of retreating round instead of through the neutral principality of Bayreuth (Prussian). Hitherto Charles had intended to unite his armies on the Danube against Moreau. His later choice of Jourdan's army as the objective of his combination grew out of circumstances and in particular out of the brilliant reconnaissance work of one of Wartensleben's cavalry brigadiers, Nauendorff. This general's reports induced the archduke, on the 12th, to begin a concentration of his own army towards Ingolstadt; the 13th showed that the main columns of the French were swinging away to the east against Wartensleben's front and inner flanks, and on the 14th he boldly suggested the idea that decided the campaign, "If your Royal Highness will or can advance 12,000 men against Jourdan's rear, he is lost." When this message arrived at headquarters the archduke had already issued orders to the same effect. Latour, with 30,000 men, was to keep Moreau occupied—another expedient of the moment, due to the very close pressure of Moreau's advance, and the failure of the attempt to put him out of action at Neresheim. The small remainder of the army, with a few detachments gathered en route, in all about 27,000 men, began to recross the Danube on the 14th, and slowly advanced north on a broad front, its leader being now sure that at some point on his line he would encounter the French, whether they were heading for Ratisbon or Amberg. Meanwhile, the Directory, still acting on the theory of the archduke's weakness, had ordered Moreau to combine the operations with those of Bonaparte in Italian Tirol, and Jourdan to turn both flanks of his immediate opponent, and thus to prevent his joining the archduke, as well as his retreat into Bohemia. And, curiously enough, it was this latter, and not Moreau's move, which suggested to the archduke that his chance had come. The chance was, in fact, one dear to the 18th century general, catching his opponent in the act of executing a manoeuvre.

Amberg and Würzburg.—The decisive events of the campaign can be described very briefly, the ideas that directed them having been made clear. The long thin line of the archduke wrapped itself around Jourdan's right flank near Amberg, while Wartensleben fought him in front. The battle (Aug. 24) was a series of engagements between the various columns that met; it was a repetition in fact of Fleurus, without the intensity of fighting spirit that redeems that battle from dullness. Success followed, not upon bravery or even tactics, but upon the pre-existing strategical conditions. At the end of the day the French retired, and the next morning the archduke began another wide extension to his left, hoping to head them off. This consumed several days. In the course of it Jourdan attempted to take advantage of his opponent's dissemination to regain the direct road to Wiirzburg, but the attempt was defeated by an almost fortuitous combination of forces at the threatened point. More effective, indeed, than this indirect pursuit was the very active hostility of the peasantry, who had suffered in Jourdan's advance and retaliated so effectually during his retreat that the army became thoroughly demoralized, both by want of food and by the strain of incessant sniping. Defeated again at Würzburg (*q.v.*) on Sept. 3, Jourdan confined his retreat to the Lahn, and finally withdrew the shattered army over the Rhine. In the last engagement on the Lahn the young and brilliant Marceau was mortally wounded. Far away in Bavaria, Moreau had meantime been driving Latour from one line of resistance to another. On receiving the news of Jourdan's reverses, however, he made a rapid and successful retreat to Strasbourg, evading the prince's army, which had ascended the Rhine valley to head him off, in the nick of time.

This celebrated campaign raised the reputation of the archduke Charles to the highest point, and deservedly, for he wrested victory from the most desperate circumstances by the skilful and resolute employment of his one advantage. But this was only possible because Moreau and Jourdan were content to accept strategical failure without seeking to redress the balance by hard fighting. The great question of this campaign is, why did Moreau and Jourdan fail against inferior numbers, when in Italy Bonaparte with a similar army against a similar opponent won victory after victory against equal and superior forces? So far as it is possible to summarize the answer in one phrase, it lies in the fact that though the Directory meant this campaign to be the final word in the Revolutionary War, for the nation at large this final word had been said at Fleurus. In default of a cause, however, soldiers will fight for a man, and this brings us by a natural sequence of ideas to the war in Italy.

THE WAR IN ITALY 1793-97

Hitherto we have ignored the operations on the Italian frontier, partly because they were of minor importance and partly because the conditions out of which Bonaparte's first campaign arose can be best considered in connection with that campaign itself. It has been mentioned that in 1792 the French overran Savoy and Nice. In 1793 the Sardinian army and a small auxiliary corps of Austrians waged a desultory mountain warfare against the Army of the Alps about Briançon and the Army of Italy on the Var. That furious offensive on the part of the French, which signalized the year 1793 elsewhere, was made impossible here by the counter-revolution in the cities of the Midi. In 1794, when this had been crushed, the intention of the French government was to take the offensive against the Austro-Sardinians. The first operation was to be the capture of Oneglia. The concentration of large forces in the lower Rhone valley had naturally infringed upon the areas told off for the provisioning of the Armies of the Alps (Kellermann) and of Italy (Dumerbion); indeed, the sullen population could hardly be induced to feed the

troops suppressing the revolt, still less the distant frontier armies. Thus the only source of supply was the Riviera of Genoa: "Our connections with this district are imperilled by the corsairs of Oneglia (a Sardinian town) owing to the cessation of our operations afloat. The army is living from hand to mouth," wrote the younger Robespierre in Sept. 1793. Vessels bearing supplies from Genoa could not avoid the corsairs by taking the open sea, for there the British fleet was supreme. The Army of Italy began operations in April, and not only was Oneglia captured, but also the Col di Tenda. Napoleon Bonaparte served in these affairs on the headquarters staff. Meantime the Army of the Alps had possessed itself of the Little St. Bernard and Mont Cenis, and the Republicans were now (May) masters of several routes into Piedmont. But the Alpine roads merely led to fortresses, and both Carnot and Bonaparte—who had by now captivated the younger Robespierre and become the leading spirit in Dumerbion's army—considered that the Army of the Alps should be weakened to the profit of the Army of Italy, and that the time had come to disregard the feeble neutrality of Genoa, and to advance over the Col di Tenda.

Bonaparte in 1794.—Bonaparte's first suggestion for a rapid condensation of the French cordon, and an irresistible blow on the centre of the Allies by Tenda-Coni, came to nothing owing to the waste of time in negotiations between the generals and the distant Committee, and meanwhile new factors came into play. The capture of the pass of Argentera by the right wing of the Army of the Alps suggested that the main effort should be made against the barrier fortress of Demonte, but here again Bonaparte proposed a concentration of effort on the primary and economy of force in the secondary objective. About the same time, in a memoir on the war in general, he laid down his most celebrated maxim: "The principles of war are the same as those of a siege. Fire must be concentrated on one point, and as soon as the breach is made, the equilibrium is broken and the rest is nothing." These tactical ideas of concentration and breaking the equilibrium he had already carried into the sphere of policy and strategy on the same lines. "Austria is the great enemy; Austria crushed, Germany, Spain, Italy fall of themselves. We must not disperse, but concentrate our attack." Bonaparte argued that Austria could be effectively wounded by an offensive against Piedmont, and even more effectively by an ulterior advance from Italian soil into Germany. But the younger Robespierre perished with his brother in the coup *d'état* of 9th Thermidor, the advance was suspended, and Bonaparte, amongst other leading spirits of the Army of Italy, was arrested and imprisoned. Profiting by this moment, Austria increased her auxiliary corps, and the allied forces moved (in September) towards the Riviera. This threat to the French supplies was averted by the expedition of Dego, planned chiefly by Bonaparte, who had been released from prison and was at headquarters, though unemployed.

Schdrer and **Kellermann.**—In November 1794, Dumerbion was replaced by Schérer, who was soon transferred to the Spanish frontier, while the plan he left, as limited in scope as in force, was never put into execution, for spring had scarcely arrived when the prospect of renewed revolts in the south of France practically paralysed the army. This encouraged the enemy to deliver the blow that had so long been feared. Their combined forces, the Sardinians, the Austrian auxiliary corps and the newly arrived Austrian main army, advanced together and forced the French right wing to evacuate Vado and the Genoese littoral. But at this juncture the conclusion of peace with Spain released the Pyrenees armies, and Schérer returned to the Army of Italy at the head of reinforcements. He was faced with a difficult situation, but he had the means wherewith to meet it, as Bonaparte promptly pointed out. Up to this time, Bonaparte said, the French commanded the mountain crest, and therefore covered Savoy and Nice, and also Oneglia, Loano and Vado, the ports of the Riviera. But now that Vado was lost the breach was made. Genoa was cut off, and the south of France was the only remaining resource for the army commissariat. Vado must therefore be retaken and the line reopened to Genoa. But Bonaparte's mind ranged beyond the immediate future. He calculated that if the French advanced into the interior by the road Savona-Ceva, the Austrians would seek to cover Lombardy, the Piedmontese Turin, and this separation, already morally accomplished, it was to be the French general's task to accentuate in fact. Next, Sardinia having been coerced into peace, the Army of Italy would expel the Austrians from Lombardy and connect its operations with those of the French in South Germany by way of Tirol. The supply question, once the soldiers had gained the rich valley of the Po, would solve itself.

Loano.—This was the essence of the first of four memoranda on this subject prepared by Bonaparte in his Paris office. The second indicated the means of coercing Sardinia—first the Austrians were to be driven or scared away towards Alessandria, then the French army would turn sharp to the left, driving the Sardinians eastward and north-eastward through Ceva, and this was to be the signal for the general invasion of Piedmont from all sides. In the third paper he framed an elaborate plan for the retaking of Vado, and in the fourth he summarized the contents of the other three. Having thus cleared his own mind as to the conditions and the solution of the problem, he did his best to secure the command for himself. The measures recommended by Bonaparte were translated into a formal and detailed order to recapture Vado. To Bonaparte the miserable condition of the Army of Italy was the most urgent incentive to prompt action. In Schérer's judgment, however, the army was unfit to take the field, and therefore ex hypothesi to attack Vado, without thorough reorganization, and it was only in November that the advance was finally made. It culminated, thanks once more to the resolute Masséna, in the victory of Loano (Nov. 23–24). But Schérer thought more of the destitution of his own army than of the fruits of success, and contented himself with resuming possession of the Riviera. Meanwhile the mentor, whose suggestions and personality were equally repugnant to Schérer, had undergone strange vicissitudes of fortune—dismissal from the headquarters staff, expulsion from the list of general officers, and then the "whiff of grapeshot" of 13th Vendémiaire, followed shortly by his marriage with Josephine, and his nomination to command the Army of Italy. These events had neither shaken his cold resolution nor disturbed his balance.

Napoleon in Command.—The Army of Italy spent the winter of 1795–96 as before in the narrow Riviera, while on the one side, just over the mountains, lay the Austro-Sardinians, and on the other, out of range of the coast batteries but ready to pounce on the supply ships, were the British frigates. On Bonaparte's left Kellermann, with no more than 18,000, maintained a string of posts between Lake Geneva and the Argentera as before. Of the Army of Italy 10,000 watched the Tenda road and 12,000 the coast line. There remained for active operations some 27,000 men, ragged, famished and suffering in every way in spite of their victory of Loano. The Sardinian and Austrian auxiliaries (Colli), 25,000 men, lay between Mondovi and Ceva; a force strung out in the Alpine valleys opposed Kellermann; and the main Austrian army (commanded by Beaulieu) in widely extended cantonments between Acqui and Milan, numbered 30,000 field troops. Thus the short-lived concentration of all the allied forces for the battle against Schérer had ended in a fresh separation. Austria was far more concerned with Poland than with the moribund French question, and committed as few of her troops as possible to this distant and secondary theatre of war. As for Piedmont, "peace" was almost the universal cry, even within the army. All this scarcely affected the regimental spirit and discipline of the Austrian squadrons and battalions, which had now recovered from the defeat of Loano. But they were important factors for the new general-in-chief on the Riviera, and formed the basis of his strategy.

Bonaparte's first task was to grasp the reins and to prepare his troops, morally and physically, for active work. It was not merely that a young general with many enemies, a political favourite of the moment, had been thrust upon the army. The army itself was in a pitiable condition. Whole companies with their officers went plundering in search of mere food, the horses had never received as much as half-rations for a year past, and even the generals were half-starved. Thousands of men were barefooted and hundreds were without arms. But in a few days he had secured an almost incredible ascendancy over the sullen, starved, half-clothed army.

"Soldiers," he told them, "you are famished and nearly naked. The government owes you much, but can do nothing for you. Your patience, your courage, do you honour, but give you no glory, no advantage. I will lead you into the most fertile plains of the world. There you will find great towns, rich provinces. There you will find honour, glory and riches. Soldiers of the Army of Italy, will you be wanting in courage?"

He augmented his army of operations to about 40,000, at the expense of the coast divisions, and set on foot also two small cavalry divisions, mounted on the half-starved horses that had survived the winter. Then he announced that the army was ready and opened the campaign. If the present separation of the Allies continued, he proposed to overwhelm the Sardinians first, before the Austrians could assemble from winter quarters, and then to turn on Beaulieu. If, on the other hand, the Austrians, before he could strike his blow, united with Colli, he proposed to frighten them into separating again by moving on Acqui and Alessandria. Hence Carcare, where the road from Acqui joined the "cannon-road" over the Apennines to Ceva, was the first objective of his march, and from there he could manoeuvre and widen the breach between the allied armies. His scattered left wing would assist in the attack on the Sardinians as well as it could—for the immediate attack on the Austrians its co-operation would of course have been out of the question. In any case he grudged every week spent in administrative preparation. The delay due to this, as a matter of fact, allowed a new situation to develop. Beaulieu was himself the first to move, and he moved towards Genoa instead of towards his Allies. The gap between the two allied wings was thereby widened, but it was no longer possible for the French to use it, for their plan of destroying Colli *while Beaulieu was ineffective* had collapsed.

In connection with a plan for a Genoese loan, and to facilitate the movement of supply convoys, a small French force had been pushed forward to Voltri. Bonaparte ordered it back as soon as he arrived at the front, but the alarm was given. The Austrians broke up from winter quarters at once, and rather than lose the food supplies at Voltri, Bonaparte actually reinforced Masséna at that place, and gave him orders to hold on as long as possible, cautioning him only to watch his left rear (Montenotte). But he did not abandon his purpose. Starting from the new conditions, he devised other means, as we shall see, for reducing Beaulieu to ineffectiveness. The French advance to Voltri had not only spurred Beaulieu into activity, but convinced him that the bulk of the French army lay east of Savona. He therefore made Voltri the object of a converging attack, not with the intention of destroying the French army but with that of "cutting its communications with Genoa and expelling it from the only place in the Riviera where there were sufficient ovens to bake its bread." As the Sardinians and auxiliary Austrians were ordered to extend leftwards on Dego to close the gap that Beaulieu's advance on Genoa-Voltri opened up, and the furthest to the right of Beaulieu's own columns had orders to seize Monte Legino, the wings were therefore so far connected that Colli wrote to Beaulieu on this day "the enemy will never dare to place himself between our two armies." The event belied the prediction, and the proposed minor operation against granaries and bakeries became the first act of a decisive campaign.

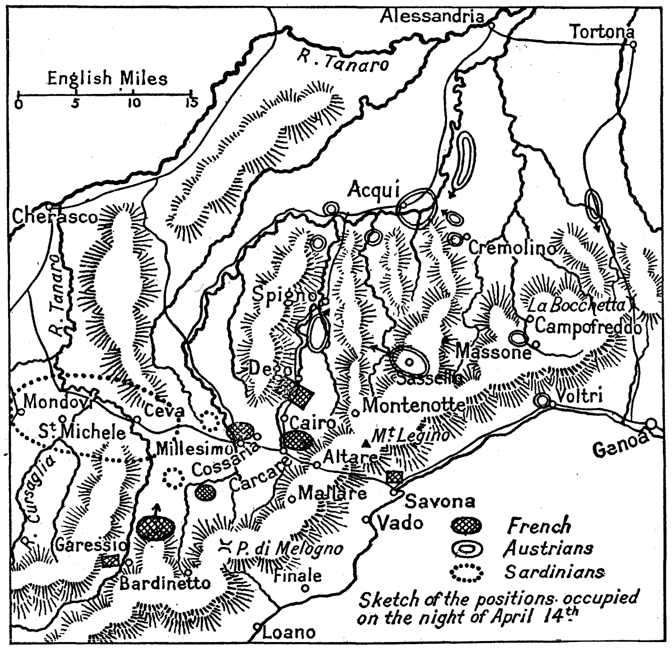
On the night of April 9 the French were grouped as follows: brigades under Garnier and Macquard at the Finestre and Tenda passes, Sérurier's division and Rusca's brigade east of Garessio; Augereau's division about Loano, Meynier's at Finale, Laharpe's at Savona with an outpost on the Monte Legino, and Cervoni's brigade at Voltri. Masséna was in general charge of the last-named units. The cavalry was far in rear beyond Loano. Colli's main force was around Coni and Mondovi-Ceva, the latter group connecting with Beaulieu by a detachment under Provera between Millesimo and Carcare. Of Beaulieu's army, Argenteau's division, still concentrating to the front in many small bodies, extended over the area Acqui-Dego-Sassello. Vukassovich's brigade was equally extended between Ovada and the mountain-crests above Voltri, and Pittoni's division was grouped around Gavi and the Bocchetta, the two last units being destined for the attack on Voltri. Farther to the rear was Sebottendorf's division around Alessandria-Tortona. On the afternoon of the 10th Beaulieu delivered his blow at Voltri, not, as he anticipated, against three-quarters of the French army, but against Cervoni's detachment. This, after a long irregular fight, slipped away in the night to Savona. Discovering his mistake next morning, Beaulieu sent back some of his battalions to join Argenteau. But there was no road by which they could do so save the détour through Acqui and Dego, and long before they arrived Argenteau's advance on Monte Legino had forced on the crisis. On the 11th (a day behind time), this general drove in the French outposts, but he soon came on three battalions under Col. Rampon, who threw himself into some old earthworks that lay near, and said to his men, "We must win or die here, my friends." His redoubt and his men stood the trial well, and when day broke on the 12th Bonaparte was ready to deliver his first "Napoleon-stroke."

Montenotte.—The principle that guided him in the subsequent operations may be called that of "concentrating a temporary superiority of force at the point of balance." Touch had been gained with the enemy all along the long line between the Tenda and Voltri, and he decided to concentrate swiftly upon the nearest enemy—Argenteau. Augereau's division, or such part of it as could march at once, was ordered to Mallare. Masséna, with 9,000 men, was to send two brigades in the direction of Carcare and Altare, and with the third to swing round Argenteau's right and to head for Montenotte village in his rear. Laharpe with 7.000 (it had become clear that the enemy at Voltri would not pursue their advantage) was to join Rampon, leaving only Cervoni and two battalions in Savona. Sérurier and Rusca were to keep the Sardinians in front of them occupied. The far-distant brigades of Garnier and Macquard stood fast, but the cavalry drew eastward as quickly as its condition permitted. In rain and mist on the early morning of the 12th the French marched up from all quarters, while Argenteau's men waited in their cold bivouacs for light enough to resume their attack on Monte Legino. About nine the mists cleared, and heavy fighting began, but Laharpe held the mountain, and Masséna with his nearest brigade stormed forward against Argenteau's right. A few hours later, seeing Augereau's columns heading for their line of retreat, the Austrians retired, sharply pressed, on Dego. The threatened intervention of Provera was checked by Augereau's presence at Carcare.

Montenotte was a brilliant little victory, and one can imagine its effects on the but lately despondent soldiers of the Army of Italy, but only two-thirds of Argenteau's force, and none of the other divisions, had been beaten, and the heaviest fighting was to come. Bonaparte, eager to begin at once the subjugation of the Piedmontese (for which purpose he wanted to bring Sérurier and Rusca into play) sent only Laharpe's division and a few details of Masséna's, under the latter, towards Dego. These were to protect the main attack from interference by the forces that had been engaged at Montenotte (imagined to be Beaulieu's main body), the said main attack being delivered by Augereau's division, reinforced by most of Masséna's, on the positions held by Provera. The latter, only 1,000 strong to Augereau's 9,000, shut himself in the castle of Cossaria, which, imitating Rampon, he defended against a series of furious assaults. Kot until the morning of the 14th was his surrender secured, after his ammunition and food had been exhausted.

Argenteau also won a day's respite on the 13th, for Laharpe did not join Masséna till late, and nothing took place opposite Dego but a little skirmishing. During the day Bonaparte saw for himself that he had overrated the effects of Montenotte. Beaulieu, on the other hand, underrated them, treating it as a mishap that was more than counterbalanced by his own success in "cutting off the French from Genoa." He began to reconstruct his line on the front Dego-Sassello, trusting to Colli to harry the French until the Voltri troops had finished their détour through Acqui and rejoined Argenteau. This, of course, presumed that Argenteau's troops were intact and Colli's able to move, which was not the case with either. Not until the afternoon of the 14th did Beaulieu place a few extra battalions at Argenteau's disposal "to be used only in case of extreme necessity," and order Vukassovich from the region of Sassello to "make a diversion" against the French right with *two* battalions.

Dego.—Thus Argenteau, already shaken, was exposed to destruction. On the 14th, after Provera's surrender, Masséna and Laharpe, reinforced until they had nearly a two-to-one superiority, stormed Dego and killed or captured 3,000 of Argenteau's 5,500 men, the remnant retreating in disorder to Acqui. But nothing was done towards the accomplishment of the purpose of destroying Colli on that day, save that Sérurier and Rusca began to close in to meet the main body between Ceva and Millesimo. Bloreover, the victory at Dego had produced its usual results on the wild fighting swarms of the Republicans, who threw themselves like hungry wolves on the little town, without pursuing the beaten enemy or even placing a single outpost on the Acqui road. In this state, during the early hours of the 15th, Vukassovich's



brigade,[1] marching up from Sassello, surprised them, and they broke and fled in an instant. The whole morning had to be spent in rallying them at Cairo, and Bonaparte had for the second time to postpone his union with Sérurier and Rusca, who meanwhile, isolated from one another and from the main army, were groping forward in the mountains. A fresh assault on Dego was ordered, and after very severe fighting, Masséna and Laharpe sutceeded late in the evening in retaking it. Vukassovich lost heavily, but retired steadily and in order on Spigno. The killed and wounded numbered probably about 1,000 French and 1,500 Austrians, out of considerably less than 10,000 engaged on each side—a loss which contrasted very forcibly with those suffered in other battles of the Revolutionary Wars, and by teaching the Army of Italy to bear punishment, imbued it with self-confidence. But again success bred disorder, and there was a second orgy in the houses and streets of Dego which went on till late in the morning and paralysed the whole army.

This was perhaps the crisis of the campaign. Even now it was not certain that the Austrians had been definitively pushed aside, while it was quite clear that Beaulieu's main body was intact and Colli was still more an unknown quantity. But Bonaparte's intention remained the same, to attack the Piedmontese as quickly and as heavily as possible, Beaulieu being held in check by a containing force under Masséna and Laharpe. The remainder of the army, counting in now Rusca and Sérurier, was to move westward towards Ceva. This disposition, while it illustrates the Napoleonic principle of delivering a heavy blow on the selected target and warding off interference at other points, shows also the difficulty of rightly apportioning the available means between the offensive mass and the defensive system, for, as it turned out, Beaulieu was already sufficiently scared, and thought of nothing but self-defence on the line Acqui-Ovada-Bocchetta, while the French offensive mass was very weak compared with Colli's unbeaten and now fairly concentrated army about Ceva.

On the afternoon of the 16th the real avalanche was begun by Augereau's division, reinforced by other troops. Rusca joined Augereau towards evening, and Sérurier approached Ceva from the south. Colli's object was now to spin out time, and having repulsed a weak attack by Augereau, and feeling able to repeat these tactics on each successive spur of the Apennines, he retired in the night to a new position behind the Cursaglia. On the 17th, reassured by the absence of fighting on the Dego side, and by the news that no enemy remained at Sassello, Bonaparte released Masséna from Dego, leaving only Laharpe there, and brought him over towards the right of the main body, which thus on the evening of the 17th formed a long straggling line on both sides of Ceva, Sérurier on the left, écheloned forward, Augereau, Joubert and Rusca in the centre, and Masséna, partly as support, partly as flank guard, on Augereau's right rear. Sérurier had been bidden to extend well out and to strive to get contact with Masséna, *i.e.,* to encircle the enemy. The line of supply, as an extra guarantee against interference, was changed from that of Savona-Carcare to that of Loano-Bardinetto. When this was accomplished, four clear days could be reckoned with certainty in which to deal with Colli.

The latter, still expecting the Austrians to advance to his assistance, had established his corps (not more than 12,000 muskets in all) in the immensely strong positions of the Cursaglia. Opposite this position the French arrived, after many delays due to the weariness of the troops, on the 19th. A day of irregular fighting followed, everywhere to the advantage of the defenders. Bonaparte, fighting against time, ordered a fresh attack on the 20th, and only desisted when it became evident that the army was exhausted, and, in particular, when Sérurier reported frankly that without bread the soldiers would not march. The delay thus imposed, however, enabled him to clear the "cannon-road" of all vehicles, and to bring up the Dego detachment to replace Masséna in the valley of the western Bormida, the latter coming in to the main army. Twenty-four thousand men, for the first time with a due proportion of cavalry and artillery, were now disposed along Colli's front and beyond his right flank. Colli, outnumbered by two to one, and threatened with envelopment, decided once more to retreat, and the Republicans occupied the Cursaglia lines on the morning of the 21st without firing a shot. But Colli halted again at Vico, half-way to Mondovi, and while he was in this unfavourable situation the pursuers came on with true Republican swiftness, lapped round his flanks and crushed him. A few days later (April 27), the armistice of Cherasco put an end to the campaign before the Austrians moved a single battalion to his assistance.

The Napoleon Touch.—The interest of the campaign lies in the "Napoleon touch" that differentiated it from other Revolutionary campaigns. Revolutionary energy was common to the Army of Italy and to the Army of the North. Why, therefore, when the war dragged on from one campaign to another in the great plains of the Meuse and Rhine countries, did Bonaparte bring about so swift a decision in these cramped valleys? The answer is to be found partly in the exigencies of the supply service, but still more in Bonaparte's own personality and the strategy born of it. Action of some sort was the plain alternative to starvation. He would have no quarter-rations on the Riviera, but plenty and to spare beyond the mountains. Strategical conditions and "new French" methods of war did not save Bonaparte in the two crises—the Dego rout and the sullen halt of the army at San Michele—but the personality which made the soldiers, on the way to Montenotte, march barefoot past a wagon-load of new boots. Later critics evolved from his success the theory of "interior lines," but actually the method was in many respects old. What, therefore, in the theory or its application was the product of Bonaparte's own genius and will? A comparison with Souham's campaign of Tourcoing will enable us to answer this question. To begin with, Souham found himself midway between Coburg and Clerfayt almost by accident, and his utilization of the advantages of his position was an expedient for the given case. Bonaparte, however, placed himself deliberately in an analogous situation at Carcare and Cairo. Then he swifty "concentrated fire, made the breach, and broke the equilibrium" at the spot where the interests and forces of the two allies converged and diverged.

[1] Vukassovich had'received Beaulieu's order to demonstrate with two battalions, and also appeals for help from Argenteau. He therefore brought most of his troops with him.

Relative Superiority.— Another guiding idea was that of "relative superiority." Whereas Souham had been in superior force (90,000 against 70,000), Bonaparte (40,000 against 50,000) was not, and yet the Army of Italy was always placed in a position of relative superiority (at first about 3 to 2 and ultimately 2 to 1) to the immediate antagonist. "The essence of strategy," said Bonaparte in 1797, "is, with a weaker army, always to have more force at the crucial point than the enemy. But this art is taught neither by books nor by practice: it is a matter of tact." In this he expressed the result of his victories on his own mind rather than a preconceived formula which produced those victories. But the idea, though undefined, and the method of practice, though imperfectly worked out, were in his mind from the first. As soon as he had made the breach, though preparing to throw all available forces against Colli, he posted Masséna and Laharpe at Dego to guard, not like Vandamme on the Lys against a real and pressing enemy, but against a *possibility*, and he only diminished the strength and altered the position of this protective detachment in proportion as the Austrian danger dwindled Later in his career he defined this system as "having all possible strength at the decisive point," and "being nowhere vulnerable," and the art of reconciling these two requirements, in each case as it arose, was always the principal secret of his generalship At first his precautions (judged by events and not by the probabilities of the moment) were excessive, and the offensive mass small But the point is that such a system, however rough its first model, had been imagined and put into practice.

The first phase of the campaign satisfactorily settled, Bonaparte was free to turn his attention to the "arch-enemy" to whom he was now considerably superior in numbers (35,000 to 2; 000). The day after the signature of the armistice of Cherasco he began preparing for a new advance and also for the rôle of arbiter of the destinies of Italy. Beaulieu had fallen back into Lombardy, and now bordered the Po right and left of Valenza. To achieve further progress, Bonaparte had first to cross that river, and the point and method of crossing was the immediate problem, a problem the more difficult as he had no bridge train and could only make use of such existing bridges as he could seize intact If he crossed above Valenza he would be confronted by one river-line after another. Milan was his objective, and Tortona-Piacenza his indirect route thither To give himself every chance he had stipulated with the Piedmontese authorities for the right of passing at Valenza. and he had the satisfaction of seeing Beaulieu fall into the trap and concentrate opposite that part of the river. The French meantime had moved to the region Alessandria-Tortona. Thence on May 6 Bonaparte set out for a forced march on Piacenza, and that night the advanced guard was 30m. on the way, at Castel San Giovanni, and Laharpe's and the cavalry divisions at Stradella, 10m. behind them. Augereau was at Broni, Masséna at Salo and Sérurier near Valenza, the whole forming a rapidly extending fan. jom. from point to point. If the Piacenza detachment succeeded in crossing, the army was to follow rapidly in its track. If, on the other hand, Beaulieu fell back to oppose the advanced guard, the Valenza divisions would take advantage of his absence to cross there. In either case, be it observed, the Austrians were to be evaded, not brought to action. On the 7th, the advanced guard under Dallemagne crossed at Piacenza,' and, hearing of this, Bonaparte ordered every division except Sérurier's thither with all possible speed. In the exultation of the moment he mocked at Beaulieu's incapacity, but the old Austrian was already on the alert. This game of manoeuvres he understood; already one of his divisions had arrived in close proximity to Dallemagne and the others were marching eastward by all available roads. But the mobility of the French enabled them to pass the river before the Austrians (who had actually started a day in advance of them) put in an appearance, and afterwards to be in superior numbers at each point of contact. The culmination Bonaparte himself indicated as the turning-point of his life. "Vendémiaire and even Montenotte did not make me think myself a superior being It was after Lodi that the idea came to me . . . that first kindled the spark of boundless ambition "

Lodi.—Abandoning his original idea of giving battle, Beaulieu retired to the Adda, and most of his troops were safely beyond it before the French arrived near Lodi, but he felt it necessary to leave a strong rearguard on the river opposite that place to cover the reassembly of his columns after their scattered march. On the afternoon of May 10, Bonaparte, with Dallemagne, Masséna and Augereau, came up and seized the town. But 200yds. of open ground had to be passed from the town gate to the bridge, and the bridge itself was another 250yds. in length. A few hundred yards beyond it stood the Austrians, 9,000 strong with 14 guns. Bonaparte brought up all his guns to prevent the enemy from destroying the bridge. Then sending all his cavalry to turn the enemy's right by a ford above the town, he waited two hours, employing the time in cannonading the Austrian lines, resting his advanced infantry and closing up Masséna's and Augereau's divisions. Finally he gave the order to Dallemagne's 4,000 grenadiers, who were drawn up under cover of the town wall, to rush the bridge. As the column, not more than 30 men broad, made its appearance, it was met by the concentrated fire of the Austrian guns, and half way across the bridge it checked, but Bonaparte himself and Masséna rushed forward, the courage of the soldiers revived, and, while some jumped off the bridge and scrambled forward in the shallow water, the remainder stormed on, passed through the guns and drove back the infantry This was, in bare outline, the astounding passage of the bridge of Lodi It was not till after the battle that Bonaparte realized that only a rearguard was in front of him. When he launched his 4,000 grenadiers he thought that on the other side there were four or five times that number of the enemy No aonder, then, that after the event he recognized in himself the flash of genius, the courage to risk everything, and the "tact" which, independent of and indeed contrary to all reasoned calculations, told him that the moment had come for "breaking the equilibrium," Lodi was a tactical success in the highest sense, in that the principles of his tactics rested on psychology—on the "sublime" part of the art of war as Saxe had called it long ago. The spirit produced the form, and Lodi was the prototype of the Napoleonic battle—contact, manoeuvre, preparation and finally the well-timed, massed and unhesitating assault. The failure to reap the strategical fruits mattered little Many months elapsed before this bold assertion of superiority ceased to decide the battles of France and Austria.

Milan.—Next day he set off in pursuit of Beaulieu, postponing his occupation of the Milanese, but the Austrians were now out of reach, and during the next few days the French divisions were installed at various points in the area Pavia-Milan-Pizzighetone, facing outwards in all dangerous directions, with a central reserve at Milan. Thus secured, Bonaparte turned his attention to political and military administration. This took the form of exacting from the neighbouring princes money, supplies and objects of art, and the once famished Army of Italy revelled in its opportunity. Now, however, the Directory, suspicious of the too successful and too sanguine young general, ordered him to turn over the command in Upper Italy to Kellermann, and to take an expeditionary corps himself into the heart of the peninsula, there to preach the Republic and the overthrow of princes Bonaparte absolutely refused, and offered his resignation In the end (partly by bribery) he prevailed, but the incident reawakened his desire to close with Beaulieu. This indeed he could now do with a free hand, since not only had the Milanese been effectively occupied, but also the treaty with Sardinia had been ratified. But no sooner had he resumed the advance than it was interrupted by a rising of the peasantry in his rear. The exactions of the French had in a few days generated sparks of discontent nhich it was easy for the priests and the nobles to fan into open flames Milan and Pavia as well as the countryside broke into insurrection, and at the latter place the mob forced the French commandant to surrender. Bonaparte acted swiftly and ruthlessly. Bringing back a small portion of the army with him, he

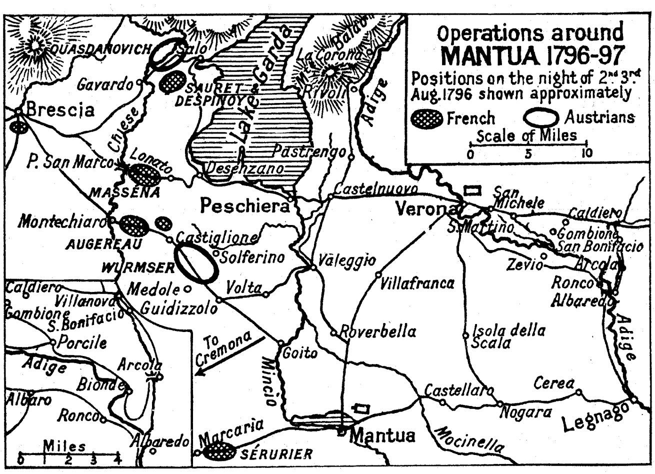
[1]On entering the territory of the duke of Parma, Bonaparte imposed, besides other contributions, the surrender of 20 famous pictures, and thus began a practice which for many years enriched the Louvre and only ceased with the capture of Paris in 1814.

punished Milan on the 25th, sacked and burned Binasco on the 26th, and on the evening of the latter day, while his cavalry swept the open country, he broke his way into Pavia with 1,500 men and beat down all resistance. Then he advanced to the banks of the Mincio, where the remainder of the Italian campaign was fought out, both sides contemptuously disregarding Venetian neutrality. It centred on the fortress of Mantua, which Beaulieu, too weak to keep the field, and dislodged from the Mincio in the action of Borghetto (May 30), strongly garrisoned before retiring into Tirol. Beaulieu was soon afterwards replaced by Wurmser who brought reinforcements from Germany.

At this point, mindful of the narrow escape he had had of losing his command, Bonaparte thought it well to begin the resettlement of Italy. The scheme for co-operating with Moreau on the Danube was indefinitely postponed, and the Army of Italy (now reinforced from the Army of the Alps) was again disposed in a protective "zone of manoeuvre." with a strong central reserve. Against hlantua no siege artillery was available till the Austrians in the citadel of Milan capitulated, and thus not till July 18 was the first parallel begun Almost at the same moment Rurmser began his advance from Trent with 55,000 men to relieve Mantua.

Siege of **Mantua.**—The protective system on which his attack would fall in the first instance was now as follows: Augereau (6,000) about Legnago, Despinoy (8,000) south-east of Verona, Masséna (13,000) at Verona and Peschiera, Sauret (4,500) at Salo and Gavardo Sérurier (12,000) was besieging Mantua, and the only central reserve was the cavalry (2 000) under Kilmaine. The main road to Milan passed by Brescia. Sauret's brigade, therefore, was practically a detached post on the line of communication, and on the main defensive front less than 30,000 men were disposed at various points between La Corona and Legnago (30m. apart), and at a distance of 1j to 20m. from Mantua. The strength of such a disposition depended on the fighting power and handiness of the troops, who in each case would be called upon to act as a rearguard to gain time. The lie of the country scarcely permitted a closer grouping, unless Bonaparte fell back on the old-time device of a "circumvallation." and shut himself up in a ring of earthworks round Mantua —and this was impossible for want of supplies.

As Wurmser's attack procedure has received almost universal condemnation, in justice it may be pointed out that the object of the expedition was not to win a battle by falling on the disunited French with a well-concentrated army, but to overpower



one, any one, of the corps covering the siege, and to press straight forward to the relief of Mantua. New ideas and new forces, undiscernible to a man of 72 years of age, obliterated his achievement by surpassing it; but such as it was—a limited use of force for a limited object—the venture undeniably succeeded.

The Austrians formed three corps, one (Quasdanovich, 18,000 men) marching round the west side of the lake of Garda. the second (under Wurmser, about 30,000) moving directly down the Adige, and the third (Davidovich, 6,000) making a détour by the Brenta valley and heading for Verona by Vicenza. On the 29th Quasdanovich attacked Sauret at Salo, drove him towards Desenzano, and pushed on to Gavardo and thence into Brescia. Wurmser expelled Masséna's advanced guard from La Corona, and captured in succession the Monte Baldo and Rivoli posts. The Brenta column approached Verona with little or no fighting. News of this column led Bonaparte early in the day to close up Despinoy, Masséna and Kilmaine at Castelnuovo; and to order Augereau from Legnago to advance on Montebello (19m. east of Verona) against Davidovich's left rear. But after these orders had been despatched came the news of Sauret's defeat, and this moment was one of the most anxious in Bonaparte's career. He could not make up his mind to give up the siege of Mantua, but he hurried Augereau back to the Mincio, and sent order after order to the officers on the lines of communication to send all convoys by the Cremona instead of by the Brescia road. More, he wrote to Sérurier a despatch which included the words "perhaps we shall recover ourselves . . . but I must take serious measures for a retreat." On the 30th he wrote: "The enemy have broken through our line in three places . . . and . . . captured Brescia. You see that our communications with Milan and Verona are cut." Early reports that day enabled him to "place" the main body of the enemy opposite Masséna, and this at least helped to make his course less doubtful. Augereau was ordered to hold the line of the Molinella, in case Davidovich's attack, the least-known factor, should after all prove to be serious: Masséna to hold Wurmser at Castelnuovo as long as he could. Sauret and Despinoy were concentrated at Desenzano with orders on the 31st to clear the main line of retreat and to recapture Brescia. On the Austrian side Quasdanovich wheeled inwards, his right finally resting on Montechiaro and his left on Salo, and Wurmser drove back Masséna to the west side of the Mincio. Davidovich made a slight advance.

In the late evening Bonaparte held a council of war at Roverbella. The proceedings of this council are unknown, but it at any rate enabled Bonaparte to see clearly and to act. Hitherto he had been covering the siege of Mantua with various detachments, the defeat of any one of which might be fatal to the enterprise. Thus, when he had lost his main line of retreat, he could assemble no more than 8,000 men at Desenzano to win it back. Now, however, he made up his mind that the siege could not be continued, and bitter as was the decision, it gave him freedom. At this moment of crisis the instincts of the great captain came into play, and showed the way to a victory that would more than counterbalance the now inevitable failure. Sérurier was ordered to spike the 140 siege guns which had been so welcome a few days before, and, after sending part of his force to Augereau, to establish himself with the rest at Marcaria on the Cremona road. The field forces were to be used on interior lines. On the 31st Sauret, Despinoy, Augereau and Kilmaine advanced westward against Quasdanovich. The first two found the Austrians at Salo and Lonato and drove them back, while with Augereau and the cavalry Bonaparte himself made a forced march on Brescia, never halting night or day till he reached the town and recovered his depots. Meantime Masséna had gradually drawn in towards Lonato, Sérurier had retired (night of July 31) from before Mantua, and Wurmser's advanced guard triumphantly entered the fortress (Aug. 1).

Lonato and **Castiglione.**—The Austrian general now formed the plan of crushing Bonaparte between Quasdanovich and his own main body. But meantime Quasdanovich had evacuated Brescia under the threat of Bonaparte's advance and was now fighting a long irregular action with Despinoy and Sauret about Gavardo and Salo, and Bonaparte, having missed his expected target, had brought Augereau by another severe march back to Montechiaro. Masséna was now assembled between Lonato and Ponte San Marco. Wurmser's main body, weakened by the detachment sent to Mantua, crossed the Mincio about Valeggio and Goito on the and, and penetrated as far as Castiglione, whence Masséna's rearguard was expelled. But a renewed advance of Quasdanovich, ordered by Wurmser, which drove Sauret and Despinoy back on Brescia and Lonato, in the end only placed a strong detachment of the Austrians within striking distance of

Masséna, who on the 3rd attacked and destroyed it, while at the same time Augereau recaptured Castiglione from Wurmser. On the 4th Sauret and Despinoy pressed back Quasdanovich beyond Salo and Gavardo, and Masséna annihilated an isolated column which tried to break its way through to Wurmser. Wurmser, thinking rightly or wrongly that he could not now retire to the Mincio without a battle, drew up his whole force, close on 30,000 men, in the plain between Solferino and Medole. The finale may be described in very few words. Bonaparte, convinced that no more was to be feared from Quasdanovich, called in Despinoy's division to the main body and sent orders to Sérurier, then far distant on the Cremona road, to march against the left flank of the Austrians. On the 5th the battle of Castiglione (*q.v.*) was fought. Closely contested in the first hours of the frontal attack till Sérurier's arrival decided the day, it ended in the retreat of the Austrians over the Mincio and into Tirol, whence they had come.

Thus the new way had failed to keep back Wurmser, and the old had failed to crush Bonaparte. In former wars a commander threatened as Bonaparte was would have fallen back at once to the Adda, abandoning the siege in such good time that he would have been able to bring off his siege artillery. Instead of this Bonaparte hesitated long enough to lose it, which, according to accepted canons, was a waste, and held his ground, which was, by the same rules, sheer madness. But revolutionary discipline was not firm enough to stand a retreat. Once it turned back, the army would have streamed away to Milan and perhaps to the Alps (*cf.* 1799). As to the manner of this fighting, even the principle of "relative superiority" failed him so long as he was endeavouring to cover the siege and again when his chief care was to protect his new line of retreat and to clear his old. In this period, viz., up to his return from Brescia on Aug. 2, the only "mass" he collected delivered a blow in the air, while the covering detachments had to fight hard for bare existence. Once released from its trammels, the Napoleonic principle had fair play. He stood between Wurmser and Quasdanovich, ready to fight either or both. The latter was crushed, thanks to local superiority and the resolute leading of Masséna, but at Castiglione Wurmser actually outnumbered his opponent till the last of Bonaparte's precautionary dispositions had been given up, and Sérurier brought back from the "alternative line of retreat" to the battlefield. The moral is, again, that it was not the mere fact of being on interior lines that gave Bonaparte the victory, but his "tact," his fine appreciation of the chances in his favour, measured in terms of time, space, attacking force and containing power. All these factors were greatly influenced by the ground, which favoured the swarins and columns of the French and deprived the brilliant Austrian cavalry of its power to act. But of far greater importance was the mobility that Bonaparte's personal force imparted to the French. Bonaparte himself rode five horses to death in three days, and Augereau's division marched from Roverbella to Brescia and back to Montechiaro, a total distance of nearly 50m., in about 36 hours. This indeed was the foundation of his "relative superiority," for every hour saved in the time of marching meant more freedom to destroy one corps before the rest could overwhelm the covering detachments and come to its assistance.

By the end of the second week in August the blockade of Mantua had been resumed, without siege guns. But still under the impression of a great victory gained, Bonaparte was planning a long forward stride. He thought that by advancing past Mantua directly on Trieste and thence onwards to the Semmering he could impose a peace on the emperor. The Directory, however, which had by now focussed its attention on the German campaign, ordered him to pass through Tirol and to co-operate with Moreau, and this plan, Bonaparte, though protesting against an Alpine venture being made so late in the year, prepared to execute. Wurmser was thought to have posted his main body near Trent, and to have detached one division to Bassano "to cover Trieste." The French advanced northward on the and, in three disconnected columns which successfully combined and drove the enemy before them to Trent. There, however, they missed their target. Wurmser had already drawn over the bulk of his army (22,000) into the Val Sugana, whence with the Bassano division as his advanced guard, he intended once more to relieve Mantua, while Davidovich with 13,000 (excluding detachments) was to hold Tirol against any attempt of Bonaparte to join forces with Moreau.

Thus Austria was preparing to hazard a second (as in the event she hazarded a third and a fourth) highly trained and expensive professional army in the struggle for the preservation of a fortress, and we must conclude that there were weighty reasons which actuated so notoriously cautious a body as the Council of War in making this unconditional venture. While Mantua stood, Bonaparte, for all his energy and sanguineness, could not press forward into Friuli and Carniola, and immunity from a Republican visitation was above all else important for the Vienna statesmen, governing as they did more or less discontented and heterogeneous populations that had not felt the pressure of war for a century and more. If we neglect pure theory, and regard strategy as the handmaiden of statesmanship—which fundamentally it is—we cannot condemn the Vienna authorities unless it be first proved that they grossly exaggerated the possible results of Bonaparte's threatened irruption.

Bassano.—When Masséna entered Trent on the morning of Sept. 5, Bonaparte became aware that the force in his front was a mere detachment, and news soon came in that Wurmser was in the Val Sugana about Primolano and at Bassano. This move he supposed to be intended to cover Trieste. He therefore informed the Directory that he could not proceed with the Tirol scheme, and spent one more day in driving Davidovich well away from Trent. Then leaving Vaubois to watch him, Bonaparte marched Augereau and Masséna, with a rapidity he scarcely ever surpassed, into the Val Sugana. Wurmser's rearguard was attacked and defeated again and again, and Wurmser himself felt compelled to stand and fight, in the hope of checking the pursuit before reaching the plains. Half his army had already reached Montebello on the Verona road, and with the rear half he posted himself at Bassano, where on the 8th he was defeated with heavy losses. Then began a strategic pursuit or general chase, and in this Bonaparte at first directed the pursuers so as to cut off Wurmser from Trieste, not fron Mantua. Late on the 9th, Bonaparte realized that his opponent was heading for Mantua via Legnago and despite the fresh cast his net closed so rapidly that Wurmser barely succeeded in reaching Mantua on the 12th, with all the columns of the French, weary as most of them were, converging in hot pursuit. After an attempt to keep the open field, defeated in a general action on the 15th, the relieving force was merged in the garrison, now some 28,000 in all. So ended the episode of Bassano, the most brilliant feature of which was the marching power of the French infantry. Between the 5th and the 11th, besides fighting three actions, Masséna had marched 100m. and Augereau 114.

Alvintzi was now appointed to command a new army of relief. Practically the whole of the fresh forces available were in Carniola, the military frontier, etc., while Davidovich was still in Tirol. Alvintzi's intention was to assemble his new army (29,000) in Friuli, and to move on Bassano. Meantime, Davidovich (18,000) was to capture Trent, and the two columns were to connect by the Val Sugana. All being well, Alvintzi and Davidovich, still separate, were then to converge on the Adige between Verona and Legnago. Wurmser was to co-operate by vigorous sorties. At this time Bonaparte's protective system was as follows: Kilmaine (9,000) investing Mantua, Vaubois (10,000) at Trent, and Masséna (9,000) at Bassano and Treviso, Augereau (9,000) and Macquard (3,000) at Verona and Villafranca constituting, for the first time in these operations, important mobile reserves. Hearing of Alvintzi':: approach in good time, he meant first to drive back Davidovich, then with Augereau, Masséna, Macquard and 3,000 of Vaubois's force to fall upon Alvintzi who, he calculated, would at this stage have reached Bassano, and finally to send back a large force through the Val Sugana to attack Davidovich. This plan miscarried.

By Nov. 7 Davidovich had forced Vaubois back to Rivoli, and Alvintzi pressed forward within 5m. of Vicenza. Bonaparte watched carefully for an opportunity to strike out, and on the 8th massed his troops closely around the central part of Verona. On the 9th, to give himself air, he ordered Masséna to join Vaubois, and to drive back Davidovich at all costs. But before this order was executed, reports came in that Davidovich had suspended his advance. The 10th and 11th were spent by both sides in relative inaction, the French waiting on events and opportunities, the Austrians resting after their prolonged exertions. Then on the afternoon of the 11th, being informed that Alvintzi was approaching, Bonaparte decided to attack him. On the 12th Alvintzi's advanced guard was assailed at Caldiero. But the troops in rear came up rapidly, and by 4 P.M. the French were defeated all along the line and in retreat on Verona. Bonaparte's situation was now indeed precarious. He was on "interior lines" it is true, but he had neither the force nor the space necessary for the delivery of rapid radial blows. Alvintzi was in superior numbers, as Caldiero had proved, and at any moment Davidovich, who had twice Vaubois' force, might advance to the attack of Rivoli. The reserves had proved insufficient, and Kilmaine had to be called up from Mantua, which was thus for the third time freed from the blockaders. Bonaparte chose a daring move on the enemy s rear in preference to the hazards of a retreat, though it was not until the evening of the 14th that he actually issued the fateful order.

The Austrians, too, had selected the 15th as the date of their final advance on Verona, Davidovich from the north, Alvintzi via Zevio from the south. But Bonaparte was no longer there; leaving Vaubois to hold Davidovich as best he might, he had collected the rest of his small army between Albaro and Ronco. His plan seems to have been to cross the Adige well in rear of the Austrians. to march north and establish himself on the Verona-Vicenza highway, where he could supply himself from their convoys. The troops passed the Adige in three columns near Ronco and Albaredo, and marched forward along the dikes, with deep marshes and pools on either hand. If Bonaparte's intention was to reach the dry open ground of San Bonifacio in rear of the Austrians, it was not realized, for the Austrian army, instead of being at the gates of Verona, was still between Caldiero and San Bonifacio, heading, as we know, for Zevio. Thus Alvintzi was able, easily and swiftly, to wheel to the south.

Arcola.—The battle of Arcola almost defies description. The first day passed in a series of resultless encounters between the heads of the columns as they met on the dikes. In the evening Bonaparte withdrew over the Adige, expecting every moment to be summoned to Vaubois' aid. But Davidovich remained inactive, and on the 16th the French again crossed the river. Masséna from Ronco advanced on Porcile, driving the Austrians along the causeway thither, but on the side of Arcola, Alvintzi had deployed a considerable part of his forces on the edge of the marshes, within musket shot of the causeway by which Bonaparte and Augereau had to pass, along the Austrian front, to reach the bridge of Arcola. In these circumstances the second day's battle was more murderous and no more decisive than the first, and again the French retreated to Ronco. But Davidovich again stood still, and with extraordinary resolution, Bonaparte ordered a third assault for the 17th, trying a fresh tactical move. Masséna again advanced on Porcile, Robert's brigade on Arcola, but the rest, under Augereau, were to pass the Alpone near its confluence with the Adige, and joining various small bodies which passed the main stream lower down, to storm forward on dry ground to Arcola. The Austrians, however, themselves advanced from Arcola, overwhelmed Robert's brigade on the causeway and almost reached Ronco. This was perhaps the crisis of the battle, for Augereau's force was now on the other side of the stream, and Masséna, with his back to the new danger, was approaching Porcile. But the fire of a deployed regiment stopped the head of the Austrian column; Masséna, turning about, cut into its flank on the dike; and Augereau, gathering force, was approaching Arcola from the south. The bridge and the village were evacuated soon afterwards, and Masséna and Augereau began to extend in the plain beyond. But the Austrians still sullenly resisted. It was at this moment that Bonaparte secured victory by a mere ruse, but a ruse which would have been unprofitable and ridiculous had it not been based on his fine sense of the moral conditions. Both sides were nearly fought out, and he sent a few trumpeters to the rear of the Austrian army to sound the charge. They did so, and in a few minutes the Austrians were streaming back to San Bonifacio. This ended the drama of Arcola, which more than any other episode of these wars, perhaps of any wars in modem history, centres on the personality of the hero. It is said that the French fought without spirit on the first day, and yet on the second and third Bonaparte had so thoroughly imbued them with his own will to conquer that in the end they prevailed over an enemy nearly twice their own strength.

The climax was reached just in time, for on the 17th Vaubois was completely defeated at Rivoli and withdrew to Peschiera, leaving the Verona and hlantua roads completely open to Davidovich. But on the 19th Bonaparte turned upon him, and combining the forces of Vaubois, Masséna and Augereau against him, drove him back to Trent. Meantime Alvintzi returned from Vicenza to San Bonifacio and Caldiero (Nov. 21), and Bonaparte at once stopped the pursuit of Davidovich. On the return of the French main body to Verona, Alvintzi finally withdrew, Wurmser, who had emerged from hlantua on the 23rd, was driven in again, and this epilogue of the great struggle came to a feeble end because neither side was now capable of prolonging the crisis. In Jan. 1797 Alvintzi renewed his advance with all the forces that could be assernbled for a last attempt to save Mantua. At this time 8,000 men under Sérurier blockaded Mantua. Masséna (9,000) was at Verona, Joubert (Vaubois' successor) at Rivoli with 10,000, Augereau at Lcgnago with 9,000. In reserve were Rey's division (4,000) between Brescia and Montechiaro, and Victor's brigade at Goito and Castelnuovo. On the other side Alvintzi's location was the reverse of that in the previous campaign, for while he had 9,000 men under Provera at Padua, 6,000 under BayaliE at Bassano, he himself with 28,000 men stood in the Tirol about Trent. This time he intended to make his principal effort on the Rivoli side. Provera was to capture Legnago on Jan. 9, and Bayalič Verona on the 12th, while the main army was to deliver its blow against the Rivoli position on the 13th.

Rivoli.—The first marches of this scheme were duly carried out, and several days elapsed before Bonaparte was able to discern the direction of the real attack. Augereau fell back, skirmishing a little, as Provera's and Bayalič's advance developed On the 11th, when the latter was nearing Verona, Alvintzi's leading troops appeared in front of the Rivoli position. On the 12th BayaliE, weakened by sending reinforcements to Alvintzi, made an unsuccessful attack on Verona, Provera, farther south, remaining inactive. On the 13th, Bonaparte, still in doubt, launched Masséna's division against BayaliE, who was driven back to San Bonifacio; but at the same time definite news came from Joubert that Alvintzi's main army was in front of La Corona. From this point begins the decisive, though by no means the most intense or dramatic, struggle of the campaign. Once he felt sure of the situation Bonaparte acted promptly. Joubert was ordered to hold on to Rivoli at all costs. Rey was brought up by a forced march to Castelnuovo, where Victor joined him, and ahead of them both Masséna was hurried on to Rivoli. Bonaparte himself joined Joubert on the night of the 13th. There he saw the watch-fires of the enemy in a semicircle around him, for Alvintzi, thinking that he had only to deal with one division, had begun a widespread enveloping attack. The horns of this attack were as yet so far distant that Bonaparte, instead of extending on an equal front, only spread out a few regiments to gain an hour or two and to keep the ground for Masséna and Rey, and on the morning of Jan. 14, with 10,000 men in hand against 26,000, he fell upon the central columns of the enemy as they advanced up the steep broken slopes of the foreground. The fighting was severe, but Bonaparte had the advantage. Masséna arrived at 9 A.M., and a little later the column of Quasdanovich, which had moved along the Adige and was now attempting to gain a foothold on the plateau in rear of Joubert, was crushed by the converging fire of Joubert's right brigade and by Masséna's guns, their rout being completed by the charge of a handful of cavalry under Lasalle. The right horn of Alvintzi's attack, when at last it swung in upon Bonaparte's rear, was caught between Masséna and the advancing troops of Rey and annihilated, and even before this the dispirited Austrians were in full retreat. A last alarm, caused by the appearance of a French infantry regiment in their rear (this had crossed the lake in boats from Salo), completed their demoralization, and though less than 2,000 had been killed and wounded, some 12,000 Austrian prisoners were left in the hands of the victors. Rivoli was indeed a moral triumph. After the ordeal of Arcola, the victory of the French was a foregone conclusion at each point of contact. Bonaparte refrained from striking so long as his information was incomplete, but he knew now from experience that his covering detachment, if well led, could not only hold its own without assistance until it had gained the necessary information, but could still give the rest of the army time to act upon it. Then, when the centre of gravity had been ascertained, the French divisions hurried thither, caught the enemy in the act of manoeuvring and broke them up. And if that confidence in success which made all this possible needs a special illustration, it may be found in Bonaparte sending Murat's regiment over the lake to place a mere 2,000 bayonets across the line of retreat of a whole army. Alvintzi's manoeuvre was faulty neither strategically in the first instance, nor tactically as regards the project of enveloping Joubert on the 14th. It failed because, apart from Bonaparte's genius, Joubert and his men were better soldiers than their Austrian opponents, and because a French division could move twice as fast as an Austrian division, and from these two factors a new form of war was evolved, the essence of which was that, for a given time and in a given area, a small force of the French should engage and hold a much larger force of the enemy.

The remaining operations can be very briefly summarized. Provera, still advancing on Mantua, joined hands there with Wurmser, and for a time held Serurier at a disadvantage. But hearing of this, Bonaparte sent back Masséna from the field of Rivoli, and that general, with Augereau and Sérurier, not only forced Wurmser to retire again into the fortress, but compelled Provera to lay down his arms. And on Feb. 2, 1797, Mantua, and with it what was left of Wurmser's army, surrendered. The campaign of 1797, which ended the war of the First Coalition, was the brilliant sequel of these hard-won victories. Austria had decided to save Mantua at all costs, and had lost her armies in the attempt, a loss which was not compensated by the "strategic" victories of the archduke. Thus the Republican "visitation" of Carinthia and Carniola was one swift march—politically glorious, if dangerous from a purely military standpoint—of Bonaparte's army to the Semmering. The archduke, who was called thither from Germany, could do no more than fight a few rearguard actions and make threats against Bonaparte's rear, which the latter, with his usual "tact," ignored.

On the Rhine, as in 1795 and 1796, the armies of the Sambre-and-Meuse (Hoche) and the Rhine-and-Moselle (Moreau) were opposed by the armies of the Lower Rhine (Werneck) and of the Upper Rhine (Latour). Moreau crossed the river near Strasbourg and fought a series of minor actions. Hoche, like his predecessors, crossed at Ddsseldorf and Neuwied and fought his way to the Lahn, where for the last time in the history of these wars, there was an irregular widespread battle. But Hoche, in this his last campaign, displayed the brilliant energy of his first, and delivered the "series of incessant blows" that Carnot had urged upon Jourdan the year before. Werneck was driven with ever-increasing losses from the lower Lahn to Wetzlar and Giessen. Thence, pressed hard by the French left wing under Championnet, he retired on the Nidda, only to find that Hoche's right had swung completely round him. Nothing but the news of the armistice of Leoben saved him from envelopment and surrender. This general armistice was signed by Bonaparte, on his own authority and to the intense chagrin of the Directory and of Hoche, on April 18, and was the basis of the peace of Campo Formio.

BONAPARTE IN EGYPT

Within the scope of this article, yet far more important from its political and personal than from its general military interest, comes the expedition of Bonaparte to Egypt and its sequel. (See also EGYPT: *History;* NAPOLEON I; etc.) Bonaparte left Toulon on May 19, 1798, at the same time as his army (40,000 strong in 400 transports) embarked secretly at various ports. Nelson's fleet was evaded, and, capturing Malta *en route,* the armada reached the coast of Egypt on July 1. The Republicans stormed Alexandria on the 2nd. Between Embabeh and Gizeh, on the left bank of the Nile, 60,000 Mamelukes were easily dispersed on the 21st (battle of the Pyramids), the French for the most part marching and fighting in the chequer of infantry squares that afterwards became the classical formation for desert warfare. While his lieutenants pursued the more important groups of the enemy, Bonaparte entered Cairo in triumph, and proceeded to organize Egypt as a French protectorate. Meantime Nelson, though too late to head off the expedition, had annihilated the squadron of Admiral Brueys. This blow severed the army from the home country, and destroyed all hope of reinforcements. But to eject the French already in Egypt, military invasion of that country was necessary. The first attempts at this were made in September by the Turks as overlords of Egypt. Bonaparte—after suppressing a revolt in Cairo—marched into Syria to meet them, and captured El Arish and Jaffa; at the latter place the prisoners, whom he could afford neither to feed, to release, nor to guard, were shot by his order. But he was brought to a standstill (March 17–May 20) before the half-defensible fortifications of Acre, held by a Turkish garrison and animated by the leadership of Sir Sidney Smith, In May, though meantime a Turkish relieving army had been severely beaten in the battle of Mount Tabor (April 16, 1799), Bonaparte gave up his enterprise and returned to Egypt, where he won a last victory in annihilating at Aboukir, with 6,000 of his own men, a Turkish army 18,000 strong that had landed there (July 25, 1799). With this tactical success to set against the Syrian reverses, he handed over the command to Kléber and returned to France (hug. 22) to ride the storm in a new *coup d'état,* the "18th Brumaire." Kléber, attacked by the English and Turks, concluded the convention of El Arish (Jan. 27, 1800), whereby he secured free transport for the army back to France. But this convention was disavowed by the British Government, and Kléber prepared to hold his ground. On March 20, 1800, he thoroughly defeated the Turkish army at Heliopolis and recovered Cairo, and French influence was once more in the ascendant in Egypt, when its director was murdered by a fanatic on June 14, the day of Marengo. Kléber's successor, the incompetent Menou, fell an easy victim to the British expeditionary force under Sir Ralph Abercromby in 1801. The British forced their way ashore at Aboukir on March 8. On the 21st Abercromby won a decisive battle, and himself fell in the hour of victory. (See ALEXANDRIA: *Battle of 1801.*) His successor, Gen. Hely Hutchinson, slowly followed up this advantage, and received the surrender of Cairo in July and of Alexandria in August, the dèbris of the French army being given free passage back to France. Meantime a mixed force of British and native troops from India, under Sir David Baird, had landed at Kosseir and marched across the desert to Cairo.

THE WAR OF THE SECOND COALITION

In the autumn of 1798, while Bonaparte's Egyptian expedition was in progress, and the Directory was endeavouring at home to reduce the importance and the predominance of the army and its leaders, the Powers of Europe once more allied themselves, not now against the principles of the Republic, but against the Treaty of Campo Formio. Russia, Austria, England, Turkey, Portugal, Naples and the pope formed the Second Coalition. The war began with an advance into the Roman States by a worthless and ill-behaved Neapolitan army (commanded, much against his will, by Mack), which the French troops under Championnet destroyed with ease. Championnet then revolutionized Naples. After this unimportant prelude the curtain rose on a general European war. The Directory, which now had at its command neither numbers nor enthusiasm, prepared as best it could to meet the storm. Four armies, numbering only 160,000, were set on foot, in Holland (Brune, 24,000); on the Upper Rhine (Jourdan, 46,000); in Switzerland, which had been occupied in 1798 (Masséna, 30,000); and in Upper Italy (Schérer, 60,000). In addition there was Championnet's army, now commanded by Macdonald, in southern Italy. All these forces the Directory ordered, in Jan. and Feb. 1799, to assume the offensive.

Stokach.—Jourdan, in the Constance and Schaffhausen region, had only 40,000 men against the Archduke Charles's 80,000, and was soon brought to a standstill and driven back on Stokach. The archduke had won these preliminary successes with seven-eighths of his army acting as one concentrated mass. But as he had only encountered a portion of Jourdan's army, he became uneasy as to his flanks, checked his bold advance, and ordered a reconnaissance in force. This practically extended his army while Jourdan was closing his, and thus the French began the battle of Stokach (March 25) in superior numbers, and it was not until late in the day that the archduke brought up sufficient strength (60,000) to win a victory. This was a battle of the "strategic" type, a wide-spread straggling combat in which each side took 15 hours to inflict a loss of 12% on the other, and which ended in Jourdan accepting defeat and drawing off, unpursued by the magnificent Austrian cavalry, though they counted five times as many sabres as the French.

The French secondary army in Switzerland u-as in the hands of the bold and active Masséna. The forces of both sides in the Alpine region were, from a military point of view, mere flank guards to the main armies on the Rhine and the Adige. But unrest, amounting to civil war, among the Swiss and Grison peoples tempted both Governments to give these flank guards considerable strength.

Masséna in Switzerland.—The Austrians in the Vorarlberg and Grisons were under Hotze, who had 13,000 men at Bregenz, and 7,000 commanded by Auffenberg around Chur, with, between them, 5,000 men at Feldkirch and a post of 1,000 in the strong position of the Luziensteig near Mayenfeld. Masséna's available force was about 20,000, and he used almost the whole of it against Auffenberg. The Rhine was crossed by his principal column near Mayenfeld, and the Luziensteig stormed (March 6), while a second column from the Zurich side descended upon Disentis and captured its defenders. In three days Auffenberg's division was broken up, Oudinot meanwhile holding off Hotze by a hard-fought combat at Feldkirch (March 7). But a second attack on Feldkirch made on the 23rd by Masséna was repulsed and the advance of his left wing came to a standstill. Behind Xuffenberg and Hotze was Bellegarde in Tirol with some 47,000 men. Most of these were stationed north of Innsbruck and Landeck, probably as a sort of strategic reserve to the archduke. The rest, with the assistance of the Tirolese themselves, were to ward off irruptions from Italy. Here the French offensive was entrusted to two columns, one from Masséna's command under Lecourbe, the other from the Army of Italy under Dessolle. Sjmultaneously with Masséna, Lecourbe marched from Bellinzona with 10,000 men. by the San Bernardino pass into the Splugen valley, and thence over the Julier pass into the upper Engadine. A small Austrian force under Loudon attacked him near Zernetz. but was after three days of rapid manoeuvres and bold tactics driven back to Martinsbrück, with considerable losses But ere long the country people flew to arms, and Lecourbe found himself between two fires, the levies occupying Zernetz and Loudon's regulars Martinsbrück. But though he had only some 5,000 of his original force left, he was not disconcerted, and by driving back the levies into the high valleys whence they had come, and constantly threatening Loudon, he was able to maintain himself and to wait for Dessolles. The latter, moving up the Valtelline, fought his way to the Stelvio pass, but beyond it the defile of Tauffers (south-west of Glurns), was entrenched by Loudon, who thus occupied a position midway between the two French columns, while his irregulars beset all the passes and ways giving access to the Vintschgau and the lower Engadine. In this situation the French should have been destroyed in detail. But as usual their speed and dash gave them the advantage in every manoeuvre and at every point of contact.

Operations in Tirol.—On the 2jth Lecourbe and Dessolles attacked Loudon at Nauders in the Engadine and Tauffers in the Vintschgau respectively. At Nauders the French passed round the flanks of the defence by scrambling along the high mountain crests adjacent, while at Tauffers, the assailants, only 4,500 strong, descended into a deep ravine, debouched unnoticed in the Austrians' rear, and captured 6,000 men and 16 guns. The Austrian leader with a couple of companies made his way through Glurns to Nauders, and there, finding himself headed off by Lecourbe, he took to the mountains. His corps, like Auffenberg's, was annihilated. This ended the French general offensive. Jourdan had been defeated by the archduke and forced or induced to retire over the Rhine. Masséna was at a standstill before the strong position of Feldkirch, and the Austrians of Hotze were still massed at Bregenz, but the Grisons were revolutionized, two strong bodies of Austrians numbering in all about 20.000 men had been destroyed, and Lecourbe and Dessolles had advanced far into Tirol. A pause followed. The Austrians in the mountains needed time to concentrate and to recover from their astonishment. The archduke fell ill, and the Vienna war council forbade his army to advance lest Tirol should be "uncovered," though Bellegarde and Hotze still disposed of numbers equal to those of Masséna and Lecourbe. Masséna succeeded Jourdan in general command on the French side and promptly collected all available forces of both armies in the hilly non-Alpine country between Basle, Zurich and Schaffhausen, thereby directly barring the roads into France (Berne-Neuchâtel-Pontarlier and Basle-Besançon) which the Xustrians appeared to desire to conquer. The protection of Alsace and the Vosges was left to the fortresses. There was no suggestion, it would appear, that the Rhine between Basle and Schaffhausen was a flank position sufficient of itself to bar Alsace to the enemy.

It is now time to turn to events in Italy, where the Coalition intended its principal effort. At the beginning of March the French had 80,000 men in Upper Italy and some 35,000 in the heart of the Peninsula, the latter engaged chiefly in supporting newly-founded republics. Of the former, 53,000 formed the field army on the Mincio under Schérer. The Austrians, commanded by Kray, numbered in all 84,000, but detachments reduced this figure to 67,000, of whom, moreover, 15,000 had not yet arrived when operations began. They were to be joined by a Russian contingent under the celebrated Suvórov, who was to command the whole on arrival, and whose extraordinary personality gives the campaign its special interest. Rray himself was a resolute soldier, and when the French, obeying the general order to advance, crossed the Adige, he defeatrd them in a severely fought battle at Magnano near Verona (March j). The war, however, was undertaken not to annihilate, but to evict the French, and, probably under orders from Vienna, Kray allowed the beaten enemy to depart.

Suvórov.—Suvórov appeared with 17,000 Russians on April 4. His first step was to set Russian officers to teach the Austrian troops—whose feelings can be imagined—how to attack with the bayonet, his next to order the whole army for ard. The Allies broke camp on April 17, 18 and 19, and on the 20th, after a forced march of close on 30m., they passed the Chiese. Brescia had a French garrison, but Suvórov soon cowed it into surrender by threats of a massacre, which no one doubted that he would carry into execution. At the same time, dissatisfied with the marching of the Austrian infantry, he sent the following characteristic reproof to their commander: "The march was in the service of the Kaiser. Fair weather is for my lady's chamber, for dandies. for sluggards. He who dares to cavil against his high duty is, as an egoist, instantly to vacate his command. Whoever is in bad health can stay behind. The so-called reasoners do no army any good. . . ." One day later, under this unrelenting pressure, the advanced posts of the Allies reached Cremona and the main body the Oglio. The pace became slower in the following days, as many bridges had to be made, and meanwhile Moreau, Schérer's successor, prepared with a mere 20,000 men to defend the Adda. On the 26th he was attacked all along the line. The moral supremacy had passed over to the Allies. Melas, under Suvórov's stern orders, flung tis battalions, regardless of losses, against the strong position of Cassano. The story of 1796 repeated itself with the rôles reversed. The passage was carried, and the French rearguard under Sérurier was surrounded and captured by an inferior corps of Austrians. The Austrians (the Russians at Lecco were hardly engaged) lost 6.000 men, but they took 7,000 prisoners, and in all Moreau's little army lost half its numbers and retreated in many disconnected bodies to the Ticino, and thence to Alessandria.

Everywhere the Italians turned against the French, mindful of the exactions of their commissaries. The strange Cossack cavalry that western Europe had never yet seen entered Milan on April 29, 11 days after passing the Mincio, and next day the city received with enthusiasm the old field-marshal, whose exploits against the Turks had long invested him with a halo of romance and legend. Here, for the moment, Suvorov's offensive culminated. He desired to pass into Switzerland and to unite his own, the archduke's, Hotze's and Bellegarde's armies in one powerful mass. But the emperor would not permit the execution of this scheme until all the fortresses held by the enemy in Upper Italy should have been captured. In any case, Macdonald's army in southern Italy, cut off from France by the rapidity of Suvórov's onslaught, and now returning with all speed to join Moreau by force or evasion, had still to be dealt with.

Suvórov's mobile army, originally 90,000 strong, had now dwindled, by reason of losses and detachments to sieges, to half that number, and serious differences arose between the Vienna Government and himself. If he offended the pride of the Austrian army, he was at least respected as a leader who gave it victories; but in Vienna he was regarded as a madman who had to be kept within bounds. But at last, when he was becoming thoroughly exasperated by this treatment, Macdonald came within striking distance and the active campaign recommenced. In the second week of June, Moreau, who had retired into the Apennines about Gavi, advanced with the intention of drawing upon himself troops that would otherwise have been employed against Macdonald. He succeeded, for Suvórov with his usual rapidity collected 40,000 men at Alessandria, only to learn that Macdonald with 35,000 men was coming up on the Parma road. When this news arrived, Macdonald had already engaged an Austrian detachment at hfodena and driven it back, and Suvórov found himself between hforeau and Macdonald with barely enough men under his hand to enable him to play the game of "interior lines." But at the crisis the rough energetic warrior who despised "raisonneurs," displayed generalship of the first order, and taking in hand all his scattered detachments, he manoeuvred them in the Napoleonic fashion.

The **Trebbia.**—On the 14th Macdonald was calculated to be between Modena, Reggio and Carpi, but his destination was uncertain. Would he continue to hug the Apennines to join Moreau, or would he strike out northwards against Kray, who with 20,000 men was besieging Mantua? From Alessandria it is four marches to Piacenza and nine to Mantua, while from Reggio these places are four and two marches respectively. Piacenza, therefore, was the crucial point if Macdonald continued westward, while in the other case nothing could save Kray but the energetic conduct of Hohenzollern's detachment, which was posted near Reggio. This, however, was soon forced over the Po, and Ott, advancing from Cremona to join it, found himself sharply pressed in turn. The field-marshal had hoped that Ott and Hohenzollern together would be able to win him time to assemble at Parma, where he could bring on a battle whichever way the French took. But on receipt of Ott's report he was convinced that Macdonald had chosen the western route and ordering Ott to delay the French as long as possible by stubborn rearguard actions and to put a garrison into Piacenza under a general who was to hold out "on peril of his life and honour," he collected what forces were ready to move and hurried towards Piacenza, the rest being left to watch Moreau. He arrived just in time. When after three forced marches the main body (only 26,000 strong) reached Castel San Giovanni, Ott had been driven out of Piacenza, but the two joined forces safely. Both Suvórov and Macdonald spent the 17th in closing up and deploying for battle. The respective forces were Allies, barely 25.000, French, 35,000. Suvórov believed the enemy to be only 26,000 strong, and chiefly raw Italian regiments, but his temperament would not have allowed him to stand still even had he known his inferiority. He had already issued one of his peculiar battle-orders, which began with the words: "The hostile army will be taken prisoners" and continued with directions to the Cossacks to spare the surrendered enemy. But Macdonald was too full of energy, and believed still that he could annihilate Ott before Suvórov's arrival. Thus the battle of the Trebbia (June 17–19) was fought by both sides in the spirit of the offensive. It was one of the most severe struggles in the Republican wars, and it ended in Macdonald's retreat with a loss of 15,000 men—probably 6,000 in the battle and 9,000 killed and prisoners when and after the equilibrium was broken—for Suvórov, unlike other generals, had the necessary surplus of energy, after all the demands made upon him by a great battle, to order and to direct an eflective pursuit. The Allies lost about 6,000. Macdonald retreated to Modena, harassed by the peasantry, and finally recrossed the Apennines and made his way to Genoa. The battle of the Trebbia is one of the most clearly defined examples in military history of the result of moral force—it was a matter not merely of energetic leading on the battlefield, but far more of educating the troops beforehand to meet the strain, of ingraining in the soldier the determination to win at all costs.

To return now to the Alpine region, where the French offensive had culminated at the end of March. Their defeated left was behind the Rhine in the northern part of Switzerland, the half-victorious centre athwart the Rhine between Mayenfeld and Chur, and their wholly victorious right far within Tirol between Glurns, Nauders and Landeck. But neither the centre nor the right could maintain itself. The forward impulse given by Suvórov spread along the whole Austrian front from left to right. Dessolles' column (now under Loison) was forced back to Chiavenna. Bellegarde drove Lecourbe from position to position towards the Rhine during April. There Lecourbe added to the remnant of his expeditionary column the outlying bodies of Masséna's right wing, but even so he had only 8,000 men against Bellegarde's 17,000, and he was now exposed to the attack of Hotze's 25,000 as well. The Luziensteig fell to Hotze and Chur to Bellegarde, but the defenders managed to escape from the converging Austrian columns into the valley of the Reuss. Having thus reconquered all the lost ground and forced the French into the interior of Switzerland, Bellegarde and Hotze parted company, the former marching with the greater part of his forces to join Suvórov, the latter moving to his right to reinforce the archduke. Only a chain of posts was left in the Rhine valley between Disentis and Feldkirch. The archduke's operations now recommenced.

Charles and Hotze stood, about May 15, at opposite ends of the lake of Constance. The two together numbered about 88,000 men, but both had sent away numerous detachments to the flanks, and the main bodies dwindled to 35,000 for the archduke, and 20,000 for Hotze. Masséna, with 45,000 men in all, retired slowly from the Rhine to the Thur. Pressed by the combined forces he continued to yield ground until at last he halted in the position he had prepared for defence at Ziirich. He had only 25,000 men in hand, owing to detachments, to cover his right and his left. These 25,000 occupied an entrenched position 5m. in length, against which the Austrians, detaching as usual many posts to protect their flanks and rear, deployed only 42,000 men, of whom 8,000 were sent on a wide turning movement and 8.000 held in reserve 4m. in rear of the battlefield. Thus the frontal attack was made with forces not much greater than those of the defence and it failed accordingly (June 4). But Masséna, fearing perhaps to strain the loyalty of the Swiss to their French-made constitution by exposing their town to assault and sack, retired on the 5th to the valley of the Aar between Baden and Lucerne. The archduke did not seek to press Masséna, and for two months operations were at a standstill.

Döttingen.—Ere mid-August, Lecourbe, who formed a loose right wing of the French army in the Reuss valley, was reinforced to a strength of 25,000 men, and pounced upon the extended left wing of the enemy, which had stretched itself, to keep pace with Suvórov, as far westward as the St. Gothard. The movement began on the 14th, and in two days the Austrians were driven back from the St. Gothard and the Furka to the line of the Linth, with the loss of 8,000 men and many guns. At the same time an attempt to take advantage of Masséna's momentary weakness by forcing the Aar at Dottingen near its mouth failed completely (Aug. 16–17). This was the end of the archduke's campaign in Switzerland. Though he would have preferred to continue it, the Vienna Government desired him to return to Germany. An Anglo-Russian expedition was about to land in Holland,[1] and the French were assembling fresh forces on the Rhine, and, with the double object of preventing an invasion of South Germany and of inducing the French to augment their forces in Alsace at the expense of those in Holland, the archduke left affairs in Switzerland to Hotze and a fresh Russian force under Korsákov, and marched away to the Black Forest. His new campaign never rose above the level of a war of posts and manoeuvres about Mannheim and Philippsburg.

Suvórov's last exploit in Italy coincided in time, but in no other respect, with the skirmish at Dottingen. Returning swiftly from the battlefield of the Trebbia, he began to drive back Moreau to the Riviera. At this point Joubert succeeded to the command on the French side, and against the advice of his generals, gave battle. Equally against the advice of his own subordinates, Suvórov accepted it, and won his last great victory at Novi on Aug. 13, Joubert being killed, and only a third of his army making good its retreat. This was followed by another rapid march against a new French "Army of the Alps" which had entered Italy by way of the Mt. Cenis. But immediately after this he left all further operations in Italy to Melas, and himself, with the Russians and an Austrian corps, marched away for the St. Gothard to combine operations against Masséna with Hotze and Korsákov. It was with a heavy heart that he left the scene of his battles, in which the force of his personality had carried the old-fashioned "linear" armies for the last time to complete victory. He had himself urged an advance into France, but the Vienna Government had been unwilling, for their interest was concentrated on Italy. The Tsar Paul I., annoyed with the Austrians, ordered Suvórov to bring back the Russian army, through Switzerland and thence to South Germany. The archduke had already left Switzerland, and was committed to a resultless warfare in the high mountains, with an army which was a mere detachment and in the hope of co-operating with two other detachments far away on the other side of Switzerland.

In loyalty to the formal order of his sovereign Suvórov prepared to carry out his instructions. Masséna's command (77,000 men) was distributed, at the beginning of September, along an enormous S, from the Simplon through the St. Gothard and Glarus, and along the Linth, the Züricher See and the Limmat to Basle. Opposite the lower point of this S, Suvórov (28,000 men) was about to advance. Hotze's corps (25,000 Austrians), extending from Utznach by Chur to Disentis, formed a thin line roughly parallel to the lower curve of the S, Korsákov's Russians (30,000) were opposite the centre at Zurich, while Nauendorff with a small Austrian corps at Waldshut faced the extreme upper point. Thus the only completely safe way in which Suvórov could reach the Zurich region was by skirting the lower curve of the S, under protection of Hotze. But this détour would be long and painful, and the ardent old man preferred to cross the mountains once for all at the St. Gothard, and to follow the valley of the Reuss to Altdorf and Schwyz—*i.e.,* to strike vertically upward to the centre of the S—and to force his way through the French cordon to Zurich; and if events, so far as concerned his own corps, belied his optimism, they at any rate justified his choice of the shortest route. For, aware of the danger gathering in his rear, Masséna gathered up all his forces within reach towards his centre, leaving Lecourbe to defend the St. Gothard and the Reuss valley and Soult on the Linth. On Sept. 24 he forced the passage of the Limmat at Dietikon. On the 25th, in the second battle of Zurich, he completely routed Korsákov, who lost 8,000 killed and wounded, large numbers of prisoners and 100 guns. All along the line the Allies fell back, one corps after another, at the moment when Suvórov was approaching the foot of the St. Gothard.

Suvórov in the Alps.--On the 21st his headquarters were at Bellinzona, where he made the final preparations. Expecting to be four days en *route* before he could reach the nearest friendly magazine, he took his supply trains with him, which inevitably augmented the difficulties of the expedition. On the 24th Airolo was taken, but when the far greater task of storming the pass presented itself before them, even the stolid Russians were terrified, and only the passionate protests of the old man, who reproached his "children" with deserting their father in his extremity, induced them to face the danger. At last after 12 hours' fighting the summit was reached. The same evening Suvórov pushed on to Hospenthal, while a flanking column from Disentis made its way towards Amsteg over the Crispalt. Lecourbe was threatened in rear and pressed in front, and his engineers, to hold off the Disentis column, had broken the Devil's bridge. Discovering this, he left the road, threw his guns into the river and made his way by fords and water-meadows to Goschenen, where by a furious attack he cleared the Disentis troops off his line of retreat. His rearguard meantime held the ruined Devil's bridge. This point and the tunnel leading to it, called the Urner Loch, the Russians attempted to force, with the most terrible losses, battalion after battalion crowding into the tunnel and pushing the foremost ranks into the chasm left by the broken bridge. But at last a ford was discovered and the bridge, cleared by a turning movement, was repaired. More broken bridges lay beyond, but at last Suvórov joined the Disentis column near Goschenen. When Altdorf was reached, however, Suvórov found not only Lecourbe in a threatening position, but an entire absence of boats on the Lake of the Four Cantons. It was impossible (in those days the Axenstrasse did not exist) to take an army along the precipitous eastern shore; and thus, passing through one trial after another, each more severe than the last, the Russians, men and horses and pack animals in an interminable single file, ventured on the path leading over the Kinzig pass into the Muotta Thal. The passage lasted three days, the leading troops losing men and horses over the precipices, the rearguard from the fire of the enemy, now in pursuit. And at last, on arrival in the Muotta Thal, Suvórov received definite information that Korsákov's army was no longer in existence. Yet even so it was long before he could make up his mind to retreat, and the pursuers gathertd on all sides. Fighting, sometimes severe, and never altogether ceasing, went on day after day as the Allied column, now reduced to 15,000 men, struggled on over one pass after another, but at last it reached Ilanz on the Vorder Rhine (Oct. 8). The Archduke Charles meanwhile had, on hearing of the disaster of Zurich, brought over a corps from the Neckar, and for some time negotiations were made for a fresh combined operation against Massitna. But these came to nothing, for the archduke and Suvórov could not agree, either as to their own relations or as to the plan to be pursued. Practically, Suvórov's retreat from Altdorf to Ilanz closed the campaign. It was his last active service, and formed a gloomy but grand climax to the career of the greatest soldier who ever wore the Russian uniform.

MARENGO AND HOHENLINDEN

The disasters of 1799 sealed the fate of the Directory, and placed Bonaparte, who returned from Egypt with the prestige of a recent victory, in his natural place as civil and military head of France. In the course of the campaign the field strength of the French had been gradually augmented, and in spite of losses now numbered 227,000 at the front. These were divided into the army of Batavia, Brune (25,000), the army of the Rhine, Moreau (146,000), the army of Italy, Masséna (56,000), and, in addition, there were some 100,000 in garrisons and depots in France. Most of these field armies were in a miserable condition owing to the losses and fatigues of the last campaign. The treasury was empty and credit exhausted, and worse still—for spirit and enthusiasm, as in 1794, would have remedied material deficiencies—the conscripts obtained under Jourdan's law of 1798 came to their regiments most unwillingly. Most of them, indeed, deserted on their way to join the colours. A large draft sent to the Army of Italy arrived with 310 men instead of 10,250, and after a few such experiences, the First Consul decided that the untrained men were to be assembled in the fortresses of the interior and afterwards sent to the active battalions in numerous small drafts, which they could more easily assimilate. Besides accomplishing the immense task of reorganizing existing forces, he created new

[1]For this expedition, which was repulsed by Brune in the battle of Castricum, *see* Fortescue's *History of the British Army,* vol. iv., and Sachot's *Brune en Hollande.*

ones, including the Consular Guard, and carried out at this moment of crisis two such far-reaching reforms as the replacement of the civilian drivers of the artillery by soldiers, and of the hired teams by horses belonging to the State, and the permanent grouping of divisions in army corps.

The Army **of** Reserve.—As early as Jan. 25, 1800, the First Consul provided for the assembly of all available forces in the interior in an "Army of Reserve." He reserved to himself the command of this army,[1] which gradually Came into being as the pacification of Vendée and the return of some of Brune's troops from Holland set free the necessary nucleus troops. The conscription law was stringently reinforced, and impassioned calls were made for volunteers (the latter, be it said, did not produce 500 useful men). The district of Dijon, partly as being central with respect to the Rhine and Italian armies, partly as being convenient for supply purposes, was selected as the zone of assembly. As for the process of assembling it, we can scarcely imagine one which required more accurate and detailed staff work—correspondence with the district commanders, with the adjutant-generals of the various armies, and orders to the civil authorities on the lines of march, to the troops themselves and to the arsenals and magazines. No one but Bonaparte, even aided by a Berthier, could have achieved so great a task in six weeks, and the great captain, himself doing the work that nowadays is apportioned amongst a crowd of administrative staff officers, still found time to administer France's affairs at home and abroad, and to think out a general plan of campaign that embraced Moreau's, Masséna's and his own armies.

The Army of the Rhine, by far the strongest and best equipped, lay on the upper Rhine. The small and worn-out Army of Italy was watching the Alps and the Apennines from Mt. Blanc to Genoa. Between them Switzerland, secured by the victory of Zürich, offered a starting-point for a turning movement on either side—this year the advantage of the flank position was recognized and acted upon. The Army of Reserve was assembling around Dijon, within 200m. of either theatre of war. The general plan was that the Army of Reserve should march through Switzerland to close on the right wing of the Army of the Rhine. Thus supported to whatever degree might prove to be necessary, Moreau was to force the passage of the Rhine about Schaffhausen, to push back the Austrians rapidly beyond the Lech, and then, if they took the offensive in turn, to hold them in check for 10 or 12 days. During this period of guaranteed freedom the decisive movement was to be made—a swoop along an immense arc on to the rear of the Austrians who had penned Masséna into the north-west corner of Italy. The Army of Reserve, augmented by one large corps of the Army of the Rhine, was to descend by the Splügen (alternatively by the St. Gothard and even by Tirol) into the plains of Lombardy. Magazines were to be established at Zürich and Lucerne (not at Chur, lest the plan should become obvious from the beginning), and all likely routes reconnoitred in advance. The Army of Italy was at first to maintain a strict defensive, and then to fix the Austrians until the entry of the reserve army into Italy was assured.

But Moreau was tardy in moving, and at the beginning of April the enemy took the offensive against Masséna. On the 8th Melas's right wing dislodged the French from the Mt. Cenis, and most of the troops that had then reached Dijon were shifted southward to be ready for emergencies. By the 25th Berthier reported that Masséna was seriously attacked and that he might have to be supported by the shortest route, *i.e.*, the more westerly passes. Bonaparte's resolution was already taken. He waited no longer for Moreau (who, indeed, so far from volunteering assistance, actually demanded it for himself). Convinced from the paucity of news that Masséna's army was closely pressed and probably severed from France, and feeling also that the Austrians were deeply committed to their struggle with the Army of Italy, he told Berthier to march with 40,000 men at once by way of the St. Bernard unless otherwise advised. Berthier protested that he had only 25,000 effectives, and the equipment and armament were still far from complete—as indeed they remained to the end—but the troops marched, though their very means of existence were precarious from the time of leaving Geneva to the time of reaching Milan, for nothing could extort supplies and money from the sullen Swiss.

Bonaparte's Plan **of** Campaign.—At the beginning of May the First Consul learned of the serious plight of the Army of Italy. Masséna with his right wing was shut up in Genoa, Suchet with the left aing driven back to the Var. Meanwhile Moreau had won a preliminary victory at Stokach, and the Army of Reserve had begun its movement to Geneva. With these data the plan of campaign took a clear shape at last—Masséna to resist as long as possible; Suchet to resume the offensive, if he could do so, towards Turin; the Army of Reserve to pass the Alps and to debouch into Piedmont by Aosta and Ivrea; the Army of the Rhine to send a strong force into Italy by the St. Gothard. Bonaparte left Paris on May 6. Gradually, and with immense efforts, Berthier's leading troops were passed over the snow-clad St. Bernard, drawing their artillery on sledges, on the 15th and succeeding days. Driving away small posts of the Austrian army, the advance guard entered Aosta on the 16th—and the alarm was given. Melas, committed as he was to his Riviera campaign, began to look to his right rear, but he was far from suspecting the seriousness of his opponent's purpose. Infinitely more dangerous for the French than the small detachment that Melas opposed to them, or even the actual crossing of the pass, was the unexpected stopping power of the little fort of Bard. The advanced guard of the French appeared before it on the 19th, and after three wasted days the infantry managed to find a difficult mountain by-way and to pass round the obstacle. Ivrea was occupied on the 23rd, and Bonaparte hoped to assemble the whole army there by the 27th. But except for a few guns that with infinite precautions were smuggled one by one through the streets of Bard, the whole of the artillery, as well as a detachment to besiege the fort, had to be left behind. Bard surrendered on June 2, having delayed the infantry of the French army for four days and the artillery for a fortnight.

The military situation in the last week of May, as it presented itself to Bonaparte, at Ivrea, was this. The Army of Italy under Masséna was closely besieged in Genoa, where provisions were running short and the population hostile. But Masséna was no ordinary general, and Bonaparte knew that while Masséna lived the garrison would resist to the last extremity. Suchet was defending Nice and the Var by vigorous minor operations. The Army of Reserve, the centre of which had reached at Ivrea the edge of the Italian plains, consisted of four weak army corps under Victor, Duhesme, Lannes and Murat. There were still to be added to this small army of 34,000 effectives, Turreau's division, which had passed over the Mt. Cenis and was aproaching Turin, Moncey's corps of the Army of the Rhine, which had at last been extorted from Moreau and was due to pass the St. Gothard before the end of May, Chabran's division left to besiege Bard, and a small force under Béthencourt, which was to cross the Simplon and to descend by Arona (this place proved in the event a second Bard and immobilized Béthencourt until after the decisive battle). Thus it was only the simplest part of Bonaparte's task to concentrate half his army at Ivrea, and he had yet to bring in the rest. The problem was to reconcile the necessity for time which he wanted to ensure the maximum force being brought over the Alps, with the necessity for haste, in view of the impending fall of Genoa. As early as May 14 he had informed Moncey that from Ivrea the Army of Reserve would move on Milan. On May 25 he ordered Lannes (advanced guard) to push out on the Turin road, "in order to deceive the enemy and to obtain news of Turreau," and Duhesme's and Murat's corps to proceed along the Milan road.

The March to Milan.—Very few of Bonaparte's acts of generalship have been more criticized than this resolution to march on Milan, which abandoned Genoa to its fate and gave Melas a week's leisure to assemble his scattered forces. But to hasten to Genoa would, in Bonaparte's eyes, have been playing the enemy's

[1] He aftenvards appointed Berthier to command the Amy of Reserve, but himself accompanied it and directed it, using Berthier as chief of staff.

game, for they would have concentrated at Alessandria, facing west "in their natural position." The course which he took gave his army the enemy's depôts at Milan, of which it unquestionably stood in sore need, and the reinforcement of Moncey's 15,000 men from the Rhine, while at the same time Moncey's route offered an "assured line of retreat" by the Simplon and the St. Gothard. Above all, it provided him with a "natural position" across Melas's rear—that strategic barrage which seems to have been the initial objective of most of his manoeuvres against the enemy's rear. For such a position, offering natural obstacles, afforded him a secure pivot from which to prepare a warm embrace for the enemy, whose natural tendency, when cut off from their line of retreat and supply, was to turn and flow back, often in driblets, towards him. Once possessed of Milan, Bonaparte says, he could have engaged Melas with a light heart and with confidence in the greatest possible results of a victory, whether the Austrians sought to force their way back to the east by the right or the left bank of the Po. Thus, we are justified in assuming that his object was not the relief of Genoa, but the most thorough defeat of Melas's field army, to which end, putting all sentiment aside, he treated the hard-pressed Masséna as a "containing force" to keep Melas occupied during the strategical deployment of the Army of Reserve. In the beginning he had told Masséna that he would "disengage" him, even if he had to go as far east as Trent to find a way into Italy. From the first, then, no direct relief was intended, and when, on hearing bad news from the Riviera, he altered his route to the more westerly passes, it was because he felt that Masséna's containing power was almost exhausted, and that the passage and reassembly of the reserve army must be brought about in the minimum time and by the shortest way. It was a *pis aller* forced upon him by Moreau's delay and Masséna's extremity, and from, the moment at which he arrived at Milan he did, as a fact, abandon it altogether in favour of the St. Gothard.

Bonaparte's immediate purpose, then, was to reassemble the Army of Reserve in a secure zone of manoeuvre about Milan. This was carried out in the first days of June. Lannes at Chivasso stood ready to ward off a flank attack until the main army had filed past on the Vercelli road, then leaving a small force to combine with Turreau (whose column had not been able to advance into the plain) in demonstrations towards Turin, he moved off, still acting as right flank guard to the army, in the direction of Pavia. On the morning of June 2 Murat occupied Milan, and in the evening the headquarters entered the great city, the Austrian detachment under Vukassovich (the flying right wing of Melas's general cordon system in Piedmont) retiring to the Adda. Duhesme's corps forced that river at Lodi, and pressed on with orders to organize Crema and if possible Orzinovi as temporary fortresses. Lannes reached Pavia, where, as at Milan, immense stores of food, equipment and warlike stores were seized. Bonaparte was now safe in his "natural" position and barred one of the two main lines of retreat open to the Austrians. But his ambitions went farther, and he intended to cross the Po and to establish himself on the other likewise, thus establishing across the plain a complete barrage between Melas and Mantua. Here his end outranged his means, as we shall see. But he gave himself every chance that rapidity could afford him, and the moment that a "zone of manoeuvre" had been secured between the Ticino and the Oglio, he pushed on his main body—or rather what was left after the protective system had been provided for—to the Po.

The Movements of **Melas.**—At this point the action of the enemy began to make itself felt. Melas had not gained the successes that he had expected in Piedmont and on the Riviera, thanks to Masséna's obstinacy and to Suchet's brilliant defence of the Var. These operations had led him very far afield, and the protection of his over-long line of communications had caused him to weaken his large army by throwing off many detachments to watch the Alpine valleys on his right rear. He was further handicapped by the necessity of supporting Ott before Genoa and Elsnitz on the Var, and hearing of Lannes' bold advance on Chivasso and of the presence of a French column with artillery (Turreau) west of Turin, he assumed that the latter represented the main body of the Army of Reserve—in so far indeed as he believed in the existence of that army at all. Next, when Lannes moved away towards Pavia, Melas thought for a moment that fate had delivered his enemy into his hands, and began to collect such troops as were at hand at Turin with a view to cutting off the retreat of the French on Ivrea while Vukassovich held them in front. It was only when news came of Moncey's arrival in Italy and of Vukassovich's fighting retreat on Brescia that the magnitude and purpose of the French column that had penetrated by Ivrea became evident. Melas promptly decided to give up his western enterprises, and to concentrate at Alessandria, preparatory to breaking his way through the network of small columns—as the disseminated Army of Reserve still appeared to be—which threatened to bar his retreat. But orders circulated so slowly that he had to wait in Turin till June 8 for Elsnitz, whose retreat was, moreover, sharply followed up and made exceedingly costly by the enterprising Suchet. Ott, too, in spite of orders to give up the siege of Genoa at once and to march with all speed to hold the Alessandria-Piacenza road, waited two days to secure the prize, and agreed (June 4) to allow Masséna's army to go free and to join Suchet. And lastly, the cavalry of O'Reilly, sent on ahead from Alessandria to the Stradella defile, reached that point only to encounter the French. The barrage was complete, and it remained for Melas to break it with the mass that he was assembling, with all these misfortunes and delays, about Alessandria. His chances of doing so were anything but desperate.

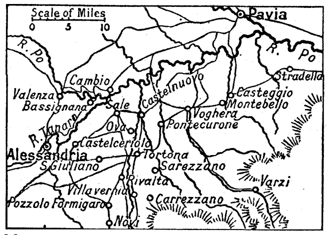
On June 5 Murat had moved on Piacenza, and stormed the bridge-head there. Duhesme pushed out on Crema and Orzinovi and also towards Pizzighetone. Moncey's leading regiments approached Milan, and Berthier thereupon sent on Victor's corps to support Murat and Lannes. Meantime the half-abandoned line of operations, Ivrea-Vercelli, was briskly attacked by the Austrians, who had still detachments on the side of Turin. On the 6th Lannes from Pavia, crossing the Po, encountered and defeated O'Reilly, and barred the Alessandria-Parma main road. Opposite Piacenza, Murat had to spend the day in gathering material for his passage, as the pontoon bridge had been cut by the retreating garrison of the bridge-head. Meantime the last divisions of the Army of Reserve (two of Moncey's excepted) were hurried towards Lannes' point of passage, as Murat had not yet secured Piacenza. On the 7th, while Duhesme continued to push back Vukassovich and seized Cremona, Murat at last captured Piacenza, finding there immense magazines. Meantime the army, division by division, passed over slowly, owing to a sudden flood, near Belgiojoso, and Lannes' advanced guard was ordered to open communication with Murat along the main road Stradella-Piacenza. "Moments are precious," said the First Consul. He was aware that Elsnitz was retreating before Suchet, that Melas had left Turin for Alessandria, and that heavy forces of the enemy were at or east of Tortona. He knew, too, that Murat had been engaged with certain regiments recently before Genoa and (wrongly) assumed O'Reilly's column to have come from the same quarter. Whether this meant the deliverance or the surrender of Genoa he did not yet know, but it was certain that Masséna's pinning action was over, and that Melas was gathering up his forces to recover his communications. Hence Bonaparte's great object was concentration. "Twenty thousand men at Stradella," in his own words, was the goal of his efforts, and with the accomplishment of this purpose the campaign enters on a new phase.

Bonaparte's Dispositions.—The army now being disseminated between the Alps, the Apennines, the Ticino and the Chiese, it was of vital importance to connect up the various parts into a well-balanced system. Duhesme was still absent at Cremona. Lechi was far away in the Brescia country, Béthencourt detained at Arona. Moncey with about 15,000 men had to cover an area of 40m. square around Milan, which constituted the original zone of manoeuvre, and if Melas chose to break through the flimsy cordon of outposts on this side (the risk of which was the motive for detaching Moncey at all) instead of at the Stradella, it would take Moncey two days to concentrate his force on any battlefield within the area named, and even then he would be outnumbered by two to one. As for the main body at the Stradella, its position was wisely chosen, for the ground was too cramped for the deployment of the superior force that Melas might bring up, but the strategy that set before itself as an object 20,000 men at the decisive point out of 50,000 available was, to say the least, hazardous. In truth, here, in contrast to his later campaigns, he had not the material to cement his strategic barrage. It is, however, clear from a letter to Carnot that Bonaparte counted greatly upon the union of Masséna and Suchet, with 18,000 men, to press Melas against the Army of Reserve. Another questionable feature was the order to Lannes to send forward his advanced guard, and to attack whatever enemy he met with on the road to Voghera. Bonaparte, in fact, calculated that Melas could not assemble 20,000 men at Alessandria before June 12. Acting on this order Lannes fought the battle of Montebello on the 9th. This was a very severe running fight, in which the French drove the Austrians from several successive positions, and it culminated in a savage fight at close quarters about Montebello itself. The singular feature of the battle is the disproportion between the losses on either side—French, 500 out of 12,000 engaged; Austrians, 2,100 killed and wounded and 2,100 prisoners out of 14,000. These figures are most conclusive evidence of the intensity of the French military spirit in those days, and also give a likely explanation of Bonaparte's apparent rashness in pushing Lannes forward. If, without endangering the bait, he could draw Melas towards the Stradella, he could thereby curtail the undue extent of his strategic barrage.

Meanwhile, Bonaparte had issued orders for the main body to stand fast, and for the detachments to take up their definitive covering positions Duhesme's corps was directed, from its eastern foray, to Piacenza, to join the main body. Moncey was to provide for the defence of the Ticino line, Lechi to form a "flying camp" in the region of Orzinovi-Brescia and Cremona, and another mixed brigade was to control the Austrians in Pizzighetone and in the citadel of Piacenza. On the other side of the Po, between Piacenza and Montebello, was the main body (Lannes, Murat and part of Victor's and Duhesme's corps), and a flank guard was stationed near Pavia. with orders to keep on the right of the army as it advanced (this is the first hint of an intention to go westward) and to fall back fighting should Melas come on by the left bank.

For a new idea, and doubt, had begun to form in his mind. Still believing that Melas would attack him on the Stradella side, and hastening his preparations to meet this, he began to allow for the contingency of Melas giving up his attempt to re-establish his normal line of communication, and retiring instead on Genoa, which was now in his hands and could be provisioned and reinforced by sea. On the 10th Bonaparte ordered reserve ammunition to be sent from Pavia, giving Serravalle, which is south of Novi, as its probable destination. Such reports as were available indicated no important movements whatever which happened to be true, but could hardly appear so to the French headquarters. On the 11th, though he thereby forfeited the reinforcements coming up from Duhesme's corps at Cremona, Bonaparte ordered the main body to advance to the Scrivia. Lapoype's division (the right flank guard) was called to the south bank of the Po, and the zone around Milan was stripped so bare of troops that there was no escort for the prisoners taken at Ilfontebello. The crisis was at hand, and influenced by the reports collected by Lapoype as to the quietude of the Austrians towards Valenza and Casale, Bonaparte and Berthier strained every nerve to bring up more men to the Voghera side in the hope of preventing the prey from slipping away to Genoa.

But Moncey, Duhesme, Lechi and Chabran were at a distance —and these represented almost exactly half of Berthier's command (30,000 out of 58,000), and even the concentration of 28.000 men on the Scrivia had only been obtained by practically giving up the "barrage" on the left bank of the Po Even now (the 12th) the enemy showed nothing but a rearguard, and the old questions reappeared in a new and acute form. Was bfelas still in Alessandria? Was he marching on Valenza and Casale to cross the Po, or to Acqui against Suchet, or to Genoa to base himself on the British fleet? As to the first, why had he given up his chances of fighting on one of the few cavalry battlegrounds in north Italy—the plain of Marengo—as he could not stay in Alessandria for any definite time? The second question had been answered in the negative by Lapoype, but his latest information was 36 hours old. As for the other questions, no answer whatever was forthcoming, and the only course open was to postpone decisive measures and to send forward the cavalry, supported by infantry, to gain information.



MAP SHOWING THE AREA ASSOCIATED WITH NAPOLEON'S ADVANCE AGAINST MELAS, JUNE 12–13, 1800

Marengo.—On the 13th, therefore, Murat, Lannes and Victor advanced into the plain of Marengo, traversed it without difficulty and carrying the villages held by the Austrian rearguard, established themselves for the night within a mile of the fortress. But meanwhile Bonaparte had taken a step that was fraught with the gravest consequences. He had, as we know, no intention of forcing on a decision until his reconnaissance produced the information on which to base it, and he had therefore kept back three divisions under Desaix at Pontecurone. But as the day wore on without incident, he began to fear that the reconnaissance would be profitless, and unwiiling to give Melas any further start, he sent out these divisions right and left to find and to hold the enemy, whichever may the latter had gone. At noon Desaix with one division was despatched southward to Rivalta to head off Melas from Genoa, and at 9 A.M. on the 14th, on the strength of a report, false as it turned out, that the Austrian rearguard had broken the bridges of the Bormida, Lapoype was sent back over the Po to hold the Austrians should they be advancing from Valenza towards the Ticino. Thus there remained in hand only 23.000 men when at last in the forenoon of the 14th the whole of Melas's army, 45,000 strong, moved out of Alessandria, not southward nor northward, but due west into the plain of Marengo (*q.v.*). The extraordinary battle that followed is described elsewhere. The outline of it is simple enough The Austrians advanced slowly and in the face of the most resolute opposition, until their attack had gathered weight, and at last they were carrying all before them, when Desaix returned from beyond Rivalta and initiated a series of counterstrokes These were brilliantly successful, and gave the French not only local victory but the supreme self-confidence that, coupled with their strategic position, enabled them to extort next day from Melas an agreement to evacuate all Lombardy as far as the Mincio. And though in this way the chief prize, Melas's army, escaped after all, Marengo was the birthday of the First Empire.

One more blow, however, was required before the Second Coalition collapsed, and it was delivered by Moreau. We have seen that he had crossed the upper Rhine and defeated Kray at Stokach. This was followed by other partial victories, and Kray then retired to Ulm, where he reassembled his forces, hitherto scattered in a long weak line from the Neckar to Schaffhausen. Moreau continued his advance, extending his forces up to and over the Danube below Ulm, and winning several combats of which the most important was that of Höchstädt, fought on the famous battlegrounds of 1703 and 1704, and memorable for the death of La Tour d'Auvergne, the "First Grenadier of France" (June 19). Finding himself in danger of envelopment, Kray now retired, swiftly and skilfully, across the front of the advancing French, and reached Ingolstadt in safety. Thence he retreated over the Inn, Moreau following him to the edge of that river, and an armistice put an end for the moment to further operations.

This not resulting in a treaty of peace, the war was resumed both in Italy and in Germany. The Army of Reserve and the Army of Italy, after being fused into one, under Masséna's command, were divided again into a fighting army under Brune, who opposed the Austrians (Bellegarde) on the Mincio, and a political army under Murat, which re-estahlished French influence in the peninsula. The former, extending on a wide front as usual, won a few strategical successes without tactical victory, the only incidents of which worth recording are the gallant fight of Dupont's division, which had become isolated during a manoeuvre, at Pozzolo on the Mincio (Dec. 25) and the descent of a corps under hfacdonald from the Grisons by way of the Splügen, an achievement far surpassing Bonaparte's and even Suvórov's exploits, in that it was made after the winter snows had set in.

Hohenlinden.—In Germany the war for a moment reached the sublime. Kray had been displaced in command by the young archduke John, who ordered the denunciation of the armistice and a general advance. His plan, or that of his advisers, was to cross the lower Inn, out of reach of Moreau's principal mass, and then to swing round the French flank until a complete chain was drawn across their rear. But during the development of the manoeuvre, Moreau also moved, and by rapid marching made good the time he had lost in concentrating his over-dispersed forces. The weather was appalling, snow and rain succeeding one another until the roads were almost impassable. On Dec 2 the Austrians were brought to a standstill, but the inherent mobility of the Revolutionary armies enabled them to surmount all difficulties, and thanks to the respite afforded him by the archduke's halt, Moreau was able to see clearly into the enemy's plans and dispositions. On Dec. 3, while the Austrians in many disconnected columns were struggling through the dark and muddy forest paths about Hohenlinden, Moreau struck the decisive blow. While Ney and Grouchy held fast the head of the Austrian main column at Hohenlinden, Richepanse's corps was directed on its left flank. In the forest Richepanse unexpectedly met a subsidiary Austrian column which actually cut his column in two. But profiting by the momentary confusion he drew off that part of his forces which had passed beyond the point of contact and continued his march, striking the flank of the archduke's main column, most of which had not succeeded in deploying opposite Ney, at the village of Mattempost. First the baggage train and then the artillery park fell into his hands, and lastly he reached the rear of the troops engaged opposite Hohenlinden, whereupon the Austrian main body practically dissolved The rear of Richepanse's corps, after disengaging itself from the Austrian column it had met in the earlier part of the day, arrived at Mattempost in time to head off thousands of fugitives who had escaped from the carnage at Hohenlinden. The other columns of the unfortunate army were first checked and then driven back by the French divisions they met, which, moving more swiftly and fighting better in the broken ground and the woods, were able to combine two brigades against one wherever a fight developed. On this disastrous day the Austrians lost 20,000 men, 12,000 of them being prisoners, and 90 guns.

Marengo and Hohenlinden decided the war of the Second Coalition as Rivoli had decided that of the first, and the Revolutionary Wars came to an end with the armistice of Steyer (Dec. 25, 1800) and the treaty of Lunéville (Feb. 9, 1801). But only the first act of the great drama was accomplished. After a short respite Europe entered upon the Napoleonic Wars.

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(C. F. A.; X.)

NAVAL OPERATIONS

The sweeping aims of the French Revolutionary government, to obtain for France her so-called natural limits—the Rhine, the Alps, the Pyrenees, and the Ocean—quickly provoked a coalition of many European Powers pledged to resist it. Of these powers, England proved the most implacable; and it became the object of the Revolutionary, and still more of the Napoleonic, government to reduce her to submission. The intensity of the struggle produced a series of naval campaigns extending over most of the world. In the earlier years of the war France was hampered by the excessively democratic spirit which spread amongst her fleets. Her crews were often mutinous, and some of her most competent admirals were guillotined, their places being filled by men hastily promoted from very junior ranks—for example, Villaret-Joyeuse was promoted straight from lieutenant to admiral. Such drawbacks mattered less in 1792 when operations were confined to giving some assistance to troops operating against Austria in north Italy, and to reducing Naples; but when the First Coalition was completed by the entry of England in Feb., and Spain in March 1793, the naval weakness of the French became manifest. This was seen in the operations in the Channel, where they were unable to maintain an effective force for some time. It is true that Lord Howe, commanding the British Channel fleet, did not attempt to blockade Brest throughout 1793–94—in this connection, the many calls on the British navy for commerce and colonial protection over the whole world must be remembered—and that this freedom enabled Villaret to cover the safe arrival of a large convoy bringing corn from America in 1794. But he himself—more important than the convoy—was caught by Howe in the process, and severely defeated at the Battle of the Glorious 1st of June, losingseven ships. This defeat effectually completed the disorganization of the French, and their engagements in the Channel for the next two years, such as those with Cornwallis and Lord Bridport in 179j, only served to emphasize this ineffectiveness. None the less, French successes on land added to the already heavy British commitments at sea. Having overrun Holland in 1794, the French compelled her to go to war with England in Jan. 1795; and England was thereafter forced to maintain a separate North Sea fleet to guard against invasion from the Texel.

In the meantime operations had been proceeding in various colonial waters and in the Mediterranean. In the former the British had, as early as 1793, seized various French stations in the East Indies, including Pondicherry. In 1793–94 they also achieved some success in the West Indies, capturing Tobago, French San Domingo, Martinique and Guadeloupe, though the last-named was retaken by the Terrorist. Victor Hugues. Later in the war St. Lucia and other islands were also taken. In 1795, Admiral Elphinstone. afterwards Lord Keith, began operations against the colonial possessions of the unfortunate Dutch, and took from them the Cape of Good Hope and their station at Malacca. The importance of these operations lay not only in the captures made, but in the destruction of French sea-borne commerce that they involved.

Lord Hood was given the British command in the Mediterranean and, with 21 ships, directed his energies to the reduction of Toulon, in which he was joined by Spanish and Neapolitan squadrons. The extreme dissension between the Jacobins and Girondists helped him to secure the surrender of the city and its great arsenal; but after the Jacobin triumph, lack of troops forced him to relinquish his hold. Over 30 French ships, including 13 of the line, were destroyed before the withdrawal; but, owing to the lukewarm support of the Spanish, a sufficient number were left intact to form, later, the nucleus of a Mediterranean fleet. Several thousands of the inhabitants were also taken off to escape the ferocious vengeance which was wreaked by the victorious Jacobins on their less fortunate countrymen left behind. From 1794–96 the British were mainly occupied in reducing Corsica and trying to help the Austrians in north Italy. Hood's successor, Hotham, failed to deal effectively with the Toulon squadron, though he was twice in action with it in 1795; on each occasion the French escaped serious damage, losing only three ships. Fortune, in the shape of the wind, assisted them; but Nelson held the opinion that Hotham's lack of energy did so too. Jervis, afterwards Lord St. Vincent, relieved Hotham at the end of 1795, and imparted a livelier spirit to the fleet; but in the following year Spain, who had made peace in 1795, re-entered the war on the French side. This gave England another long piece of coast-line to watch and forced her temporarily to withdraw from the Mediterranean.

From 1796 onwards French movements at sea became somewhat more purposeful; and in December they tried to strike at England by the time-honoured method of invading Ireland; but, though the expedition was allowed to sail from Brest, and some of the ships reached Bantry Bay, bad weather caused its failure, and the fleet returned in fragments to Brest. The year 1797 saw England standing alone against France and further embarrassed by the great naval mutinies at Spithead and the Nore, in which the sailors expressed their dissatisfaction with a state of affairs now admitted to have been disgraceful. None the less the gloom was relieved by the light of two great victories at sea, as a result of which Pitt was enabled to reopen negotiations for the formation of another coalition. In Feb. Jervis with 15 sail of the line encountered 27 Spaniards off Cape St. Vincent and, relying on Spanish inefficiency to counteract their advantage in numbers, attacked them and took four prizes. In Oct., Admiral Duncan in command of the North Sea fleet of 16 ships caught the Dutch at sea off Camperdown, also 16 strong. They tried to lure him on to the shoals, but he accepted the risk, chased them and took nine prizes.

In 1798, another, and slightly more successful, attempt was made to invade Ireland. General Humbert with 1,100 troops was actually landed; but, after some initial success, was compelled to surrender, while other forces were captured before they landed. But the most important movements were in the Mediterranean. Austria was willing to join a second coalition, but insisted on making the re-entry of the British into the Mediterranean a condition. Jervis, therefore, was ordered either to re-enter the Mediterranean himself, or, if he felt it necessary to continue the blockade of Cadiz, to detach a force thither. He replied that Nelson had already been detached to inquire into the nature of reported activities in Toulon, and he reinforced him with ten ships. The reported activities were the preparations for Napoleon's expedition to Egypt, the origin of which lay chiefly in his desire to keep himself in the public eye. The force succeeded in sailing from Toulon, covered by a fleet of 13 battleships commanded by Admiral Brueys, and in reaching Alexandria, where Napoleon was landed; but Nelson, discovering their whereabouts after a long search, came upon Brueys anchored in Aboukir Bay and destroyed his entire fleet with the exception of two battleships and two frigates, all of which were accounted for later. This placed Napoleon in a most awkward position. He advanced some distance, but was repulsed before Acre by Commodore Sir Sidney Smith, who had landed with Napoleon's own guns, taken at sea. The French tried to relieve his position, and Admiral Bruix succeeded in bringing the Brest fleet to the Mediterranean; but he did not venture far to the East and ultimately returned to Brest without having been brought to action. Napoleon came home as a fugitive, leaving his army to the mercy of the British, who followed up their victory at the Nile, and made further successes possible, by the capture of Minorca (1798) and Malta (1800). Some measure of success was also achieved in the autumn of 1799 by a combined Russian and British expedition, which proposed to attack the French army of occupation in Holland: Admiral Mitchell forced the entrance to the Texel and obtained the surrender of the Dutch fleet—the Dutch sailors showing little inclination to fight on behalf of their French conquerors. From the military standpoint, however, the affair was not so successful.

By this time Napoleon had become First Consul, and was responsible for the formation of the Armed Neutrality of the Northern Powers which brought about the last great expedition of the war. The Scandinavian Powers, Russia and Prussia pledged themselves to resist the right of search of the British, who were dependent for the very existence of their fleet on supplies of timber and hemp from the Baltic. The Neutrality had to be broken, and in March 1801, a fleet of 18 ships under Sir Hyde Parker, with Nelson as second-in-command, sailed to the Baltic for the purpose. It was decided that an attempt should first be made to detach Denmark from her allies, peaceably or forcibly. Peaceable methods failing, it became necessary to attack the Danish fleet that was anchored along the sea-front of Copenhagen, protected by shoals. Parker thought approach to it impossible; but Nelson with 12 ships solved the problem, smashed the Danish fleet, and the Armed Neutrality with it. By this time peace was near. The English people were sick of the war, while Napoleon needed a truce for the consolidation of his position and the preparation of new schemes. Consequently the Peace of Amiens ended the Revolutionary War in 1802, a peace that was to be the truce Napoleon intended, rather than anything more lasting.

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FRENCH SOUTHERN OCEAN AND ANTARCTIC TERRITORIES (TERRES AUSTRALES ET ANTARCTIQUES FRANÇAISES), a group of islands in the southern part of the Indian ocean including a section of Antarctica. A separate administration for these territories was created by a decree of Sept. 18, 1956, with a senior administrator (administrateur *supérieur*), who resides in Paris, and is directly responsible to the minister for overseas France. From 1924 to 1956 these *terres australes* were administered from Madagascar (Malagasy Republic). The following islands are included in the new administrative unit: (1) two small volcanic islands, Saint Paul (*q.v.*) and Nouvelle Amsterdam; (2) the island of Kerguelen. with many adjacent smaller islands totalling about 2,703 sq.mi.; and (3) the Crozet Islands archipelago. Also included is Terre Adélie. (See ANTARCTICA.)

(Hu. DE.)

FRENCH WEST AFRICA (AFRIQUE OCCIDENTALE FRANÇAISE), a former federation of French overseas territories, comprised an area of 1,831,079 sq.mi. (approximately eight times the area of France and nearly one-sixth that of all Africa), extending from the central Sahara south ard to the Gulf of Guinea and from the Atlantic eastward to Lake Chad. It was bounded on the north by Rio de Oro, by the southern territories of Algeria and by Libya; on the east by former French Equatorial Africa; and on the south and the west by the Atlantic ocean, except where foreign enclaves (Gambia; Portuguese Guinea; Sierra Leone and Liberia; Ghana [Gold Coast] and the former trust territory of Togoland [Republic of Togo] ; and Nigeria) indent its coastal zone. French West Africa was a federation of eight territories: Mauritania, Senegal, Dahomey, French Sudan (renamed Mali Republic), Ivory Coast, Upper Volta, Niger and French Guinea. In 1958 the territories became autonomous republics, and in 1960 independent republics, within the French Community. Later, all but Senegal withdrew from the French Community. French Guinea in 1958 left the French Community and was renamed Guinea.

Physical Features.— The area of former French West Africa consists of gneisses and crystalline schists. There also occur at various points granites, old volcanic rocks, porphyries and diorites, old sedimentary deposits, schists and Silurian quartzites. Above these old folded formations are horizontal strata of nonfossiliferous sandstones which cover immense areas. Secondary and Tertiary marine formations (Cretaceous and Eocene) are met with in Senegambia and extend as far as Lake Chad. The Quaternary and Recent deposits include alluvial deposits, dunes and laterites, and ferruginous red clays which are often found in strata of great thickness and are the result of the decomposition of rocks in situ under the influence of the intertropical climate.

The country is in the form of a plateau, broken up by two systems of fractures, one running southwest and northeast, the other at right angles, northwest and southeast. The heights are domes of granite or diorite, which are remains of older chains of mountains now worn away; and the cliffs in which the plateau ends. The southern highland areas are the Futa Jallon (Fouta Djallon), the Nimba mountains and the Atakora highlands. The Futa Jallon is a much-dissected plateau region lying about 60 mi. inland in Guinea. It has a northwest-southeast length of nearly 500 mi. and averages 175 mi. in width; the maximum elevation reaches 4,675 ft. The Nimba mountains stand nearly on the boundary of Liberia and Ivory Coast; they rise to 6,069 ft. The Atakora highlands form a series of north-south ridges in northwestern Dahomey; their highest elevations rise to 2,146 ft. In the districts of the Sahara which are attached to Mauritania, Mali, and Niger there are three principal highland regions: the Adrar of Mauritania (2,628 ft.), the Adrar of Iforas (3,280 ft.) and the Aïr (5,905 ft.). The coast is straight and sandy from Cape Blanc to Cape Verde, which shelters the port of Dakar; after this it is cut up by estuaries, especially between Cape Verde and the island of Sherbro. After Cape Palmas the coast line runs from west to east and is bordered by unbroken beaches and lagoons.

Rivers.—The Niger (*q.v.*), the third longest river of Africa and the second in volume of water, is the main artery of former French West Africa. It rises at an altitude of 2,800 ft. not far from the frontier of Sierra Leone and at first flows from southwest to northeast and then takes a great bend which brings it into the Sahara in the neighbourhood of Timbuktu. After Bourem (Burem) it turns in a northwest-southeast direction and finally runs into the Gulf of Guinea. In its upper reaches, from its source to Koulikoro (Kulikoro), it receives tributaries from the right, particularly the Tankisso. In the middle reaches, from Koulikoro to Say, it receives a great tributary, the Bani or Bagoe, and spreads out into a sort of wide inland delta—a great area subject to flooding, which in the rainy season is about 90 mi. wide at Mopti and narrows in again after Tosaye and Bourem. The lower part of the river, from below Gaya to the sea, belongs to Nigeria; it is separated from the middle reaches by the Bussa rapids. The upper course of the Niger is subject to summer floods between June and September; the floods arrive gradually and late in the Timbuktu district, where the maximum is not reached until January. The middle reaches of the Niger are of great importance from the point of view of navigation, which is possible over a distance of 800 mi. from Koulikoro to Ansongo, as well as for irrigation. The most important of the coast rivers is the Senegal (*q.v.*), formed by the junction of the Bakoy (Bakhoy), with its tributary the Baoulé (Baule), and the Bafing; it is navigable up to Kayes in the wet season (Aug. 15 to Oct. 15) and up to Podor in the dry season. The Casamance, the Cavally, the Sassandra, the Bandama, the Comoé, the Volta and the Ouémé should also be mentioned.

Climate and Vegetation.—The climate varies from an equatorial type along the Gulf of Guinea coast to a desert type in the north. Temperatures are high the year around, with annual averages above 75° F. along the coast and above 80° in the interior. The range between the coldest month and the warmest is seldom more than 5° F. along the Guinea coast, but increases toward the north. From Dakar northward, there is a distinct cool season along the coast. On the whole, seasons are based not on temperature but rather on rainfall. Along the Gulf of Guinea, there are two rainy and two dry periods every year, the shorter dry season being in July and August. Northward. the rainy periods merge, eliminating the short dry season, while the other dry season becomes longer and more pronounced. As far north as the latitude of St. Louis there is an observable rainy season of three months and a dry season of nine months. Still farther north rain is uncertain at all times. The average yearly amount of rain exceeds 17j in. along the coast of Guinea and Ivory Coast but decreases inland and northward to less than 5 in. in northern Mauritania.

From the point of view of vegetation, a distinction may be drawn between the Saharan zone (rainfall of less than 8 in.); the Sahelian zone (rainfall of less than 24 in.), which is a region of steppes in which grow doum palms and narrow-leaved acacias; the Sudanese zone (rainfall from 24 in. to 60 in.), a country of savannas with forest belts, which is the principal agricultural region; and the Guinea zone (rainfall of more than 60 in.) which is occupied by the great forest: attaining a width of more than 180 mi. at Cape Palmas, and the characteristic feature of which is the oil palm (Elaeis guineensis).

For further physiographical information, see WEST AFRICA.

History.—The French were established early on the west coast of Africa; but, if a few attempts at colonization such as that of André Brue at the end of the 17th and beginning of the 18th century are excepted, their main object was the trade in slaves and gum, their practice being similar to that of other European states. Their two principal factories were at St. Louis and on the island of Gorée. which the English disputed with them till the early years of the 19th century. A new era was inaugurated by Col. Louis Faidherbe. who, in the decade of 1854–65, subdued the hinterland of Senegal and conceived the scheme of linking the upper Senegal with the upper Niger. From 1876 onward the coast settlements were considerably extended into the hinterland by a series of campaigns and missions, and at the same time the possessions of other European powers in the same region were reduced to the state of enclaves by a number of conventions. The most important events were: the campaigns on the upper Niger (1876–go), which resulted in the destruction of the upstart empires of Omar al-Haji (el-Hadj Omar) and Samory; L. G. Binger's mission to the Ivory Coast (1887–89); the campaigns of Dahomey (1889–94); the occupation of Timbuktu (1893); and the Franco-British conventions of 1890 and 1898. By about 1900 the period of expansion may be regarded as over, and the period of organization and development begun.

French West Africa was constituted in 1895 by the grouping of the several colonies under one governor general. Subsequently the development of the federation as a unit was promoted, while a large measure of autonomy was left to each territory (which had its own governor and its own territorial assembly). See below, Administration; and the articles on the individual territories.

Population.—There is no racial unity among the populations of the area. They differ in physique, in physiognomy, in manners and in dialect and are of very mixed stock. They have spread mainly in two directions, toward the south and toward the west. Some of them are not connected with the Negro races: for example, the Saharans, Moors and Tuaregs, and the Fulani (Fula, Peul), who, with their reddish-brown colouring and only slightly woolly hair, appear to be of Ethiopian or Hamitic, and some of Semitic stock. Among the strictly Negro populations, a distinction may be made between those of the region enclosed by the bend of the Niger and of Senegal on the one hand and those of the Gulf of Guinea on the other. The former include the great group of the Mandingo, which extends over the region of the upper courses of the Niger; it is subdivided into a number of tribes, including the Malinké, the Soninke, the Bambara and the Diula; then there are the Wolof and the Tukulor of Senegal, the Sonrhaï of the district of Gao and the Mossi of Upper Volta. The Negroes of the coast are generally shorter than the Sudanese; their heads are not so long and their colour is lighter. Of this type are the Fon of Dahomey; the Agni and the Baule of the eastern Ivory Coast and the Kru of the western; and the Susu (Soussou) of Guinea. In the middle region live naked Palaeo-Negritic peoples (Koniagui, Lobi, Bobo, Kabré, Samba).

The original religion of the Sudanese tribes is animism, or belief in the omnipotence of spirits. About one-half of the population is Moslem, in name at any rate; but the Negro manages to reconcile Islam with his ancient beliefs, and it is only the populations in the neighbourhood of the Sahara which have really been profoundly affected by Mohammedanism. The Guinea tribes, as well as the Mossi, have for the most part remained animists.

It was estimated. in 1951, that the total population of French West Africa amounted to 17,726.000, including 62,300 Europeans and foreigners (of whom 50,000 were metropolitan Frenchmen). The average density is 9.7 per square mile, but distribution is very irregular. In the coastal section of Dahomey there are about 250 people per square mile, while most of the area has less than 12 per square mile, the northern desert regions and some parts of the great forest having less than 1. Up to the beginning of the 20th century the country was depopulated by internecine warfare in the region enclosed by the bend of the Niger; and the slave trade had previously taken vast numbers from the Guinea coast.

In 1951 the population of the several territories (including that of their principal towns) was as follows: Mauritania, 560,000 (there are no towns, administration being from St. Louis in Senegal); Senegal. 2.158,000 (capital: St. Louis. 60,000; Dakar, capital of French Rest Africa, 229,200; Rufisque, 33,000; Kaolack, 37,600; Thiès, 31,500); French Sudan, 3,461,000 (capital:

Bamako, 68.197; Kayes, 19,605; French Guinea, 2,506,852 (capital: Conakry, 34,770); Ivory Coast. 2,485,086 (capital: Abidjan, 119,135; Bouake, 42,117); Upper Volta. 3,324,969 (capital: Ouagadougou. 32.077; Bobo-Dioulasso: 44,8jj); Dahomey, 1,614,633 (capital: Porto-Novo, 30,800; Cotonou, 28,064); Niger, 2,335,436 (capital: Niamey, 18,098).

Administration.—The eight territories of French West Africa were administered by governors, who were subordinate to a governor general (high commissioner) at Dakar. All the inhabitants were made French citizens in 1946. Each territory elected its own territorial assembly to vote the budget and to watch over the administration. The assemblies elected the members of the grand council, which met at Dakar. French West Africa likewise sent 20 deputies to the French national assembly. 20 senators to the council of the republic and 26 representatives to the council of the French Community in Paris. The territorial capitals and the major towns also elected their own municipal councils.

Communications.—The problem of communications in French West Africa has always been that of linking the interior with the coast. The earliest line of penetration was the Senegal river. the northernmost permanent stream south of the Sahara. From that stream's upper course access to the upper reaches of the Niger was relatively easy. Together, the streams were thought to form an east-west traffic corridor across a large part of west Africa. But they were never as effective as was originally hoped, because their flows vary markedly during the year; *e.g.*, the Senegal is navigable as far upstream as Kayes (600 mi.) for boats with a draught of 15 ft. from Aug. 1j to Oct. 1j; but for the rest of the year it is quite unsatisfactory save for very small craft, and during April and May it is unusable. The Niger is navigable from Kouroussa and Kankan (Guinea) to Bamako (Sudan) from August to December; from Bamako to Ansongo, by shallow-draught boats, for most of the year; and from Ansongo to Gaya (Niger), regularly. throughout the year.

With the expansion of French control from the coast, railways seemed to offer an effective means of access to the interior. The line from Dakar to St. Louis, 163 mi. long and the first to be built in West Africa, was completed in 1885. A line begun near Kayes on the Senegal in 1881 reached Bamako on the Niger in 1904. Meanwhile, lines toward the interior were begun at Conakry in 1900, at Cotonou in 1902 and at Abidjan in 1905. In 1907 a railway joined Dakar to Kayes, so that by 1923 there was a Dakar-Bamako line, connecting the Niger with the coast 800 mi. away. Previously. in 1914, the Conakry line had reached navigable water at Kouroussa on the upper Niger and at Kankan. In 1934, the Cotonou line reached Parakou. The Abidjan line, stopped for a long time at Bobo-Dioulasso, reached Ouagadougou in 1954. Meanwhile. roads which were motorable during most of the year connected the railway termini. Furthermore. there were three trans-Saharan bus routes. one going northward from Zinder (Niger) to Algiers, one northward from Gao (Sudan) on the Niger to Oran in western Algeria and the third. less used, north-northeastnard from St. Louis to Agadir in Rforocco.

Dakar has cable connections with Brest in France, with Fernando Noronha in Brazil. with Casablanca in Morocco and with Conakry. Abidjan and Cotonou within the federation. Regular steamship and air services link Dakar with Europe and with South and North America; and there are services linking all the major ports of the French West African coast. Air services connect all the capitals to Paris.

Dakar overshadowed all other ports in the federation. In 1953 tonnage cleared there amounted to 3,300,000 metric tons, as against 660.000 at Abidjan. 350,000 at Conakry and 150,000 at Cotonou.

Economy.— Since the latter part of the 19th century there has been a remarkable change in the economy of French West Africa. Ivory, bird plumage, rubber, cabinet woods and gum arabic n-ere among the more important items of commerce in the early days of French control. But these products are now less important. and agriculture. with the controlled use of natural resources, has come to supersede uncontrolled exploitation.

For the most part, agricultural development in French West Africa has differed from that in many tropical colonies. Plantation agriculture, which means alienation of the land from the natives, has been kept at a minimum. Few concessionary companies and individual colonists were allowed to establish themselves in Ivory Coast and French Guinea. Attention has been given to promoting sustenance crops for the Africans as well as crops destined for commerce. To speak broadly, the natives have retained control of the land and are the real producers.

The principal food crops are millets, rice and maize. Livestock is important in the grassland areas; above all in Senegal. in French Sudan, in Niger and in Mauritania. In 1953 sheep and goats together numbered 17,000,000; cattle. mostly of the humpbacked zebu variety. numbered about 8,500,000. There were more than 250,000 horses and about 250,000 camels.

By the middle of the 20th century the principal commercial crops were those yielding vegetable oils. Peanuts, originally a food staple, were the most important of these. The first consignment of them was shipped from Rufisque to Rouen in 1640, and after 1844 regular shipments to Marseilles were made from several West African ports. In 1954 output amounted to 700,000 metric tons unshelled (including 550,000 from Senegal) and 488,000 metric tons shelled. Palm kernels and castor-oil seeds are other sources of commercial vegetable oil. Both peanut oil and palm oil are exported in large amounts. Cacao, coffee and bananss. as well as cotton, sisal and kola (a source of caffeine and theobromine). were all likewise of increasing importance. All these products are cultivated in native plantations or gardens. Particular efforts have been made to stimulate cotton growing. As most native kinds were not suited to French manufacturing needs. agricultural experiments (including irrigation systems affecting 300 sq.mi. in the region of the middle Niger river) were undertaken. with the result that quality was improved and quantity raised. Output however was still far behind France's requirements.

Of the minerals, gold has been known to exist in the region since mediaeval times. but French West Africa is not one of the great producing countries, Salt has been important in the desert areas of Mauritania and Niger for nearly 1,000 years. There is manganese in Ivory Coast, iron and copper in Mauritania and iron and bauxite in French Guinea. By the middle of the 20th century the oil works at Dakar still constituted French West Africa's only large-scale industry. Native industries, leather and cotton goods, are of little external importance.

In 1953 French West Africa's imports amounted to 1,257,000 metric tons. with a value of 55,242,000,000 fr. C. F. .4. (1 franc C. F. A.=2 metropolitan French francs). Exports in the same year amounted to 1,806,000 metric tons. with a value of 46,761,000,000 ir. C. F. A., mainly peanuts and peanut oil {constituting more than 40% of the total value). coffee (about 21%), cacao (17%), almonds and palm oil (6%), bananas (3%) and timber (2%). By far the greater part of French West Africa's trade is with France and other countries of the French Community.

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FRENEAU, PHILIP MORIN (1752–1832), U.S. poet, essayist and editor, known as the "poet of the American Revolution," was born of parents of French Huguenot descent in New York city on Jan. 2, 1752. After graduating from Princeton in 1771, he taught school and studied for the ministry until the outbreak of the American Revolution, when he turned his ready pen to vitriolic satire against British and Tories. Not until his return from two years in the Caribbean islands, where he produced two of his most ambitious poems, "The Beauties of Santa Cruz" and "The House of Night," did he become, however, an active participant in the war, joining the New Jersey militia in 1778 and sailing as a privateer to the West Indies. Captured and imprisoned by the British in 1780, he wrote bitterly, on his release, of *The British Prison-Ship* and with infectious enthusiasm of *American Independence*, and during the next several years wrote patriotic contributions to the *Freeman's Journal* in Philadelphia. The war over, he became a sea captain until 1790, when he again entered partisan journalism, ultimately as editor from 1791 to 1793 of the outspokenly republican *National Gazette,* in which he so effectively attacked Federalist policies that Thomas Jefferson credited him with saving the country when it was "galloping fast into monarchy." Ardently devoted to principles of liberty, but recognizing also the necessity of finding solitude for poetry, he alternated his time between quiet periods at sea and periods of active newspaper work as editor or contributor, until he retired early in the 19th century to his farm in Monmouth County, N.J., where he died on Dec. 18, 1832.

For more than 50 years his verse and prose appeared in periodicals and in something more than a dozen volumes; collected editions were published in 1786. 1788, 1795, 1809 and 1815. Well schooled in the classics and in antecedent English poetry. he strove for a fresh idiom which would be unmistakably American. hut except in a few poems he failed to avoid the influence of his models. He has been called the father of American poetry, anticipating Bryant and Poe in theme and technique. A dozen years before Wordsworth's influence was felt on English verse, Freneau looked with wonder on nature in such poems as "The Wild Honey Suckle" and "Stanzas Written on the Hills of Neversink" which, with "The Indian Burying Ground" and "To the Memory of the Brave Americans," deserve a place in any anthology of his period.

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FRENSSEN, GUSTAV (1863–1945), German novelist: perhaps the most powerful of the school of writers of the *Heimatkunst* (*i.e.,* literature of particular regions). He was born at Barlt, Holstein. Oct. 19, 1863, took orders in 1890 and until 1902 was pastor at Hemme; but he had already for several years been known as a novelist, and after the success of *Jorn Uhl* (1901), he gave up his pastorate and devoted all his time to writing. He died at Barlt, April 11, 1945. His novels include *Die Sandgräfin* (1896); *Die drei Getreuen* (1898; Eng. trans.. *The Three Comrades,* 1907); *Hilligenlei* (1905; Eng. trans., *Holyland,* 1906); *Klaus Hinrich Baas* (1909); *Die Brüder* (1918); *Otto Babendiek* (1926); and *Der brennende Baum* (1931). He also published sermons (*Dorfpredigten,* 1899–1902) and plays. His novels give realistic and vivid descriptions of the peasantry and the countryside in north Germany. His great popularity was due partly to this and partly to the many subsidiary and propagandist elements associated with his work.

See N. Numsen, *G. Frenssen* (1940). (A. Gs.)

FREON. A trade name covering a family of chemicals containing fluorine and used as fluids in refrigeration compressors. The more commonly used are usually known by a code name; for example the substance CCl_2F_2 is known as either Freon-12 or F-12; similarly F-11 is CCl_3F; F-22 is $CHClF_2$; and F-114 is $CClF_2.CClF_2$. These compounds are economically manufactured by part replacement of fluorine for chlorine in inexpensive compounds such as carbon tetrachloride (CCl_4) or chloroform ($CHCl_3$); each of the replacements causes a drop of about 50° C. in the boiling point. so that CCl_4, which boils at 76° C., becomes CCl_3F (F-11) boiling at 25° C., then CCl_2F_2 (F-12) boiling at −29° C. The low boiling property makes the compound usable as a refrigerating fluid. In addition; the presence of a group of fluorine atoms causes a general tightening up of the molecular structure of the Freons, and this results in a much improved stability which permits the Freons to resist tenaciously any destructive physical or chemical factors; it also renders them physiologically inert. It is possible to inhale or be exposed to concentrations of these materials to as large as 10% to 20% for several hours with impunity. The practice of air-conditioning public places such as theatres! restaurants, trains and auditoriums requires the use of refrigerating fluids which! in case of accidents, would not create a fire hazard or be injurious to the audience, should they leak into the atmosphere; neither can the refrigerating fluids have a detectable odour. lest a panic be created in an audience detecting even an insignificant leakage. The importance of the Freons lies in the fact that they are so stable that they are entirely harmless. The Freons were first manufactured in 1930 and increased rapidly in commercial importance after 1934. During World War II they were adapted to the use of dispersing agents for insecticides. A solution of an insecticide such as pyrethrum or DDT in Freon-12 is carried in a steel container; by opening a valve, the solution is forced out as a fine spray: and the insecticide is thereby fully dispersed in a room, a tent or the space enclosed under the mosquito nets used in the tropics. The mist so created is harmless because it will neither burn nor injure the lungs and the space may be occupied while the fumigation proceeds.

See also REFRIGERATION. (A. L. HE.)

FREQUENCY. A term used in scientific work generally to denote the number of occurrences of some periodic phenomenon or quantity which occur in unit time.

In physics the term is applied to wave motions of all types, mechanical, sound (*q.v.*), light (*q.v.*), electromagnetic waves (*q.v.*) or oscillations generally. *See* ALTERNATING CURRENT; BROADCASTING; RADAR; RADIO; RADIO RECEIVER. (H. B. LM.)

FREQUENCY, RADIO, a term designating the portion of the electromagnetic energy spectrum that is useful in radio communication. The frequency of electromagnetic energy is the number of complete reversals of energy direction that take place in one second and is usually expressed in cycles per second (c.p.s.), kilocycles per second (kc.) or megacycles per second (mc.) where 1 kc. equals 1,000 c.p.s. and 1 mc. equals 1,000,000 c.p.s. The radio-frequency spectrum extends from the lowest frequency that can be efficiently radiated (about 3 kc.) to the lower edge of the infrared region (about 300,000 mc.).

It is often convenient to divide the radio-frequency spectrum into smaller ranges (or bands) which can be designated by appropriate abbreviations.

Radio-Frequency Classifications

Band number	Frequency range	Designation
4	3 kc.–30 kc.	Very low frequency (VLF)
5	30 kc.–300 kc.	Low frequency (LF)
6	300 kc.–3,000 kc.	Medium frequency (MF)
7	3,000 kc.–30,000 kc.	High frequency (HF)
8	30 mc.–300 mc.	Very high frequency (VHF)
9	300 mc.–3,000 mc.	Ultrahigh frequency (UHF)
10	3,000 mc.–30,000 mc.	Superhigh frequency (SHF)
11	30,000 mc.–300,000 mc.	Extremely high frequency (EHF)

The various portions of the radio-frequency spectrum are usually allocated, by law, to different types of radio service. For example. the familiar AM (amplitude modulation) broadcasting stations (540 kc.–1,600 kc.) are located in the MF band while FM (frequency modulation) and television broadcasting are allocated to the VHF band. The two lowest frequency bands (VLF and LF) are used for radiotelephone and radio navigation service while the SHF band is primarily for radar and microwave relay systems. The highest frequency band (EHF) is used largely for experimental purposes. *See* also RADIO. (G. R. CR.)

FRERE, SIR HENRY BARTLE EDWARD, 1ST BART., cr. 1876 (1815–1884), British administrator, born at Clydach in Brecknockshire on March 29, 1815, was the son of Edward Frere, and a nephew of J. H. Frere. of *Anti-Jacobin* and *Aristophanes* fame. After leaving Haileybury, Bartle Frere was appointed a writer in the Bombay civil service in 1834, and in 1835 assistant collector at Poona. In 1842 he became private secretary to Sir George Arthur, governor of Bombay. In 1844 he became political resident at the court of the raja of Satara, administering the province, on the raja's death in 1848, even after its formal annexation in 1849. In 1850 he was appointed chief commissioner of Sind.

On his return to India from leave in 1857 Frere learned at Karachi of the mutiny. He sent his only European regiment to secure the strong fortress of Multan against the rebels, and sent further detachments to aid Sir John Lawrence in the Punjab. For his services he received the thanks of both houses of parliament and was made K.C.B. In 1863 he was appointed governor of Bombay, where he effected great improvements, including the inauguration of the university buildings. He established the Deccan college at Poona, and a college for instructing natives in civil engineering. The prosperity, due to the U.S. Civil War. which rendered these developments possible, resulted in a speculative mania, leading eventually to the disastrous failure of the Bombay bank, for which Frere incurred severe and not wholly undeserved censure. In 1867 he returned to England and was made a member of the Indian council. In 1872 he was sent by the foreign office to negotiate a treaty with the sultan, Seyyid Burghash, at Zanzibar, for the suppression of the slave traffic. In 1875 he accompanied the prince of Wales to Egypt and India.

But the greatest service that Frere undertook on behalf of his country was to be attempted not in Asia, but in Africa. He landed at Capetown as high commissioner of South Africa on March 31, 1877. He had been chosen by Lord Carnarvon in the previous October as the statesman most capable of carrying his scheme of confederation into effect, and within two years it was hoped that he would be the first governor of the South African Dominion. The first year of his rule was marked by a Raffir war on the one hand and by a rupture with the Cape (Molteno-Merriman) ministry on the other. The Transkei Kaffirs were subjugated early in 1878 by General Thesiger (the and Lord Chelmsford) and a small force of regular and colonial troops. The constitutional difficulty was solved by Frere dismissing his obstructive cabinet and entrusting the formation of a ministry to Gordon Sprigg. Frere emerged successfully from a year of crisis, but the advantage was more than counterbalanced by the resignation of Carnarvon early in 1878, at a time when Frere required the steadiest and most unflinching support. He was convinced that there was a widespread insurgent spirit pervading the natives, which had its focus and strength in the celibate military organization of Cetywayo. Frere told the colonial office that this organization must be broken up, if necessary, by force. The colonial office appeared to agree, but when Frere sent, in Dec. 1878, an ultimatum to Cetywayo, the home government abruptly discovered that a native war in South Africa was inopportune and raised difficulties about reinforcements. Having entrusted to Lord Chelmsford the enforcement of the British demands, Frere's immediate responsibility ceased. On Jan. 11, 1879 the British troops crossed the Tugela, and 14 days later the disaster of Isandhlnana was reported; and Frere, attacked and censured in the house of commons, was but feebly defended by the government. Lord Beaconsfield, it appears, supported Frere; the majority of the cabinet were inclined to recall him. He was censured, but begged to stay on.

The Zulu trouble and the disaffection that was brewing in the Transvaal reacted upon each other in the most disastrous manner. Frere had had no part in the actual annexation of the Transvaal. which was announced by Sir Theophilus Shepstone a few days after the high commissioner's arrival at Capetown. The delay in giving the country a constitution afforded a pretext for agitation to the malcontent Boers, a rapidly increasing minority, while the reverse at Isandhlwana had lowered British prestige. Oning to the Kaffir and Zulu wars Frere had hitherto been unable to give his undivided attention to the state of things in the Transvaal, which he visited in 1879. A large camp, numbering 4.000 disaffected Boers, had been formed near Pretoria, and they were terrorizing the country. Frere visited them unarmed and practically alone. On the condition that the Boers disperse. Frere undertook to present their complaints to the British government, and to urge the fulfilment of the promises that had been made to them They parted with mutual good feeling, and the Boers did eventually disperse—on the very day upon which Frere received the telegram announcing the government's censure. But bad nens met him on his return to Capetown—on June 1. 1879, the prince imperial had met his death in Zululand—and a few hours later Frere heard that the government of the Transvaal and Natal, together with the high commissionership in the eastern part of South Africa, had been transferred from him to Sir Garnet Wolseley.

When Gladstone's ministry came into office in the spring of 1880, Lord Kimberley had no intention of recalling Frere In June, however, a section of the Liberal party memorialized Gladstone to remove him, and the prime minister weakly complied (Aug. 1, 1880). Upon his return Frere replied to the charges relating to his conduct respecting Afghanistan as well as South Africa, previously preferred in Gladstone's Midlothian speeches, and was preparing a fuller vindication when he died at Wimbledon from the effects of a severe chill on May 29, 1884.

His *Life and Correspondence, by* John Martineau, was published in 1895. *See* the article SOUTH AFRICA, UNION OF: *History.*

FRERE, JOHN HOOKHAM (1769–1846), English diplomat and author. was born in London. He was educated at Eton, where he met Canning, and at Caius college, Cambridge. He entered public service in the Foreign Office under Lord Grenville, and sat from 1796 to 1802 as M.P. for the close borough of West Looe in Cornwall. He and Canning were ardent supporters of Pitt, and contributors to the *Anti-Jacobin.* On Canning's removal to the board of trade in 1799 he succeeded him as under-secretary of state; in Oct. 1800 he was appointed envoy extraordinary and plenipotentiary to Lisbon; and in Sept. 1802 he was transferred to Madrid, where he remained for two years. He was made a member of the privy council in 1805; in 1807 he was appointed plenipotentiary at Berlin, but the mission was abandoned, and Frere was again sent to Spain in 1808 as plenipotentiary to the Central Junta. The condition of Spain rendered his position a very responsible and difficult one. When Napoleon began to advance on Madrid Frere wholeheartedly advised Sir John Moore not to retreat. After Corunna public opinion accused him of having endangered the army, and he was recalled.

Thus ended Frere's public life. In 1816 he married Elizabeth Jemima, dowager countess of Erroll, and in 1820, on account of her failing health, he went with her to the Mediterranean. There he finally settled in Malta, where he lived the rest of his life. He died at the Pietà Valetta on Jan. 7, 1846. Frere's literary reputation now rests entirely upon his spirited verse translations of Aristophanes, which remain in many ways unrivalled. The translations of *The Acharnians, The Knights, The Birds* and *The Frogs* were privately printed, and were first brought into general notice by Sir G. Cornewall Lewis in the *Classical Museum* for 1847.

Frere's complete works were published in 1871, with a memoir by his nephews, W. E. and Sir Bartle Frere, and reached a second edition in 1874. *See* also Gabrielle Festing, J. H. *Frere and his Friends* (1899).

FRÈRE-ORBAN, HUBERT JOSEPH WALTHER (1812–1896), Belgian statesman, was born at Liége on April 24. 1812. After studying law in Paris, he practised as a barrister at Liége, took a prominent part in the Liberal movement, and in June 1847 was returned to the chamber as member for Liége. He was minister of public works in the Rogier cabinet, and from 1848 to 1852 was minister of finance. He founded the Banque Nationale and the Caisse d'Épargne, abolished the newspaper tax. reduced the postage, and modified the customs duties as a preliminary to a decided free-trade policy. To facilitate the negotiations for a new commercial treaty, he conceded to France a law of copyright, which proved highly unpopular in Belgium, and he resigned office, soon followed by the rest of the cabinet. His work La *Mainmorte et la charité* (1854–1857), published under the pseudonym of "Jean van Damme," helped his party back to power in 1857, when he again became minister of finance. He now embodied his free-trade principles in commercial treaties with England and France, and abolished the *octroi* duties and the tolls on the national roads. He resigned in 1861 on the gold question, but soon resumed office, and in 1868 succeeded Rogier as prime minister. In 1869 he defeated the attempt of France to gain control of the Luxemburg railways. Defeated in 1870, he returned to office in 1878 as president of the council and foreign minister. He provoked the bitter opposition of the Clerical party by his law of 1879 establishing secular primary education, and in 1880 broke off diplomatic relations with the Vatican. Frère-Orban, while rejecting the Radical proposal of universal suffrage, conceded an extension of the franchise (1883); but the hostility of the Radicals, and the discontent caused by a financial crisis, overthrew the government at the elections of 1884. Frère-Orban continued to lead the Liberal opposition till 1894, when he failed to secure re-election. He died at Brussels on Jan. 2, 1896.

FRÉRET, NICOLAS (1688–1749), French scholar, was hardly 26 years of age when he was admitted as pupil to the Academy of Inscriptions. One of the first memoirs which he read mas *Sur l'origine des Francs* (1714). He maintained that the Franks were a league of South German tribes and not, according to popular legend, a nation of free men deriving from Greece or Troy. These sensible views excited great indignation in the Abbé Vertot, who denounced Fréret as a libeler of the monarchy. A *lettre de cachet* was issued, and FrCret was sent to the Bastille until March 1715. In Jan. 1716 he was received associate of the Academy of Inscriptions, and in Dec. 1742 he was made perpetual secretary. His memoirs, many of them posthumous, treat of history, chronology, geography, mythology and religion. He died in Paris on March 8, 1749.

FRERICHS, FRIEDRICH THEODOR (1819–1885): German pathologist, became professor of pathology at Gottingen (1848), at Kiel (1850), at Breslau (1852) and Berlin (1859). He developed scientific clinical teaching in Germany. He discovered leucin and tyrosin in the urine in cases of acute yellow atrophy of the liver (1855), made pathological studies of cirrhosis of the liver and of pernicious malarial fever and published works on Bright's disease (1851) and diseases of the liver (1858).

FRÉRON, ÉLIE CATHERINE (1718–1776), French controversialist, prominent mainly as the opponent of the *philosophes*, was born at Quimper in Brittany, Jan. 20, 1718. He was editor of *L'Année litte'raire,* founded by him in 1754, which gave a thorough survey of French literary production. Although submissive to authority, he was imprisoned at Vincennes in 1746, in the Bastille in 1757, and narrowly escaped a similar fate in 1765. He appears to have carried his opposition to the *Encyclopédie* to the length of denouncing the printers to the police. He was not without affability in his private life, but was bitterly attacked on many occasions by Voltaire, most notably in his comedy *L'Écossaise* (1760). He died in Paris, March 10, 1776.

See F. Cornou, *Élie Friron* (1922). (RT. S.)

FRÉRON, LOUIS MARIE STANISLAS (1765–1802), French revolutionist, son of Elie FrCron (*q.v.*), was born at Paris on Aug. 17, 1765. On the death of his father his name was attached to *Année littéraire,* which was continued until 1790 and edited successively by the abbés G. M. Royou and J. L. Geoffroy. On the outbreak of the Revolution Fréron, who was a schoolfellow of Robespierre and Camille Desmoulins, established the violent journal *L'Orateur du peuple.* With Barras in 1793 he repressed the opposition to the convention at Marseilles and Toulon, but both afterward joined the Thermidoriens, and Fréron became the leader of the *jeunesse dorée* and of the Thermidorian reaction. He brought about the accusation of Fouquier-Tinville and of J. B. Carrier, the deportation of B. Barère and the arrest of the last *Montagnards*. His paper became the official journal of the reactionists. He went in 1799 as commissioner to Santo Domingo and died there in 1802. He wrote *Mémoire historique sur la réaction royale et sur les malheurs du midi* (1796).

FRESCO (Ital. for *cool,* "fresh"), a term introduced into English, both generally (as in such phrases as *al fresco,* "in the fresh air"), and more especially as a technical term for mural painting on plaster. In the latter sense the Italians distinguished painting *a secco* (when the plaster had been allowed to dry) from *a fresco* (when it was newly laid and still wet). *See* FRESCO PAINTING and PAINTING.

FRESCOBALDI, GIROLAMO (1583–1644), Italian organist and composer, was born in Ferrara. He studied under the cathedral organist Luzzasco Luzzaschi, and owed his first reputation to his beautiful voice. He was organist at St. Peter's in Rome from 1608 to 1628. In 1628 he went to live in Florence, becoming organist to Duke Ferdinand II. Political troubles drove him back to Rome in 1633, and he was again organist at St. Peter's until March 1643. He died on March 2, 1644. Frescobaldi was perhaps the greatest organist of the 17th century. His compositions show the consummate art of the early Italian school, and his works for the organ are full oi the finest devices of fugal treatment. He also wrote numerous vocal compositions, such as canzoni, motets, hymns, etc., a collection of madrigals for five voices (1608) being among the earliest of his published works.

FRESCO PAINTING. Fresco is a method of painting on freshly applied, wet lime-plaster walls with colours made by grinding artists' dry powder pigments in pure water. The colours dry and set with the plaster and become a permanent part of the wall. The terms *buon fresco* and *a fresco* are sometimes used to distinguish true fresco from its substitutes.

Like other processes which have their roots in remote antiquity, it is basically simple and direct; it operates on the most commonplace of chemical reactions; and at the same time it demands of the painter thorough competence and familiarity with a multitude of details. The execution of a fresco should not be attempted by the inexperienced. The restrictions imposed in modern times by economic and other circumstances usually preclude the use of this most desirable kind of mural painting.

A mural is not merely a large-scale version of an easel painting. blown up and projected on a wall. No other, form has so many technical requirements. In addition to the restrictions common to all forms of painting, resulting from the artist's desire for maximum control of the paint and for permanence, mural painting has certain limitations peculiar to itself. The mural must be effective when viewed from any point in the room, whereas the easel painting may be effective only from the most favourable point. Ideally, the surface of the mural should be without glare under general illumination. It must have a "mural quality" — it should seem to be a part of the building rather than a superimposed en~bellishment.

From the early Renaissance to the present day, fresco has been the technique that has met all mural requirements in the most satisfying way; it has survived and retained its pre-,eminence as the most appropriate medium through every change in style.

History. — Nobody knows when or where fresco painting began. One theory was that it arose from the preparatory outlines drawn on the plaster for setting mosaics. The most accepted explanation points to the ancient use of stucco to cover rough or unsightly masonry: a smooth, flawless white finish was gradually developed, which was then tinted or coloured by the addition of pigments and eventually decorated with more intricate colours in the form of designs and pictures.

The Egyptians did not use fresco. Mud plaster was employed for building; lime was not used until its introduction by the Romans. Wall painting was prominent, however, throughout the long history of Egypt. Examples have survived because of the dryness of the climate and the 'protection of the tombs. Some of these paintings have simple water colour binders; after thousands of years they are still bright, but can be removed with a damp sponge. Others, particularly those used with carving, were mixed with a resinous binder.

True frescoes. of a high level of technical accomplishment. were a prominent feature of the prehistoric Minoan culture in Crete (before 1500 B.C.) discovered in the 20th century. Chemical analysis showed the lime and all the earth pigments of the Minoan frescoes to have been produced locally with the exception of an imported Egyptian blue frit. Some, not all, of the Etruscan wall paintings still to be seen in Italy, notably at Tarquinia, were painted in fresco. No wall paintings from ancient Greece have survived but writings suggest that fresco was a standard method there. Little is known about Greek painting from the artistic or stylistic viewpoint. or what relation it had to Roman wall painting, but it is known that the Romans were profoundly influenced by Greek methods and technical procedures.

Roman fresco painting is well-documented, especially in the books of Vitruvius and Pliny. Whole frescoed walls have been excavated in Pompeii and Herculaneum and fragments have been unearthed in nearly every Roman site.

In India the cave temples of Ajanta (200 B.C.–A.D. 600) contain a large number of frescoes skillfully executed with lime and pigments of local origin plus Afghan lapis lazuli blue. Considerable ingenuity and resourcefulness must have been used to overcome local difficulties. There is no indication of joins in these murals; a possible explanation is that the work was done by guilds or families rather than individual painters, so that a wall could be finished in one session. Another isolated find of ancient frescoes (5th–8th centuries A.D.) is a group of Buddhist decorations at Tun-huang, Kansu, in remote western China.

European artists from the 13th through the 17th centuries employed fresco as their major mural painting method, and this was its heyday, especially in Italy where it fulfilled the requirements of every conceivable personal technique and pictorial objective. From the 18th century, artists and chemists experimented widely with new methods designed to replace fresco with mediums more resistant to the polluted atmosphere of towns and cities, but technically, fresco remained the most desirable.

The demanding and formidable process does not conform to the exigencies of the 20th century, so it has been largely supplanted by inferior methods, such as *secco* and the traditional easel painting techniques—(*e.g.*, oil, casein, tempera). In the 1930s, during a period of extensive construction of public buildings, there was a widespread revival of fresco painting in the Cnited States and in Mexico.

See also PAINTING; MURAL PAINTING.

Technique.—Onto a brick, tile or metal lath wall, the artist or his plasterer trowels or "throws" three coats of specially made mortar composed of aged slaked lime-putty (quicklime which has been slaked with water and kept in storage for a year or more to improve its plasticity), sand and sometimes marble dust, each in its own carefully measured proportion. The first or scratch coat (trulisatio) and the second or brown coat (arricaccato) are applied and allowed to set. The artist, who has made enlarged full-scale cartoons completely finished in detail from his original drawings, then transfers them onto the mall in outline, usually by going over the lines of a tracing of the cartoon with a perforating wheel; while the tracing is held in place against the wall. a little cloth bag of dry powder pigment is tapped or pounced through the perforations. The final painting coat (*intonaco*) is then smoothly troweled on as much of the upper left-hand corner of the wall as can be painted in one session. The boundaries of this area are confined carefully along contour lines, so that the joins of each successive day's work are imperceptible. The perforated tracing is then held against the fresh intonaco and lined up carefully with the adjacent drawing; the pigment is then gently pounced over it once more.

If the wall has been correctly prepared the *intonaco* will hold its moisture for a long working period. When the painter freely dilutes his colours with water and applies them with deft brushstrokes. they will be drawn into, or imbibed by, the surface through capillary action. As the wall dries and sets; the pigment particles become bound or cemented along with the lime and sand particles. They are part of the same cementitious, porous mass; their colour permanence and resistance to aging is entirely due to their own chemical inertness and not to a transparent skin or binding medium as is the case with other forms of painting. The painting is actually part of the wall, not a superimposed layer of paint.

After the mortar reaches a certain degree of set or dryness, it will no longer take or absorb colours from the brush; as soon as this is observed, the painter must stop, and await the next fresh area of plaster, or else his colour will lie on the surface like dusty pastel instead of becoming incorporated into the rocklike mass.

Secco or limewash painting is a simplified offshoot of fresco which does away with the complex preparation of the wall with fresh plaster. Dry, finished walls are soaked with limewater and painted while wet with casein colours. The colours do not penetrate into the plaster but form a surface film like any other paint. Practised since early times, it has always held an inferior position to true fresco.

Pigments.—The fresco palette is more rigidly restricted than any other. The pigments not only must have the usual colour stability required of artists' pigments in general. but also must be completely alkali proof to resist the caustic action of the lime and sufficiently acid resistant to withstand concentrations of acid impurities existing in the atmosphere. As a routine check on the behaviour of his pigments, the fresco painter makes a plaster test block upon which his supply of pigments is tried so that he can check on their colour when dry, their ability to combine with the mortar and their resistance to the lime (six months' aging is necessary for this test).

The modern fresco painter uses the following pigments: white, either plain lime-putty, the traditional biartco *sangiovanni* (partially carbonated lime putty) or blanc fixe; Mars black; Indian red; light red; the umbers; the siennas; green earth; ochre (or Mars yellow); Mars violet; a special cementitious rosy-red earth called Pozzuoli red; chromium oxide green; viridian; cobalt blue; cerulean blue; phthalocyanine blue; and some specimens of cobalt violet (must be tested). Most painters reject vermilion, the cadmium yellows and reds and ultramarine blue, because they contain sulfides and are therefore extremely sensitive to the action of acids. These are used by others. however: on the theory that they are no more sensitive to acids than the calcium carbonate of the wall itself.

Three chemical reactions are involved: the making of lime. the slaking of lime and the hardening of mortar. Lime is obtained from kilns where limestone or marble or some other form of calcium carbonate is burned to form quicklime (calcium oxide). The slaking or mixing with water converts it into hydrated lime (calcium hydroxide). When the mortar is spread out and exposed to air, its lime is converted to calcium carbonate, chemically identical to the original limestone or marble. The carbonation is caused by carbon dioxide which is a constituent of the atmosphere. Calcium carbonate is a durable substance indoors, where plastered and frescoed walls have lasted for centuries and where marble retains a high polish. But it is too susceptible to the abrasion of rain and airborne particles and to acid conditions to be used outdoors or even in a semiexposed position.

Chemists rate fresco as a completely permanent indoor method but not sufficiently permanent outdoors. For exposure to outdoor or drastic conditions! some imperishable mural method must be chosen. for example. mosaic and terra cotta or one of the modern developments such as ethyl silicate or porcelain enamel.

Ser Olle Nordmark, *Fresco Painting* (1947); Ralph Mayer, *The Artist's Handbook of Materials and Techniques*, rev. ed. (1957), extensive bibliography. (RH. M.)

FRESENIUS, KARL REMIGIUS (1818–1897), German chemist and author of standard texts on chemical analysis, was born at Frankfurt-on-Main on Dec. 28, 1818. In 1836 he was apprenticed to an apothecary. He studied at Bonn in 1840 and at Giessen in 1841, where he acted as assistant in Justus von Liebig's laboratory, and in 1843 became *Privatdocent* in chemistry. In 1845 he was appointed to the chair of chemistry, physics and technology at the Wiesbaden Agricultural institution, and in 1848 he became the first director of the chemical laboratory and school for chemists which the Nassau government established there. This establishment. which was set up in his home. was augmented in 1862 with a pharmacy school, and in 1868 with an agricultural experiment station especially devoted to the wine industry. He established a bacteriologic institute in 1884. Fresenius occupied himself almost exclusively with analytical chemistry, and the fullness and accuracy of his textbooks on that subject (of which that on qualitative analysis first appeared in 1841 and that on quantitative in 1846) soon rendered them standard works. They passed through numerous editions and were translated into many languages. including Japanese.

Many of his original papers were published in the *Zeitschrift* fur analytische *Chemie*, which hc founded in 1862 and continued to edit until his death.

Fresenius died suddenly at Wiesbaden on June 11, 1897. His sons and brothers continued the laboratory and school.

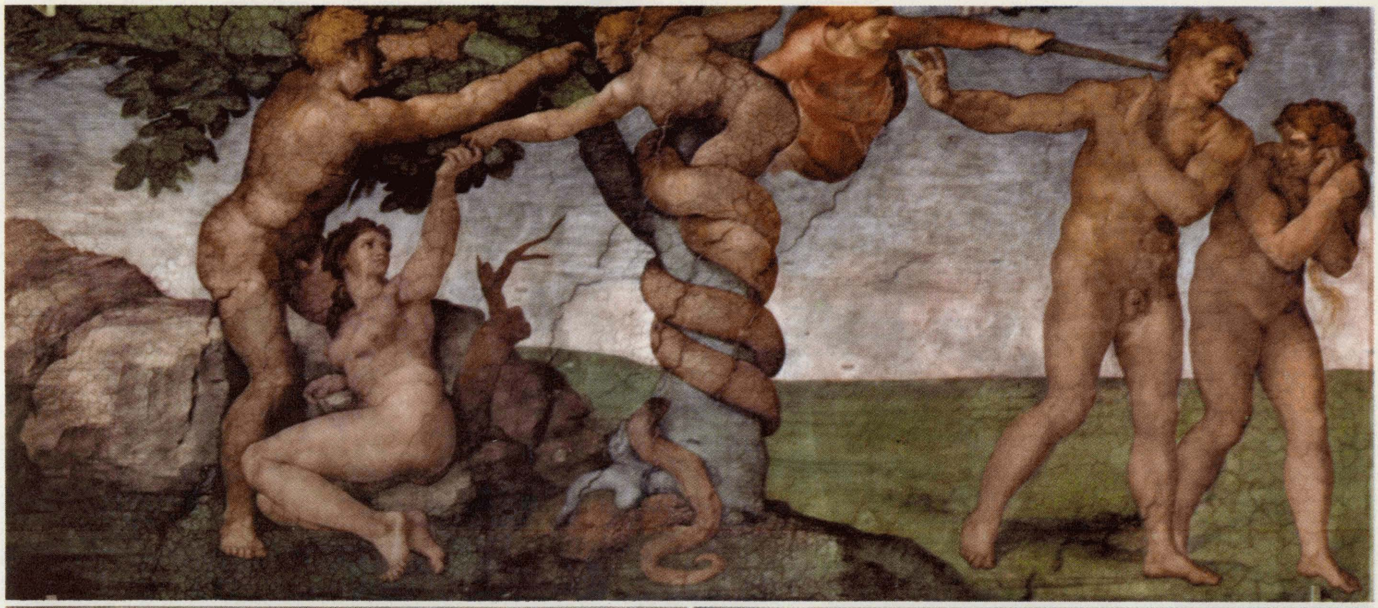
(R. E. O.)

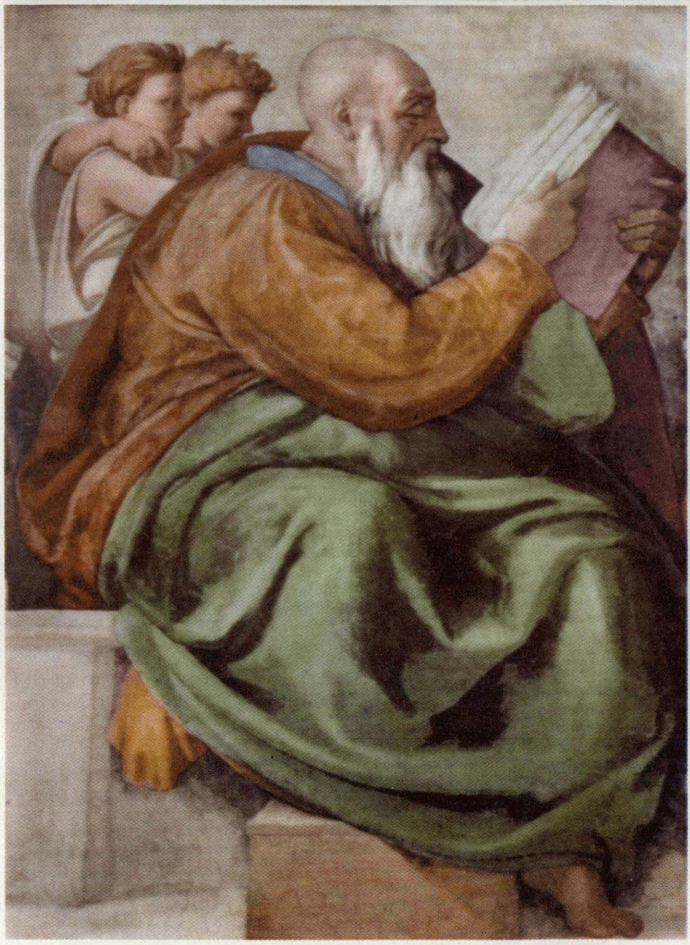
FRESHWATER, a seaside holiday town in the Isle of Wight, Eng., about 10 mi. S.W. of Newport by road. Pop. (1951) 3,423. It is a scattered township lying on the peninsula west of the river Yar at the western extremity of the island. Freshwater bay is separated from Alum bay on the west by the promontory between, with the group of detached rocks, known as the Needles, jutting from the sea. The cliffs are magnificent, rising 400–500 ft.

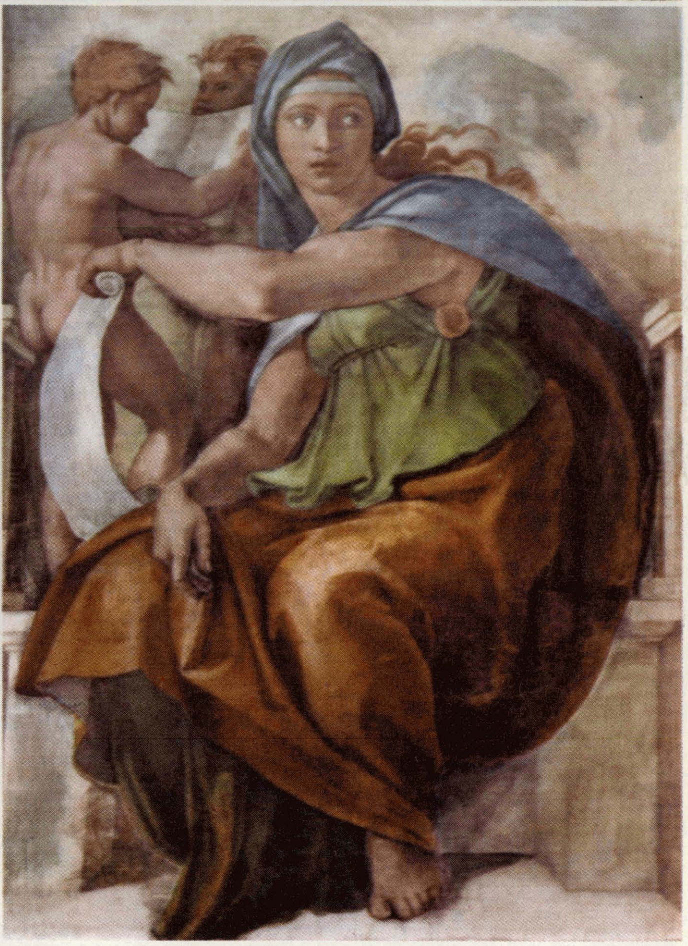
Farringford house in the parish was the home of Alfred, Lord Tennyson, who is commemorated by a tablet in All Saints' church and by a great cross on High down overlooking Freshwater bay. There are two golf links on the downs.

FRESNEL, AUGUSTIN JEAN (1788–1827), French physicist and pioneer in optical theory, was born at Broglie, Nor-

FRESCO PAINTING







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CEILING OF THE SISTINE CHAPEL

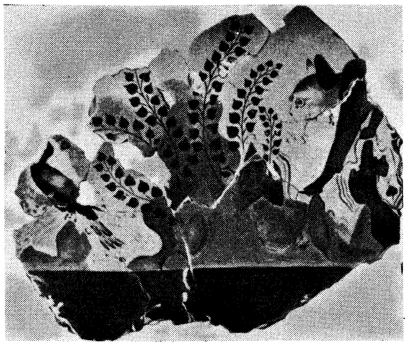
Among the most important series of frescoes were those painted by Michelangelo (1475–1564) on the ceiling of the Sistine chapel in the Vatican. This work, which took four and a half years to complete, is comprised of 343 figures grouped in scenes from the Book of Genesis. Bordering the central panels of the vaulted ceiling of the chapel are large, seated figures of prophets and sibyls md, interspaced with them, triangular spandrels depicting the ancestors of Christ and four miraculous salvations of the chosen people. The ceiling is enclosed in and divided by a painted framework

Top: The Fall of Man, om of the central panels, shows Adam and Eve taking the forbidden fruit and being expelled from the Garden of Paradise. The serpent, with the head of & woman, $ coiled around the Tree of Knowledge

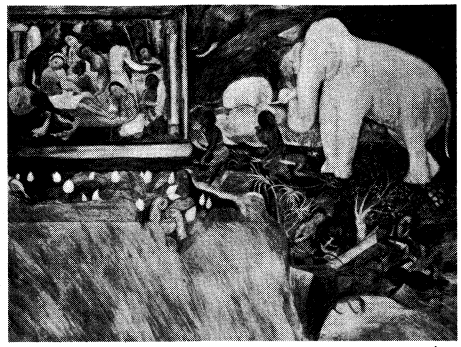
Bottom left: The Prophet Zacharias. The Genii of the intellect peer over the shoulders of the prophets md sibyls

Bottom right: The Delphic Sibyl. Five sibyls and seven prophets are depicted

FRESCO PAINTING



"Cat Hunting a Pheasant"; late Minoan period (c. 1500 B.C.) from Hagia Traida. Facsimile from original in Candia museum, Crete

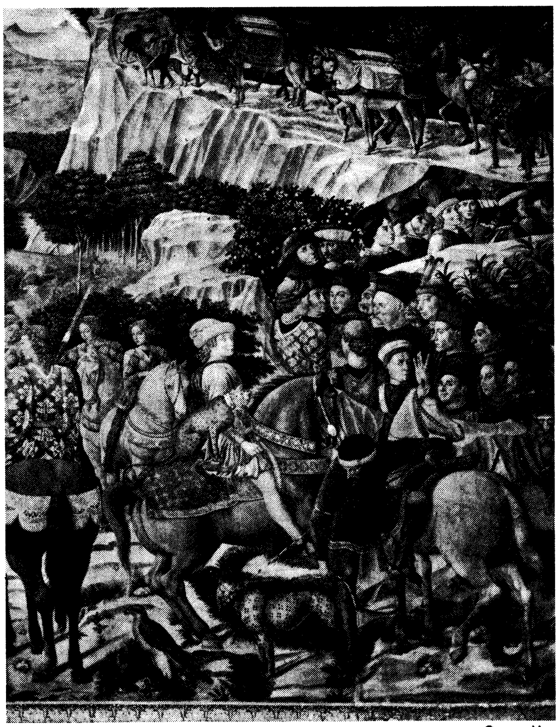


"Six-Tusked Elephant and the Queen of Benares," Indian fresco from Ajanta, cave XVII

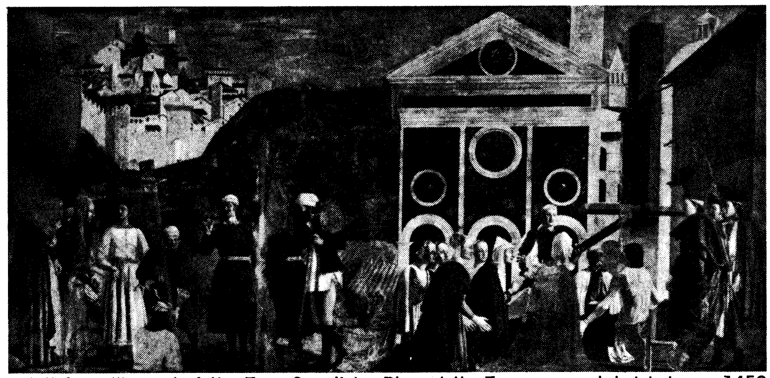
"Pieth" from "The Life of Christ and the Virgin" by Giotto; painted 1305–06. From the Arena chapel, Padua, Italy

"Lady Playing the Cithera," Roman fresco from Boscoreale, 1st century A.D.

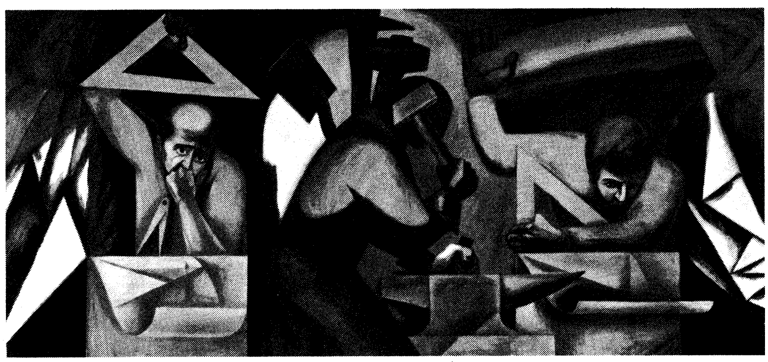
"Musicians," Etruscan wall painting of the 5th century B.C. Detail from the Tomb of the Leopards, Tarquinia



Detail of panel 1, "Procession of the Magi," by Benozzo Gozzoli; about 1460. From the Ricciardi-Medici palace, Florence, Italy



Detail from "Legend of the True Cross" by Piero della Francesca, painted between 1452 and 1466. Church of S. Francesco, Arezzo, Italy



"Creative Man" by José Clemente Orozco (1883–1949), Mexican. From a series at the New School for Social Research, New York city

FRESCO PAINTING OF VARIOUS PERIODS

BY COURTESY OF (SECOND ROW LEFT) METROPOLITAN MUSEUM OF ART. ROGERS FUND, 1903, (BOTTOM RIGHT) THE NEW SCHOOL PHOTOGRAPH BY PETER JULEY & SON; PHOTOGRAPH, (BOTTOM LEFT) ALINARI mandy, on May 10. 1788. He was educated at the École Centrale in Caen, the École Polytechnique, and finally went to the École des Ponts et Chaussées. He served as an engineer in several departments, but lost his appointment in 1814 because he opposed Napoleon's return from Elba. On the second restoration he obtained a post as engineer in Paris. His researches in optics appear to have been begun about 1814, when he prepared a paper on the aberration of light, which, however, was not published. Fresnel's work on interference did a great deal to establish the wave theory of light. and various devices for producing interference fringes bear his name. He applied mathematical analysis to his work and removed a number of objections to the wave theory. With D. F. J. Arago he studied the laws of the interference of polarized rays. Circularly polarized light he obtained by means of a rhomb of glass, known as "Fresnel's rhomb." He was a pioneer in the use ot compound lenses instead of mirrors for lighthouses. He was a member of the Académie des Sciences and a foreign member of the Royal society. He died at Ville-d'Avray, near Paris, on July 14, 1827.

Fresnel's labours in the cause of optical science received during his lifetime only scant public recognition, and some of his papers were not printed by the académie until many years after his death. But, as he wrote to Thomas Young, the English scientist. in him "that sensibility, or that vanity, which people call love of glory" had been blastcd. "All the compliments," he said, "that I have received from Xrago, Laplace and Biot never gave me so much pleasure as the discovery of a theoretic truth, or the confirmation of a calculation by experiment."

See *Oeuvres Complètes* **(1866–70).**

FRESNILLO (FRESNILLO DE GONZÁLEZ ECHEVERRÍA), a town of the state of Zacatecas, Mex., 37 mi. N.W. of Zacatecas city. Pop. (1950) 29.908. Fresnillo is located on a plain between two ranges of mountains, about 7,700 ft. above sea level. It has a generally temperate climate but is often swept by cold winds. Five miles northeast is a station of the Mexican National railroad linking the town with Mexico City and with El Paso, Tex. Fresnillo is on the central highway and has an airport.

The town was founded in 1554 by Francisco de Ibarra. It has been an important silver mining centre since 1569, when rich mines were discovered in the neighbouring Proaño hill. A school of mines was founded in 1853. Gold, copper, lead and zinc are produced in limited quantities.

The region served by Fresnillo has become important agriculturally. Limited irrigation facilities have been instrumental in increasing grain and vegetable production and the livestock industry dates from the colonial period. (J. J. J.)

FRESNO, a city of California, U.S., near the geographical centre of the state, is the chief city of the San Joaquin valley and the seat of Fresno county. It is the commercial and mercantile centre of an area extending from the Sierra Nevada to the Coast range. and for 100 mi. to the north and south. The population, which in 1900 was 12.470. increased rapidly. Pop. (1960) city 133.929; standard metropolitan statistical area (the entire county) 365.945; for comparative population figures see table in CALIFORNIA: *Population.* The chief national groups are Armenians. Mexicans and Russian Germans. the last-named being the descendants of German colonists who in the 18th century settled in Russia and in the late 19th and early 20th centuries emigrated to the U.S. The city presents the aspects of a large farm town; it is the focus for the processing of farm products as well as the distributing point for farm labour and machinery.

Fresno was settled in 1872 as a station on the newly opened line of the Central (now Southern) Pacific railway, in an arid and flat area which up to that time had supported only a sparse population; the name (Sp., "ash tree") comes from the name of the county, so called because of the ash trees in the foothills, not at the townsite. The introduction of irrigation canals in the 1870s and 1880s made intensive agriculture possible and encouraged settlement. The seat of Fresno county was transferred from Millerton to Fresno in 1874 and the city was incorporated in 1885.

The climate of Fresno is characterized by summers of high temperature and almost complete absence of rainfall; the low humidity moderates the effects of the temperature, and the nights are cool. About 87% of the annual rainfall occurs in the six months from November to April, when the temperature rarely falls below freezing. The mean annual temperature is 63° F., and the mean annual rainfall 9.52 in. A fertile soil and favourable climatic conditions have made Fresno county one of the richest agricultural counties in the United States. The chief crops are cotton. grain. alfalfa and fruits (especially raisin grapes. figs, peaches and melons). There is little industry apart from wine making and the drying and packing of fruit.

Higher education is provided by Fresno State college (established 1911) and Fresno City college. a junior college established in 1910. There is a philharmonic orchestra and Roeding park has a zoological garden. Three national parks—Yosemite, Sequoia and Kings Canyon—are nithin 90 mi. of the city. (HE. M. M.)

FRET, in decorative art and architecture, is any one of several types of running or repeated ornament consisting of lengths of straight lines or narrow bands. usually connected and at right angles to each other in T. L or square-cornered G shapes, so arranged that the spaces between the lines or bands are approximately equal to the width of the bands. Occasionally the system is arranged so that the lines intersect or interlace. as in the common "swastika (*q.v.*) fret." As the fret is one of the simplest and most natural decorative forms that can be produced in textiles: it is one of the most widely spread and is found alike from early times in all the continents. Thus it was a favourite decoration for the ceilings of Egyptian tombs from the fourth dynasty on, in later examples combined with rosettes, scarabs and the lotus into patterns of great richness.

In America. it is found in early Peruvian textiles, it is frequent in sculpture and architecture in the Maya and Aztec remains in Middle America; and it is one of the most universal of pottery decorations among American Indians. It was highly developed by both Chinese and Japanese for textiles as well as for architectural ornament; it occurs not only as a band but as a complicated allover pattern. sometimes with acute and obtuse angles instead of the more usual right angles. But its most important development was that by the Greeks (hence the common name "Greek fret"), who used it not only for pottery, but painted on architectural members, such as the abaci of capitals, and later carved it.

Like so many Greek motives it was widely used by the Romans particularly in Syria (*e.g.,* the *propylaea* at Damascus and the great temple at Baalbek) and occurs in Byzantine and Romanesque work.

"Fretwork" has a wider significance and is the most often used .of any small-scale repeated ornament in which geometrical forms occur, especially if in low relief or pierced. (T. F. H.; X.)

FREUD, SIGMUND (1856–1939), founder of psychoanalysis. was born of Jewish parents at Freiberg in Moravia on May 6, 1856. From the age of 4 until the age of 82 he lived in Vienna. As a student he found it difficult to decide on a profession. Though he was greatly impressed by the work of Darwin and other scientists of that period, he also was attracted to the history of culture and to philosophy; one volume of the German edition of John Stuart Mill's collected works was translated by Freud. In his preliminary studies he was interested in chemistry, but finding that he was not particularly gifted in that field he turned for a time to physiology and anatomy, in which he did some original research work in his student days. He was not primarily interested in the therapeutic aspects of medicine, preferring scientific research. Still, he finally decided to study medicine, as many of the great physiologists had done.

Freud worked for several years in the physiological laboratory of E. W. von Bruecke and later in the psychiatric clinic, then under the, direction of the brain anatomist T. H. Meynert. But his financial condition did not allow him to follow a career in research, particularly after he decided to get married. Thus he came to start practice as a neurologist (1886). In the following years he made some important contributions to neurology, his studies on aphasia and on the cerebral paralyses of children remaining highly regarded by neurologists. But in that period the interests that n·ere to become the centre of his lifework were already in the ascendancy.

In 1885 Freud studied in Paris under the neurologist Jean Charcot, who strengthened his determination to investigate hysteria from a psychological point of view. But the decisive influence in his turning to problems of psychopathology and psychology came from another source. An outstanding Viennese physician and thinker, Josef Breuer, had told him of an extraordinary experience in which he had cured symptoms of hysteria by getting the patient to recollect in hypnosis the circumstances of their origin and to express the emotions accompanying them. After his return from Paris. Freud suggested to Breuer that they publish the case, together with some others Freud had in the meantime treated with the same method, and with an added chapter on the theoretical conclusions that could be drawn from their observations. This book about what they called the "cathartic" method of treatment (*Studien über Hysterie,* 1895) was the starting point of what later became psychoanalysis.

Soon afterward: however, Freud took the decisive step of replacing hypnotism by the method of free association. This allowed him to isolate and study the phenomena of resistance (which the patient opposes to the uncovering of repressed experiences) and transference (the patient's emotional ties to the analyst). These two factors have ever since remained central in the technique of psychoanalysis. From this change from catharsis to free association the beginning of psychoanalysis (in the sense that the word is used today) is generally dated.

The development of Freud's psychological thinking also greatly benefited when, beginning in 1897, he had the courage to use his newly acquired knowledge for a study of his own unconscious mental processes. The degree of insight that he achieved in this way is accessible by the method of self-analysis only to the very few. But from this pioneering experience grew the demand that the student of analysis undergo, as part of his training, a personal analysis conducted by an experienced psychoanalyst.

In Freud's work the clinical, theoretical and technical aspects are closely interrelated. His method of free association is essential lo the therapeutic technique and also a powerful tool of psychological research. Freud, who had been reluctant to abandon research for medical practice, discovered a practically efficient method of treatment that was at the same time to satisfy what he considered the main endeavour of his life: "To infer or to guess how the mental apparatus is constructed and what forces interplay and counteract in it." (E. Jones) *The Life and Work of Sigmund Freud,* New York: Basic Books, London: Hogarth Press, 1953, vol. 1. p. 45.) This led to radical progress in the understanding of neurosis, psychosis, perversion and, of course, the normal mind. Some fundamental aspects of this are: (1) the dynamic effect of unconscious processes on consciousness and action; (2) the central role of mental conflict not only in pathology but also in normal development — part of this was the insight into the various mechanisms of defense by which instinctual tendencies are either excluded from consciousness and action (as in repression) or modified (as in sublimation); (3) the structural aspects of personality; (4) the motivating force of the instinctual drives (sexuality and aggression); and (5) more specifically, the existence and importance of infantile sexuality. (For the Oedipus conflict, *see* PSYCHOANALYSIS.)

Freud's first classical contribution to normal psychology was *Die Traumdeutung (The Interpretation of Dreams,* 1900), which he considered his greatest book. It was followed by studies of the parapraxes and of wit, by analytic interpretations of works of literature and by the application of psychoanalysis to anthropology and to the psychology of religion.

Freud's work contains striking discoveries; it is also the expression of a powerful mind, capable of extracting the fullest meaning from his discoveries. His unfailing intellectual courage allowed him to face previously unknown aspects of the human mind. The characteristic elements of his style of thinking and his creativity remained unimpaired either by age or by a disease process that started when he was 67 and led to his death 16 years later. He wrote one of his most lucid and significant papers at the age of 80. His last book *Moses and Monotheism* (1939) was written at 83; in this he uses his full mastery of the method and science he had created to elucidate one of those questions of the history of culture that had fascinated him as a young man.

Freud's discoveries particularly his findings about the sexuality of children, from the beginning met opposition, misunderstanding and abuse. This reaction did not surprise Freud, after he had learned from his work the role played by opposition to the uncovering of unconscious motivations. Recognition of analysis was slow to come. Freud, though he had the title professor, was never made a full professor at the University of Vienna. Only in his last years, and partly under the influence of the comparatively broad acceptance of analysis in the United States. did the opposition to analysis also in other countries assume a less vehement character. In 1930 he received the Goethe prize and in 1936 he was elected to the Royal society.

For ten years Freud had worked alone at psychoanalysis. About 1906 he was joined by a number of colleagues who met in 1908 at the first International Congress of Psychoanalysis, and two years later the International Psychoanalytic association was founded.

Freud was married to Martha Bernays in 1886. They had six children, the youngest. Anna Freud, became a famous psychoanalyst in her own right. In 1938, after the annexation of Austria by Nazi Germany, Freud moved to London, where he died on Sept. 23, 1939

Freud s works have been translated into many languages. An English standard edition of his complete works is edited by J. Strachey, thirteen volumes of which had been published by 1960.

See also PSYCHOANALYSIS.

See for a biography, Ernest Jones, *The Life and Work of Sigmund Freud, 3* vol (1953–55). (Hz. H.)

FREY, ADOLF (1855–1920), Swiss poet. literary historian and critic, son of Jacob Frey, was born at Aarau on Feb. 18, 1855, and died at Ziirich on Feb. 12. 1920. He became professor of German literature, first at Xarau and then at Ziirich. His chief claim to attention is his keen and profound interpretation of Swiss literature and art, as shown in his book on *Schweizer Dichter* (1919), and in his monographs on *Albert von Haller* (1879), *Gottfried Keller* (enlarged edition, 1893), *C. F. Meyer* (1900), *Böcklin* (1903), *Koller* (1906), *Welti* (1908), *Hodler* (1922) and others.

He wrote also two vigorous historical novels, *Die Jungfer von Wattenwil* (1912) and *Bernhard Hirzel* (1918). *A* final selection of his best *Poems* was issued in 1922. His lyrics are graceful, and his dialect poems were especially popular. His dramas (*e.g., Erni Winkelvied,* 1893) are less important.

See C. F. Wiegand, *Das Adolf Frey Buch* (1920); L. Frey, *Adolf Frey: sein Leben und Schassen (1923).*

FREY, son of Njord, one of the chief deities in the northern pantheon and the national god of the Swedes. He is the god of fruitfulness, the giver of sunshine and rain. His sister Freyia, the most prominent goddess in northern mythology, shares his characteristics.

See TEUTONIC PEOPLES.

FREYBERG, BERNARD CYRIL FREYBERG, 1ST BARON (1889–), of Wellington, New Zealand, and of Munstead, Surrey, commander in chief of the New Zealand forces in World War II and governor general of New Zealand from 1946 to 1952, was born in London on March 21, 1889. Two years later he emigrated with his parents to New Zealand and was educated at Wellington college and at the New Zealand university. He joined the army in New Zealand in 1909. In 1914 he took part in the Mexican revolution on the side of Pancho Villa.

Early in World War I he served in a British naval division in the retreat from Antwerp and took part in the operations in Gallipoli from the landing to the evacuation. Later in France he took part in many of the fiercest battles and was awarded the Victoria cross (Dec. 16, 1917). He was promoted to brigadier general at 27, then the youngest of that rank in the British army. He commanded the 29th division in 1917–18.

Freyberg was nine times wounded, and his bravery became legendary.

Between the wars he held senior staff appointments and a command in England. In World War II, as major general, he commanded the New Zealand Expeditionary force, and the Allied forces during the battle of Crete, in 1941. Later in the war he fought in the western desert and in Italy under Montgomery and Alexander. During the latter campaign he received a third bar to his Distinguished Service Order. In 1942 he received a knighthood. Freyberg in 1946 became governor general of New Zealand, an appointment he held for six years. He was created a baron in 1951, and in 1953 was appointed lieutenant governor of Windsor castle. (E. B. Bn.)

FREYCINET, CHARLES LOUIS DE SAULCES DE (1828–1923), French statesman, was born at Foix on Nov. 14. 1828. He was educated at the École Polytechnique, and entered the government service as a mining engineer. He was sent on a number of special missions, among which, one to England, on which he wrote a *Mémoire sur le travail des femmes et des enfants dans les manufactures de l'Angleterre* (1867). On the establishment of the Third Republic in Sept. 18 jo, he offered his services to Gambetta, was appointed prefect of the department of Tarn-et-Garronne, and in October became chief of the military cabinet. It was mainly his powers of organization that enabled Gambetta to raise army after army to oppose the invading Germans. In 1871 he published a defence of his administration under the title of *La Guerre en province pendant le sikge de Paris.* He entered the senate in 1876. and in Dec. 1877 became minister of public works in the Dufaure cabinet. He retained his post in the ministry of Waddington, whom he succeeded in Dec. 1879 as president of the council and minister for foreign affairs. He passed an amnesty for the Communards. but in attempting to steer a middle course on the question of the religious associations, lost the support of Gambetta, and resigned in Sept. 1880. In Jan. 1882 he again became president of the council and minister for foreign affairs. His ministry resigned on the rejection of his plan to occupy the Isthmus of Suez. He returned to office in April 1885 as foreign minister in the Brisson cabinet, and retained that post when, in Jan. 1886, he succeeded to the premiership. He came into power with an ambitious program of internal reform; but except that he settled the question of the exiled pretenders. his successes were won chiefly in the sphere of colonial extension. His ministry fell on Dec. 3, 1886.

In April 1888 he became minister of war in the Floquet cabinet —the first civilian since 1848 to hold that office. His services to France in this capacity were the crowning achievement of his life. He held his office without a break for five years through as many successive administrations—those of Floquet and Tirard, his own fourth ministry (March 1890–February 1892), and the Loubet and Ribot ministries. He introduced the three-years' service and established a general staff, a supreme council of war, and the army commands. He failed to clear himself entirely of complicity in the Panama scandals, and in Jan. 1893 resigned the ministry of war. In Nov. 1898 he once more became minister of war in the Dupuy cabinet, but resigned office May 6, 1899. He published, besides the works already mentioned. *Traitd de mécanique rationnelle* (1858); *De l'analyse infinitésimale* (1860, revised ed., 1881); *Des pentes e'conomiques en chemin de fer* (1861); *Emploi des eaux d'égaut en agriculture* (1869); *Principes de l'assainissement des villes* and *Trait4 d'assainissement industriel* (1870); *Essui sur la philosophie des sciences* (1896); *La Question d'Égypte* (1905); besides some remarkable "Pensées" contributed to the *Contemporain* under the pseudonym of "Alceste." He died on May 14, 1923 in Paris.

FREYCINET, LOUIS CLAUDE DE SAULCES DE (1779–1842), French navigator and explorer of the southern hemisphere, was born at Montélimar. Drôme, on Aug. 7, 1779. In 1793 he entered the French navy. In 1800. after taking part in several engagements against the British, he and his brother Louis Henri Freycinet (1777–1840) joined the expedition sent out under Capt. Baudin in the "Naturaliste" and the "Géographe" to explore the south and southwest coasts of Australia. Much of the ground already gone over by M. Flinders was revisited, and new names were imposed by this expedition. In 1805 Freycinet returned to Paris and prepared the maps and plans of the expedition; he also completed the narrative entitled *Voyuge de de'couvertes aux terres australes* (1807–15). In 1817 he commanded the "Uranie," in which Jacques Arago, the French novelist and dramatist, went to Rio de Janeiro, on a scientific expedition. During the three-year voyage Freycinet visited Australia, Marianne Island, the Sandwich (Hawaiian) and other Pacific islands, South America and other places. Notwithstanding the loss of the "Uranie" on the Falkland Islands during the return voyage, he returned to France with fine collections in all departments of natural history, and with voluminous notes and drawings. The results of this voyage were published under Freycinet's supervision as *Voyage autour du monde sur les corvettes "l'Uranie" et "la Physicienne"* (1824–44).

Freycinet was one of the founders of the Paris Geographical society (1821). He died at his estate of Freycinet, near Loriol (Drôme), on Aug 18, 1842.

FREYSSINET, (MARIE) EUGÈNE (LÉON) (1879–), French civil engineer, chiefly renowned for his successful development of prestressed concrete. was born at Objat, Corrèze, on July 13. 1879. After studying at the École Polytechnique and the École Nationale des Ponts et Chaussées, he was appointed bridge and highway engineer at Moulins in 1905. From then until 1914 he designed and built many reinforced concrete bridges, including one of goo-ft. span. After World War I he worked for a firm of contractors until 1928. In the late 1920s he built Plougastel bridge. with three 600-ft. spans, the largest reinforced concrete bridge to be constructed up to that time. After 1928 he devoted his time to the development of prestressed concrete and also to the making of high-strength concrete. His most significant contribution was the quantitative assessment of creep and shrinkage and the realization that only a high-strength steel at a high stress would achieve a permanent prestress in concrete. At first little recognized, Freyssinet's methods, successfully applied at the Gare Maritime at Le Havre in 1933, were gradually adopted. After his invention in 1938 of a practical tool to stress wires his methods were used all over the world. (F. Wy.)

FREYTAG, GUSTAV (1816–1895), German novelist, was born at Kreuzburg, in Silesia, on July 13, 1816. He studied philology at Breslau and Berlin, and in 1838 took the degree with a remarkable dissertation, *De initiis poëseos scenicae apud Germanos.* In 1839 he settled at Breslau, as *Privatdocent* in German language and literature. His comedy *Die Brautfahrt, oder Kunz von der Rosen* (1844), had some success, but he made his name by his comedy *Die Journalisten* (1853), one of the best German comedies of the 19th century, the subject of which was drawn from his own experience. In 1847 he edited, with Julian Schmidt, *Die Grenzboten,* a weekly journal which, founded in 1841, now became the leading organ of German and Austrian liberalism. Freytag helped to conduct it until 1861. and again from 1867 until 1870. when for a short time he edited a new periodical, *Im neuen Reich.* His fame became universal with the publication in 1855 of his novel of the counting house, *Soll und Haben,* which was translated into almost all the languages of Europe. It was certainly the best German novel of its day, impressive by its sturdy but unexaggerated realism. Its main purpose is the recommendation of the German middle class as the soundest element in the nation. His powerful advocacy of the hegemony of Prussia in his *Grenzboten* gained him the friendship of the duke of Saxe-Coburg-Gotha, whose neighbour he had become on acquiring the estate of Siebleden near Gotha. At the duke's request Freytag was attached to the staff of the crown prince of Prussia in the campaign of 1870, and was present at the battles of Worth and Sedan. Before this he had published another novel, *Die verlorene Handschrift* (1864), a description of Leipzig society, in which he endeavoured to do for German university life what in *Soll und Haben* he had done for commercial life. His *Bilder aus der deutschen Vergangenheit,* a popular account of the history and manners of the Germans, has been compared to Green's *Short History of the English People.* In 1872 he began a work with a similar patriotic purpose, *Die Ahnen,* a series of historical romances in which he unfolds the history of a German family from the earliest times to the middle of the 19th century. His other works include an autobiography (*Erinnerungen aus meinem Leben,* 1887); *Gesammelte Aufsätze,* chiefly reprinted from the *Grenzboten*

(1888) ; *Der Kronprinz und die deutsche Kaiserkrone; Erinnerungsblatter* (1889). He died at Wiesbaden on April 30, 1895.

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FRIAR, the English generic name for members of the mendicant religious orders (from Lat. *frater* through Fr. *frère*). Formerly it was the title given to individual members of these orders, as Friar Laurence (in *Romeo and Juliet*), but this is not now common. In England the chief orders of friars were distinguished by the colour of their habit: thus the Franciscans or Minors were the Grey Friars; the Dominicans or Preachers were the Black Friars (from their black mantle over a white habit), and the Carmelites were the White Friars (from their white mantle over a brown habit): these, together with the Austin Friars or Hermits, formed the four great mendicant orders—Chaucer's "alle the ordres foure." Detailed information on these orders and on their position in England is given in separate articles. The difference between friars and monks is explained in article MONASTICISM.

See Fr. Cuthbert, *The Friars and How They Came to England,* pp. 11–32 (1903) ; also F. A. Gasquet, *English Monastic Life,* pp. 234–249 (1904), where special information on all the English friars is conveniently brought together.

FRIARBIRD, the name given to several Australian birds of the honey eater family, from their ruff of feathers on the head and their sober plumage. The best-known species is *Tropidorhynchus corniculatus,* also known as pimlico and as four-o'clock, after its loud cry. Friarbirds are bold and noisy, haunting trees in small flocks. The forms inhabiting some of the islands of the Malay archipelago are mimicked by orioles.

See HONEY EATER; ORIOLE.

FRIAR'S BALSAM, known also as compound tincture of benzoin, appeared in the *Pharmacopoeia Londinensis* of 1746 as traumatic balsam and for many years it was held in wide repute in the treatment of wounds and infections. It is now used mainly as an inhalent in the treatment of bronchitis and laryngitis, its efficacy being due to the presence of benzoic acid in a volatile form.

FRIBOURG (Ger. *Freiburg),* one of the Swiss cantons, in the western portion of the country, taking its name from the town around which the various districts that compose it gradually gathered. Its area is 645 sq.mi. of which 568 sq.mi. are classed as productive. It is a hilly region, the highest summits (of which the Vanil Noir, 7,838 ft., is the loftiest) rising in the Gruyère district at its southeastern extremity, the best known being probably the Moléson (6,568 ft.) and the Berra (5,640 ft.). It is the heart of pastoral Switzerland and is famed for its cheese and cattle. It is watered by the Sarine or Saane river (with its tributaries the Singine or Sense and the Glâne) that flows through the canton from north to south, and traverses its capital town. The upper course of the Broye (like the Sarine, a tributary of the Aar) and that of the Veveyse (flowing to the Lake of Geneva) are in the southern portion of the canton. A small portion of lakes Neuchâtel and Morat belong to the canton, wherein is the Lac Noir or Schwarzsee. There are sulphur springs near the lake, and at Montbarry and Bonn. The main line from Lausanne to Berne past Fribourg runs through the canton with important branch lines in all directions. Pop. (1930) 143,230; by 1960 census 159,194; most of whom are Roman Catholics. The canton is on the linguistic frontier in Switzerland, the line of division running nearly due north and south through it, and even through its capital. The German-speaking inhabitants are found chiefly in the northwestern (Morat region) and northeastern (Singine valley) portions, as well as in the upper valley of the Jogne or Jaun in the southeast. Besides the capital, Fribourg (*q.v.*), the only villages of importance are Bulle, Chbtel St. Denis, Morat (*q.v.*) or Murten, Romont and Estavayer le Lac or Stäffis am See.

The canton is pre-eminently a pastoral and agricultural region, tobacco, cheese and timber being its chief products. Its industries include watchmaking (Semsales), papermaking (Marl)) and chocolate manufacturing. It forms part of the diocese of Lausanne and Geneva, the bishop living since 1663 at Fribourg. It is a stronghold of Roman Catholicism aith monasteries and nunneries, such as those of the Carthusian monks at Valsainte. and the Cistercian nuns at La Fille Dieu and at Maigrauge.

FRIBOURG (Ger. *Freiburg*), the capital of the Swiss canton of that name. It is built almost entirely on the left bank of the Sarine, the oldest bit (the Bourg) being just above the river bank, flanked by the Neuveville and Auge quarters, these with the Planche quarter on the right bank of the river forming the *Ville Basse.* On the steep ground to the west of the Bourg is the Ouartier des Places, beyond which. to the west and south-west. is the still newer Pérolles quarter, with the railway station and university; all these (with the Bourg) constituting the *Ville Haute.* In 1960 the population of the town was 32.583. In 1921 the French-speaking numbered 12,831 and the German-speaking 6,921. these last being mainly in the Ville Basse. Founded as a German town. French became the official language during the 14th and 1jth centuries, but when it joined the Swiss Confederation in 1481 German influence came to the fore, and German was the official language from 1483 to 1798. From 1798 to 1814, and again from 1830 onward, French prevailed, as at present. Fribourg is on the main line from Berne (20 mi.) to Lausanne (41 mi.).

The town was founded in 1157 by Berchthold IV, duke of Zahringen. The spot was chosen for purposes of military defense, and was situated in the *Uechtland* or a aste land between Alamannian and Burgundian territory. The oldest existing charter of the town dates from 1249. In 1218, the lands passed to Anna, the sister of the last duke and wife of Count Ulrich of Kyburg. The line became extinct in 1264. Their heiress married Eberhard, count of Habsburg-Laufenburg, who sold Fribourg in 1277 to his cousin Rudolf, the head of the house of Habsburg. The town had to struggle for its existence against Berne and the count of Savoy, between 1448 and 1452. Abandoned by the Habsburgs, and desirous of escaping from the increasing power of Berne, Fribourg in 1452 finally submitted to the count of Savoy. In the 15th century Fribourg exported much leather and cloth to France, Italy and Venice. When Tolande, dowager duchess of Savoy, entered into an alliance with Charles the Bold, duke of Burgundy, Fribourg joined Berne, and helped to gain the victories of Grandson and of Morat (1476).

In 1477 the town was finally freed from the rule of Savoy, while in 1481 (with Soleure) it became a member of the Swiss Confederation. In 1475 the town had taken Illens and Arconciel from Savoy, and in 1536 won from Vaud much territory, including Romont, Rue, Chhtel St. Denis, Estavayer, St. Aubin, as well as Vuissens and Surpierre, which still form outlying portions (physically within the canton of Vaud) of its territory, while in 1537 it took Bulle from the bishop of Lausanne. In 1502–04 the lordship of Bellegarde or Jaun was bought, while in 155j it acquired (jointly with Berne) the lands of the last count of the Gruyère, and thus obtained the rich district of that name. From 1475 it ruled (with Berne) the bailiwicks of Morat, Grandson, Orbe and Echallens, just taken from Savoy, but in 1798 Morat was incorporated with (finally annexed in 1814) the canton of Fribourg, the other bailiwicks being then given to the canton of Léman (later of Vaud). From the 16th century the democratic government gave place to an oligarchy which continued till the French occupation of 1798.

From 1803 (Act of Mediation) to 1814, Fribourg was one of the 19 cantons of the Swiss Confederation. But, on the fall of the new regime, in 1814, the old patrician rule was partly restored. In 1831 the Radicals secured a more liberal constitution. In 1846 Fribourg joined the Sonderbund and, in 1847, had to surrender to the Federal troops. The Radicals came back to power. In 1857 the Conservatives secured the adoption of a new cantonal constitution, and have since maintained their power.

The principal building in the town is the collegiate church of St. Xicholas, of which the nave dates from the 13th–14th centuries. while the choir was rebuilt in the 17th century. It has a lofty bell tower (1jth century). The town hall dates from the 16th century. In the Lycée is the Cantonal museum of fine arts.

On the Pérolles plateau is the International Catholic university founded in 1889. A dam built to the north of the town forms a sheet of water known as the Lac de Pérolles.

FRICK, HENRY CLAY (1849–1919), U.S. industrialist, art collector and philanthropist, was born at Rest Overton, Pa., Dec. 19,1839. He organized the firm Frick and Company (1871), acquired extensive coal deposits, built about 12,000 coke ovens and supplied the Pittsburgh steel mills with the coke that city required for its steel and iron industry. During the Homestead (Pa.) steel strike of 1892 Frick was shot and stabbed by Alexander Berkman, an anarchist, but survived. He was chairman of the board of Carnegie Brothers (1889–92), and a director of a number of railroads and of U.S. Steel corporation.

Frick died in New York city on Dec. 2, 1919. He left a park to Pittsburgh with an endowment and established the H. C. Frick Educational foundation. He bequeathed his New York town house to that city with numerous paintings, bronzes and enamels. He also endowed many hospitals and educational and charitable institutions. (J. n. 0.)

FRICTION is the resistance which is offered to the sliding of one solid body over another. From earliest times man has made ingenious attempts to diminish it to as small a value as possible. The development of the wheel helped considerably; since rolling friction is less than sliding friction it is easier to pull a cart along the ground than to pull a sledge of the same weight. It is not so much the work done in overcoming the friction—the power loss—which is important, although this can be considerable. In a motor car about 20% of the power is so wasted, in an airplane piston engine about 9% and in a turbojet engine about 1% to 2%. The most important aspect is the damage which is done by friction—the wear or seizure of some vital parts of the machine.

The two main experimental laws which govern the friction of sliding solids are simple. The first states that the friction is independent of the area of the solids. If a brick is pulled along a table the frictional force is the same whether the brick is lying flat or standing on its end. The second law is that the friction is proportional to the load (W) between the surfaces. If the load is doubled by putting a second brick on top of the first, the force required to cause sliding is twice as great. If a pile of three bricks is used the friction would be three times as great and so on. This means that for any particular pair of surfaces, the ratio of

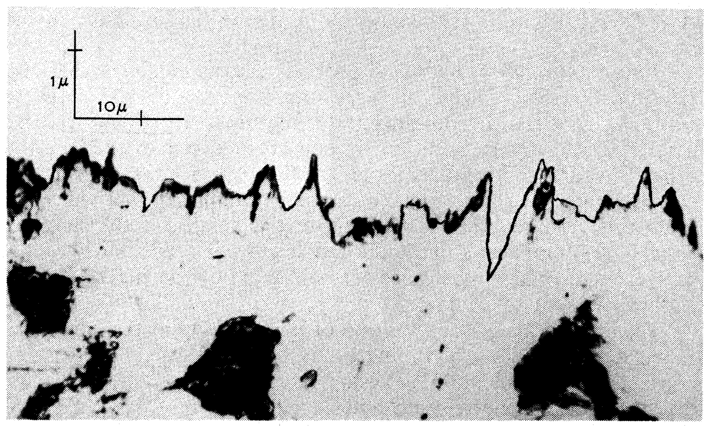
$$\frac{\text{friction } (F)}{\text{load } (W)}$$

is constant and this constant is called the coefficient of friction (μ). In the case of a brick sliding on a clean wooden table, the coefficient of friction (y) is about 0.5 (*i.e.,* a force equal to one-half the weight of the brick is required to pull it along). The coefficient of friction varies widely for different solids. For ice sliding on ice, for example, it is about 0.02, so that a pull equal to about $\frac{1}{50}$ of the weight of the ice block will cause sliding. With copper sliding on copper, the coefficient of friction is about 0.8 to 1.0 and. if the metal is carefully cleaned so that all traces of surface contamination are removed, it may rise to a much higher value still.

These two laws were formulated by Leonardo da Vinci and rediscovered by the French engineer G. Amontons in 1699. Amontons' observations were verified in 1785 by C. A. Coulomb, who made a clear distinction between the static friction (the force required to start sliding) and kinetic friction (the force required to maintain it). He showed that kinetic friction could be appreciably lower than static friction.

Coulomb concluded that friction was due to the interlocking of the surface asperities and represented the work of lifting the load over these asperities. Modern work suggests, however, that it is due primarily to a local adhesion between the surfaces.

Area of **Contact.**—A detailed examination of the contours of solid surfaces by electron microscopy and other delicate methods has shown that it is almost impossible, even with the best modern methods. to make a surface which is truly flat. To a person the size of an atom an optically polished mirror surface would look like country consisting of valleys and rolling hills differing in height by a hundred atoms or more. Most of the engineer's best



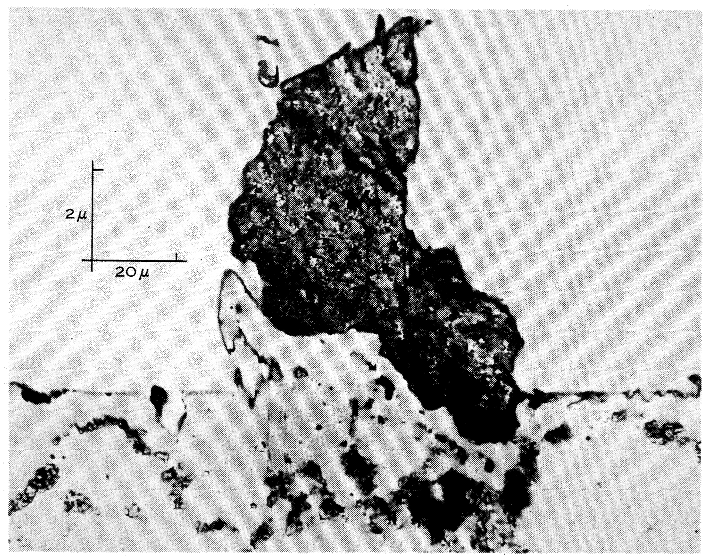
BY COURTESY OF F. P. BOWDEN, D. TABOR AND A. J. W. MOORE

FIG. 1.—OBLIQUE SECTION OF FINELY ABRADED STEEL SURFACE. THE SECTION GIVES A VERTICAL MAGNIFICATION OF TEN THOUSAND AND A HORIZONTAL MAGNIFICATION OF ONE THOUSAND

surfaces have irregularities which are much greater than this and may be thousands of atoms high: they may be compared with Alpine peaks rather than hills (see fig. 1). Putting two solids together is rather like turning Switzerland upside down and standing it on Austria, and the area in intimate contact will be relatively small.

Measurements of the electrical conductivity across metal surfaces placed together confirm that the real area of contact is indeed very small. It varies with the load. but for flat steel surfaces it may be less than $\frac{1}{10\,000}$ of the apparent area. Such experiments are also Interesting in that they show that the real area of contact is almost independent of the size of the surface. It is little influenced by the shape and degree of roughness of the surfaces It depends mainly on the load which is applied to them and is in fact directly proportional to the load

The general behaviour is consistent nith the view that the surfaces are held apart by small irregularities. This means that even with lightly loaded surfaces, the local pressure at these small points of contact is very high and may be sufficiently great to cause the hardest metals to flow plastically. Although the stresses will cause elastic deformation of the metal in the vicinity of the points of contact. the experiments suggest that the summits of irregularities on which the bodies are supported flow plastically and are crushed down until their cross section is sufficient to enable them to support the applied load. The real area of contact A is given by



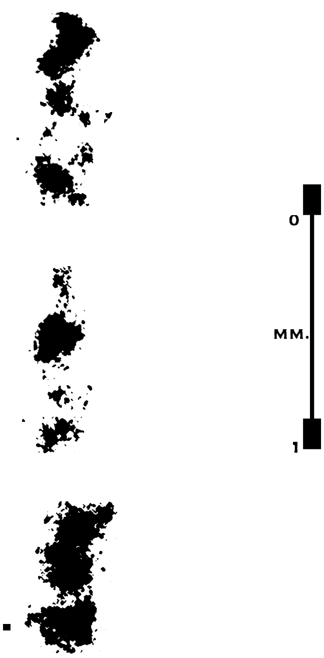
BY COURTESY CF F P BOWDEN D TABOR AND A J W MOORE

FIG. 2 — OBLIQUE SECTION OF STEEL SURFACE OVER WHICH A COPPER SURFACE HAS SLID ONCE, RESULTING IN A HEAVY PLUCKING OF COPPER (DARK), A FRAGMENT OF WHICH IS ATTACHED TO THE STEEL. THE JUNCTION IS SO STRONG THAT THE COPPER HAS PULLED THE STEEL ABOYE ITS ORIGINAL LEVEL

$A = W/p_m$, where W is the load and p_m is the yield pressure of the metal.

Mechanism of Friction.—There is strong evidence that the friction of metals is due, in large measure! to adhesion at these contact regions and represents the force necessary to shear these small junctions. In addition, if one surface is harder than the other the surface irregularities on the hard surface may plow their way through the softer surface and some of the friction will arise from this. In general the plowing term is small and the shearing term is predominant so that the friction may be written $F = A.s$, where s is the shear strength (per unit area) of the junctions, and A the real area of contact.

This offersa simple explanation of the two laws of friction. (1) Since A the real area of intimate contact is independent of the area of the surfaces, the friction will be independent of it also. (2) Since the real area of contact A is proportional to the load W the friction will be also. The formation and shearing of junctions is a primary cause of wear. If slip were to occur at the interface, wear would be negligibly small. Unfortunately, this is rarely the case—the adhesion at the surface is strong. When shearing takes place it frequently occurs at a small distance from the interface so that a small fragment of one metal is torn away and may be welded onto the other metal (*see* fig. 2). These wear fragments are very small! but may be revealed by making one of the metals radioactive by irradiating it in a pile and using it as a slider. The radioactive fragments adhering to the other surface can then be detected photographically (*see* fig. 3). In a running engine these wear fragments would accumulate in the lubricating oil so that a determination of the radioactivity of the oil can provide a sensitive test of engine wear.



BY COURTESY OF E RABINOWICZ AND D. TABOR

FIG. 3.—AUTORADIOGRAPHIC RECORD OF METALLIC TRANSFER PRODUCED BY SLIDING

A radioactive copper surface with a load of 2 kg. is slid at a low speed over a clean steel surface. A photographic plate is then placed in contact with the steel so that radioactive copper fragments attached to the steel sensitize the photographic emulsion. When developed' an autoradiograph is obtained. The pick-UP consists of small fragments and corresponds to about one-millionth of a gram of copper per centimetre of track

Friction of Nonmetals.—So far the discussion has dealt mainly with metals but the friction of nonmetallic solids is governed by the same general principles. If the solids are deformed plastically (as a metal is) it obeys the same two frictional laws, This is true for the solids popularly known as plastics or polymers (*e.g.*, polymethyl methacrylate, polyethylene or nylon). The coefficientof friction for these solids is in the region of $\mu = 0.3–0.6$. An interesting exception is the solid polytetrafluroethylene (Teflon) which gives a much lower friction $\mu = 0.05–0.1$.

If an elastic solid such as rubber is used the real area of contact is no longer proportional to the load W but to $W^{\frac{2}{3}}$. The coefficient of sliding friction μ should not therefore be constant. It should decrease as the load is increased, and it can be shown that μ should be proportional to $W^{-\frac{1}{3}}$. Experiment confirms this and shows that in addition an appreciable part of the friction is due to elastic hysteresis loss inside the rubber when it is deformed (see *Rolling Friction* below). The friction of wood is also due partly to adhesion at the surface and partly to internal deformation hysteresis loss inside the wood.

Diamond, which is the hardest of solids, is elastically deformed even under the heaviest loads so that its friction also obeys the elastic laws. It is interesting to note that the friction of a diamond crystal depends on the direction of sliding. The crystallographic directions which give the highest friction are those in which the diamond is mostly easily polished or abraded.

The friction of ice ($\mu = 0.02$) is remarkably low and there is evidence that this is due to the presence of a water film at the surface. This may be formed by "pressure melting" if the temperature is close to freezing or by frictional heating if the sliding speed is appreciable. There is evidence that this frictional melting can play an important part in the sliding of skis on snow.

Effect of Surface Films.—It has been assumed that the surfaces dealt with are clean. In fact metal surfaces exposed to the air are always covered with a film of oxide and adsorbed gas or vapour. This may be only a few molecules thick and invisible, but it may have a profound effect on the friction for it can enormously reduce the strength of adhesion at the points of real contact. It is difficult to get rid of these films, but if the metals are put in a vacuum and the last molecular layer is removed, it is found that the friction rises to an enormous value; in fact, complete seizure of the two metal surfaces occurs. It is only when a trace of air or other contaminating material is allowed to enter the apparatus that the friction falls to its usual everyday value. The friction of most nonmetals is also increased if these surface films are removed in a high vacuum.

Temperature of Sliding Surfaces.—Another important factor comes into play when the surfaces slide at an appreciable speed. The work done against friction is dissipated mainly in the form of heat and quite simple calculations suggest that the rise of temperature at the surface may be high. This is confirmed by experiments which show that the tiny points of sliding contact may be red hot or even white hot, although to ordinary observation there is no sign of this and the metal appears quite cool. These high temperatures can cause a local softening or melting at the points of contact of the metal surfaces, even at moderate speeds of sliding. The upper limit of temperature is fixed by the melting point of the metal since the surface temperature will not, in general, rise above this. When metal surfaces are rubbed together at high speeds (1,000 m.p.h. or 2,000 m.p.h.) a thin film of the metal is melted which can act as a lubricant so that the friction falls to a very low value. A shell leaving the muzzle of a gun may rub against the barrel at this speed, but in ordinary engineering the rubbing speeds are, of course, much lower.

These high surface temperatures may also be important in lubrication. At elevated temperatures lubricant films cease to be effective and a temperature flash at a rubbing hot spot may lead to failure of the lubricant precisely at the region where its protective properties are most needed.

Since the major source of friction and wear arises from interaction between the rubbing surfaces, the most effective way of reducing them is to keep the rubbing surfaces apart. The simplest way of doing this is to put a layer of oil or some other fluid between the surfaces. Under appropriate conditions an air or gas film can be used. If the lubricant layer is a thick one the conditions are those of fluid lubrication or a hydrodynamic lubrication. If the lubricant layer is only a few molecules in thickness it is termed boundary lubrication. Boundary lubricated surfaces obey the two frictional laws mentioned above and there is evidence that some metallic or solid contact usually occurs through the boundary films.

See LUBRICATION.

Rolling Friction.—There are two main types of rolling. The first occurs for example when a driving wheel rolls over a road in a motor car or over a rail in a train. Here considerable tangential forces are involved in pulling the vehicle along and the conventional frictional grip between the wheel and the surface is of great importance. There is, however, another type of rolling which involves only a minute tangential traction—this is the type of rolling that occurs when a wheel or a ball or a cylinder rolls freely over another surface. We may call this "free" rolling and its most common application is in ball bearings and roller bearings (*see* BEARINGS). The resistance to rolling in these cases is phenomenally low, corresponding to a coefficient of friction of perhaps less than $\frac{1}{1,000}$. A ball bearing was designed by C. Varlo in 1772.

The source of rolling friction has long been a matter of speculation. The first basic study was by Osbome Reynolds in 1875. He showed that when a metal cylinder rolls over a rubber surface it moves forward a distance less than its circumference in each revolution of the cylinder. This is because the cylinder measures out its circumference over a stretched portion of rubber. Reynolds suggested that this stretching was not uniform over the region of contact so that minute slipping between cylinder and rubber occurs. Another type of microslip, of far greater importance than the Reynolds' slip, occurs when a hard ball rolls in a groove. This was first pointed out by H. L. Heathcoate in 1920 and arises from the fact that the central band on the ball measures out its full circumference in each revolution whereas the bands at the edge of the groove measure out a length smaller than their circumference. Consequently some slip must occur within the ellipse of contact.

Although there is little doubt that both types of slip can occur, D. Tabor has shown that in many cases the friction arising from this is minute and constitutes only a small fraction of the total observed rolling friction. The reason for this is relatively simple. In rolling, any interfacial junctions that are formed are peeled apart, whereas in sliding they must be sheared. The peeling action is a very easy one so that little work is necessary to break the junctions during rolling. Thus interfacial frictional effects are of secondary importance. This is confirmed by the observation that lubricants which greatly reduce the sliding friction have little effect on the rolling friction.

Lubricants may play a useful and important part in reducing surface attrition or wear and it is probable that this is one of their main functions in ball and roller bearings. In addition they help to reduce corrosion and diminish sliding friction between the rolling elements and the cage in the assembled bearing.

The main source of friction in free rolling appears to be due to deformation losses in the rolling materials. If the rolling of a hard sphere over a somewhat softer surface is considered the material ahead of the sphere is deformed elastically, and work is done on it. As the sphere rolls forward the deformed material emerging behind it recovers elastically and urges the ball fonvard. If the material were ideally elastic the energy restored as the material recovered behind the ball would be exactly equal to the energy stored in the front region and no net force would be required to roll the ball.

However, in practice all solids lose some energy when they are deformed elastically. This effect is known as internal friction or elastic hysteresis. It is this loss which is reflected in the work required to roll the ball along. Hysteretic properties vary enormously and there is a corresponding variation in rolling resistance. Some types of rubber which are "soggy" or "dead" have high hysteresis losses and with these materials the free rolling friction may be relatively large. Even so the rolling friction will be much less than the sliding friction. On the other hand, with hard steels, such as those used in ball bearings, the elastic hysteresis losses are small and the rolling friction is correspondingly low. In ball and roller bearings these hysteretic losses are not only important in determining the rolling friction but they are also closely associated with the fatigue life of the bearing material. As seen above the elastic hysteresis loss can also play a part in sliding friction if the solid is deformed by the sliding process.

See BEARINGS; LUBRICATION; MECHANICS.

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(F. P. B.)

FRIDOLIN, SAINT (fl. 6th century?), Irish missionary, first mentioned by the monk Balther of Sackingen *(c.* 1000) as apostle of the Alamanni on the upper Rhine and founder of Sackingen in the time of Clovis I. Most historians regard this account as untrustworthy. An Irishman named Fridolin was probably at Poitiers during the reign of Clovis II. St. Fridolin's feast day is March 6.

See J. F. Kenney, *Sources for the Early History of Ireland,* pp. 497–498 (1929).
(L. BR.)

FRIED, ALFRED HERMANN (1864–1921), Austrian writer and leader of the peace movement, was born in Vienna, Nov. 11, 1864. After a brief career as bookseller and publisher in Berlin, he dedicated himself in 1891 to the propagation of peace and became in 1894 a free-lance journalist and writer. He founded a number of periodicals concerned with international understanding and interstate organization. The aim of the peace movement he led was not merely to condemn war but to spread the understanding of the process of interstate organization, which he defined as voluntary co-operation between independent states for the realization of common purposes.

Fried's contributions to peace were recognized by the award of the Nobel peace prize in 1911, which he shared with Tobias Asser. During World War I he lived in exile in Switzerland. He died at Vienna on May 4, 1921. (L. Gs.; X.)

FRIEDEL, CHARLES (1832–1899), French chemist and mineralogist, best known as a co-discoverer of the chemical process known as the Friedel-Crafts reaction *(q.v.),* was born at Strasbourg on March 12.1832. In 1854 he entered C. A. Wurtz's laboratory, and in 1856 was appointed conservator of the mineralogical collections at the École des Mines. In 1871 he began to lecture at the École Normale, and in 1876 he became professor of mineralogy at the Sorbonne, but on the death of Wurtz in 1884 he exchanged that position for the chair of organic chemistry. He died at Montauban on April 20, 1899. Friedel worked both in mineralogy and organic chemistry. He collaborated from 1879 to 1887 with Émile Edmond Sarasin (1843–90) on the formation of minerals by artificial means. He also devoted much attention to the pyroelectric phenomena of crystals, to the determination of crystallographic constants, and to the study of the ketones and aldehydes. Friedel was associated with Wurtz in editing the latter's *Dictionnaire de chimie,* and undertook the supervision of the supplements issued after 1884. He was the chief founder of the *Revue générale de chimie* in 1899. His publications include a *Notice sur la vie et les travaux de Wurtz* (1885), *Cours de chimie organique* (1887) and *Cours de minéralogie* (1893).

FRIEDEL-CRAFTS REACTION. The reaction is commonly considered as the process of uniting two or more organic molecules through the formation of carbon-to-carbon bonds under the influence of certain strongly-acidic metal halide catalysts, such as aluminum chloride, boron fluoride, ferric chloride, zinc chloride, etc. The useful applications of the reaction include such typical examples as aromatic alkylation *(e.g.,* the formation of cumene from benzene and isopropyl chloride), aromatic acylation *(e.g.,* the formation of acetophenone from benzene and acetyl chloride), aliphatic alkylations *(e.g.,* the formation of isooctane from isobutane and isobutylene) and polymerizations *(e.g.,* the formation of butyl rubber from isobutylene and isoprene), all effectively catalyzed by aluminum chloride.

The Friedel-Crafts reaction was discovered in 1877 by Charles Friedel and James Mason Crafts, working at the Sorbonne in Paris. In the amazingly short period of six weeks, they proceeded from the observation of a vigorous reaction between amyl chloride and aluminum foil to a remarkably clear definition of the scope of aluminum chloride and similar metal halides as catalysts for alkylation, acylation, polymerization and cracking. The typical reactions catalyzed by aluminum chloride, which they reported in a series of publications in 1877 and subsequently, and which now bear the general name of Friedel-Crafts reactions, have proven to be among the most versatile and useful reactions in all of organic chemistry.

One indication of the scope and utility of the reaction is the fact that a definitive monograph on the subject, appearing in 1941, encompassed 963 pages (Charles Allen Thomas, *Anhydrous Aluminum Chloride in Organic Chemistry,* American Chemical

Society Monograph no. 87). Investigations of extensions and applications of the Friedel-Crafts reaction have been the subject of literally thousands of scientific publications and patents since 1877.

Aromatic **Alkylation.**—Among the earliest examples of the Friedel-Crafts reaction, reported in the original papers in 1877, were cases of alkylation of benzene to give toluene, ethylbenzene and amylbenzene. Perhaps the most useful applications of this reaction are in the large-scale commercial preparation of ethylbenzene and cumene (isopropylbenzene).

$$\underset{\text{benzene}}{C_6H_6} + \underset{\text{ethyl chloride}}{CH_3CH_2Cl} \xrightarrow{AlCl_3} \underset{\text{ethylbenzene}}{C_6H_5CH_2CH_3} + HCl$$

$$\underset{\text{benzene}}{C_6H_6} + \underset{\text{isopropyl chloride}}{(CH_3)_2CHCl} \xrightarrow{AlCl_3} \underset{\text{cumene}}{C_6H_5CH(CH_3)_2} + HCl$$

In each instance only small amounts of aluminum chloride are required. The reaction may be conveniently carried out either by mixing the benzene and organic chloride and then adding the aluminum chloride portionwise, or by mixing the benzene and aluminum chloride and then adding the organic chloride portionwise. The reactions proceed vigorously at room temperature or slightly above.

The above organic chlorides are prepared commercially by the addition of hydrogen chloride to ethylene and propylene, and, in fact, the Friedel-Crafts reactions are frequently carried out directly on the olefin.

$$\underset{\text{ethylene}}{CH_2 = CH_2} + HCl \longrightarrow \underset{\text{ethyl chloride}}{CH_3CH_2Cl}$$

$$C_6H_6 + CH_2 = CH_2 \xrightarrow{AlCl_3} C_6H_5CH_2CH_3$$

$$C_6H_6 + \underset{\text{propylene}}{CH_2 = CHCH_3} \xrightarrow{AlCl_3} C_6H_5CH(CH_3)_2$$

One of the major modifications of the Friedel-Crafts reaction, not encompassed in the original publications, is the use of sulphuric acid in place of aluminum chloride. Thus, the reaction of propylene (or isopropyl alcohol) with benzene in the presence of concentrated sulphuric acid produces cumene.

$$C_6H_6 + CH_2 = CHCH_3 \xrightarrow{H_2SO_4} C_6H_5CH(CH_3)_2$$

$$C_6H_6 + \underset{\text{isopropyl alcohol}}{(CH_3)_2CHOH} \xrightarrow{H_2SO_4} C_6H_5CH(CH_3)_2$$

Because of the similarity of the action of sulphuric acid to that of the metal halides originally discovered by Friedel and Crafts, this modification is frequently referred to as a reaction of the Friedel-Crafts type.

Ethylbenzene is prepared commercially by the syntheses outlined above on a large scale for dehydrogenation to styrene, a component of GRS synthetic rubber and "Styron" and related plastics.

$$C_6H_5CH_2CH_3 \xrightarrow{\text{catalyst}} \underset{\text{styrene}}{C_6H_5CH = CH_2} + Hz$$

Cumene was prepared in large amounts during World War II as a component of high test aviation fuels and is the starting point for an economical synthesis of phenol and acetone.

$$\underset{\text{cumene}}{C_6H_5CH(CH_3)_2} \xrightarrow{O_2} \underset{\text{hydroperoxide}}{C_6H_5\underset{OOH}{\underset{|}{C}}(CH_3)_2} \xrightarrow[\text{or } HCl]{AlCl_3} \underset{\text{phenol}}{C_6H_5OH} + \underset{\text{acetone}}{(CH_3)_2C = O}$$

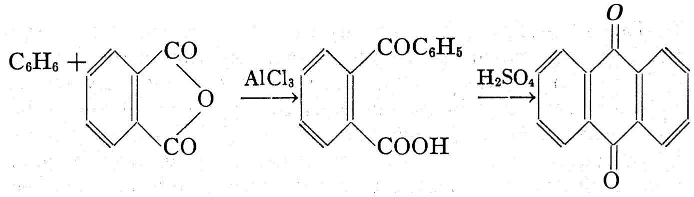
The intermediate, cumene hydroperoxide, also is utilized as a catalyst in the production of GRS synthetic rubber.

Aromatic **Acylation.**—When acyl halides are substituted for alkyl halides in the Friedel-Crafts reaction, ketones are produced in good yield.

$$C_6H_6 + CH_3\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{AlCl_3} C_6H_5\underset{CH_3}{\underset{|}{C}} = O\cdot AlCl_3 \xrightarrow{H_2O} \underset{\text{acetophenone}}{C_6H_5\overset{O}{\overset{\|}{C}}CH_3}$$

In this application, it is found that the ketones which are produced form a molecular compound with the aluminum chloride, necessitating the use of one molecular equivalent of the aluminum halide. This complex must be hydrolyzed by water to recover the ketone produced. Acetophenone is a useful article of commerce, finding particular application in the perfume industry.

Acid anhydrides also undergo the Friedel-Crafts reaction. A particularly useful example is that of phthalic anhydride.



phthalic anhydride o-benzoylbenzoic acid anthraquinone

Anthroquinone is produced synthetically in this way for use as a useful intermediate in the dye industry.

Aliphatic **Alkylation.**—Although the very first observation of Friedel and Crafts concerned the action of aluminum on a simple alkyl halide, useful application of the Friedel-Crafts reaction to nonaromatic systems was delayed nearly 50 years. By mid-20th century the application to petroleum reactions was perhaps the most important volume use of the Friedel-Crafts catalysts. One example was the condensation of two olefin molecules.

$$2CH_2 = C(CH_3)_2 \xrightarrow[\text{or } H_2SO_4]{AlCl_3} \underset{\text{diisobutylene}}{(CH_3)_3CCH = C\begin{matrix} CH_3 \\ CH_3 \end{matrix}} \xrightarrow{H_2}$$

$$\underset{\text{isooctane}}{(CH_3)_3CCH_2CH(CH_3)_2}$$

Isooctane, the standard for high-test antiknock gasoline, was once made industrially by the above procedure. In the 1950s it was made by direct reaction of isobutylene with isobutane.

$$(CH_3)_3CH + CH_2 = C(CH_3)_2 \xrightarrow[\text{or } H_2SO_4]{AlCl_3} (CH_3)_3CCH_2CH(CH_3)_2$$

The reverse of the above reaction, the "cracking" of large, saturated molecules in the presence of Friedel-Crafts catalysts, is also an extremely important reaction in petroleum refining.

Polymerization.— One other important reaction catalyzed by aluminum chloride, and recognized in the original work of Friedel-Crafts. is polymerization. The most important commercial application has been in the conversion of isobutylene to high molecular weight polymers.

$$CH_2 = \underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}} \xrightarrow[-80^\circ]{AlCl_3} -CH_2\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}} - \left(CH_2\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}} \right)_n - CH_2\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}} -$$

For moderate values of n, these materials are widely used to improve the viscosity characteristics of motor oil. By incorporating minor amounts (1%) of isoprene in the formulation, and carrying the polymerization to values of n in excess of 1,000, one obtains butyl rubber, from which highest quality automobile inner tubes are made.

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(C. C. PE.)

FRIEDJUNG, HEINRICH (1851–1920), Austrian historian, who combined historical studies with a keen interest in politics and whose reputation as a historian suffered because of his political views and his involvement in a sensational trial. He was born at Rostin, Moravia, Jan. 18, 1851, of Jewish parents. He studied at Prague, Berlin and Vienna, was at the Institut fur Österreichische Geschichtsforschung (1871–75) and taught at the Handelsakademie in Vienna (1873–79). Friedjung favoured strengthening the German character of Austria and wanted close economic connection between the two countries; he was thus unsympathetic to Slav and Magyar nationalist movements in the dual monarchy. He also wanted a centralized and liberal government. His *Der Ausgleich mit Ungarn* (1877), based on these views, led to dismissal from the Handelsakademie. He then became a political journalist. associated with the nationalist Georg von Schönerer until Schonerer's anti-Semitism made Friedjung break away.

Despite editorship of the *Deutsche Wochenschrift* (1883–86) and the *Deutsche Zeitung* (1886–87), in which he expressed his German nationalist views, Friedjung found time for historical studies. His chief historical work is *Der Kampf um die Vorherrschaft in Deutschland* (1897–98; 10th ed., 1916–17). *Das Zeitalter des Imperialismus, 1884–1914* (1919–22), unfinished at his death, was completed by A. F. Pribram, but was soon superseded by publication of important documents. His other works, dealing mainly with the period 1848–66, include *Österreich von 1848–60* (1908–12), also unfinished.

During the Bosnian crisis of 1909, Friedjung published an article based on documents supplied by the Austrian foreign office accusing leaders of the Serbo-Croat movement of treasonable practices. The men attacked sued Friedjung and the trial that followed showed that the documents were forgeries. Friedjung had used them in good faith but without adequate scrutiny and his reputation as an historian suffered. He died in Vienna, July 14, 1920.

See H. von Srbik in *Deutsches Biographisches Jahrbuch* (1917–20).

FRIEDLAND (Russian PRAVDINSK), a town of former East Prussia, after 1945 in the U.S.S.R., on the Alle, 27 mi. S.E. of Kaliningrad (Königsberg), famous as the scene of the battle fought between the French under Napoleon and the Russians commanded by Gen. Levin Bennigsen, on June 14, 1807 *(see* NAPOLEONIC CAMPAIGNS). The Russians had on June 13 driven the French cavalry outposts from Friedland to the westward, and began to occupy the town in the night.

The army of Napoleon was set in motion for Friedland, and the corps of Marshal Jean Lannes as general advanced guard was first engaged in front of Posthenen (2:30–3 A.M. on June 14).

After more than 1j hours of fighting, the more mobile French forced the Russian defenders into a congested area with their backs to the Alle river. The French guns were then brought up and a withering fire of case shot was poured into the massed enemy. It was the first example of the terrible artillery preparations of modern warfare, and the Russian defense collapsed in a few minutes.

The losses incurred by the Russians in retreating over the river at Friedland were very heavy, many soldiers being drowned. The losses of the French were reckoned at 12,100 out of 86,000, or 14%, those of the Russians at 10,000 out of 46,000, or 21%.

FRIEDRICH, CASPAR DAVID (1774–1840), German landscape painter and engraver of the romantic school, was born at Greifswald on Sept. 5, 1774. He studied under J. G. Quistorp, the university drawing master of his native town, and from 1794 to 1798 at the academy in Copenhagen. He then settled at Dresden, where he was a member of an artistic and literary circle of friends, which included Philip Otto Runge, Ludwig Tieck and Novalis. His drawings in sepia, executed in his neat early style, won Johann Goethe's approval and a prize from a Weimar art society in 1805. His first important oil painting, dated 1807, was an altarpiece for the castle of Graf Thun in Teschen, representing a "Crucifix in Mountain Scenery." Other notable works were the "Graveyard in Snow" (1810), "Alpine Scenery" (1828), "Two Men Contemplating the Moon" (1819) and "Rest in a Hayfield" (1835). In 1824 he was made professor of the Dresden academy. He died May 7. 1840, at Dresden. For a long time his work was forgotten; but it was revived in 1906 in a Berlin exhibition. His influence made itself felt in the work of his pupils and friends, K. G. Carus, G. Kersting, K. F. Lessing, F. Olivier, E. Öhme, the Norwegian J. K. C. Dahl and others.

FRIEDRICHSHAFEN, a town of Germany, in the *Land* of Baden-Württemberg on the east shore of Lake Constance, at the junction of railways to Bretten and Lindau. Pop. (1950) 20.501. It consists of the former imperial town of Buchhorn and the monastery and village of Hofen. Buchhorn is mentioned (as Buachihorn or Puchihorn) in documents of 837, and in the 12th century passed through the hands of the Welfs to the Hohenstaufen.

In 1275 it was made a free imperial city by King Rudolph I. In 1802 it was assigned to Bavaria, and in 1810 to Wiirttemberg. The monastery of Hofen was founded in 1050 as a convent of Benedictine nuns, but was changed in 1420 into a provostship of monks, was suppressed in 1802, and in 1805 came to Wiirttemberg. King Frederick I, who caused the harbour to be made, amalgamated Buchhorn and Hofen under the new name of Friedrichshafen.

Zeppelins were built there before World War II. Other industries established there include motor cars, tanning and aeroplanes. The town was bombed during World War II.

FRIENDLY SOCIETY, in British usage, a mutual association whose chief purpose is to provide its members with money allowances during incapacity for work resulting from sickness or infirmity, and with money payments on the death of a member or of his wife. Many societies also provide other benefits or services for their members. In addition a number of societies exist, known as collecting friendly societies, which have a large aggregate membership. The facts that their contributions are collected by agents at the houses of members, and that in Great Britain they are subject to the Industrial Assurance act, 1923, distinguish these societies from the ordinary friendly society, with which alone the present article is concerned.

By the National Insurance act, 1911, the friendly societies in Great Britain became associated with the administration of national health insurance. A friendly society could, under that act, become an "approved society" for national health insurance and at the same time carry on its wholly voluntary operations as a friendly society. This arrangement was terminated by the National Insurance act, 1946, which came into force in July 1948. The friendly societies then ceased to be concerned with national insurance.

The Friendly Societies act, 1896, described them as organizations whose purpose was to provide, by voluntary subscriptions, their members, with or without the aid of donations, for:

1. The relief or maintenance of the members, their husbands, wives, children, fathers, mothers, brothers or sisters, nephews or nieces, or wards being orphans, during sickness or other infirmity, whether bodily or mental, in old age (which shall mean any age after 50) or in widowhood, or for the relief or maintenance of the orphan children of members during minority; or
2. Insuring money to be paid on the birth of a member's child, or on the death of a member, or for the funeral expenses of the husband, wife or child of a member, or of the widow of a deceased member, or, as respects persons of the Jewish persuasion, for the payment of a sum of money during the period of confined mourning; or
3. The relief or maintenance of the members when on travel in search of employment, or when in distressed circumstances, or in case of shipwreck or loss or damage of or to boats or nets; or
4. The endowment of members or nominees of members at any age; or
5. The insurance against fire, to any amount not exceeding £15, of the tools or implements of the trade or calling of the members; or
6. Guaranteeing the performance of their duties by officers and servants of the society or any branch thereof;

Provided that a friendly society which contracts with any person for the assurance of an annuity exceeding £104 per annum, or of a gross sum exceeding £500, shall not be registered under this act.

These objects were widened by the Friendly Societies act, 1955, which among other things gave to any registered friendly society the power to lend funds, in certain circumstances, to other friendly societies, to invest funds in housing associations and to offer new forms of benefit, such as marriage endowments.

History. — Sickness and death benefit societies existed in early times. Burial societies and guilds of working and professional people which provided death benefits were common in Rome and the provinces of the Roman empire (see M. I. Rostovtsev, Social and Economic History of the Roman Empire, p. 178). In Great Britain similar functions were included in the objects of medieval guilds, from which the modern friendly society movement may be descended, though no definite historical links have apparently been traced.

A few societies still existing in Britain at mid-20th century were founded before the end of the 17th century; but during the 18th the system became widely established and considerable literature exists on the subject dating from the latter years of the 18th century. Thus Sir F. M. Eden's Observations on Friendly Societies for Maintenance of the Industrious Classes During Sickness, Infirmity, Old Age and Other Exigencies (published in 1801) referred to returns obtained for more than 5,000 societies enrolled under the act of 1793 (the first general statute relating to friendly societies). He concluded that the total number of societies then in existence was about 7,200. But many of them were financially unsound and much of the literature referred to (which included several reports of committees of the house of commons) was highly critical of them.

Most of these societies were purely local, drawing their membership from a single village or a restricted area in a town. But two other types of society began to develop in the early years of the 19th century. One was the so-called "county" friendly society, promoted by the rural gentry and clergy (the clergy were also active in the promotion of village friendly societies). This type was generally run on sounder financial principles than the local societies and covered a wider area, generally the greater part of a county. Several still existed at mid-20th century.

Much more important was the rise of the orders. Little is known about their origins, but it is probable that they began to take shape in the second half of the 18th century as offsprings of freemasonry, whose ceremonial and fraternal aims they imitated. One of the earliest was the Independent United Order of Mechanics, established in 1756 or 1757. The United Ancient Order of Druids was established in 1781.

Earlier than either were the Oddfellows, of which a lodge is known to have been in existence in 1745. This was the ancestor of many existing orders calling themselves Oddfellows, of which the largest is the Independent Order of Oddfellows, Manchester Unity. This order was established in 1813 and spread rapidly first through the industrial north of England and then through the whole country. In the late 1940s it had more than 4,000 branches with over 750,000 members in Great Britain, and many others elsewhere. Of the other large orders, the Ancient Order of Foresters was established in 1834, the Independent Order of Rechabites in 1835 and the Loyal Order of Ancient Shepherds, Ashton Unity, in 1826.

During the middle and latter part of the 19th century the orders were the most important, indeed the typical form of British friendly society. Their ceremonial and their fraternal aspirations made them social and convivial bodies meeting a need which was not otherwise well met for the lower middle class and the artisans who comprised the membership. Furthermore, they were, on the whole, much better administered and financially sounder than were the small local societies, because of the supervision which could be exercised over the branches by the headquarters of the order. Indeed, the Independent Order of Oddfellows, Manchester Unity, led the friendly societies in submitting itself to an actuarial valuation.

During the latter half of the 19th century, however, other varieties, which unlike the orders were essentially centralized, came into greater prominence. Thus there was the large centralized accumulating type, of which a leading example is the Hearts of Oak Benefit society. Founded in 1842, it met with early and continued success and by 1872 its membership had grown to 32,000; in the late 1950s it was more than 500,000.

The deposit societies form another group which came into prominence in the 1860s and 1870s and has achieved a continued success. The leading example, the National Deposit Friendly society, was established in 1868. By 1899 its membership numbered 46,000; in the latter 1950s it was more than 650,000.

Types of Society. — Like other English institutions, friendly societies sprang from insignificant origins and developed in a great measure independently of one another. Consequently a great variety of practice arose among them, rendering a simple classification impossible. At least three separate and overlapping classifications must be made:

General and Specialized Societies. — The typical friendly society is one assuring payments to the member during incapacity for work due to sickness, together with a lump sum on the death of the member or of his wife. The sickness benefit is generally from 10s. to 20s. a week, although many of the larger societies have introduced higher rates of contribution and benefit which members may take at their option. Sickness benefit at the full rate is usually payable for 26 or 52 weeks, after which, if incapacity still continues, it is reduced by one half. Sometimes, after a similar period, there is a further reduction. In most societies, the premiums are graduated according to age at entry in accordance with actuarial tables.

The great bulk of friendly societies offer these assurances and many provide nothing else. But in addition to these, many societies exist which have more specialized objects. These include societies offering medical or institutional treatment only, societies assuring endowments or annuities and pensions, societies for widows and orphans and a considerable number of small burial societies.

Centralized Societies and Societies With Branches. — Many friendly societies, including some very large ones, consist of a head office only, or of a head office with a number of local agencies. These agencies do not maintain any separate funds and usually have little or no control over their finances. In contrast to these there are the societies with branches, or, as they are also called, the affiliated orders. An order consists essentially of a number of local branches, all more or less closely linked by common traditions and all subject to the general rules of the order and to the central governing body. The local branch, which is called the lodge in the Oddfellows, the court in the Foresters and by other names in other orders, is the link with the individual member. He joins the branch, pays his contribution to its funds and out of its funds, as a rule, his benefits are provided. But the branches are, at any rate with the larger orders, grouped in districts on a geographical basis.

Above the district is the central authority of the order. Every branch is subject to the general rules of the order and though it has its own rules these must comply with the rules of the superior body. Branches are likewise subject to the district under which they are grouped and districts are subject to the central authority.

Often, too, districts will reinsure certain benefits in order to protect the financial stability of branches. But each branch and district must be separately registered under the act, if the order of which it is a branch is registered. If the order is unregistered no subsidiary may be registered as a branch, though it can be registered as a separate society. The domestic affairs of the branch are legally subject to the control of its own elected committee of management. The branch elects its delegates to the district meeting, at which the district committee of management is elected, and districts appoint representatives to the annual meeting of the order, at which the committee of management of the whole order is elected. Thus the typical order combines a close connection with the individual members with much of the financial stability typical of a large insurance society.

Accumulating Societies and Societies With Dividend. — This basis of classification cuts across the preceding. Thus some centralized societies are accumulating societies, while others are societies giving a dividend. Societies of the accumulating type make provision for the increasing liability to sickness as age advances by fixing the premiums for lower age groups at a figure somewhat higher than is necessary to cover the estimated sickness claims at those ages and to accumulate the surplus to form a reserve to meet sickness claims of higher age groups.

On the other hand, societies with dividend depart from this orthodox practice. In this class there are three main subdivisions, generally called "deposit," "Holloway" and "dividing" societies. All three combine some kind of savings system with the ordinary insurance. Under the deposit plan, which enjoys the widest popularity, the members are in general required to contribute monthly an amount equal to what they desire to receive daily in sickness benefit. Thus a contribution of 2*s.* a month is payable in respect of a sickness benefit of 12*s.* a week. Part of the contribution so paid is put to the member's personal savings on deposit account, part to the common fund for sickness benefit; the governing body of the society fixes the proportions in which the contributions shall be divided, but normally the proportion allocated to the deposit is considerable. Whatever sick benefit a member may claim is drawn in part from the common fund and in part from his deposit.

If, as a result. his deposit becomes exhausted, sick benefit ends and is replaced by "grace pay" at a lower rate for a limited period, but no member is allowed to resort to "grace pay" more than once in five years. If the member's deposit account is not exhausted, he may draw upon it, subject to certain restrictions, as if it were a savings bank account. He has also the option of making extra deposits to it.

The second class of society with dividend, known as Holloway societies because the idea originated with George Holloway, later member of parliament for Stroud, Gloucestershire, came into existence about 1874. These societies also achieved considerable popularity.

The principle of this system was to require a high contribution, relative to the insurance value of the benefits offered and to increase it as the member passes from age to age between 30 and 65, when sickness benefit terminates; the object of this condition is to provide, in the absence of specific reserves for sickness benefit, for the growing liability the member brings as his age increases. The claims of each year constitute a first charge on the contribution income of the year and in normal circumstances are wholly met from this source, there being no recourse to the personal account of a member in respect of his own demands for sickness benefit and no limitation on the amount of benefit that he may draw, such as the deposit system involves. The balance of the income of each year, after meeting sickness claims, is divided among the members and credited to their personal accounts.

The third type of society with dividend is known as the dividing society. Among registered friendly societies this class was declining in importance by mid-20th century. In the dividing society the member pays a periodical subscription, the rate of which, like the rates of benefit, is usually fixed arbitrarily. After payment of benefits, the surplus on the year's working, or a large part of it, is distributed as a cash dividend to members. In "slate clubs" members pay small sums periodically toward accumulating a fund to be shared out at a special time (*e.g.*, at Christmas).

Legislation. — Numerous acts of parliament for the encouragement and regulation of friendly societies were passed between 1793 and 1895, but practically everything of permanent value in these measures was incorporated in the Friendly Societies act, 1896. The latter act is administered by the Registry of Friendly Societies at the head of which is the chief registrar, who, by the statute (as amended by the Friendly Societies act, 1924), must be a barrister of 12 years' standing or have been an assistant registrar for at least five years. The privileges which the act confers are restricted to those societies which register under it, and most, though not all, of the conditions which it imposes apply to these societies only. Unregistered friendly societies are subject, of course, to common law, but the registry office exercises no functions in regard to them. The privileges of registration apply to workingmen's clubs and to societies operating under special authorities as well as to friendly societies.

The condition of registration is the adoption of rules providing, among other things, for the following matters:

The objects of the society, which must be chosen from among the objects specified in the act; terms of admission of members; conditions entitling a member to benefit; mode of holding meetings and right of voting; manner of making, altering or rescinding rules; appointment and removal of trustees, committee of management and other officers; provision, if the society is one with branches, for the composition of the central body and the conditions under which a branch may secede from the society; investment of funds; keeping of accounts and audit thereof; annual returns to registrar; manner of settling disputes (decisions arrived at in accordance with the rules are binding, are not removable into any court of law and may be enforced on application by the county court); provision for expenses of management; and quinquennial valuation.

The rules set out the conditions of the contract which the members of a friendly society make with one another and of the remedies which the law provides to secure its fulfillment. But, although the society must state in its rules what are its benefits and the conditions under which they are payable, few conditions are imposed upon it. Thus there is no compulsion to adopt an actuarially sound table of contributions. except for the insurance of annuities.

Again, while every society is compelled to submit its accounts to an annual audit and to submit its financial position to valuation at quinquennial intervals (unless exempted by the registrar on the ground that valuation is inapplicable to its undertakings), there is no compulsion on the members to employ professionally qualified actuaries (though nearly all societies do so) or to take steps to rectify any unsoundness which the valuation may reveal. The registrar may do (and does) much, through the influence which his position enables him to exercise, to ensure that societies are run on sound lines, but he has no power to order an inquiry into a society's affairs except on the application of a specified proportion of the members as laid down in the act.

The more important privileges attaching to a registered friendly society are:

It can legally hold land and other property in the names of its trustees. It also has various privileges in respect of the transference of property from one trustee to another.

It is exempt from income tax, corporation property duty and stamp duty on certain kinds of documents

Disputes with the society can be settled in any manner for which the rules provide, thus avoiding the cost of litigation.

The period from 1910 to World War II saw great changes in the friendly societies, largely because of the advent of national insurance, with the administration of which they were closely concerned until 1948. In 1910 the number of societies (including branches of orders) was 26,877, but membership was only 6,637,000 and funds £49,802,000. In 1945 societies numbered about 18,000, but membership was over 8,700,000 and funds over £200,000,000. Sickness benefits amounted to about £5,000,000 and death benefits to about £2,000,000 annually.

After 1945, numbers of societies and of members progressively declined. This decline was attributable largely to the comprehensive national social security schemes instituted shortly after World War II. These, together with full employment and the rise in money incomes, made the old friendly society schemes of insurance less attractive. Experience of the period 1948-54 suggested that the stronger friendly societies would develop new kinds of business, including endowments and perhaps those objects permitted them by the act of 1955 (see above).

Commonwealth and Other Countries. — In the dominions settled from England, friendly societies are similar to the English in their structure; many are branches of English orders. In Australia there is a Friendly Societies act for each state, with a registrar to administer it. All societies must be registered and submit annual returns to the registrar. From the returns available in 1950 (which referred to different years in the different states) it appeared that there were more than 200 societies and 5,800 branches, having more than 600,000 members.

In New Zealand there is a Friendly Societies act providing for the compulsory registration of societies, of which there were about 1.000, with 90,000 members. In South Africa there is no general Friendly Societies act. but more than 100 societies were listed, with some 300,000 members.

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UNITED STATES

The term "friendly societies" has never gained currency in the United States, but it may be used here to describe a group of more than 100 U.S. fraternal insurance bodies organized around a system of financial benefits for members. Often these bodies are embellished by ritualistic features, but fraternal insurance is their mainstay. Thus the groups. analogous to the friendly societies of Great Britain, remain distinct from many larger familiar orders. such as the Masons, which exist primarily for social reasons and offer financial benefits, if at all, only incidentally. The insurance societies are organized around a co-ordinating agency known as the National Fraternal Congress of America.

In spite of the background afforded by the friendly societies of Great Britain, founders of the United States system of benefit insurance were ignorant of British prototypes. It was not until after the middle of the 19th century that fraternal insurance orders began to proliferate in the United States. There had been earlier societies, among them the Improved Order of Red Men, established in 1833. But fraternal insurance as a movement dates from the work of John Jordan Upchurch, who organized in 1868 the Ancient Order of United Workmen. The A.O.U.W. grew rapidly and was followed by numerous other insurance societies. So popular was the movement that some of the older orders followed suit and for a time added benefit features of their own. By 1905 there were 148 national benefit orders with almost 5,000,000 members carrying insurance of $6,500,000,000.

Some of these societies fell by the wayside; members were often admitted without proper reference to age or health. Even so, the societies made remarkable adjustments by lowering benefits and increasing rates, so that they became a solid feature of United States business. Not one of the fraternal insurance societies collapsed under the pressures of 1933. By mid-20th century new fraternal insurance was being written at the rate of $1,000,000.000 annually. Membership amounted to 7,500,000, and the societies were paying out more than $100,000,000 each year in benefits. Low costs in management and in the writing of policies were factors in the financial success of the societies. Though appearing exclusive, many conducted vigorous membership campaigns.

Among the leading fraternal insurance societies at mid-20th century were the Fraternal Order of Eagles, with more than 1,300.000 members; Loyal Order of Moose, more than 900,000; and Modern Woodmen of America and Woodmen of the World, each with more than 400,000 members.

For a more complete discussion of fraternal organizations, the name by which friendly societies are known in the United States, see FRATERNAL ORGANIZATION.

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FRIENDS, SOCIETY OF, a body of Christians commonly called Quakers, originating in 17th-century England, whose members are found in small numbers in many parts of the world. Their distinctive character arises from emphasis on a measure of God's spirit being given to all men and women. which issues in a church order based on the priesthood of all believers, and a social outlook based on the sacredness of every personality. This article summarizes their history, surveys their faith and practice in the middle of the 20th century and concludes by considering the specific activities of the U.S. branch.

HISTORY

The 17th Century. — George Fox (*q.v.*; 1624–91), the founder of the society, was the son of a Leicestershire weaver. He mas brought up within the Puritan wing of the Church of England. After a long period of seeking within and without the Anglican Church, he had a vivid inward personal experience of 'God, and began a public ministry directing people inwardly to the Spirit of Christ and asserting that God's grace is given freely to every man. This twofold message came as a release to many who were finding the elaborate doctrinal structure of contemporary Calvinism feeding their minds but not their spirits, and to whom a doctrine of potential universal salvation was in joyful contrast with the doctrines of election and reprobation. Though he did not originally intend to establish another denomination. Fox's message attracted large numbers who met together for worship and soon created a church life.

The early Friends quickly found a unity of fellowship, belief and practice, which led to testimony in word and deed. Their basic belief was in the Light of Christ in every man. This led in worship to abandoning a separate ordained ministry and to meeting in unprogrammed silent worship in which anyone, man or woman, could take vocal part. They accepted the Bible as inspired by God, but declared that it was, in the words of Robert Barclay (*q.v.*; 1648–go), their best-known apologist, "a secondary rule. subordinate to the Spirit," and that it must be interpreted in the light of the Spirit of God. Their belief in the Light of Christ in every man, confirmed by their reading of the New Testament. led them to Christian pacifism. They refused to take oaths because they mere forbidden by the New Testament. Their belief in the sacredness of personality led them to refuse conventions which differentiated between superior and inferior "classes," and they accordingly refused to give "hat honour" to the upper class and to address them with the plural pronouns while reserving the singular form for equals or inferiors. This led to the retention of "thou" and "thee" by Friends long after they had lapsed from common social usage. They testified to simplicity (but not to asceticism) in putting first things first, and this led *inter* alia to a testimony against "the changeable nature of vain fashions"; and so, as fashions changed, the Quaker costume remained the same and became unintentionally a distinctive uniform. They were as much concerned with social righteousness as with personal piety. and George Fox was but the first of a long line of Quaker social reformers. At the end of the 17th and early in the 18th century, John Bellers (1654–1725) was the outstanding example in this field.

Friends came into sharp opposition with church and state. With the former, there were doctrinal controversies; but in particular the Friends' testimony against what they called "a hireling ministry" aroused violent opposition. After the restoration of Charles II in 1660, a series of laws against nonconformity led to serious conflict between Friends and the state, particularly over freedom to worship, freedom from oaths, tithes and military service and, to a lesser extent, freedom to teach. The consequent persecution led to something like 15,000 Friends' suffering various legal sentences before 1689, many of them many times; and 450 are known to have died in prison. Their steady open defiance of the Conventicle acts in particular, even meeting to worship in the street if the soldiers had locked them out of their meeting rooms, was a powerful influence leading to the Toleration act of 1689, and their persistent refusal to take judicial oaths led to the Affirmation act of 1696.

By the end of the 17th century there were probably 50,000 Friends in Great Britain and a similar number in the West Indies and other American colonies, with small groups in Ireland, Holland. Germany and Danzig.

The 18th Century.— The Toleration act of 1689 put an end to the worst suffering of Friends in Great Britain and legalized their way of worship. But the Test and Corporation acts remained, virtually excluding nonconformists from sharing in parliamentary and local government; and Oxford and Cambridge universities had no room for dissenters until 1871. Consequently Friends were debarred from a number of professions and were primarily found in industrial and commercial enterprise, where they played a very important role in Great Britain, particularly in banking and in the iron industry. In their religious thinking they were quietistic, and much of their energy was directed to maintaining the purity of their own witness rather than to evangelizing the world. They became traditionalist, so that, for example, a positive testimony for simplicity was then expressed in a complex series of prohibitions and in the manufacture of dress to conform with an outmoded fashion. Numbers declined in Europe though they increased in America.

The testimonies of the society were maintained, but added to them was a testimony against the slave trade and, from the middle of the century, against slavery itself. By 1787. largely as the result of the concerned leadership of men such as the Americans John Woolman (*q.v.*; 1720–72) and Anthony Benezet (1713–84), probably no Friend owned a slave. and Friends were campaigning steadily for the abolition of both the slave trade and slavery, being the founders in 1783 of the first abolition society in Britain. This became interdenominational in 1787.

At the end of the century Friends opened at York, Eng., the first hospital for the treatment of the insane by humane methods, believing that the Light of Christ is given to all men, including the mentally deranged, an act of faith which influenced the attitude toward mental disease all over the world. This hospital. called the Retreat. was still under the management of Friends in the mid-20th century.

The 19th Century.— The conservative quietism of the 18th century encountered the quickening influence of the evangelical movement early in the 19th century, and the theological colour of the society was soon changing under the leadership of such men as Joseph John Gurney (1788–1847), a brother of Elizabeth Fry (*q.v.;* 1780–1845), and Stephen Grellet (1773–1855), a French-born American Friend. The change was largely one of emphasis, from the inward, present, personal experience to the outward, objective historic fact of Jesus Christ. The new thought soon was in tension with the old, and in controversy each party was driven to an extreme position so that these points of emphasis were made irreconcilable alternates instead of being held firmly together as the double reality of Christian experience. The result was a serious division in United States Quakerism in 1827 and the following years (see *United States,* below). In Great Britain the Society of Friends as a whole tended toward evangelicalism without a major division, though a small number of Friends of extreme evangelical views seceded in 1836 under the leadership of Isaac Crewdson (1780–1844).

In the middle of the 19th century a further source of tension was found within the evangelical groups. This was partly a revival of the older theology (a return to greater emphasis on the inward Light of Christ) and partly a reaction against the "modernism" which allowed some of the traditional differentia (plain speech, Quaker costume, etc.) to lapse. This led to separations in the United States establishing the "conservative" Friends. and to a similar small separation in England which established the Fritchley General Meeting of Friends, which maintained close link with the "conservative" Friends in the United States.

The evangelical movement quickened the social conscience of each denomination, and Friends like others were led into great movements of social reform, sometimes as pioneers. The abolition of slavery has already been mentioned. In Great Britain Joseph Sturge (1793–1859) and in the United States the poet John Greenleaf Whittier (*q.v.;* 1807–92) were outstanding abolitionists, but the whole society was involved in this cause. This was part of a wider concern for right race relations springing directly from the Friends' belief in the Light of Christ being given to every man. Many aspects of penal reform claimed their ardent support: the first society for the abolition of capital punishment in Great Britain was formed partly by Friends in 1808, and Elizabeth Fry, supported by other Friends, initiated reforms in prisons and convict ships which quickly revolutionized both. The movement for universal education derived much of its impetus from Joseph Lancaster (*q v.;* 1778–1838) and the British and Foreign School society which sprang from his activity in opening schools on the monitorial system; in this society Friends played a prominent part. The British and Foreign Bible society had Friends among its founders, and they continued to support it. Friends were involved in founding the London Peace society to educate public opinion to the renunciation of war as an instrument of policy. The temperance movement received much support from Friends from before the middle of the century onward. In yet another field, George Cadbury (*q.v.;* 1839–1922) and Joseph Rowntree (1836–1925) were outstanding examples of industrial employers who introduced the concept of "welfare" into factory management and workers' housing, destined to have far-reaching effects all over the world.

In Britain, the repeal of the Test and Corporation acts in 1828 allowed Friends to enter local government and parliament and to serve as magistrates. They quickly found their way into these areas of service, John Bright (*q.v.;* 1811–89) being the second Friend to enter parliament. The removal of denominational tests from Oxford and Cambridge in 1871 and the growth of other universities allowed Friends increasingly to find their way into the professions.

Hesitation on the ground of their testimony against a separated ordained ministry delayed Friends from entering upon long-term residential missionary service in non-Christian countries until the second half of the 19th century, but then British and U.S. Friends committed themselves to such service, and missions were established in several parts of Asia, Africa and Central America and in Alaska. Meanwhile a strong home missionary movement arose, and in England Friends were the prime movers in the Adult School movement founded in its modern phase by Joseph Sturge in 1845.

From the earliest days Friends had made provision for the education of their children. George Fox himself was actively concerned in this, and directed that the girls in one of the schools set up in the London area should be instructed in "whatsoever things were civil and useful in the creation." Though some of the existing schools under the care of the society date from the 18th century, most were founded in the 19th. In their schools and colleges Friends have been pioneers in coeducation, the teaching of science and the encouragement of hobbies.

The 20th Century.— The turn of the century brought new theological currents into the Society of Friends as it did to all other Christians. For many, a more liberal attitude toward the Bible took the place of the earlier fundamentalism, and though this was a change fraught with tension and heart searching, it probably came more easily to Friends than to some because of their original stress on the Bible as secondary in authority to the Spirit of God known directly.

A parallel modernism invaded Friends in other ways. Their origin among Puritans had left them a heritage of puritanical opposition to music, the theatre and certain other arts. This was now seen to be an accident rather than an essential of faith, and within a generation the attitude of most Friends changed to an appreciation of the value of the arts. It may be noted here that while this distrust of the arts has prevented Friends from producing many eminent artists, a surprisingly large number of eminent scientists have been found among them from the 18th century onward.

Another development was the growth of world Quakerism. The missionary movement established groups of Friends in the middle east. India. China and Japan; in East Africa, Pemba and Madagascar; in the West Indies, Central America and Alaska. Emigration established Friends in South Africa, Australia and New

Zealand; and groups grew up in all the countries of northwest Europe except Belgium and Luxembourg. This last development was in part an indirect and unexpected outcome of widespread relief work undertaken during and after World War I. Though many of these groups are small, Quakerism has ceased to be Anglo-American but contains within its ranks men and women from most parts of the world. This fact led to the holding of world conferences of Friends in 1920, 1937 and 1952, and the establishment of the Friends' World Committee for Consultation in which the many autonomous groups find a common meeting ground.

The existence of the world committee enabled Friends to be recognized by the Economic and Social council of the United Nations as a nongovernmental organization having "consultative status." This allowed them to be present at meetings of the assembly of the United Nations, where their concern for reconciliation and peacemaking found opportunities for expression.

Throughout the history of the society, service in various fields has been rendered by its members. Relief work following disaster (flood, famine and war) has been undertaken by Friends repeatedly.

Several of the 20th-century developments are closely associated with Rufus M. Jones (1863–1948), to whose long life of inspiring leadership the society owes much. His influence was outstanding in bringing the society to a new theological outlook, in fostering a sense of world fellowship, in promoting unity among United States Friends and in creating and guiding the American Friends' Service committee (see United States, below). He also edited and wrote most of the "Rowntree Series of Quaker Histories," the standard history of the Society of Friends up to 1900.

Figures prepared for the world conference in 1952 showed a total of 174,000 Friends distributed roughly as follows: Africa, 24,000; the Americas, 124,000; Asia, 1,000; Australia and New Zealand, 1,000; Europe, 24,000 (of whom 23,000 were in Great Britain and Ireland).

FAITH AND PRACTICE

With so many autonomous groups there is very considerable variety of faith and practice among Friends. This article takes London Yearly Meeting, the parent body, as the norm, and refers to significant divergences.

Friends are Christians. Their distinctive characteristics arise from their emphasis on the fact of God's making Himself directly known in the heart of every man and woman. This experience they refer to as the Light of Christ, believing that in Christ the character of the Light is shown uniquely and supremely. But they believe that the Light is given in measure to every one, including those who lived before the coming of Jesus Christ, and those who are unacquainted with His appearance in history.

Consequently, the primary religious authority for them is the Light made known in the heart. This will be recognized and checked by the knowledge of God given in the Bible, and supremely in the person of Jesus Christ, but the Bible is secondary in authority to the Spirit.

Friends have not made any creed obligatory on their members, though many United States Yearly Meetings have accepted the Richmond Declaration of Faith (1887) as an outline of their doctrine. But the primary emphasis on experience of the Light and an early reaction from "notions" about religious experience have made them shy of creeds. They have found that membership can be based on a general acceptance of Christian experience without demanding a particular credal declaration. For this reason, some (but not all) branches of the Society of Friends have not joined the World Council of Churches, whose basis of membership involves acceptance of a brief credal statement.

Believing that God speaks directly to each one, Friends plan their worship to allow the maximum opportunity for this. They meet together in unprogrammed silent prayer. from which anyone present may speak to the congregation or offerspoken prayer on its behalf. Spontaneous Bible reading or singing may also occur, though less frequently. A modification of this pattern originated in parts of the United States in the latter part of the 19th century, and some of the groups in Asia and Africa have similarly developed a pastoral system involving partially or wholly programmed worship led by a pastor.

Friends' reaction against "forms" of religious practice from which the life easily departs was in part responsible for their disuse of the celebration of the Lord's Supper and baptism in the 17th century. They believed these to be essentially spiritual experiences to which the outward elements of bread, wine and water were unnecessary adjuncts. In a few of the more fundamentalist meetings of United States Friends the celebration of sacraments has been reintroduced, and this has also happened in certain areas of the mission field for reasons of ecumenical polity.

Another and more basic reason for disuse of the sacraments was Friends' emphasis on the sacredness of every part of life, or the potentially sacramental nature of the whole of life. They refuse to separate life into sacred and secular. For example, early Friends refused to call Sunday the Lord's Day, because every day is the Lord's; and they refused to celebrate Christmas chiefly because they claimed that Christ must be born anew in our hearts every day. (Most modern Friends celebrate Christmas.) Similarly they refused to celebrate the special occasion of the sacraments, trying instead to make every meal a reminder of the Last Supper and to know repeatedly the baptism of the Spirit.

Their emphasis on the Light of Christ in each one led them to give equal place to women and men in the religious life. Margaret (*née* Askew) Fell (1614–1702), widow of Thomas Fell, who married George Fox in 1669, gave outstanding service to the infant society from 1652 onward, making her home the geographical headquarters of the society. Women Friends were the first to preach the Quaker understanding of the gospel in London, Oxford and Cambridge, and on the American continent; and of 59 British Friends known to have visited America between 1656 and 1663, 27 were women. Women take as much vocal part in worship as men; they share equally in the whole system of church government; and they make equal and similar promises to those made by the men in marriage. This has led to the women of the society often playing a public role, and the movement for the emancipation of women owes not a little to Friends.

Belief in the Light of Christ in every man, experience of "that life and power which took away the occasion of all wars" (George Fox) and study of the gospels led Friends early to adopt the Christian pacifist position, and they have maintained this peace testimony collectively since 1660. Originally the testimony was for the Christian way of life in all circumstances and only incidentally against war. This positive aspect has continued, and led Friends to active attempts to bind up the wounds of war by relief work given entirely according to need. It has led to attempts in many ways to lessen international tension and to promote reconciliation; it has led Friends actively to support the causes of arbitration, world organization and disarmament and to oppose military conscription. Many Friends have suffered imprisonment, and in some cases worse, as conscientious objectors to military service.

On the social side, Friends have been concerned for many social reforms because they believe that every person should have the fullest opportunity to give expression to the Light within him. A number of such reforms with which the society has been collectively identified have already been mentioned.

The church government of the society is transacted in a series of meetings for church affairs. Each local congregation meets together once a month to transact its congregational business in a preparative meeting. A number of such congregations in a limited area are gathered together into a Monthly Meeting. This is the most important meeting, being responsible for admission to and termination of membership, the recording of births, marriages and deaths, the appointment of elders and overseers, the care of property, etc. Elders are responsible for the right holding of meetings for worship and the provision of opportunities for the religious education of the members. while overseers are responsible for the pastoral care of the members. Several neighbouring Monthly Meetings are gathered together into a Quarterly Meeting, the Quarterly Meetings are gathered into a Yearly Meeting which takes decisions and acts on behalf of the society as a whole in a given area. (This system is simplified in areas where meetings are less closely situated than in Britain, in which case the business of preparative and monthly meetings is combined. This is particularly true of South Africa and Australia, the continent of Europe and parts of the United States.)

At each meeting for church affairs every Friend may attend and has a responsibility to do so if he can. Friends believe that the Light in each one will lead into unity if faithfully followed. Consequently, no vote is taken. The meetings begin and conclude with worship, and a period of worship may be introduced in the course of the meeting. After discussion, the clerk records what he believes to be the judgment of the meeting in a written minute which he reads to the meeting, and which must be accepted by the meeting, after modification if necessary, before further business is taken. In practice the method is sometimes slow, but it avoids outvoted minorities.

The central offices of the Society of Friends in Great Britain are at Friends' house, Euston road, London, N.W. 1, from which the addresses of Friends in any part of the world can be obtained.

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UNITED STATES

The Colonial Period.—Between 1656 and 1658 Quaker missionaries arrived in Massachusetts Bay, Rhode Island, New Amsterdam, Maryland and Virginia, where they made converts and established meetings. The visit of George Fox to America in 1672 gave fresh impetus to the movement. By 1700 the Friends had acquired New Jersey and Delaware, founded Pennsylvania, were politically powerful in Rhode Island. North Carolina and Maryland, had organized meetings in all the colonies except Connecticut and South Carolina and had established six Yearly Meetings.

Friends were persecuted in all the non-Quaker colonies except Rhode Island. In New England and Virginia this was primarily the result of their religious nonconformity. Four Friends were hanged on Boston common in 1659 and 1660, and one died in Virginia as the result of flogging and subsequent neglect in prison. Their refusal to pay tithes, take oaths or render military service brought on them fines and civil disabilities in most of the colonies. Pennsylvania was founded by William Penn in 1682 as a "holy experiment" in the application of Quaker ideals to the state, but the Friends were not able to give their principles a full expression in Pennsylvania because the crown imposed limitations on the colony's policy.

The later settlers were hostile to the Quaker ideals, and at the outbreak of the French and Indian War the Friends voluntarily gave up control of the Pennsylvania government. They used their influence to keep peace with the Indians and to protect them from fraud and debauchery. They worked for popular education, peace, temperance and democracy and championed effectively the cause of religious liberty. Chiefly through the patient work of John Woolman the society had cleared itself of slavery, without a war or division, before 1800.

By the end of the colonial period Friends had retired from public life generally, and during the next century, chiefly because of the neglect of higher education and the prevailing quietism, the society declined in numbers and in influence. But Friends pioneered in prison reform, the care of the insane and the antislavery movement.

Migrations.—Between 1725 and 1775 there were considerable migrations of the Quaker population from New England, Pennsylvania and New Jersey southward into North and South Carolina. Toward the end of the 18th century large numbers of southern Friends, finding it difficult to live in a slaveholding society after freeing their own slaves, emigrated to the free territories of Ohio and Indiana.

Divisions.—In 1827–28 came the great disruption of the society, caused by the clashing of new forces which made themselves felt after the Revolutionary War.

Elias Hicks (*q.v.*), alarmed at the intolerant spirit and new methods of the newly felt evangelical influences, became the champion of the older quietism. In the effort to rationalize and defend the sufficiency of the doctrine of the Inner Light, he built a theology of his own. The opposition of the city elders to his views made him the champion of the democratic opposition to their authority, particularly on the part of the country Friends. The result was a division in five of the Yearly Meetings. The resulting groups are commonly, but not officially, called Orthodox and Liberal (Hicksite). Originally the Hicksites outnumbered the Orthodox by more than two to one, but since the westward migrations were mainly from the undivided Yearly Meetings of Virginia and North Carolina, which sided with the Orthodox, the latter greatly outstripped the Liberals in numbers. In 1955 the Orthodox and Hicksite Yearly Meetings in the Philadelphia and New York areas and in Canada were reunited.

The Liberal Yearly Meetings never adopted the theology of Elias Hicks, their position being that theology is not the essence of Christianity but a matter of individual opinion. In 1902 they united in the Friends General conference, which meets biennially but has no legislative authority. The conference carries on continuous work through standing committees in the fields of religious education, peace and social order, Christian unity, education and the advancement of Friends' principles. The central offices are in Philadelphia. The total membership by the latter 1950s was about 29,000.

Among the Orthodox Friends the evangelical tendencies developed most readily in the new western Yearly Meetings, and they were powerfully stimulated by the visit of Joseph John Gurney, a prominent English Friend, in 1837. He laid emphasis on the authority of the Scriptures, favoured Bible study and Bible schools and gave an impetus to higher education. The opposition of John Wilbur of New England to his work led finally to small separations in New England and Ohio. The resulting groups are unofficially called Orthodox (Gurneyite) and Conservative (Wilburite). After the Civil War a great revival movement began among Orthodox Gurneyite Friends. The leaders introduced innovations in methods and in theological expression. In consequence there were small conservative separations in Iowa, Kansas, western and Canada Yearly Meetings (1877–84) and later in North Carolina (1905).

These Conservative Yearly Meetings "recognized" one another and by the 1950s had an estimated membership of 2,700, of whom about 1,000 belonged to the Ohio Yearly Meeting.

Reorganization.—Among the western Orthodox Gurneyite Friends the evangelical emphasis on the outward authority of the Bible and other influences produced a movement toward the practice of water baptism, especially in the Ohio Yearly Meeting. To consider this tendency, a conference of the Orthodox Yearly Meetings in America and Great Britain was held at Richmond, Ind., in 1887. It issued a Declaration of Faith which reaffirmed the historic position of the society in opposition to outward ordinances and restated its doctrinal position in mildly evangelical terms. The great revival occasioned marked changes in the Gurneyite Yearly Meetings. The peculiarities of dress and speech were abandoned almost entirely. Music was introduced into the public worship, which conforms closely to the general type of "low church" Protestantism, without, however, using a fixed liturgy or abandoning the theory of Spirit-led worship. Pastors are generally employed to preach. By the 1950s mission stations were maintained in Africa, Asia, Central America and the West Indies.

In 1902 a Five Years Meeting was organized with consultative and administrative rather than legislative powers, to which all the Orthodox Yearly Meetings belong except Ohio, Oregon and Kansas. The work of this body is carried on through the following boards: Christian education, evangelism and church extension, missions, peace and social concerns, publications and education. The central offices are at Quaker hill, Richmond, Ind., where the official organ, the *American Friend,* is published. The Five Years Meeting is a member of the National Council of the Churches of Christ in America and of the World Council of Churches. The membership of the 11 Yearly Meetings belonging to the Five Years Meeting on the North American continent was approximately 69,000 in 1956; three other constituent Yearly Meetings in Cuba, Jamaica and East Africa brought the total membership to approximately 90,000.

Education and Philanthropy.—The Quaker pioneers usually established elementary schools and academies in their communities, which had a marked influence in shaping the public school systems in North Carolina, Ohio, Indiana and Kansas. In the eastern Yearly Meetings Friends of both the larger branches still maintain both elementary and high schools. By the 1950s there were ten Quaker colleges and one graduate centre for religious and social study (Pendle hill, Wallingford, Pa.).

In 1869, at the request of Pres. U. S. Grant, Friends of both branches began to take charge of many of the Indian agencies. This work was finished in 1885, but missions and schools for the Indians continued to be maintained in Oklahoma and elsewhere. Friends were active in work on behalf of freed slaves after the Civil War and contributed much to Negro education.

In 1917 Friends of all branches united in forming the American Friends Service committee, with headquarters in Philadelphia, for war relief and reconstruction work. The committee's work was carried on in the first instance by conscientious objectors furloughed from the army. In co-operation with British Friends it helped in the restoration of the devastated districts in northern France, Poland and Serbia; provided hospitals in France and Russia and orphanage schools for the children of war victims in Serbia, Poland and Syria. It co-operated with the American Relief administration in feeding the Russian peasants in the Volga basin and supervised the feeding of 2,000,000 German children.

At home in the 1920s and 1930s the committee carried on peace education, sought to further interracial understanding, set up volunteer work camps in areas of social need or tension and worked in the depressed coal fields, feeding children of unemployed miners and promoting self-help housing projects. During and after World War II, while keeping up and expanding these activities, the committee again undertook relief and reconstruction work in Europe and Asia. It has rendered service all over the world through international seminars and technical assistance projects. In 1947 the committee received, jointly with the Friends Service Council of England, the Nobel peace prize. (E. Rl.; F. B. T.)

FRIERN BARNET, an urban district, comprising Friern Barnet, most of Whetstone and part of Muswell Hill, in the Finchley parliamentary division of Middlesex, Eng., 7 mi. N. of London. The Great North road forms part of its western and East Barnet its northern and northeastern boundary. Pop. (1951) 29,163. Area 2.1 sq.mi. The manor was held by the brothers of the Order of St. John of Jerusalem, hence the name Friern. Campes almshouses were founded in 1612. The many old trees in Friary park (23 ac.) and on the North Middlesex golf course are reminiscent of the time when the land was afforested. Friern hospital (formerly Colney Hatch) is in the district, which is now a residential area.

FRIES, the name of a Swedish family distinguished for its botanists. The most eminent members are:

Elias Magnus Fries (1794–1878) was famous for his outstanding contributions to the study of fungi. Born at Femsjö, Småland, on Aug. 15, 1794, he was educated at Lund university where he became junior professor in 1824. In 1834 he became professor of practical economy in the University of Uppsala and was professor of botany during 1851–59. He was also director of the botanical garden and museum from 1851 to 1863. He died on Feb. 8, 1878. Although the author of many important works on the botany of higher plants, he is mostly known for his contributions to mycological taxonomy on which he was regarded as the greatest authority of his time.

Among his many publications are *Novitiae florae svecicae,* 7 parts (1814–24; 2nd ed., 1828); *Observationes mycologicae,* 2 vol. (1815–18); *Systema mycologicum,* 3 vol. (1821–32); *Elenchus fungorum,* 2 vol. (1828); *Epicrisis systematis mycologici* (1836–38; 2nd ed., 1874); and *Icones selectae Hymenomycetum nondum delineatorum,* 2 vol. (1867–75; 1877–84). The last mentioned work was seen to completion by Oscar Robert Fries.

Theodor (Thore) Magnus Fries (1832–1913) was noted as a lichenologist, but more especially for his studies on Linnaeus. The eldest son of Elias Magnus, he was born at Femsjö on Oct. 28, 1832, and educated at Uppsala, where, eventually, he was professor of botany and practical economy, 1877–99. He took part in the scientific exploration of arctic regions as a botanist in the expeditions of Baron N. A. E. Nordenskjöld to Spitsbergen, in 1868, and Greenland, in 1870. He also studied the vegetation of Finnmark in 1857 and 1864. He died in Uppsala on March 29, 1913.

Theodor was prominent in the fields of lichenology, mycology, arctic plant life and botanical history. His fundamental 20 years' work on the life of Linnaeus is a monument to his industry and energy.

Among others, his publications include *Lichenographia scandinavica,* etc., 2 pt. (1871–74); and *Linné, lefnadsteckning af,* 2 pt. (1903).

Oskar Robert Fries (1840–1908), son of Elias Magnus, was born at Uppsala on April 5, 1840. After training in medicine at Uppsala, he practised in Göteborg, devoting all his spare time to mycological studies. He died at Uppsala on July 18, 1908.

Among his mycological works are *Synopsis Hymenomycetum Regionis gothoburgensis* (1889); *In Synopsin . . . additamentum scripsit* (1900).

Klas Robert Elias Fries (1876–   ), a well-known botanical explorer and taxonomist, and the eldest son of Theodor Magnus, was born at Uppsala on July 11, 1876. He was educated at Uppsala university, where he became in 1913 instructor of biology and chemistry. In 1915 he was appointed professor of botany and director of the Bergian Botanical garden at Stockholm. He traveled widely, and wrote many important works on the flora of South America and central and east Africa, being especially interested in Annonaceae and contributing greatly to the study of this family. His interests, following the Linnean traditions of his father and grandfather, have also included the taxonomy and cytology of fungi.

His publications include *Zur Kenntnis der alpinen Flora im nördlichen Argentinien* (1905); "Beiträge zur Kenntnis der Flora des Kenia, Mt. Aberdare und Mt. Elgon," with T. C. E. Fries, 14 pt., *Notizbl. bot. Gart. Berl.,* vol. viii–xi (1924–30); *A Short History of Botany in Sweden* (1950).

Thore Christian Elias Fries (1886–1930), was best known for his botanical explorations. The son of Theodor Magnus, he was born at Uppsala on Nov. 2, 1886, and educated at the university there; he became conservator of the Botanical museum in 1920 and docent in botany in 1925. In 1921–22 with his elder brother, K. R. E. Fries, he explored Kenya and Uganda, particularly Mt. Kenya and the Aberdare mountains. In 1927 he was appointed professor of botany and director of the Botanical museum at Lund. In 1930 he led an expedition to the Transvaal and Southern Rhodesia and died in Umtali, S. Rhodesia, on Dec. 31, 1930. He was author of papers on arctic and alpine floras, and published with his brother valuable works on the flora of central and east Africa.

His publications include *Botanische Untersuchungen im nördliclzsten Schweden, ein Beitrag zur Kenntnis der alpinen und subalpinen Vegetation in Torne Lappmark* (1913) and *Über die regionale Gliederung der alpinen Vegetation der fennoskandinavischen Hochgebirgen* (1917).

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FRIES, JAKOB FRIEDRICH (1773–1843), German philosopher, was born at Barby, Saxony, on Aug. 23, 1773. Having studied at Leipzig and at Jena, he became professor of philosophy and elementary mathematics at Heidelberg in 1805. His attitude toward contemporary philosophies is set forth in *Reinhold, Fichte und Schelling* (1803; reprinted 1824 as *Polemische Schriften), System der Philosophie als evidente Wissenschaft* (1804) and *Wissen, Glaube und Ahndung* (1805). His important *Neue oder anthropologische Kritik der Vernunft* (3 vol.. 1807) attempted to give a new foundation of psychological analysis to the critical theory of Kant, which he sought to reconcile with the philosophy of F. H. Jacobi. His *System der Logik* appeared in 1811. In 1816 Fries accepted the chair of theoretical philosophy at Jena. In politics he was a strong Liberal and a believer in a united Germany and did much to inspire the organization of the *Burschenschaft*. In 1816 he published *Von Deutschem Bund und Deutscher Staatsverfassung,* and his influence gave a powerful impetus to the agitation which in 1819 led to the issue of the Carlsbad decrees. He was condemned by the Mainz commission, and the grand duke of Weimar was compelled to deprive him of his professorship. In 1824 he was recalled to Jena as professor of mathematics and physics, and in 1838 the right of public lecturing on philosophy was restored to him. He died at Jena on Aug. 10, 1843.

The most Important norks of his Jena professorate were the *Handbuch deu praktischen Philosophie* (1818–32), *Handbuch der psychischen Anthropologie* (1820–21). *Dze mathematische Naturphilosophie* (1822), *System der Metaphysik* (1824) and *Die Geschichte der Philosophie* (1837–40).

FRIES, JOHN *(c.* 1764–1825), U.S. insurgent leader, was born in Pennsylvania of German descent about 1764. As an itinerant auctioneer he became well acquainted with the Germans in the southeast part of Pennsylvania. In July 1798, during the troubles between the United States and France, congress levied a direct tax (on dwelling houses, lands and slaves) of $2,000,000, of which Pennsylvania was called upon to contribute $237,000. There were very few slaves in the state, and the tax was accordingly assessed upon dwelling houses and land, the value of the houses being determined by the number and size of the windows. The inquisitorial nature of the proceedings aroused strong opposition among the Germans, and many of them refused to pay. Fries, assuming leadership. organized an armed band of about 60 men, who marched about the country intimidating the assessors and encouraging the people to resist. At last the governor called out the militia (March 1799) and the leaders were arrested. Fries and two others were twice tried for treason (the second time before Samuel Chase) and were sentenced to be hanged, but they were pardoned by Pres. John Adams in April 1800, and a general amnesty was issued on May 21. The affair is variously known as the "Fries rebellion." the "Hot-Water rebellion" — because hot water was used to drive assessors from houses — and the "Home Tax rebellion." Fries died in Philadelphia in 182j.

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FRIESE-GREENE, WILLIAM (1855–1921), British photographer and inventor of the first practical motion-picture camera, was born at Bristol on Sept. 7, 1855. He took out almost 70 patents, that for the camera being in 1889. This camera used celluloid film.

The previous year the Photographic Society of Vienna had awarded him the Daguerre medal for a moving-picture camera using paper film with perforated edges. In 1889 he wrote to Thomas Alva Edison (*q.v.*) describing his camera and suggesting that it should be combined with the phonograph to make "talkies." He was a pioneer in stereoscopic and colour motion-picture making, and experimented with electrical inkless printing and radio direction of moving objects.

He died in London on May 5, 1921. A memorial in Highgate cemetery is' inscribed "William Friese-Greene, the Inventor of Kinematography."

See Leslie Wood, *The Miracle of the Movies* (London, 1947); Ray, Allister, *Friese-Greene, Close-Up of an Inventor* (London, 1948).

(R. ALL.)

FRIESLAND (VRIESLAND), a province of the Netherlands, bounded southwest, west and north by the Northeast polder, the IJsselmeer (Zuider Zee) and the North sea, east by Groningen and Drente, southeast by Overijssel; occupied by Germany in World War II. It includes the islands of Ameland and Schiermonnikoog *(see* FRISIAN ISLANDS). Area, 1,251 sq.mi.; pop. (1957 est.) 471,153. The soil of Friesland falls naturally into three divisions consisting of sandy clay in the north and northwest, of a median belt of low fen between the southwest and northeast, and of a comparatively small area of high fen in the southeast. The clay and low fen furnish good meadowland for the world-famed breed of Frisian cattle, noted especially for butter production. Horse breeding is also practised. In the high fen district peat digging is still important. but cultivation remains difficult. Droughts are specially serious in the absence of flowing rivers, and this difficulty interferes seriously with milk production at times. The water system is entirely canalized, and there is a vast network of canals, waterways and lakes in the whole north and west. The principal lakes are Tjeuke Meer, Sloten Meer, De Fluessen and Sneeker Meer. The tidal range being small on the north coast, the Waterstaat provides for the largest removal of superfluous surface water into the Lauwers Zee. The drainage problem has always been a peculiarly difficult one. The population of the province is evenly distributed in small villages. The principal centres are Leeuwarden, Sneek. Bolsward, Franeker, Dokkum and Heerenveen. With the exception of Franeker and Heerenveen all these to ns originally arose on the inlet which became the IJsselmeer. The seaport towns of Stavoren, Hindeloopen, Workum, Harlingen and Makkum are more or less decayed as a result of the increased draft of modern vessels. For history *see* FRISIANS.

SAWDERS FROM CUSHING

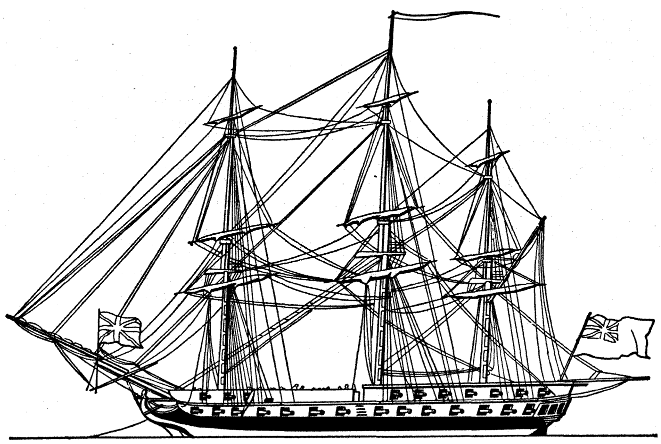
STREET SCENE AT LEEUWARDEN. CAPITAL OF FRIESLAND

FRIEZE, in architecture, the middle of the three divisions of a classic entablature (*q.v.*), above the architrave and below the cornice *(see* ORDER); also any long, narrow, horizontal panel or band used for decorative purposes. The frieze probably developed from the necessity of carrying the crossbeams of a ceiling upon the tops of the architrave beams, but below the cornice eaves.

The stone triglyphs of the Doric frieze are reminiscent of the beam ends of a primitive wood construction. In the Ionic. Corinthian and Composite orders the frieze has no architectural membering but is frequently richly ornamented. In Greek work this ornamentation consists of figures, as in the treasury of the Cnidians at Delphi (early 5th century B.C.) or the monument of Lysicrates at Athens (310 B.C.). In Roman and Renaissance work it consists of anthemions, acanthus foliage or garlands, as in the temple of Vesta at Tivoli (*c.* 80 B.C.) and the Maison Carrée at Nimes (early 1st century A.D.). In late Roman work and many Renaissance examples the profile of the frieze is a convex curve and is known as a pulvinated frieze. The most famous of decorative friezes is undoubtedly that carved on the top of the outer wall of the cella of the Parthenon (*q.v.*), just under the ceiling of the portico.

This frieze, 40 in. high and 525 ft. long, bearing a representation of the ritual procession of the Panathenaic festival, is characterized by superb rhythmic design and faultless execution. Sculptured probably from the designs and under the supervision of Phidias, it is a perfect expression of Greek sculpture of the mid-5th century B.C. and one of the best examples of architectural sculpture of all time.

FRIGATE, in ancient times, a small, swift, undecked vessel, propelled by oars or sails, in use on the Mediterranean. The word was also applied to small. fast vessels used by the Spanish and Portuguese during the 16th and 17th centuries. The French first applied the term to a particular type of warship during the second quarter of the 18th century. The Seven Years' War (1756–63) marked the definite adoption of the "frigate" as a standard class



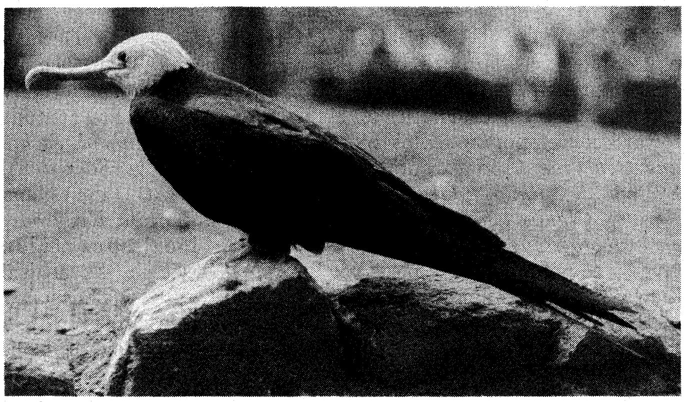
FROM "THE KING'S SHIPS," BY COURTESY OF COMMANDER H. S. LECKY, R.N.

THREE-MASTED FRIGATE. THE "CRUISER" OF SAILING-SHIP DAYS

of vessel, coming next to ships of the line and used for cruising and scouting purposes. They were three-masted, fully rigged, fast vessels, with the main armament carried on a single deck and additional guns on the poop and forecastle. The guns varied from 24 to 50, but between 30 and 40 guns was the usual number carried. The frigate "Constitution" (*q.v.*), nicknamed "Old Ironsides," won undying fame in the early years of U.S. history. "Frigate" continued in use throughout the period of transition from sail to steam but gradually gave way to "cruiser" (*q.v.*).

During World War II, in 1942, Great Britain revived the name frigate by assigning it to a particular category of warship. In 1943 the United States also revived the term and applied it to about 70 vessels each having a full load displacement of about 2,400 tons, a speed of 20 knots and 3-in. dual-purpose guns. By 1955, however, the United States had disposed of all these vessels except 22 on loan to other countries, and had placed in the frigate classification the "Norfolk" and four destroyer leaders in commission as well as six others under construction. Great Britain meanwhile retained frigates of varying size, speed and armament, designed for various purposes. Built or building, the U.S navy had also 20 frigates carrying guided missiles. in 1960. Other nations employed the term frigate in such a manner that it had no precise meaning in international usage. (J. B. HN.)

FRIGATE BIRD, large sea birds of the genus Fregata, constituting the family Fregatidae in the order Pelecaniformes. ranging throughout tropical and subtropical oceans. They are known also as man-o'-war birds because of their aggressive and piratical behaviour. Frigate birds are related to the pelican, cormorant. gannet, snakebird and tropic bird (*qq.v.*), and are about the size of a hen, with extremely long slender wings, the span of which may



BY COURTESY OF NEW YORK ZOOLOGICAL SOCIETY

MAN-O'-WAR-BIRD (FREGATA MAGNIFICENS ROTHSCHILDI)

reach $7\frac{1}{2}$ ft., and scissorlike tail. The black plumage is relieved by an orange throat pouch in the male and by a white breast in the female. Other distinguishing characters are the almost helpless feet with four toes webbed, and a long hooked' bill, used in attacking and robbing other sea birds, particularly boobies, of their fish.

Although they fly singly or in pairs, they nest in colonies, building nests of sticks in mangroves and on rocky islets, laying a single white egg. The nestlings are matted with soft white down, but the black wing feathers soon appear. The adults, without oil glands to waterproof the plumage, never alight on the water but are unbelievably fast and skillful in the air, soaring effortlessly and often diving to recover falling fish dropped aloft by panic-stricken boobies. Despite their flying ability frigate birds are usually found within 100 mi. of land. F. *aquila* is confined to Ascension Island in the Atlantic, F. *andrewsi* to Christmas Island and Cocos Keeling southeast of Java, the Anambas northeast of Singapore, wandering to nearby coasts, as far as India. F. minor, with six races, breeds on islands in the Indian, Pacific and Atlantic (south Trinidad) oceans; F. ariel has races similarly distributed. The magnificent man-0'-war bird, F. *magnificens,* breeds on the Galapagos and Pearl islands and ranges the eastern Pacific; with a race (F. *m. rothschildi*) breeding in the West Indies and along the coasts of the Caribbean and northern and eastern South America, wandering to the Gulf states, and another race in the Cape Verde Islands. (G. F. Ss.; X.)

FRIGG, the wife of the god Odin (Woden) in northern mythology, was known also to other Teutonic peoples, as Friia in German and Frea in Langobardic; in English her name still survives in the word Friday.

FRIIS, JOHAN (1494–1570), Danish statesman, was born in 1494 and was educated at Odense and at Copenhagen, completing his studies abroad. He was one of the first of the magnates to adhere to the Reformation and its promoter King Frederick I (1523–33). Friis, who made a fortune out of the church lands, succeeded Claus Gjoodsen as imperial chancellor in 1532, and held that dignity till his death. He promoted the election of Christian III (1533–59), but in the course of the "Count's War" he was taken prisoner by Count Christopher, the Catholic candidate for the throne, and forced to do him homage. He made his escape to Germany and then rejoined Christian III. He was one of the plenipotentiaries who concluded peace with Liibeck at the congress of Hamburg, and subsequently took part in the national reconstruction necessitated by the Reformation, acting as mediator between the Danish and the German parties that were contesting for supremacy during the earlier years of Christian III. Friis was a patron of learning. He encouraged Hans Svaning to complete Saxo's history of Denmark, and Anders Vedel to translate Saxo into Danish. Under King Frederick II (1559–88), Friis was well-nigh omnipotent. He was largely responsible for the Scandinavian Seven Years' War (1562–70), which did so much to exacerbate the relations between Denmark and Sweden. Friis died on Dec. 5, 1570, a few days before the peace of Stettin.

FRILLED LIZARD (*Chlamydosaurus* kingi), a tropical lizard of Australia and New Guinea, belonging to the family Agamidae, remarkable for the large erectile frill round the neck and for its ability to run on its hind legs. It is arboreal and insectivorous.

FRIMLEY AND CAMBERLEY, an urban district in the Woking parliamentary division of Surrey, Eng., on the London-Exeter trunk road, 29 mi. W.S.W. of London by road. Pop. (1951) 20,386. Area 12.1 sq.mi. The district includes York Town and Frimley Green. A healthful climate, a picturesque situation in the sandy heath district and military associations have contributed to its growth as a residential township. The land rises 200 ft. from the Blackwater river in the west to the heights of Chobham ridges overlooking Bagshot heath in the east, and coniferous trees and rhododendrons abound. In Camberley is the army's staff college and nearby is the Royal Military academy, Sandhurst.

Bret Harte, the writer, is buried at Frimley parish church. Since World War II several light industries have been established in the district.

FRINGE TREE, a common name for the genus Chionanthus of the olive family, comprising two species of shrubs or small trees that may reach to 30 ft. and bear deciduous leaves and fluffy clusters of snow-white flowers, followed by dark-blue, olivelike fruits. The American fringe tree or old-man's-beard (C. *virginica*), native from Pennsylvania and Florida to Texas, is widely planted as an ornamental while the Chinese species (C. retusa), although introduced into America, did not attain equal popularity. (J. M. Bl.)

FRINGILLIDAE, a family of small perching birds (order Passeriformes) comprising the buntings, finches and grosbeaks (*qq.v.*).

FRINTON AND WALTON, an urban district in the Harwich parliamentary division of Essex, Eng., on the east coast about 17 mi. E.S.E. of Colchester by road. Pop. (1951) 8,451. Area 9.8 sq.mi. The district comprises the parishes of Frinton-on-Sea and Walton-on-the-Naze, both seaside towns with sands, and the rural .parishes of Kirby-le-Soken and Great Holland. Walton came into existence as a seaside resort about 1830; it has a ½-mi.-long pier, a Martello tower of the Napoleonic period and a late 18th-century beacon tower. This portion of the coast has in the past suffered from sea encroachment. About 2 mi. to the northeast is the Naze promontory; local low cliffs exhibit fossiliferous Red Crag formations. Frinton grew up as a seaside resort at the end of the 19th century; the old church of St. Mary dates partly from the early 16th century. Apart from the tourist industry there is some local agriculture and a small foundry at Walton.

FRISCHES HAFF (Vistula Lagoon; Pol. Zalew Wislany; Rus. Vislinski Zaliv), a lagoon on the Baltic coast, between Danzig (Gdansk) and Konigsberg (Kaliningrad). It is 56 mi. in length, from 5 to 12 mi. broad, 324 sq.mi. in area and is separated from the Baltic by a narrow spit, the Frische Nehrung. This barrier was torn open by a storm in 1510, and the channel thus formed, now dredged out to a depth of 22 ft., affords a navigable passage for vessels. Into the lagoon flow the Nogat, the Elbing, the Pasleka, the Pregel and the Frisching.

FRISCHLIN, PHILIPP NIKODEMUS (1547–1590), German philologist. poet and commentator on Vergil. and one of the last of the humanists, was born Sept. 22, 1547, at Balingen, Wiirttemberg. He was educated at Tiibingen, where he became (1568) professor of poetry and history. In 1575 for his comedy Rebecca, which he read at Regensburg before the emperor Maximilian II, he was rewarded with the laureateship, and in 1577 he was made a count palatine.

In 1582 he had to leave Tubingen, and spent two years teaching at Laibach. Shortly after his return to Tübingen in 1585, he was threatened with a criminal prosecution for immoral conduct, and fled to Frankfurt-am-Main (1587). For 18 months he taught in Brunswick and he appears also to have lived at Strasbourg, Marburg and Mainz. From Mainz he wrote libelous letters, which led to his arrest in March 1590. He was imprisoned in the fortress of Hohenurach. near Reutlingen. where, on the night of Nov. 29/30, 1590, he was killed by a fall in attempting to let himself down from the window of his cell.

In his Latin verse Frischlin often successfully imitated classical models. His Latin comedies have freshness and vivacity, and his commentaries on the *Georgics* and *Bucolics* of Vergil were important contributions to the scholarship of his time. He also wrote plays in German.

See his *Operum poeticorum,* 4 vol. (1585–1602); D F. Strauss, *Leben und Schrijten des Dichters und Philologen Frischlin* (1856); G. Berbermeyer, *Tübinger Dichterhumanisten* (1927).

FRISIAN ISLANDS, a chain of islands, lying from 3 to 20 mi. from the mainland and stretching from the IJsselmeer east and north as far as Jutland, along the coasts of the Netherlands and Germany. They are divided into three groups: (1) West Frisian; (2) East Frisian; and (3) North Frisian. The islands mark the outer fringe of the former continental coast line, and are separated from the mainland by shallows, known as *wadden.* Notwithstanding the protection afforded by sand dunes and artificial embapkments, the Frisian Islands are slowly disappearing through marine erosion. Many of the Frisian legends and folk songs deal with submerged villages and hamlets. The German and Dutch governments annually spent large sums for the protection of the islands, and in some cases the erosion on the seaward side is counterbalanced by the accretion of land on the inner side, fine sandy beaches being formed well suited for sea bathing, attracting many visitors in summer.

The inhabitants support themselves by seafaring, pilotage, grazing of cattle and sheep, fishing and a little agriculture, chiefly potato growing.

West Frisian. — The West Frisian Islands belong to the Netherlands, and embrace Texel (62 sq.mi.), Vlieland (13 sq.mi.), Terschelling (37 sq.mi.), Ameland (22 sq.mi.), Schiermonnikoog (10 sq.mi.), as well as the much smaller islands of Boschplaat and Rottum, which are practically uninhabited. The northern end of Texel is called Eierland, or "Island of Eggs," in reference to the large number of sea birds' eggs which are found there. It was joined to Texel by a sand dike in 1629–30 and is now undistinguishable from the main island. Texel was already separated from the mainland in the 8th century. but remained a Frisian province and countship, which once extended as far as Alkmaar in North Holland, until it came into the possession of the counts of Holland. Germany occupied all the West Frisians in 1940.

The island of Terschelling once formed a separate lordship, but was sold to Holland. As early as the beginning of the 9th century Ameland was a lordship belonging to the Cammingha family. who held immediately of the emperor, and in recognition of their independence the Amelanders were in 1369 declared to be neutral in the fighting between Holland and Friesland, while Cromwell made the same declaration in 1654. The castle of the Camminghas in Ballum remained until 1829. This island is joined to the mainland of Friesland by a stone dike built in 1873 to promote the deposit of mud. Schiermonnikoog has a village and a lighthouse. Rottum was once the property of the ancient abbey at Rottum, 8 mi. N. of Groningen, of which there are slight remains. West Frisian Islands have a total area of 145 sq.mi. and a pop. (1957 est.) of 17,460.

East Frisian. — The East Frisian group belongs to Germany and comprises Borkum (13½ sq.mi.), Memmert, Juist (6 sq.mi.), Norderney (10 sq.mi.), Baltrum, Langeoog (7 sq.mi.), Spiekeroog (5 sq.mi.) and Wangeroog (2 sq.mi.). All these islands are visited for sea bathing. Many have lighthouses and lifeboat stations. In the beginning of the 18th century Wangeroog comprised eight times its present area. Borkum and Juist are two surviving fragments of the original island of Borkum (computed at 380 sq.mi.), known to Drusus as *Fabaria*, and to Pliny as *Burchana*, which was rent asunder by the sea in 1170. Neuwerk and Scharhorn are situated off the mouth of the Elbe, the former contains some marshland protected by dikes and has two lighthouses and a lifeboat station.

North Frisian.—About the year 1250 the area of the North Frisian Islands was estimated at 1,065 sq.mi.; by 1850 this had diminished to only 105 sq.mi. This group embraces the islands of Nordstrand ($17\frac{1}{4}$ sq.mi.), which to 1634 formed one larger island with the adjoining Pohnshallig and Nordstrandisch-Moor; Pellworm ($16\frac{1}{4}$ sq.mi.), protected by a circle of dikes and connected by steamer with Husum on the mainland; Amrum ($10\frac{1}{2}$ sq.mi.); Fohr (32 sq.mi.); Sylt (38 sq.mi.); Rom (16 sq.mi.), with several villages, the principal of which is Kirkeby; Fanö (21 sq.mi.); and Heligoland ($\frac{1}{4}$ sq.mi.). With the exception of Fanö and Rom which are Danish, these islands belong to Germany, which also occupied the former two in 1940. In the North Frisian group there are also several smaller islands called Halligen, rising generally only a few feet above the level of the sea.

FRISIANS, a people who in the first century of our era were found by the Romans in occupation of the coast lands stretching from the mouth of the Scheldt to that of the Ems. The first historical notices of the Frisians are found in the *Annals* of Tacitus. They (or a portion of them) were rendered tributary by Drusus, and became *socii* of the Roman people, but soon after A.D. 47 the emperor Claudius ordered the withdrawal of all Roman troops to the left bank of the Rhine. In 58 the Frisians tried unsuccessfully to appropriate certain districts between the Rhine and the Yssel and in 70 they took part in the campaign of Claudius Civilis. Ptolemy states that they inhabited the coast above the Bructeri as far as the Ems. Tacitus speaks of them as adjacent to the Rhine. But there is some reason for believing that the part of Holland which lies to the west of the Zuider Zee was at first inhabited by a different people, the Canninefates, whose name is perhaps preserved in the name Kennemerland or Kinnehem formerly applied to the same district.

In connection with the movements of the migration period the Frisians are hardly ever mentioned, though some of them are said to have surrendered to the Roman prince Constantius about the year 293. Procopius speaks of the Frisians as one of the nations which inhabited Britain in his day, but we have no evidence from other sources to bear out his statement. In Anglo-Saxon poetry mention is frequently made of a Frisian king named Finn, the son of Folcwalda, who came into conflict with a certain Hnaef, a vassal of the Danish king, Healfdene, about the middle of the 5th century. The incident is obscure, but it is worth noting that Hnaef's chief follower, Hengest, may quite possibly be identical with the founder of the Kentish dynasty. About the year 520 the Frisians are said to have joined the Frankish prince Theodberht in destroying a piratical expedition which had sailed up the Rhine under Chocilaicus (Hygelac), king of the Götar. Toward the close of the century they begin to figure much more prominently in Frankish writings. It is probable that the Frisians were to some extent associated with the Angles and Saxons in the invasion of Britain. In any case, the Frisian language, by its close resemblance to English, proves an ancient and intimate connection between these peoples.

The northward extension of Frankish dominion brought on a collision with the Frisians. Under the protection of the Frankish king Dagobert (622–638), the Christian missionaries Amandus (St. Amand) and Eligius (St. Eloi) attempted the conversion of the southern Frisians, but farther north the building of a church by Dagobert at Trajectum (Utrecht) at once aroused the fierce hostility of the heathen tribesmen of the Zuider Zee. Utrecht was attacked and captured, and the church destroyed. Wilfrid, bishop of York, who visited Frisia in 678 was allowed to preach Christianity by Aldgils, then king. Radbod, his successor, who was hostile to Christianity. was beaten by Pippin of Heristal in the battle of Dorstadt (689), and was compelled tp cede west Frisia from the Scheldt to the Zuider Zee to the conqueror. Although Frankish supremacy over Frisia was not completely established until the time of Charles the Great, it was under Frankish protection that Christianity was established in Frisia by the Englishman Willibrord, between 690 and 739. The see of Utrecht which he founded has remained the chief see of the northern Netherlands from his day to our own, though many Frisians were still heathen when the more famous English missionary Boniface was martyred at Dokkum in Frisia shortly after 750.

Charles the Great granted the Frísians important privileges under a code known as the *Lex Frisionum,* based upon the ancient laws of the country. In this text three districts are clearly distinguished: West Frisia from the Zwin to the Vlie; Middle Frisia from the Vlie to the Lauwers; East Frisia from the Lauwers to the Weser. At the treaty of Verdun (843) Frisia became part, of Lotharingia; at the treaty of Mersen (870) it was divided between the kingdoms of the East Franks and the West Franks; in 880 the whole country was united to the latter; in 911 it fell under the dominion of Charles the Simple, king of the West Franks, but the districts of East Frisia asserted their independence and for a long time governed themselves after a very simple democratic fashion. The history of West Frisia gradually loses itself in that of the countship of Holland and the see of Utrecht (*see* HOLLAND, COUNTY *AND* PROVINCE OF; UTRECHT).

The influence of the Frisians during the interval between the invasion of Britain and the loss of their independence must have been greater than is generally recognized. They were a seafaring people and engaged largely in trade, especially perhaps the slave trade, their chief emporium being Wyk te Duurstede. During the period in question there is considerable archaeological evidence for intercourse between the west coast of Norway and the regions south of the North sea, and it is worth noting that this seems to have come to an end early in the 9th century. Probably it is no mere accident that the first appearance, or rather reappearance, of Scandinavian pirates in the west took place shortly after the overthrow of the Frisians.

Besides the Frisians discussed previously, a people called North Frisians inhabited the west coast of Schleswig. In historical times these North Frisians were subjects of the Danish kingdom and not connected in any way with the Frisians of the empire. It seems not unlikely that the original settlers were Frisians who had been driven northward by the Franks in the 8th century. The inhabitants of the neighbouring islands, Sylt, Amrum and Föhr, who speak a kindred dialect, have apparently never regarded themselves as Frisians, and it is the view of many scholars that they are the direct descendants of the ancient Saxons.

In 1248 William of Holland, having become emperor, restored to the Frisians in his countship their ancient liberties in reward for the assistance they had rendered him in the siege of Aachen; but in 1254 they revolted, and William lost his life in the contest which ensued. After many struggles west Friesland became completely subdued, and was henceforth virtually absorbed in the county of Holland. But the Frieslanders east of the Zuider Zee obstinately resisted repeated attempts to bring them into subjection. In the course of the 14th century the country was in a state of anarchy, which favoured the attempts of the counts of Holland to push their conquests eastward. but the main body of the Frisians was still independent when the countship of Holland passed into the hands of Philip the Good of Burgundy. Philip laid claim to the whole country, but the people appealed to the protection of the empire, and Frederick III, in Aug. 1457, recognized their direct dependence on the empire. The marriage of Maximilian of Austria with the heiress of Burgundy produced a change in the fortunes of that part of Frisia which lies between the Vlie and the Lauwers. In 1498 Maximilian reversed the policy of his father Frederick III and gave it to Albert of Saxony, who thoroughly crushed out all resistance. In 1523 it passed with all the rest of the provinces of the Netherlands to the emperor Charles, the grandson of Maximilian and Mary of Burgundy.

The part of Frisia which lies to the east of the Lauwers had a divided history. The portion which lies between the Lauwers and the Ems after some struggles for independence had, like the rest of the country, to submit itself to Charles. It became ultimately the province of the town and district of Groningen (*q.v.*). The easternmost part between the Ems and the Weser, which had since 1454 been a county was ruled by the descendants of Edzard Cirksena, and was attached to the empire. The last of the Cirksenas, County Charles Edward, died in 1744 and in default of heirs male the king of Prussia took possession of the county.

The province of Friesland was one of the seven provinces which by the treaty known as the Union of Utrecht bound themselves together to resist the tyranny of Spain. From 1579 to 1795 Friesland remained one of the constituent parts of the republic of the United Provinces, but it always jealously insisted on its sovereign rights, especially against the encroachments of the predominant province of Holland. It maintained throughout the whole of the republican period a certain distinctiveness of nationality, which was marked by the preservation of a different dialect and of a separate stadtholder. Count William Lewis of Nassau-Siegen, nephew and son-in-law of William the Silent, was chosen stadtholder, and throughout the 17th and 18th centuries the stadtholdership was held by one of his descendants. Frederick Henry of Orange was stadtholder of six provinces, but not of Friesland, and even during the stadtholderless periods which followed the deaths of William II and William III of Orange the Frisians remained stanch to the family of Nassau-Siegen. Finally, by the revolution of 1748 William of Nassau-Siegen, stadtholder of Friesland (who by default of heirs male of the elder line, had become William IV, prince of Orangej, was made hereditary stadtholder of all the provinces. His grandson in 1815 took the title of William I, king of the Netherlands. The male line of the "Frisian" Nassaus came to an end with the death of King William III in 1890.

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FRIT FLY (*Oscinella frit*), a small, shining black fly destructive to oats, rye, barley and wheat in Europe and North America. The creamy white larvae live in the developing grains, and within the stems, causing the central leaf to milt. (*See* DIPTERA.)

(C. H. CN.)

FRITH or FRYTH, **JOHN** (c. 1503–1533), English Reformer and Protestant martyr, was born at Westerham, Kent. He was educated at Eton and King's college, Cambridge, where Gardiner, afterward bishop of Winchester, was his tutor. At the invitation of Thomas Cardinal Wolsey, after taking his degree he migrated (Dec. 1525) to the newly founded college of St. Frideswide or Cardinal college (now Christ Church), Oxford. The sympathetic interest which he showed in the Reformation movement in Germany caused him to be suspected as a heretic, and led to his imprisonment for several months. Subsequently he appears to have resided chiefly at the newly founded Protestant university of Marburg, where he became acquainted with several scholars and reformers of note, especially Patrick Hamilton (*q.v.*). Frith's first publications were printed at Marburg. His *Disputacyon of Purgatorye,* a treatise in three books, against John Rastell, Sir Thomas More and John Fisher (bishop of Rochester) respectively, was published at the same place in 1531. While at Marburg, Frith also assisted William Tyndale, whose acquaintance he had made in England, in his literary labours. In 1532 he ventured back to England. Warrants for his arrest were almost immediately issued at the instance of More, then lord chancellor! and he ultimately fell into the hands of the authorities as he was on the point of escaping to Flanders. Frith was examined by the king's order; he was afterward tried and found guilty of having denied that the doctrines of purgatory and transubstantiation were necessary articles of faith. On June 23, 1533, he was handed over to the secular arm; and was burnt at the stake at Smithfield on July 4. During his captivity he wrote a reply to More's letter against his own "lytle treatise"; also two tracts entitled *A Mirror or Glass to know thyself,* and *A Mirror or Looking-glass wherein you may behold the Sacrament of Baptism.*

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FRITH, WILLIAM POWELL (1819–1909), English painter of large, crowded scenes, was born at Aldfield, Yorkshire, on Jan. 9, 1819. He trained first at Henry Sass's school in London (1835) and then in 1837 entered the Royal Academy school. In 1840 he exhibited there his first picture "Malvolio Before the Countess Olivia." His earlier works included portraits and subject pieces in the tradition of D. Wilkie and W. Mulready, but .he developed a preciseness of technique akin to that used by the Pre-Raphaelites.

He quickly gained wide popularity. Elected associate of the Royal Academy in 1845 and a member in 1852, he established his reputation with a succession of large compositions of everyday English life, the first of which, "Ramsgate Sands" (exhibited 1854), was bought by Queen Victoria. There followed "The Derby Day" (18j8, Tate gallery, London); "Claude Duval" (1860); "The Railway Station" (1862); and "The Marriage of the Prince of Wales" (1865) painted for Queen Victoria.

Frith later turned to moralizing works exemplified by the series of five paintings—"The Race for Wealth" (1880). He died in London. Nov. 2, 1909. Commemorative exhibitions were held at Whitechapel Art gallery (London) and at Harrogate in 1951.

See Nevile Wallis (ed.), *Victorian Canvas: Memoirs,* from Frith's autobiographical writings (19j7). (D. L. FR.)

FRITILLARY (*Fritillaria*), a genus of hardy bulbous plants of the family Liliaceae (*q.v.*), containing more than 70 species widely distributed in the northern hemisphere. About 15 species are native to western North America, chiefly California, and mostly with handsome flowers, among which are the white fritillary (*F. liliacea*), the yellow fritillary (*F. pudica*), mission bells (*F. lanceolata and mutica*), brown bells (*F. parviflora*) and the chocolate lily (*F. biflora*).

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FRITILLARY OR SNAKE'S-HEAD (FRITILLARIA MELEAGRIS)

The genus is represented in the southern half of England by the fritillary or snake's-head (*F. meleagris*), which occurs in moist meadows. A much larger plant is the crown imperial (*F. imperialis*), a native of western Asia and well known in gardens. This grows to a height,of about three feet, the lower part of the stoutish stem having leaves, while near the top is developed a crown of large pendent flowers surmounted by a tuft of bright green leaves. The flowers are bell-shaped, yellow or red, and in some of the forms double. The plant grows freely in good garden soil, preferring a deep well-drained loam.

Fritillary is also the name of several species of butterfly.

FRITZLAR, a town in the *Land* of Hesse, on the left bank of the Eder, 16 mi. S.W. from Cassel by rail. Pop. (1950) 6.851. As early as 732 Boniface, the apostle of Germany, established the church of St. Peter and a small Benedictine monastery at Frideslar.

Among the earlier scholars of the famous monastery school were Sturm, abbot of Fulda, and Megingod, second bishop of Würzburg. Boniface later entrusted the office to Wigbert of Glastonbury, who thus became the first abbot of Fritzlar. In 774 the little settlement was burnt by the Saxons, but soon recovered. Soon after 786 it was the seat of the bishopric of Buraburg, founded by Boniface in 741. At the diet of Fritzlar in 919 Henry I was elected German king. Early in the 13th century the village received municipal rights. As a principality Fritzlar continued subject to the archbishopric of Mainz till 1802, when it was incorporated with Hesse. In 1866 it passed with Hesse-Cassel to Prussia.

FRITZSCHE, OTTO FRIDOLIN (1812–96), German theologian, was born on Sept. 23, 1812, at Dobrilugk. and studied at Halle. From 1837 to 1893 he was professor of theology at the University of Zurich, where he died on March 9, 1896.

His chief publications were his edition of the Apocrypha of the Old Testament (1871) and his *Kurzgefasstes exegetisches Handbuch zu den Apokryphen des Alten Testamentes* (6 vol., 1851–60). For his other works, including his text editions, *see* Herzog's *Realencyklopädie.*

FRIULI, a district at the head of the Adriatic sea, partly included in Venetia proper (province of Udine) and partly in Venetia Julia (province of Gorizia). In the north and east Friuli includes portions of the Julian and Carnic Alps, while the south is the alluvial plain of the Isonzo, Tagliamento, and lesser streams which come down in floods after rain or thaw. The inhabitants, known as Furlanians or Friulani, speak a dialect with Celtic elements, one of the Latin dialects (others being those of the Dolomite valleys and of the Engadine). Silkworms are bred.

Friuli derives its name from the Roman town of Forum Iulii, or Foroiulium, the modern Cividale del Friuli (*q.v.*). In the 2nd century B.C. it was subjugated and became part of Gallia Transpadana. During the Roman period, besides Forum Iulii, its principal towns were Concordia and Aquileia. The Lombards (6th century) made it one of their 36 duchies, the capital being Forum Iulii or, as they called it. Civitas Austriae. The discovery of the grave of Gisulf (d. 611) at Cividale is an interesting proof of the veracity of Paulus Diaconus' *Historia Langobardorum.* In the 11th century the ducal rights over the greater part of Friuli were bestowed by the emperor Henry IV on the patriarch of Aquileia; but toward the close of the 14th century the nobles called in the assistance of Venice, which, after defeating the archbishop, secured possession of the country for itself in 1420. The eastern part of Friuli was held by the counts of Gorizia till 1500, when on the failure of their line it was appropriated by Maximilian I, and became the possession of the house of Austria. By the peace of Campo Formio in r797 the Venetian district also came to Austria, and on the formation of the Napoleonic kingdom of Italy in 1805 the department of Passariano was made to include the whole of Venetian and part of Austrian Friuli, and in 1809 the rest was added to the Illyrian provinces. The title of duke of Friuli was borne by Marshal Géraud Duroc. In 1815 the whole country was recovered by the emperor of Austria, who himself assumed the ducal title and coat of arms. In 1866 the Venetian portion was again ceded to Italy by the peace of Prague, and the rest came under Italian domination in 1918. Under the Italian peace treaty of 1947 the eastern part of the district was given to Yugoslavia.

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FRIULIAN: *see* RAETO-ROMANCE DIALECTS.

FROBEN or FROBENIUS, **JOANNES** (c. 1460–1527), German printer and scholar, was born at Hammelburg in Bavaria. After completing his university career at Basel, where he made the acquaintance of the famous printer Johannes Auerbach (1443–1513), he established there about 1491 a printing house which had a European reputation for accuracy and for taste. In 1500 he married the daughter of the bookseller Wolfgang Lachner, who entered into partnership with him. He was a friend of Erasmus (*q.v.*), who not only had his own works printed by him, but superintended Frobenius' editions of St. Jerome, St. Cyprian, Tertullian, Hilary of Poitiers and St. Ambrose. His *Neues Testament in Greek* (1516) was used by Luther for his translation. Frobenius employed Hans Holbein to illuminate his texts. It was part of his plan to print editions of the Greek fathers. He did not, however, live to carry out this project, but it was very creditably executed by his son Jerome and his son-in-law Nikolaus Episcopius. Frobenius' work in Basel made that city in the 16th century the leading centre of the German book trade. An extant letter of Erasmus gives an epitome of his life.

FROBENIUS, LEO (1873–1938), German explorer and ethnologist, came to be regarded in his day as one of the world's greatest authorities on prehistoric art. He was born in Berlin, June 29, 1873, the son of a retired army officer. In ethnology he favoured extreme theories of diffusion, attributing a common origin to the cultures of Oceania and west Africa. Frobenius led 12 expeditions into Africa and explored centres of prehistoric art in the Alps, Norway, Spain, the Libyan and Sahara deserts, Trans-Jordan, Southern Rhodesia and the Bushman caves of South Africa. He wrote 60 books and numerous pamphlets and articles. In 1910 he announced that he had conclusive proof of the existence of Atlantis, the mythical lost continent in Africa. He died at Lake Maggiore, Intra, It., on Aug. 9, 1938

FROBISHER, SIR MARTIN (c. 1539–1594), English navigator and explorer, was the son of Bernard Frobisher of Altofts, Normanton, Yorkshire. In 1553 and in 1554 he went on voyages to Guinea and was there imprisoned for a time by the Portuguese. About 1559 he was in Barbary. During the 1560s he was privateering in the channel and was in trouble for piracy. In 1571–72, however, he was in the queen's service off the Irish coast. He married in 1559. As early as 1560 or 1561 Frobisher is said to have become interested in the possibility of finding a northwest passage to Cathay and India, and in 1576, by help of the earl of Warwick, he was put in command of an expedition consisting of two tiny barques, the "Gabriel" and "Michael," and a pinnace. He set sail from Blackwall on June 15 by way of the Shetland Islands. The pinnace was lost in a storm and the "Michael" deserted; but on July 20 the "Gabriel" sighted the coast of Labrador. Some days later the mouth of Frobisher bay was reached and, a farther advance northward being prevented by ice and contrary winds, Frobisher determined to sail westward up this passage (which he conceived to be a strait) to see "whether he mighte carrie himselfe through the same into some open sea on the backe syde." Butcher's Island was reached on Aug. 18 and some natives then decoyed away five of his men. After vainly trying to get them back, Frobisher turned homeward and reached London on Oct. 9.

Among the things Frobisher's men brought back was some "black earth," arid a rumour arose that this was gold ore. The result was that the next year a much more important expedition than the former was fitted out, the queen lending the "Aid" from the royal navy and subscribing £1,000. A company of Cathay was established and Frobisher was appointed high admiral of all lands and waters that might be discovered by him. On May 26, 1577, the expedition, consisting, besides the "Aid," of the "Gabriel" and "Michael" with pinnaces and 120 men, including miners, left Blackwall and reached Hall's Island at the mouth of Frobisher bay on July 17. The time was spent in collecting ore, and very little discovery was achieved. The return was begun on Aug. 22, and the "Aid" reached England on Sept. 23; the "Gabriel" and "Michael" later. Frobisher was received by the queen at Windsor. She believed in the value of the territory, and it was resolved to send out a larger expedition and establish a colony. On May 31, 1578, the expedition, consisting of 15 vessels. left Harwich and reached the south of Greenland on June 20. On July 2 the foreland of Frobisher bay was sighted. but stormy weather and dangerous ice drove the fleet unwittingly up a new (Hudson) strait. After proceeding about 60 mi. up this "mistaken strait" Frobisher turned back, and the fleet at last came to anchor in Frobisher bay.

Some attempt was made at founding a settlement, and a large quantity of ore was shipped; but the venture was not a success, and on Aug. 31 the fleet set out for England, which was reached in early October.

The ore was eventually proved to contain neither silver nor gold, and a proposal to send Frobisher out again in 1581 came to nothing.

In 1580 he commanded the "Foresight" in operations off Munster during the Desmond rebellion and took part in the capture of Smerwick. In 1585 he went in the "Primrose" as vice-admiral of Sir Francis Drake's expedition to the West Indies. He was again at sea during the vain attempts to relieve Sluys in 1587. and next year in the "Triumph" played a prominent part in the Armada campaign, being knighted during the operations. In the winter of 1588–89 he commanded a squadron guarding the Narrow Seas and in the following autumn he took another small force to the Spanish coast and the Azores. He was off the Azores again in the summer of 1590. Next year he married a second time and for a short while settled in Yorkshire, but for most of the summer of 1592 he lay off the Spanish coast with one part of a fleet fitted out by Sir Walter Raleigh. His last command was of a squadron sent in 1594 to assist in defending Brest against a Spanish force established at Fort Crozon.

In the final assault on the fort he received a wound from which he died at Plymouth on Nov. 22. Though he appears to have been somewhat rough in his bearing, and too strict a disciplinarian to be much loved, Frobisher was undoubtedly one of the most able seamen of his time.

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FROCK, originally a long, loose gown with broad sleeves, worn by members of the religious orders. The word is derived from the O.Fr. *froc*, of obscure origin. The formal stripping off of the frock became part of the ceremony of degradation in the case of a condemned monk; hence the expression "to unfrock." In the middle ages "frock" was also a long loose coat worn by men, or a coat of mail, and the word survived into the 19th century for a coat with long skirts. the "frock coat." It is now chiefly used in English-for a child's or young girl's dress.

FRODING, GUSTAF (1860–1911), one of the most outstanding Swedish lyrical poets, was born at Alster, Varmland, Aug. 22, 1860. His parents came from cultured and gifted families but both showed mental instability. He studied at Uppsala university, 1880–83, and again in 1885, but did not take a degree. At first he staved off depression by working for a liberal paper and was for ten years a journalist at Karlstad. Varmland, though forced to spend long periods in sanatoriums for treatment of nervous disorders. Stimulated by the revolt against naturalism at the end of the 1880s, in 1891 he published his first collection of poems, *Guitarr och dragharmonika* (Eng. trans., *Guitar and Concertina*, containing also later poems, 1925). It was followed in 1894 by *Nya dikter* and in 1896 by *Stank och flikar*. These three volumes contain the essential Fröding. Passages in the last led to his prosecution for pornography, and although he was acquitted, the experience was disastrous to a man so scrupulous and oversensitive. He managed to publish two more small books of poems, *Nytt och Gamnzalt* (1897) and *Gralstank* (1898), before his final breakdown. From 1898 to 1905 he was a patient in a mental hospital at Uppsala and, although he recovered a measure of sanity, he never recovered his health and died at Stockholm, Feb. 8, 1911. A collection of verse and prose, *Efterskord*, was published in 1910, and a posthumous collection, *Reconvalescentia*, appeared in 1913. Fröding also wrote humorous dialect sketches, literary essays and newspaper causeries.

Although Fröding never altogether abandoned the realism and social compassion which had first inspired him, he partly shared the neoromanticism of the 1890s, nostalgically looking back to an idealized, old-world country life. In outlook he remained a radical, involved in contemporary discussions inspired by the ideas of such writers as Tolstoy and Nietzsche, but as a poet he was influenced more by the great romantics: Goethe, Scott, Byron, Heine. He wrote a little book on Burns (1892) and translated several of his poems. His poetic style showed a virtuosity new to Swedish literature and unusual technical perfection. By uniting colloquial language with a rich musical form, he liberated Swedish verse from traditional patterns. He was a master of humorous verse, and his drolleries are as effective as the bitter pathos or evocative magic of his serious poetry. Readers were first attracted by the poems inspired by the scenes, characters and folklore of his native Värmland, but even in his early work there was also a strong personal note of melancholy, despair and revolt and a pathetic quest for a philosophy capable of resolving life's discords. One of Froding's answers to this quest was humour; another was a monistic mysticism. reconciling good and evil. His popularity as a poet was enhanced by the appeal of his personality, which remained essentially kind, noble and upright, despite the tragedy of his life.

Froding's collected writings, edited by R. G. Berg, appeared in 16 volumes, 1917–22. English translations include *Poems*, translated by A. Björck (1903) and *Selected Poems*, translated by C. W. Stork (1916).

See Henry Olsson, *Fröding, ett diktarportratt* (1950); J. Landquist, *Gustaf Fröding* (1956). (G. SDT.)

FROEBEL (FRÖBEL), **FRIEDRICH (WILHELM AUGUST)** (1782–1852), German founder of the kindergarten and influential educational reformer of the 19th century, was born on April 21, 1782, in the Thuringian village of Oberwiessbach, where his father was pastor. His mother died when he was very young, and he was neglected as a child until an uncle gave him a home and sent him to school. For two years he was apprenticed to a forester and this influenced his future development. He acquired a thorough knowledge of plants and natural phenomena while at the same time beginning the study of mathematics and languages.

Froebel's love of nature led him to take a course at Jena, but lack of funds cut short his university career. He incurred small debts and was imprisoned for nine weeks. He tried various kinds of employment until his meeting with Anton Gruner, a pupil of Johann Pestalozzi and head of the Frankfurt am Main model school, convinced him of his vocation as a teacher. After two years as assistant to Gruner, he went to Yverdon, Switz., where he came into close contact with Pestalozzi. Though he learned much at Yverdon, he quickly discovered the weakness of organization which characterized Pestalozzi's work. He entered the University of Gottingen, where military service soon interrupted his studies. During the campaign of 1813 he formed a lasting friendship with H. Langethal and W. Middendorff, who became his devoted followers and who joined him at a school he opened at Griesheim in Thuringia in 1816. Two years later the school moved to Keilhau, also in Thuringia, and it was there that Froebel put into practice his educational theories. He and his friends and their wives formed a kind of educational community. To this period belongs Froebel's most important treatise, *The Education of Man* (1826; Eng. trans. 1885). In 1831 he left Keilhau to his partner and accepted the invitation of the Swiss government to train elementary teachers. His experience at Keilhau and as head of a new orphan asylum at Burgdorf, Switz., impressed him with the importance of the early stages of education. On returning to Keilhau in 1837 he opened his first *kindergarten*, or "garden of children," in the neighbouring village of Blankenburg. The experiment attracted widespread interest and other kindergartens were started. Unfortunately, because of a confusion with the socialist views of Froebel's nephew, the Prussian government proscribed the kindergarten and the ban was not removed until after 1860, several years after Froebel's death at Marienthal on June 21, 1852.

One of Froebel's most enthusiastic disciples, Baroness Bertha von Marenholtz-Biilow. was largely responsible for bringing Froebel's ideas to the notice of educators in England, France and the Netherlands. Later they were introduced into other countries, including the United States. The first kindergarten in London was opened in 1851 under the supervision of Madame Bertha Ronge and her sister, both pupils of Froebel. Charles Dickens visited the school and wrote a full and sympathetic account of the work in *Household Words*. The later growth of the movement in England was mainly the result of the work of Madame E. Michaelis, who was instrumental in founding the Froebel society in 1875. English teachers were attracted by the practical ideas of Froebel but at first failed to grasp the importance of his theory. It was in the United States that the Froebelian movement achieved its greatest success. Thus John Dewey adopted Froebel's principles in his experimental school at The University of Chicago. It was not until the 20th century that they were thoroughly understood by English teachers. The English nursery-school movement originated by Margaret and Rachel McMillan owed much to Froebel's ideas.

Though not himself a great philosopher, Froebel was influenced by the outstanding German thinkers of his age and by Rousseau and Pestalozzi. He was a sincerely religious man who, because of his belief in the underlying unity of all things, tended toward pantheism and has been called a nature mystic. An important contribution to educational theory was his belief in self-activity and the essential factor of play in child education. This resulted in the introduction of a series of toys or apparatus known as the "gifts," devised to stimulate learning through well-directed play accompanied by songs and music. The modern "playway" in education is much indebted to Froebel.

In addition to the *Education of Man,* Froebel wrote the *Pädagogik d. Kindergartens; Kleinere Schriften* and *Mutter-und Koselieder.* Collective editions were edited by W. Lange (1862) and F. Seidal (1883). There are English editions of the *Autobiography of Friedrich Froebel,* new ed. (1903), *Froebel's Chief Writings on Education* (1912) and the *Mother's Songs, Games and Stories* (1920).

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FROESCHWILLER, BATTLE OF. The name given by the French to the battle of Wörth in the Franco-German War (*q.v.*), which is the name commonly adopted.

FROG, a name of wide application, strictly for an animal belonging to the family Ranidae, but also used properly for any representative of the order Salientia of the class Amphibia (*q.v.*). It is a deficiency of the English language that there is no vernacular name in general use for the tailless amphibians as a whole.

Frogs proper are typified by the common European species, *Rana temporaria,* the edible frog, *R. esculenta,* and by the American leopard frog, *R. pipiens* and the bullfrog, *R. catesbeiana.* The genus *Rana* includes in all about 200 species.

Some of the species are permanently aquatic and have fully webbed toes, while others are terrestrial, except during the breeding season. On the other hand, other species are adapted for burrowing, by means of the much-enlarged and sharp-edged tubercle at the base of the outer toe, while not a few have the tips of the digits dilated into discs by which they are able to climb on trees.

Some frogs grow to a large size. The bullfrog of eastern North America grows to nearly eight inches from snout to vent, *R. guppyi* of the Solomon Islands to eight and one-half inches and *R. goliath,* of the South Cameroons, to ten inches. Among species belonging to other genera of the family may be mentioned the hairy frog of west Africa, *Trichobatrachus robustus,* some specimens of which have the sides of the body and of the hind limbs covered with long villosities, and its ally *Gampsosteonyx batesi,* in which the last phalanx of the fingers and toes is sharp and claw-like and perforates the skin. *Dimorphognathus,* from west Africa, is the unique example of a sexual dimorphism in the dentition, the males being provided with a series of large sharp teeth in the lower jaw, which in the female is edentulous. The curious horned frog of the Solomon Islands, *Ceratobatrachus guentheri,* has teeth in the lower jaw in both sexes, while a few forms, such as *Cardioglossa,* have no teeth.

A closely allied family, the Rhacophoridae, includes the arboreal genus *Rhacophorus* of eastern Asia, some species of which are remarkable for the extremely developed webs which are believed to act as a parachute (flying frog of A. R. Wallace). Some species have been observed to make aerial nests between leaves overhanging water, a habit shared by the closely related *Chiromantis* of tropical Africa. (K. P. S.)

FROGBIT, in botany, the English name for a small rootless plant with floating leaves known botanically as *Hydrocharis morsus-ranae,* a member of the family Hydrocharitaceae. The plant has rosettes of roundish floating leaves, and multiplies like the strawberry plant by runners, at the end of which new leaf-rosettes develop. Staminate and pistillate flowers are borne on different plants; they have three small green sepals and three broadly ovate white membranous petals. The fruit is fleshy. The plant occurs in ponds and ditches in England.

FROGMEN, the popular name for members of the U.S. navy's underwater demolition teams in World War II. Their efforts reduced troop losses and facilitated the landing of men and supplies on enemy shores. Before an amphibious landing was made, frogmen reconnoitered the beach area. They measured the actual depths of the water, detected natural or man-made obstructions under the surface and observed the enemy's defensive positions close to the water's edge. One of their most important functions was to destroy dangerous underwater obstructions. Frogmen were carefully chosen volunteers who were intensively trained and worked without weapons. The explosive charges they used for demolitions, their boats, tools, equipment and clothing were developed by test and war experience.

About 1,000 frogmen prepared the way for the invasion of Okinawa, working for three days in very cold water, after the mine-sweepers had done their work. The frogmen dealt with a few beaches at a time, beginning by taking soundings on the reefs offshore and examining the extensive obstructions which the enemy had erected. This was followed by the demolition work and a final recheck. The frogmen, protected by heavily concentrated gunfire and by aerial strikes, lost only a few men. *See* also DIVING APPARATUS.

See Francis Douglas Fane and Don Moore, *The Naked Warriors* (1956). (J. B. HN.)

FROGMOUTH, a name, in reference to the broad, froglike gape, for birds comprising the family Podargidae, in the order Caprimulgiformes, which also contains the nightjar, nighthawk, whippoorwill and oilbird (*qq.v.*). There are about 12 species of frogmouths, including *Batrachostomus auritus* of the Malay peninsula and Sumatra and Borneo, *B. septimus* of the Philippines and *B. moniliger* of India; others occur in southeastern Asia and the Malays. The genus *Podargus* of Australia and the Malays is usually called morepork (*q.v.*). Owlet frogmouths, intermediate in appearance to owls and nightjars, belong to the family Aegothelidae. (G. F. Ss.; X.)

FRÖHLICH, ABRAHAM EMANUEL (1796–1865), a Swiss poet, pastor and professor, was born at Brugg, Feb. 1, 1796, and died at Baden, Dec. 1, 1865. His earliest literary work was in the form of versified apologues (*Fabeln,* 1825), which achieved great popularity for their satirical humour and sound morality. Among his other works were *Hymns,* the ultra-Protestant epics of *Ulrich Zwingli* (1840) and *Ulrich von Hutten* (1845), and *Der Junge Deutsch-Michel* (1846), an attack on the youth of his day. Fröhlich was highly conservative and orthodox in his views.

FROHMAN, CHARLES (1860–1915), U.S. theatrical manager, a star maker who developed, among others, Maude Adams, Ethel Barrymore, Julia Marlowe, Billie Burke, William Gillette and Otis Skinner, was born in Sandusky, O., on June 17, 1860. In his early youth his family moved to New York city, and Charles became interested in theatrical activities through his elder brothers, Daniel (*see* below) and Gustave. After several years of part-time positions with local newspapers and theatres, Frohman, in 1883, managed the Wallack Theatre company on tour. He later opened a theatrical booking office in New York and laid the foundation of the Theatrical Syndicate, which for several years controlled U.S. theatres. Frohman's first real success was Bronson Howard's *Shenandoah* in 1889. In 1892 he engaged John Drew (*see* DREW) as his star and established the Empire Stock company. Frohman's encouragement of such playwrights as Clyde Fitch, David Belasco and Augustus Thomas was indicative of his ability to perceive theatrical talent. He dominated the U.S. theatre during 25 of its most exciting years, and when he died with the sinking of the "Lusitania," May 7, 1915, an era ended. Frohman never married.

His brother, DANIEL FROHMAN (1851–1940), was an important theatrical producer from the 1880s to his retirement in 1912. At various times he managed the Fifth Avenue, the Madison Square, the Lyceum, the New Lyceum and Daly's theatres, and was president of the Actor's Fund of America. He died Dec. 26, 1940. (S. W. H.)

FROHSCHAMMER, JAKOB (1821–1893), German theologian and philosopher, was born at Illkofen, near Regensburg, on Jan. 6, 1821. He studied theology at Munich and in 1847 became a priest. In 1850 he published Beitriige *zur Kirchengeschichte*, which was placed on the Index Expurgatorius, and in 1854, his Uber den *Ursprung* dcr menschlichen Seelen, which maintained that the human soul was not individually created, but was the result of a secondary creative act on the part of the parents, and that soul like body was subject to the laws of heredity. This was supplemented in 1855, the year in which he became professor of philosophy in Munich, by Menschenseele und *Physiologie*. The Einleitung in die Philosophie und *Grundriss* der Metaphysik of 1858 assailed the doctrine of Thomas Aquinas, that philosophy was the handmaid of theology. In 1861 appeared Uber die Aufgabe der Naturphilosophie und ihr *Verhältnis zur Naturwissenschaft,* and Uber die Freiheit der *Wissenschaft,* in which he declared the independence of science from authority, and reproached the excessive respect for the latter in the Roman Church. In 1862 he founded Atheniium as the organ of liberal Catholicism, writing for it the first adequate German account of the Darwinian theory of natural selection. Excommunicated in 1871, he replied with Der Fels Petri in Rom (1873), Der *Primat* Petri und des Papstes (1875) and Das *Christentum* Christi und das Christentum des Papstes (1876). Of his later works, the most important are: Die Phantasie *als Grundprincip* des Weltprocesses (1877), Uber die Genesis der Menschheit (1883) and Uber die Organisation und *Cultur* der menschlichen Gesellschaft (1885).

Frohschammer died at Bad Kreuth, Bavaria, on June 14, 1893.

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FROISSART, JEAN (1338–1410?), French chronicler and raconteur, historian of his own times. His forefathers were *jurés* (aldermen) of the little town of Beaumont, lying near the river Sambre, to the west of the forest of Ardennes. His father, who seems to have been a painter of armorial bearings, migrated to Valenciennes. The date generally adopted for his birth is 1338. His native city of Valenciennes was rich in romantic associations. Not far from its walls was the western fringe of the great forest of Ardennes, sacred to the memory of Pepin, Charlemagne, Roland and Ogier. Along the banks of the Scheldt stood, one after the other, not then in ruins, but bright with banners, the gleam of armour, and the liveries of the men at arms, castles whose seigneurs, now forgotten, were famous in their day for many a gallant feat of arms. The castle of Valenciennes itself was illustrious in the romance of Perceforest. There was born that most glorious and most luckless hero, Baldwin, first emperor of Constantinople. All the splendour of mediaeval life was to be seen in Froissart's native city: on the walls of the Salle le Comte glittered — perhaps painted by his father — the arms and scutcheons beneath the banners and helmets of Luxembourg, Hainaut and Avesnes; the streets were crowded with knights and soldiers, priests, artisans and merchants; the churches were rich with stained glass, delicate tracery and precious carving; there were libraries full of richly illuminated manuscripts on which the boy could gaze with delight; every year there was the fete of the *puy d'Amour* de Valenciennes, at which he would hear the verses of the competing poets; there were festivals, masques, mummeries and moralities.

The moon, he says, rules the first four years of life; Mercury the next ten; Venus follows. He was 14 when the last goddess appeared to him in person, as he tells us, after the manner of his time, and informed him that he was to love a lady, "belle, *jone,* et *gente.*" Meanwhile he was placed in some commercial position which he very soon abandoned, for he had resolved on becoming a learned clerk. He then naturally began to make verses, like every other learned clerk, and fell in love. He found one day a damoiselle reading a book of romances. It was the romance of Cleomades. He remarks the singular beauty of her blue eyes and fair hair, while she reads a page or two, and then — one would almost suspect a reminiscence of Dante — "Adont *laissames nous le* lire." She was rich and he was poor; she was nobly born and he obscure; it was long before she would accept the devotion, even of the conventional kind, which Froissart offered her.

In England. — He was 18 years old when he left Valenciennes for the court of England, taking with him letters of recommendation from the king of Bohemia and the count of Hainaut to Queen Philippa, niece of the latter. He was well received by the queen, always ready to welcome her own countrymen; he wrote ballades and virelays for her and her ladies. But after a year he began to pine for another sight of "la *très douce,* simple, et *quoie,*" whom he loved loyally. Good Queen Philippa gave him his *congé* on the condition that he was to return. The conclusion of his single love adventure is simply and unaffectedly told in his Trettie de *l'espinette* amoureuse. It was a passion conducted on the well-known lines of conventional love; it ended with calumny and a complete rupture. The damoiselle not only scornfully refused to speak to her lover or acknowledge him, but even seized him by the hair and pulled out a handful. Nor would she ever be reconciled to him again.

Perhaps to get healed of his sorrow, Froissart began those wanderings in which the best part of his life was to be consumed. He first visited Avignon in 1360, and in 1361 he returned to England after an absence of five years. He brought with him as a present to Queen Philippa a book of rhymed chronicles of the wars of his time written by himself. The queen now made young Froissart one of her secretaries, and he began to serve her with "beaux *dittiés* et traite's amoureux." She seems to have suggested to him the propriety of travelling in order to get information for more rhymed chronicles. It was at her charges that Froissart travelled to Scotland, where he was well received by King David, William of Douglas and the earls of Fife, Mar, March and others. His travels in Scotland lasted for six months. Returning southward he rode along the whole course of the Roman wall, showing the true spirit of an archaeologist; he thought that Carlisle was Carlyon, King Arthur's capital; he calls Westmorland, where the common people still spoke the ancient British tongue, North Wales; he rode down the banks of the Severn, and returned to London by way of Oxford — "l'escole *d'Asque-Suffort.*" In London Froissart entered the service of King John of France as secretary, and probably acquired at this period that art, in which he has probably never been surpassed, of making people tell him all they knew. He liked the story of a battle from both sides and from many points of view; he wanted the details of every little cavalry skirmish, every capture of a castle, every gallant action and brave deed. And he forgot nothing.

At the age of 29, in 1366, Froissart left England for Brussels, where there was a great concourse of minstrels from all parts, from the courts of the kings of Denmark, Navarre and Aragon, from those of the dukes of Lancaster, Bavaria and Brunswick. Froissart received a gift of money, as appears from the accounts: "*uni* Fritsardo, dictori, qui est cum regina Angliae, *dicto* die, VI. mottones." He then went to Brittany, where he heard from eyewitnesses details of the battles of Cocherel and Auray, the great day of the Thirty and the heroism of Jeanne de Montfort. Windsor Herald told him something about Auray, and a French knight, one Antoine de Beaujeu, gave him the details of Cocherel. From Brittany he went southward to Nantes, La Rochelle and Bordeaux, where he arrived a few days before the visit of Richard (afterward Richard II). He accompanied the Black Prince to Dax, and hoped to go on with him into Spain, but was dispatched to England on a mission. He next formed part of the expedition which escorted Lionel, duke of Clarence, to Milan, to marry the daughter of Galeazzo Visconti. Geoffrey Chaucer was also one of the prince's suite. At the wedding banquet Petrarch was a guest sitting among the princes. From Milan Froissart, accepting gratefully a cotte hardie with 20 florins of gold, went to Bologna, and met Peter, king of Cyprus, from whose follower and minister, Eustache de Conflans, he learned particulars of the king's exploits. He accompanied Peter to Venice, where he left him after receiving a gift of 40 ducats. At Rome he learned of the death of his friend, King Peter of Cyprus, and of the good Queen Philippa, of whom he writes, in grateful remembrance—

Propices li soit Diex à l'âme!
J'en suis bien tenus de pryer
Et ses larghesces escuyer,
Car elle me fist et créa.

Philippa dead, Froissart returned to Flanders and presented himself, with a new book in French, to the duchess of Brabant, from whom he received the sum of 16 francs, given in the accounts as paid *uni Frissardo dictatori.* Froissart may also have found a patron in Yolande de Bar, grandmother of Ring René of Anjou. In any case he received a substantial gift from someone in the shape of the benefice of Lestines, a village near Binche. He was placed upon the duke of Brabant's pension list, and was entitled to a yearly grant of grain and wine, with some small sum in money. Froissart was not the man to sit down at ease to discharge the duties of parish priest, to say mass, to bury the dead, to marry the villagers and to baptize the young. From time to time he repaired to the court of Coudenberg, and became '*(moult frère et accointé"* with the duke of Brabant. And then came Gui de Blois, one of King John's hostages in London in the old days. He had been fighting in Prussia with the Teutonic knights, and now proposed to settle down for a time in his castle of Beaumont. This prince, in emulation of his grandfather, the patron of Jean le Bel, advised Froissart seriously to take in hand the history of his own time.

THE CHRONICLE

He began his career by rewriting the work of the chronicler Jean le Bel; Gui de Blois, among others, supplied him with additional information. His own notes, taken from information obtained in his travels, gave him more details, and when in 1374 Gui married Marie de Namur, Froissart found in the bride's father, Robert de Namur, one who had himself largely shared in the events which he had to relate. He, for instance, is the authority for the story of the siege of Calais and the six burgesses. Froissart remained for 12 years at Lestines, or at Beaumont, arranging and writing his chronicles. During this period, too, he composed his *Espinette amoureuse,* and the *Joli Buisson de jonesce,* and his romance of *Méliador.* He also became chaplain to the count of Blois, and obtained a canonry of Chimay. After this appointment we hear nothing more of Lestines, which he probably resigned,

In 1386 his travels began again, when he accompanied Gui to his castle at Blois, in order to celebrate the marriage of his son Louis de Dunois with Marie de Berry. He wrote a *pastourelle* in honour of the event. Then he attached himself for a few days to the duke of Berry, from whom he learned certain particulars of current events, and then, becoming aware of what promised to be the most mighty feat of arms of his time, he hastened to Sluys, where the French were collecting an enormous fleet, and making preparations to repeat the invasion of William the Conqueror. But there was no invasion of England. In Flanders Froissart met many knights who had fought at Rosebeque. and could tell him of the troubles which in a few years desolated that country, once so prosperous. He stayed at Ghent, among those ruined merchants and mechanics, for whom, as one of the same class, he felt a sympathy never extended to English or French, perhaps quite as unfortunate, and he devotes 300 chapters to the Flemish troubles, This portion of the chronicle was written at Valenciennes. During this residence in his birthplace his verses were crowned at the *puys d'amour* of Valenciennes and Tournay.

This part of his work finished, he determined on making a journey to the south of France in order to learn something new. On this occasion he rode first to Blois; on the way he fell in with two knights who told him of the disasters of the English army in Spain; one of them also informed him of the splendid hospitality of Gaston Phoebus, count of Foix, on hearing of which Froissart resolved to seek him out. Arrived at Foix he discovered that the count was at Orthez, whither he proceeded in company with a knight named Espaing de Lyon, who, Froissart found, had not only fought, but could describe.

The account of those few days' ride with Espaing de Lyon is the most charming, the most graphic, and the most vivid chapter in the whole of Froissart. Every turn of the road brings with it the sight of a ruined castle, about which this knight of many memories has a tale or a reminiscence. The whole country teems with fighting stories. Froissart never tires of listening nor the good knight of telling. "Sainte Marie!" cries Froissart in mere rapture. "How pleasant are your tales, and how much do they profit me while you relate them! And you shall not lose your trouble, for they shall all be set down in memory and remembrance in the history which I am writing." Arrived at length at Orthez, Froissart introduced himself to the count as a chronicler. He heard much from the count, and there was a good deal, too, to be learned of people about the court. One knight recently returned from the east told about the Genoese occupation of Famagosta; two more had been in the fray of Otterbourne; others had been in the Spanish wars.

Leaving Gaston at Iength, Froissart assisted at the wedding of the old duke of Berry with the youthful Jeanne de Bourbon, and was present at the reception given to Isabeau of Bavaria by the Parisians. He then returned to Valenciennes, and sat down to write his fourth book. While engaged in the events of the year 1385 he found that his notes taken at Orthez and elsewhere on the affairs of Castile and Portugal were incomplete. He hastened to Bruges, where, he felt certain, he should find someone who would help him. There was, in fact, at this great commercial centre, a colony of Portuguese. From them he learned that a certain Portuguese knight, Dom Juan Fernand Pacheco, was at the moment in Middelburg on the point of starting for Prussia. He instantly embarked at Sluys, reached Middelburg in time to catch this knight, introduced himself and conversed with him uninterruptedly for the space of six days, getting his information on the promise of due acknowledgment. During the next two years he seems to have had trouble with his seigneur Gui de Blois, and even to have resigned his chaplaincy. He next calls Robert de Namur his seigneur, and dedicates to him, in a general introduction, the whole of his chronicles. We then find him at Abbeville, trying to learn all about the negotiations pending between Charles VI and the English. He was unsuccessful, either because he could not get at those who knew what was going on or because the secret was too well kept. He next made his last visit to England, where, after 40 years' absence, he naturally found no one who remembered him. He stayed in England several months, seeking information on all points from his friends Henry Chrystead and Richard Stury, from the dukes of York and Gloucester and from, Robert the Hermit.

On his return to France, he found preparations going on for that unlucky crusade, the end of which he describes in his *Chronicle.* It was headed by the count of Kevers. After him floated many a banner of knights, descendants of the crusaders, who bore the proud titles of duke of Athens, duke of Thebes, sire de Sidon, sire de Jericho. They were going to invade the sultan's empire by way of Hungary; they were going to march south; they would reconquer the holy places. And presently we read how it all came to nothing, and how the slaughtered knights lay dead outside the city of Nikopoli. In almost the concluding words of the *Chronicle* the murder of Richard II of England is described. His death ends the long and crowded *Chronicle,* though the pen of the writer struggles through a few more unfinished sentences.

The Man and His Work.—The rest is vague tradition. He is said to have died at Chimay in 1410 and to have been buried at the church of St. Monegunda. It is further said that he died in poverty so great that his relations could not even afford to carve his name upon the headstone of his tomb; not one of his friends, not even Eustache Deschamps, writes a line of regret in remembrance; the greatest historian of his age had a reputation so limited that his death was no more regarded than that of any common monk or obscure priest. Among his friends were Guillaume de Machault, Eustache Deschamps and Cuvelier, a follower of Bertrand du Guesclin. It is probable that he knew Chaucer, with whom Deschamps maintained a poetical correspondence; there is nothing to show that he ever made the acquaintance of Christine de Pisan.

The selection of Froissart's own poems published by Buchon in 1829 includes the *Dit dou florin;* the *Débat dou cheval et dou levrier,* written during his journey in Scotland; the *Dittie de la flour de la Margherite;* a *Dittie d'amour* called *L'Orlose amoureus,* in which he compares himself. the imaginary lover, with a clock; the *Espinette amoureuse,* which contains a sketch of his early life, freely and pleasantly drawn, accompanied by rondeaux and virelays; the *Buisson de jonesce,* in which he returns to the recollections of his own youth; and various smaller pieces.

There has never been any difference of opinion on the distinctive merits of his *Chronicle.* It presents a vivid and faithful drawing of the things done in the 14th century. No more graphic account exists of any age. No historian has drawn so many and such faithful portraits. There are, it is true. portraits of men as they seemed to the writer, not of men as they were. Froissart was uncritical; he accepted princes by their appearance. Who, for instance, would recognize in his portrait of Gaston Phoebus de Foix the cruel voluptuary, stained with the blood of his own son, which we know him to have been? Froissart, again, had no sense of historical responsibility; he was no judge to enquire into motives and condemn actions; he was simply a chronicler. He has been accused by French authors of lacking patriotism. Yet it must be remembered that he was neither a Frenchman nor an Englishman, but a Fleming. He has been accused of insensibility to suffering. Indignation against oppression was not, however, common in the 14th century; why demand of Froissart a quality which is rare enough even in our own time? Yet there are moments when, as in describing the massacre of Limoges, he speaks with tears in his voice.

As regards his personal character, Froissart depicts it himself for us. Such as he was in youth, he tells us. so he remained in more advanced life; rejoicing mightily in dances and carols. in hearing minstrels and poems; inclined to love all those who love dogs and hawks; pricking up his ears at the uncorking of bottles, "Car au voire prens grand plaisir"; pleased with good cheer, gorgeous apparel and joyous society, but no commonplace reveller or greedy voluptuary — everything in Froissart was ruled by the good manners which he set before all else; and always eager to listen to tales of war and battle. As has been said above, he shows, not only by his success at courts, but also by the whole tone of his writings, that he possessed a singularly winning manner and strong personal character.

Froissart lived wholly in the present, and had no thought of the coming changes. Born when chivalrous ideas were most widely spread, but when the spirit of chivalry itself, as inculcated by the best writers, was in its decadence, he is penetrated with the sense of knightly honour, and ascribes to all his heroes alike those qualities which only the ideal knight possessed.

BIBLIOGRAPHY.—The first edition of Froissart's *Chronicle* was published in Paris. It bears no date; the next editions are those of the years 1505, 1514, 1518 and 1520. The edition of Buchon, 1924, was a continuation of one commenced by Dadier. The best modern editions are those of Kervyn de Lettenhove (1863–77) and Siméon Luce (1869–88); for bibliography *see* A. Potthast, *Bibliotheca hist. medii aevi,* i (1896). An abridgment was made in Latin by Belleforest, and published in 1672. An English translation was made by Bourchier, Lord Berners, and published in London, 1525. *See* the "Tudor Translations" edition of Berners (1901), with introduction by W. P. Ker; and the "Globe" edition, with introduction by G. C. Macaulay (1913). The translation by Thomas Johnes was originally published in 1802–05. For Froissart's poems *see* Scheler's text in K. de Lettenhove's complete edition; *Méliador* has been edited by A. Longnon ior the Société des Anciens Textes (1895–99). *See* also Mme. Agnes Darmesteter (Duclaux), *Froissart* (1894). *Froissarts Cronycles,* translated from the French by Sir John Bourchier, Lord Berners, 7 vol. (1927–28).

FROME (pron. "Froom"), a market town and urban district in the Wells parliamentary division of Somerset, Eng., 17½ mi. E.N.E. of Wells by road. Pop. (1951) 11,298. Area 1.9 sq.mi. It is unevenly built on high ground above the Frome river, and the country round is richly wooded and picturesque. The early version of its name was Froom.

The parish church of St. John the Baptist, with its fine tower and spire, was rebuilt in the 13th and 14th centuries and much restored in the 19th. Bishop Thomas Ken (*q.v.*) who died at Longleat (4 mi S.E.) is buried there.

There are the Literary and Scientific institution, with a museum, a school of art and science, and a grammar school founded under Edward VI. The George hotel in the market square is one of many old houses. Selwood forest, now diminished, on whose border the town once stood, was long a favourite haunt of brigands and highwaymen. The Saxon occupation is the earliest in Frome of which there is evidence, the settlement being the result of the foundation of a monastery by St. Aldhelm. A witenagemot was held there in 934 and at the time of the Domesday survey the manor was owned by William I. Frome was not represented in parliament until given one member by the Reform act of 1832; its separate representation was merged in that of the county in 1885.

A charter of Henry VII to Edmund Leversedge. then lord of the manor, granted the right to have two fairs, and in the 18th century two others nere held.

An agricultural show and cheese fair is held on the third Wednesday in September. The industries include plastics. die-stamping and hot pressing and paint manufacture. One of the oldest is cloth making. The town is an agricultural centre.

About 3 mi. west of Frome is the village of Mells. where the manor house is associated with the rhyme of "Little Jack Horner."

FROMENTIN, EUGÈNE (1820–1876), French painter and author, best known for his pictorial scenes of Algeria, was born at La Rochelle on Oct. 24, 1820. He studied under Louis Cabat, the landscape painter. The land and people of Algeria suggested the subjects of most of his works.

Among his more important early works are "Moisson en Algérie"; "Diffa, reception du Soir"; "Chasse à la gazelle"; and "Enterrement maure." They are somewhat stiff in design and execution. His second period extends until 1859 and includes the following works: "Les Bateleurs nkgres"; "Le Sirnoun"; and "La Lisikre d'oasis." They are grey in tone and were executed under the influence of Jean-Baptiste Carot.

After 1860 Fromentin's colour becomes bright and luminous: "Fauconnier arabe"; "Chasse au héron"; "La curée"; "Centaures et centauresses"; here Fromentin was influenced by Eugène Delacroix. Fromentin's paintings show only one side of a talent that was perhaps even more felicitously expressed in literature; "Dominique," first published in the *Revue des deux mondes* in 1862, and dedicated to George Sand, is remarkable among the fiction of the century for imaginative observation. Fromentin's other literary works are *Visites artistiques* (1852); *Simples Pèlerinages* (1856); *Un Été dans le Sahara* (1857); *Une Année dans le Sahel* (1858); and *Les Maîtres d'autrefois* (1876). He died at La Rochelle on Aug. 27, 1876.

FROMMEL, GASTON (1862–1906), Swiss theologian, professor of theology in Geneva from 1894 to 1906. An Alsatian by birth, he belonged mainly to French Switzerland. He may best be described as continuing the spirit of Alexandri Vinet (q v.) amid later mental conditions. Like Vinet, he derived his philosophy of religion from a deeply personal experience of the Gospel of Christ as meeting the demands of the moral consciousness; but he developed even further than Vinet the psychological analysis of conscience and the method of verifying every doctrine by direct reference to spiritual experience. Both made much of moral individuality or personality as the criterion of reality, believing that its correlation with Christianity, both historically and philosophically, was most intimate. But while Vinet's stress was on the liberty from human authority essential to the moral consciousness, the changed needs of the age caused Frommel to develop rather the aspect of man's dependence on God's spiritual initiative, "the conditional nature of his liberty." "Liberty is not the primary, but the secondary characteristic" of conscience; "before being free, it is the subject of obligation."

Frommel claimed that a deeper analysis carries us beyond the subjectivity of Immanuel Kant's categorical imperative, since consciousness of obligation was *"une expérience imposée sous le* *mode de l'absolu." By imposée* (Solomon Malan's phrase) he emphasized the priority of man's sense of obligation to his moral consciousness either of self or of God. He appealed to the psychology of the subconscious for confirmation of his analysis, insisting on priority to self-conscious thought as a mark of metaphysical objectivity in the case of moral, no less than of physical experience. He found in the Christian revelation the same characteristics as belonged to the universal revelation in conscience, viz. God's sovereign initiative and his living action in history. From this standpoint he argued against a purely psychological type of religion (*agnosticisme religieux,* as he termed it) —a tendency to uhich he saw even in A. Sabatier and the *symbolofidéisme* of the Paris school—as giving up a real faith. Like Vinet, Frommel was a man of letters and a penetrating critic of men and systems: *see* his *Études litteraires et morales* (1907).

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FRONDE, THE, the name given to a civil war in France which lasted from 1648 to 1652, and to its sequel, the war with Spain in 1653–59. The word means a sling. and mas applied to this contest from the circumstance that the windows of Jules Cardinal Mazarin's adherents were pelted with stones by the Paris mob. Its original object was the redress of grievances, but the movement soon degenerated into a factional contest among the nobles, who sought to reverse the results of Armand Cardinal Richelieu's work and to overthrow his successor Mazarin. In May 1648 a tax levied on judicial officers of the *parlement* of Paris was met by that body, not merely with a refusal to pay, but with a condemnation of earlier financial edicts and even with a demand for the acceptance of a scheme of constitutional reforms framed by a committee of the *parlenzent.* This charter was somewhat influenced by contemporary events in England. But there is no real likeness between the two revolutions, the French *parlement* being no more representative of the people than the Inns of Court were in England. The political history of the time is dealt with in the article FRANCE: *History,* the present article being concerned chiefly with the military operations of what was perhaps the most costly and least necessary civil war in history.

The military record of the first or "parliamentary" Fronde is almost blank. In Aug. 1648, strengthened by the news of Louis II. prince of Condé's victory at Lens, Mazarin suddenly arrested the leaders of the *parlement,* whereupon Paris broke into insurrection and barricaded the streets. The court, having no army at its immediate disposal, had to release the prisoners and to promise reforms, and fled from Paris on the night of Oct. 22. But the signing of the peace of Westphalia set free Condé's army, and by Jan. 1649 it was besieging Paris. The peace of Rueil was signed in March, after little blood had been shed. The Parisians, though still and always anticardinalist, refused to ask for Spanish aid, as proposed by their princely and noble adherents, and having no prospect of military success without such aid, submitted and received concessions. Thenceforward the Fronde becomes a story of sordid intrigues and halfhearted warfare, losing all trace of its first constitutional phase. The leaders were discontented princes and nobles—Monsieur (Gaston of Orléans, the king's uncle), the great Condé and his brother Armand de Bourbon, prince of Conti, the duc de Bouillon and his brother the vicomte de Turenne. To these must be added Gaston's daughter, Mlle. Anne Marie de Montpensier (La grande Mademoiselle), Condé's sister, Mme. Anne de Longueville, Mme. Marie de Chevreuse, and the astute intriguer Paul de Gondi, later Cardinal de Retz. The military operations fell into the hands of war-experienced mercenaries, led by two great, and many second-rate, generals, and of nobles to whom war was a polite pastime. The feelings of the people at large were enlisted on neither side.

This peace of Rueil lasted until the end of 1649. The princes, received at court once more, renewed their intrigues against Mazarin, who, having come to an understanding with Monsieur, Gondi and Madame de Chevreuse, suddenly arrested Condé, Conti and Longueville (Jan. 14, 1650). The war which followed this coup is called the "Princes' Fronde." This time it was Turenne, before and afterward the most loyal soldier of his day. u-ho headed the armed rebellion. Listening to the promptings of his Egeria, Madame de Longueville, he resolved to rescue her brother, his old comrade of Freiburg and Nordlingen. It was with Spanish assistance that he hoped to do so; and a powerful army of that nation assembled in Artois under the archduke Leopold, governor general of the Spanish Netherlands. But the peasants of the countryside rose against the invaders, the royal army in Champagne was in the capable hands of César de Choiseul, comte du Plessis-Praslin, and the little fortress of Guise successfully resisted the archduke's attack. Thereupon. however, Mazarin drew upon Plessis-Praslin's army for reinforcements to be sent to subdue the rebellion in the south, and the royal general had to retire. Then, happily for France, the archduke decided that he had spent sufficient of the king of Spain's money and men in the French quarrel. The magnificent regular army withdrew into winter quarters, and left Turenne to deliver the princes with a motley host of Frondeurs and Lorrainers. Plessis-Praslin by force and bribery secured the surrender of Rethel on Dec. 13, 1650, and Turenne, who had advanced to relieve the place, fell back hurriedly. But he was a terrible opponent, and Plessis-Praslin and Mazarin himself, who accompanied the army, had many misgivings as to the result of a lost battle. The marshal chose nevertheless to force Turenne to a decision, and the battle of Blanc-Champ (near Somme-Py) or Rethel was the consequence. Both sides were at a standstill in strong positions. Plessis-Praslin doubtful of the trustworthiness of his cavalry. Turenne too weak to attack. when a dispute for precedence arose between the *Gardes françaises* and the *Picardie* regiment. The royal infantry had to be rearranged in order of regimental seniority, and Turenne, seeing and desiring to profit by the attendant disorder, came out of his stronghold and attacked with the greatest vigour. The battle (Dec. 15, 1650) was for a time doubtful, but Turenne's Frondeurs gave way in the end, and his army, as an army, ceased to exist. Turenne himself, undeceived as to the part he was playing in the drama, asked and received the young king's pardon, and meantime the court, with the *maison du roi* and other loyal troops, had subdued the minor risings without difficulty (March–April 1651). Condé, Conti and Longueville were released, a few months of hollow peace followed, and the court returned to Paris. Mazarin. an object of hatred to all the princes, had already retired into exile. *"Le temps est un galant homme,"* he remarked, *"laissons le faire!"* and so it proved. His absence left the field free for mutual jealousies, and a state of anarchy soon reigned. In December Mazarin returned with a small army, the war began again, and this time Turenne and Condé were pitted against one another. After the first campaign, as we shall see, the civil war ceased, but for several other campaigns the two great soldiers were opposed to one another, Turenne as the defender of France, Condé as a Spanish invader. Their personalities alone give threads of continuity to these seven years of wearisome manoeuvres, sieges and combats, though for a right understanding of the causes which were to produce the standing armies of the age of Louis XIV and Frederick the Great the military student should search deeply into the material and moral factors that here decided the issue.

The debut of the new Frondeurs took place in Guyenne (February–March 1652), while their Spanish ally, the archduke Leopold William, captured various northern fortresses. On the Loire, whither the centre of gravity was soon transferred, the Frondeurs were commanded by intriguers and quarrelsome lords, until Condé's arrival from Guyenne. His bold trenchant leadership brought initial success in the action of Bléneau (April 7, 1652), but fresh troops came up to oppose him, and from the skilful dispositions made by his opponents Condé felt the presence of Turenne and broke off the action. The royal army did likewise. Condé invited the commander of Turenne's rearguard to supper. chaffed him unmercifully for allowing the prince's men to surprise him in the morning, and by way of farewell remarked to his guest, *"Quel dommage que des braves gens comnce nous se coupent la gorge pour un faquin"*—an incident and a remark that thoroughly justify the iron-handed absolutism of Louis XIV.

There was no hope for France while tournaments on a large scale and at the public's expense were fashionable amongst the *grands seigneurs.* After Bléneau both armies marched to Paris to negotiate with the *parlement,* de Retz and Mlle. de Montpensier, while the archduke took more fortresses in Flanders, and Charles IV, duke of Lorraine, with an army of plundering mercenaries, marched through Champagne to join Condé. But Turenne manoeuvred past Condé and planted himself in front of the mercenaries, and their leader, not wishing to expend his men against the old French regiments, consented to depart with a money payment and the promise of two tiny Lorraine fortresses. A few more manoeuvres, and the royal army was able to hem in the Frondeurs in the Faubourg St. Antoine (July 2, 1652) with their backs to the closed gates of Paris. The royalists attacked all along the line and won a signal victory in spite of the knightly prowess of the prince and his great lords, but at the critical moment Gaston's daughter persuaded the Parisians to open the gates and to admit Condé's army. She herself turned the guns of the Bastille on the pursuers. An insurrectional government was organized in the capital and proclaimed Monsieur lieutenant general of the realm. Mazarin, feeling that public opinion was solidly against him, left France again, and the *bourgeoisie* of Paris, quarrelling with the princes, permitted the king to enter the city on Oct. 21, 1652. Mazarin returned unopposed in Feb. 1653.

The Fronde as a civil war was now over. The whole country, wearied of anarchy and disgusted with the princes, came to look to the king's party as the party of order and settled government, and thus the Fronde prepared the way for the absolutism of Louis XIV. The general war continued in Flanders, Catalonia and Italy wherever a Spanish and a French garrison were face to face, and Condé with the wreck of his army openly and definitely entered the service of the king of Spain. The "Spanish Fronde" was. except for a few outstanding incidents, a dull affair. In 1653 France was so exhausted that neither invaders nor defenders were able to gather supplies to enable them to take the field till July. At one moment, near Péronne, Condé had Turenne at a serious disadvantage, but he could not galvanize the Spanish general Count Fuensaldana, who was more solicitous to preserve his master's soldiers than to establish Condé as mayor of the palace to the king of France, and the armies drew apart again without fighting. In 1654 the principal incident was the siege and relief of Arras. On the night of Aug. 24–25 the lines of circumvallation drawn round that place by the prince were brilliantly stormed by Turenne's army, and Condé won equal credit for his safe withdrawal of the besieging corps under cover of a series of bold cavalry charges, led by himself as usual, sword in hand. In 1655 Turenne captured the fortresses of Landrecies, Condé and St. Ghislain. In 1656 Condé revenged himself for Arras by storming Turenne's circumvallation around Valenciennes (July 16), but Turenne drew off his forces in good order. In the campaign of 1657 a body of 6,000 British infantry, sent by Oliver Cromwell in pursuance of his treaty of alliance with Mazarin, took part. The presence of the English contingent and its very definite purpose of making Dunkirk a new Calais, to be held by England forever, gave the next campaign a character of certainty and decision which is entirely wanting in the rest of the war. Dunkirk was besieged promptly and in great force, and when Don Juan of Austria and Condé appeared with the relieving army from Furnes, Turenne advanced boldly to meet them. The battle of the Dunes (*q.v.*) fought on June 14, 1658, was the first real trial of strength since the battle of the Faubourg St. Antoine, ended in Turenne's victory. Here the redcoats made their first appearance on a continental battlefield, under the leadership of Sir W. Lockhart, Cromwell's ambassador at Paris, and astonished both armies by the stubborn fierceness of their assaults, for they were the products of a war where passions ran higher and the determination to win rested on deeper foundations than in the *dégringolade* of the feudal spirit in which they now figured. Dunkirk fell, as a result of the victory, and flew the St. George's cross till Charles II sold it to the king of France. A last desultory campaign followed in 1659—the 25th year of the Franco-Spanish War—and the peace of the Pyrenees was signed on Nov. 5. On Jan. 27, 1660, the prince asked and obtained at Aix the forgiveness of Louis XIV. The later careers of Turenne and Condé as the great generals—and obedient subjects—of their sovereign are described in the article DUTCH WARS. (For their earlier careers see THIRTY YEARS' WAR.)

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FRONT. When two great masses of air forming part of the atmosphere lie side by side, each horizontally uniform in air density but with appreciable differences in density between them at each height, the heavier air lies as a thin wedge under the lighter air. The differences in density are associated with horizontal differences in temperature and humidity (*q.v.*) between them, and are accompanied by differences in air motion and transparency. The sloping area of contact of the two air masses is known as a frontal surface. The line marking the intersection of such a frontal surface with a horizontal surface, more particularly the earth's surface, is called a front. In middle latitudes such fronts, generally in motion, extend continuously for hundreds and often for thousands of miles over the earth. The interplay of great air masses at fronts results in some of the most dramatic types of weather, and the study of such interplay is therefore of primary importance in the science of meteorology.

Near the end of the 19th century H. Helmholtz pointed out that two currents of air having different densities could flow side by side with different speeds and with little mixing between them. H. Bigelow in 1902 stated that the centres of the low-pressure systems known as cyclones are to be found along the line marking the boundary between adjacent warm and cold air currents. Similar conclusions were later reached by S. Hanzlik, by Sir Napier Shaw and R. G. K. Lempfert and by H. von Ficker. However, it was not until the end of World War I that the behaviour of these frontal surfaces and fronts during the development of a cyclone of middle latitudes was described in detail, and an integrated picture presented by the Norwegian meteor-

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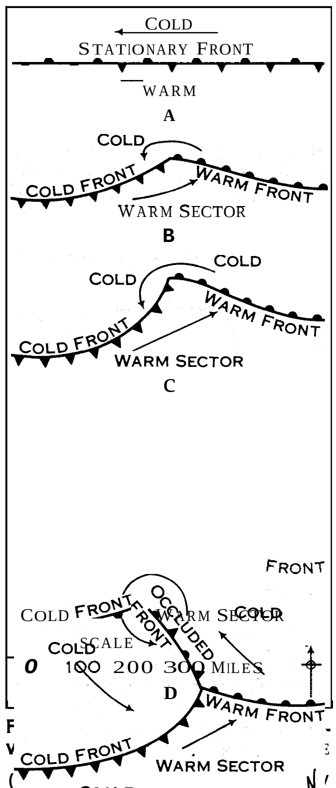
aspects of the wave motion of a frontal surface. Further descriptive and theoretical investigations of frontal cyclones have been made, largely by the Norwegian school of meteorologists under the leadership of the two Bjerkneses.



front, (B) the pressure falls: cyclonic air flow commences along the front, accompanied by a wavelike deformation of the front; (C) the deformation increases; (D) finally the cold front overtakes the warm front, resulting in an occluded front; thereafter the cyclone wanes

Their approach to the problem may be briefly described as follows. There are two main types of air masses found in middle latitudes: polar air masses which have their origin at higher latitudes and are therefore cold and dry, and tropical air masses which originate at lower latitudes and are therefore warm and moist. The front marking the line of contact of these two main air masses is the polar front. The development of most cyclones of middle and higher latitudes occurs at the polar front and is associated with a deformation of it. Four stages of a typical development in the northern hemisphere viewed from above are shown in fig. 1.

Frontal Stages. — Stage A. — Initially there is a straight stationary or slowly moving front extending in an east-west direction; a cold polar air mass lies to the north and a warm tropical one to the south. In the warm air the wind is west, as indicated by the arrow; in the cold air the wind may be east, as shown, or west but with a smaller speed than that of the wind in the warm air.

Stage *B*.—The pressure starts to fall near a section of the front, cyclonic (counterclockwise in northern hemisphere) rotation of the air commences, and simultaneously the front undergoes a wavelike perturbation. The forward edge of an advancing warm-air mass with receding cold air ahead of it is a warm front; that of an advancing cold-air mass before which warm air recedes is a cold front. To the west of the centre of low pressure the black triangles on the southern edge of the front indicate that it is a cold front moving southward; to the east the black semicircles on the northern side of the front indicate that it is a warm front moving northward. The warm air between the two fronts is known as the warm sector.

Stage C.—As the pressure fall continues, the wavelike deformation of the front increases. The cold front moves more rapidly than the warm one, and as a result near the centre the warm sector becomes narrower. During stages B and C the wave moves rapidly eastward along the front, with the lowest pressure at the crest of the wave.

Stage D. — Finally, near the centre of low pressure the cold front overtakes the warm front to produce an occluded front. By this stage the pressure has ceased to fall and may have started to rise, and the eastward rate of motion of the centre has decreased. The cyclone is now past its prime, and its last hours are spent as a circular vortex of decreasing strength in which the occluded front gradually loses its identity as such. From birth to death, the life span of such frontal cyclones is from one to three days.

Cyclones of this type sometimes occur in families. One cyclone grows and then dies as it moves eastward along a front; another develops on the same front, generally to the south of the birthplace of the first, and goes through the same cycle. Three or four cyclones developing at intervals of several days may make up a family. Not all cyclones reach the unstable state represented by the occlusion phase. Some cease to develop at stage B, and thereafter move rapidly along the front as stable waves until they dissipate.

FIG. 2.— VERTICAL CROSS SECTION THROUGH A COLD FRONTAL SURFACE. SHOWING ASSOCIATED CLOUDS AND PRECIPITATION

It must not be inferred from the foregoing that all cyclones of middle latitudes have a frontal structure, although the great majority do. A few cyclones develop without discernible fronts in them.

Vertical Structure. — A knowledge of the vertical structure of fronts is essential in understanding the weather phenomena which accompany them. The cold air lies as a thin wedge under the warm air. A cold frontal surface (shown in fig. 2 by a vertical cross section in a plane perpendicular to the surface front) has an average slope of about 1 in 50. The frontal surface is steeper near the ground because the roughness of the latter produces a frictional drag which retards the air just above it. Often the warm air just

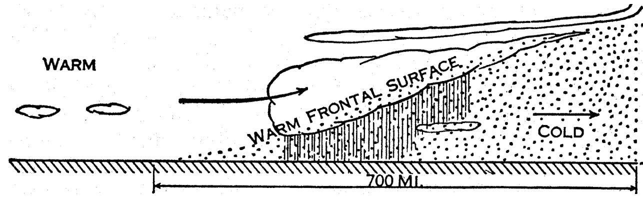


FIG. 3.— VERTICAL CROSS SECTION THROUGH A WARM FRONTAL SURFACE. SHOWING ASSOCIATED CLOUDS AND PRECIPITATION

ahead of the frontal surface rises as the cold-air mass advances. When the rate of ascent of this warm air is small, not much cloud develops at the frontal surface. With rapid ascent, however, heavy towering clouds (fig. 2), perhaps giving showers or even thunder and lightning, may result. One often hears a comment on how a certain thunderstorm has cleared the air. When this happens, the clearing of the air is caused by the arrival of the cooler and drier air mass which replaces the sultry air; the thunderstorm merely develops at the cold front. A thunderstorm unaccompanied by a cold front affords only temporary relief. In addition, as the cold front passes, the wind suddenly veers, perhaps from southwest to northwest, and freshens. the visibility improves and the barometric pressure starts to rise.

A warm frontal surface (fig. 3) has a smaller slope, about 1 in 175. Frictional forces retard the cold air near the earth's surface, and the slope there is less than at higher levels. Usually the warm air moves more rapidly normal to the front than the cold air ahead of it, and therefore overruns the latter. Clouds form in and just below this ascending warm air. Hundreds of miles ahead of the surface warm front, wispy. hooked cirrus clouds (mares' tails) made up of ice crystals are seen. As the front approaches, the cloud, now of the layer type, becomes thicker and lower, and finally rain or snow falls steadily from it. Frequently there are two or more layers of stratified cloud, with clear air between them (fig. 3). Occasionally thunderstorms develop ahead of the warm front, but not so frequently as at a cold front, for the rate of ascent of the warm air is less. The passage of the aarm front is marked by a gradual temperature rise, a decrease in the rate of pressure fall, a veering of the wind, perhaps from south to southwest, and a decrease in the amount of cloud and a change in its type.

The vertical structure of an occluded front (or occlusion, as it is often called) has several interesting features (fig. 4). When the cold front overtakes the warm front. the warm air which was previously between them (fig. 1 [C]) is carried aloft, and only cold air is left at the ground. There are two types of occlusions, depending on whether the air behind the cold front is colder or less cold than the air ahead of the warm front. When the air behind is colder than that ahead (fig. 4 [A]), the former undercuts the latter, and the system displays many of the characteristics of a cold front. It is therefore known as a cold-front type of occlusion. At the forward part of the system, the clouds are similar to those which accompany a warm front. Under suitable conditions, the warm air just above the advancing cold air may ascend so rapidly that towering clouds form in it and showers or even thunderstorms occur. The warm-front type of occlusion develops when the air ahead of the warm front is colder than that behind the cold front and consequently the latter overruns the former (fig. 4 [B]), in the same way that warm air overruns cold at a warm front. Precipitation generally falls from the extensive cloud system near the frontal surfaces, but may evaporate during its descent through drier air below. and never reach the ground. The two cold air masses are sometimes so similar in physical properties that little change in temperature and humidity is noted as an occlusion passes. The chief indications of passage are the cessation of the pressure fall and the beginning of a rise and a veering of the wind, usually from southwest to northwest.

A type of front known as an upper front is associated with occlusions. but also occurs independently of them. In the cold-front type of occlusion (fig. 4 [A]). the surface front is of the cold type and only the original narm front appears aloft. The line of discontinuity aloft along which the three air masses meet acts as a warm front, and is therefore called an upper warm front. Similarly, in the warm-front type of occlusion (fig. 4 [B]), there is a surface front of the warm type, but a cold front aloft; *i.e.*, an upper cold front. An upper front may also develop independently of occlusions. This type is especially prevalent to the east of an extensive mountain range lying in a north-south direction and located at the western side of a continent. It occurs when air advances eastward from the adjacent ocean over the mountain range and at the same time east of the range there is a stagnant mass of cold air near the surface (fig. 5). Frequently the maritime air is colder than the air aloft over the continent, so that it undercuts the latter, and the front is an upper cold front (fig. 5). The maritime air, being not so cold as the lower continental air, moves along aloft without disturbing it, just as if the upper boundary of the lower air were an elevated land surface. Clouds are usually present near the leading edge of the advancing cold maritime air, and rain or snow may fall from them. Upper warm fronts of this type (not illustrated) occur less frequently than the corresponding type of upper cold fronts. Upper fronts often travel for hundreds of miles before dissipating or reaching the earth's surface and becoming ordinary fronts. The chief manifestations of upper fronts observable at the ground are the associated cloud types and precipitation, and a variation in the rate of pressure change as the upper front passes.

Frontogenesis and **Frontolysis.**—A field of air motion which brings two large air masses with differing properties into closer proximity promotes the formation of a front between them or the intensification of an existing front there, a process known as frontogenesis. Initially there may be a relatively uniform variation of temperature or some other property in a broad zone of transition, perhaps several hundred miles wide, between the t o air masses. However, a change of air flow may occur which brings the warm and cold air masses closer together, so that the zone of transition narrows. As this process continues, the zone narrows until it becomes a true front; *i.e.*, frontogenesis has occurred. The horizontal mixing between the air masses prevents the zone from ever becoming less than several miles in width, and it is usually much wider than that. In general, near the surface, cold fronts are more sharply marked, with a narrower zone of transition, than warm fronts.

New fronts form mainly in polar air masses. The process of development occurs between their northern portions, which remain relatively cold and dry, and their southern sections, which have become warmer and moister during their journey southward. Fronts increase in intensity most frequently near the eastern coasts of the continents.

In the northern hemisphere during winter there are five main zones of frontogenesis: (1) near the east coast of North America; (2) near the east coast of Asia; (3) in the North Pacific; (4) to the east of Greenland; and (5) along the Mediterranean. In summer there are three main zones only: (1) across Canada; (2)

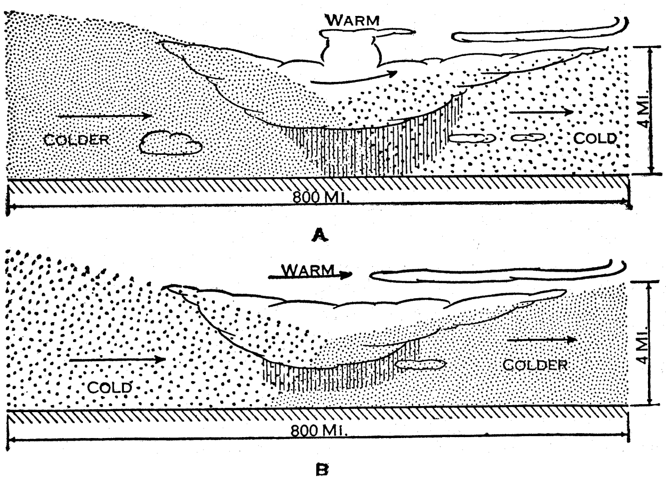


FIG. 4.— DETAILS OF OCCLUSIONS, SHOWN BY VERTICAL CROSS SECTIONS
(A) Cold-front type of occlusion; (B) warm-front type of occlusion

across northern Europe; and (3) from northeast Russia to Alaska. In the southern hemisphere the main zones lie between latitudes 30° and 50° at all seasons. During both summer and winter there are zones of frontogenesis over the ocean to the west and east of South America and to the east of South Africa; in January (summer) there is a zone to the southeast of Australia and in July (winter) one to the southwest.

As the zone of transition between two air masses broadens and the front between them weakens or dissipates, frontolysis is said to occur. In the absence of frontogenesis, the horizontal mixing between the two masses slowly produces this result. In other cases, the air flow may change and cause a decrease in the sharpness of the contrast of properties between them.

Slope.—It is well known that in a state of equilibrium a lighter liquid rests on top of a heavier one; *e.g.*, oil lies on top of water.

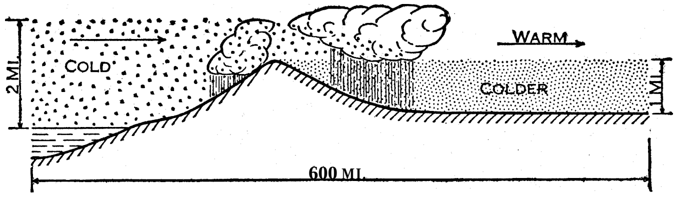


FIG. 5.— AN UPPER COLD FRONT, SHOWN IN A VERTICAL CROSS SECTION. THIS TYPE OCCURS MAINLY TO THE EAST OF AN EXTENSIVE MOUNTAIN RANGE

Similarly, in the atmosphere warmer and therefore lighter air tends to rest above colder and therefore heavier air. But because of the rotation of the earth, the state of equilibrium is attained not when the frontal surface is horizontal, but nhen it makes a slight angle with the horizontal. In 1906, Max Margules developed a formula which expresses the slope of a frontal surface in terms of the latitude at which it is found, and the winds and temperatures in the adjacent air masses. Other factors being equal, the slope is less at low latitudes than at high ones. For example, a frontal surface at latitude 60° will have a slope 50% greater than one at latitude 35° if the distribution of temperatures and minds near each frontal surface is the same. The slope of a frontal surface is relatively large when the temperature difference between the two air masses is small, and small when the temperature contrast is large. When the difference in wind components parallel to the frontal surface in the two air masses is large, its slope is greater than when the difference is small. Margules' formula is chiefly valuable in providing general criteria, such as those outlined above.

Arctic and Equatorial Fronts.—The main frontal systems of the earth are the polar fronts of the northern and southern hemispheres; these, although not continuous around the globe, nevertheless extend for thousands of miles. Of secondary importance in temperate latitudes are the arctic and antarctic fronts. These systems occur at high latitudes. and chiefly affect the weather of the polar and subpolar regions; cyclones sometimes form along these fronts.

Near the equator, true fronts are rarely if ever found. The zone along which the trade wind systems of the northern and southern hemispheres converge, known as the doldrums, has sometimes been called the intertropical or equatorial front. A closer study of this system has revealed, however, that there is little difference in physical properties across it and little undercutting or overrunning by the air masses involved, in contrast with frontal systems of middle and high latitudes. Rather it is a region over which there is a general ascent of air which results from the horizontal convergence of the trade winds. It has therefore been given the more appropriate name of the intertropical convergence zone. Heavy cloud formations, frequently accompanied by showers and thunderstorms, occur in this zone. The width of the zone itself varies widely, being small at times, and at others very large.

The mean position of the intertropical convergence zone changes with the seasons: in August the farthest northward displacement occurs, with the zone at latitude 5° N. over South America and at latitude 25° N. over southern China; its maximum southward displacement occurs in February, when it lies near the equator between South America and western Africa, and at latitude 15° S. over northern Madagascar and over northern Australia. The violent tropical disturbances known as tropical hurricanes or typhoons develop at or near this convergence zone when at these positions of maximum displacement.

See also METEOROLOGY; WEATHER FORECASTING.

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(E. W. HE.)

FRONTENAC ET PALLUAU, LOUIS DE BUADE, COMTE DE (1620–1698), French-Canadian statesman, governor and lieutenant general for the French king in La *Nouvelle France* (Canada), son of Henri de Buade, colonel in the regiment of Navarre, was born in the year 1620. Louis de Buade served in 1635 under the prince of Orange in Holland, and fought in many engagements in the Low Countries and in Italy. His service seems to have been continuous until the conclusion of the peace of Westphalia in 1648, when he returned to his father's house in Paris and married Anne de la Grange-Trianon, a girl of great beauty, who later became the friend and confidante of Anne Marie de Montpensier. Incompatibility of temper led to a separation, the count retiring to his estate on the Indre, where by an extravagant course of living he became hopelessly involved in debt. In 1669, when France sent a contingent to assist the Venetians in the defense of Crete against the Turks, Frontenac was placed in command of the troops on the recommendation of the vicomte de Turenne. In this expedition he won military glory; but his fortune was not improved.

At this period the affairs of New France claimed the attention of the French court. Frontenac was appointed to succeed Rémy de Courcelle as governor, and arrived in Quebec on Sept. 12, 1672. It was immediately evident that he proposed to pursue a policy of colonial expansion, and to exercise an independence of action that did not coincide with the views of Louis XIV, or of his minister Jean Colbert. One of the first acts of the governor, by which he sought to establish in Canada the three estates—nobles, clergy and people—met with the disapproval of the French court, and measures were adopted to curb his ambition by increasing the power of the sovereign council and by reviving the office of intendant. Frontenac soon became involved in quarrels with the intendant touching questions of precedence, and with those priests who ventured to criticize his proceedings. The church in Canada had been administered for many years by the religious orders; for the see of Quebec had not yet been erected. But three years after the arrival of Frontenac a former vicar apostolic, François Xavier de Laval-Montmorency, returned to Quebec as bishop, with a jurisdiction over the whole of Canada. In him the governor found a vigorous opponent who was determined to render the state subordinate to the church. Frontenac had issued trading licences which permitted the sale of intoxicants. The bishop, supported by the intendant, endeavoured to suppress this trade, and sent an ambassador to France to obtain remedial action. The views of the bishop were upheld, and henceforth authority was divided. Troubles ensued between the governor and the sovereign council, most of the members of which sided with the one permanent power in the colony—the bishop; while the intrigues of the intendant, Duchesneau, were a constant source of strife. At last both governor and intendant were recalled to France in the year 1682.

During Frontenac's first administration many improvements had been made in the country. The defenses had been strengthened, a fort was built at Cataraqui (now Kingston), Ont., bearing the governor's name, and conditions of peace had been fairly maintained between the Iroquois on the one hand and the French and their allies, the Ottawas and the Hurons, on the other. The recall of the governor was ill-timed. The Iroquois were assuming a threatening attitude toward the inhabitants, and Frontenac's successor, A. J. L. La Barre, was quite incapable of leading an army against such cunning foes. At the end of a year La Barre was replaced by the marquis de Denonville, a man of ability and courage, who, though he showed some vigour in marching against the western Iroquois tribes, angered rather than intimidated them, and the massacre of Lachine (Aug. 5, 1689) must be regarded as one of the unhappy results of his administration.

The affairs of the colony were now in a critical condition, and Louis XIV once more sent out Frontenac. He arrived in Quebec as governor for the second time on Oct. 15, 1689, and confidence was at once restored. But on Oct. 16, 1690, several New England ships under the command of Sir William Phipps appeared off the Island of Orleans, and an officer was sent ashore to demand the surrender of the fort. Frontenac repulsed the enemy and prepared to follow up his advantage by an attack on Boston from the sea, but his resources were inadequate for the undertaking. In 1696 Frontenac, now 76 years of age, decided to take the field against the Iroquois. On July 6 he left Lachine for the village of the Onondagas, where he arrived a month later. In the meantime the Iroquois had abandoned their villages, and as pursuit was impracticable the army commenced its return march on Aug. 10. Frontenac died on Nov. 28, 1698, at the Chbteau St. Louis after a brief illness, deeply mourned by the Canadian people. He was fearless, resourceful and decisive, and triumphed as few men could have done over the difficulties and dangers of a most critical position.

See *Count Frontenac,* by W. D. Le Sueur (Toronto, 1906); *Count Frontenac and New France under Louis XIV,* by Francis Parkman (Boston, 1878); *Le Comte de Frontenac,* by Henri Lorin (Paris, 1895); *Frontenac et ses amis,* by Ernest Myrand (Quebec, 1902).

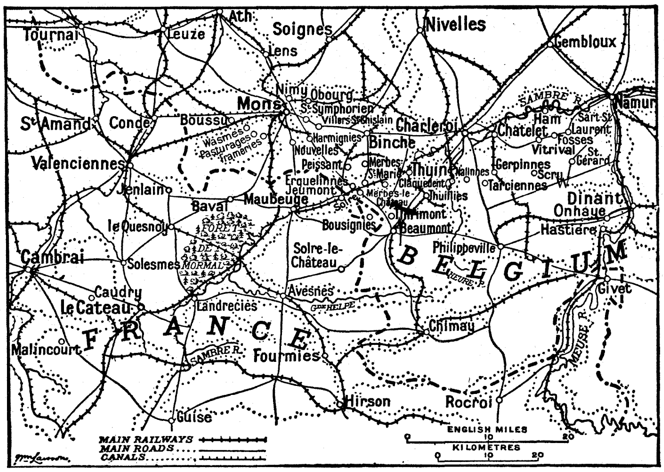
(A. G. D.)

FRONTIER, BATTLES OF THE. The generic name of "battles of the frontier" covers the whole of the actions fought at the opening of World War I in Aug. 1914, on or near the French frontiers. For convenience, these are here divided into six sections, each of which deals with a more or less distinct part of the series of operations. These are: I. Early battles in Upper Alsace; II. First battles in Lorraine; III. Battle of the Ardennes; IV. Charleroi and Mons; V. Le Cateau; and VI. Guise.

I. EARLY BATTLES IN UPPER ALSACE

It was laid down in the original French plan (*see* WORLD WAR) that the action of their right wing would be much assisted by a preliminary operation in Upper Alsace to be carried out by the 7th corps and 8th cavalry division; this force was to advance by Mulhouse on Colmar, so holding fast the hostile forces in that area, besides encouraging the Francophile elements of the population to throw off the German yoke. In accordance with this plan, Gen. Dubail, commanding the 1st army on the right of the French line, issued orders on Aug. 5 for this operation to commence on the 7th, and by the evening of Aug. 8 the French had secured Mulhouse and taken up a defensive position around that town, the weak German covering troops falling back before them to the east bank of the Rhine. Their success, however, was short-lived; Gen. Josias von Heeringen, commanding the 7th German army, was already planning a counter offensive with the 14th and 15th corps. then detraining in the area Colmar-Breisach, and on Aug. 10 the French, heavily attacked by these superior forces, were forced to evacuate Mulhouse and commence a retreat which by the 12th had brought them back to within 10 mi. of Belfort. On neither side had the conduct of the operations been a model of skill, but the Germans had at least the satisfaction of having scored the advantage in the first clash of arms.

The French high command now decided to entrust the execution of the task in which the 7th corps had so completely failed to a newly formed army of Alsace under Gen. Paul Pau, comprising, besides that corps, one additional regular division, and three reserve divisions. The concentration of this new army and the preparations for a renewed advance could not be completed before Aug. 14, by which date the 7th German army, in expectation of the main French offensive in Lorraine, was concentrating all its forces to the north, leaving in Upper Alsace only three weak brigades of second-line troops. These were, of course, easily driven back by Pau's army, which by Aug. 20 had reoccupied Mulhouse, together with Munster to the north and Altkirch to the south, and had cleared Upper Alsace entirely of the enemy. But the object of holding important hostile forces and so assisting Dubail's army now engaged in the main offensive had not been achieved;



MAP OF "BATTLES OF THE FRONTIER" **IN** WORLD WAR I, SHOWING MONS, **CHARLEROI** AND LE CATEAU. WHERE ENGAGEMENTS OCCURRED IN AUG. 1914

nor could Pau from his present position even cover its right flank effectively. It was therefore decided to withdraw him. On Aug. 20 the short-lived Army of Alsace was dissolved, the troops comprising it being placed under Dubail or dispatched to other parts of the front. The early French operations in Upper Alsace had been unproductive of either political or military advantage and had absorbed forces which might have found more useful employment elsewhere. (E. W. S.)

II. FIRST BATTLES IN LORRAINE

The first French plan (General Instruction No. 1 of Aug. 8, 1914) was purely offensive. It proposed to seek action with all forces united with the right on the Rhine. The two armies of Lorraine (1st and 2nd) were to lead, the 1st (Gen. Augustin Y. E. Dubail) in the direction of Saarburg, after having thro n back the 7th German army toward Strasbourg and Lower Alsace, while an isolated corps would make a diversion to the east of the Vosges. The 2nd army (Gen. Edouard de Castelnau), covering itself from Metz, was to attack in the direction of Saarbriick, pivoting on Dubail's in the neighbourhood of Étangs. . The two left corps were to the west of the Moselle, with a view to their eventual employment in the north.

Disposition of **Forces.**—In front of Dubail's and De Castelnau's armies the Germans had approximately equal strength (6th and 7th armies). They would at first keep to the defensive, acting as a pivot to the huge wheel being made by their centre and right. The rapidity of the invasion of Belgium determined the French to hasten the operations in the east in order to make a diversion. On Aug. 13 Dubail's army had two corps on the Meurthe (8th and 13th). Dubail counted besides on the cooperation of the two right corps of De Castelnau's army and on that of the 21st corps descending from the Vosges on his right. On Aug. 16 the 2nd cavalry corps was placed under his orders. The final concentration of the complete fighting force, however, could not be complete until the 18th. Nevertheless. the 13th and 8th corps moved on the 14th, and on the 15th entered Cirey and Blamont, pushing back the 1st Bavarian corps, which retired toward Saarburg.

By the evening of the 17th the two French corps had reached the line Vasperveiller-Aspach-St.' Georges, and the 21st extended the line toward the Vosges. The 2nd cavalry corps had orders to go ahead on the 18th toward Saarburg, which was entered after a skirmish. The 21st corps pushed to the northeast as far as Walscheid; the 13th held the heights north and east of Saarburg; the 8th, marching on Heming, seized the passage of the Marne-Rhine canal and entered Saarburg. The 2nd cavalry corps bivouacked toward Diane-Capelle, in liaison with De Castelnau's army, which had reached the line Bisping-Château Salins. The Germans held entrenched positions on a front of 40 mi., from the neighbourhood of Dobbenheim to Biberkirch.

Dubail's Offensive.—It was decided that Dubail's army should attack with its left northwest of Saarburg, its centre and right standing fast to repulse an eventual counterattack in the Vosges. The 2nd cavalry corps was to move on Saar-Union in order to operate south of the Saar. On Aug. 19 the 8th corps commenced the attack before dawn, gained the terrain northwest of Saarburg, and repulsed a counterattack. On the 20th it resumed the offensive, but during the morning it became evident that it was incapable of opening a passage for the cavalry corps; indeed. it was necessary to bring back a division on the canal with heavy losses. In the centre and on the right the French were more fortunate. The 21st corps met no resistance on the 19th, and the 13th had not yet been engaged.

On Aug. 20, the 21st corps, attacked by the German 14th corps, inflicted on it a serious check near Walscheid; the 13th corps, coming into line, attacked to the northeast of Saarburg, disengaging the right of the 8th corps. which held the town until nightfall. Dubail's intention was to entrench on the front Kerprich-Soldatenkopf, and to undertake afterward a methodical advance; but the check to De Castelenau's army led Joffre to direct a retreat in Lorraine. On the morning of Aug. 21 Dubail's army retired slowly toward Blamont. Afterward it was necessary to accelerate the movement on account of the rapidity of De Castelnau's retreat. On the evening of the 23rd, Dubail held a front from Dames-aux-Bois to the Col du Bonhomme. His army had suffered heavy losses, the casualties in the 8th corps amounting to more than 50%.

De Castelnau's **Offensive.**—The offensive of De Castelnau's army had been still less fortunate. On Aug. 14 the 16th and 15th corps moved in the direction of Avricourt, uith the bulk of the 20th, the remainder covering the front to the north. In the evening the army faced to the northeast on the high ground at Gondrexon, the 15th corps alone having been stopped by the enemy at Rfoncourt. On Aug. 15 the advance still suffered a brake by the condition of the 1 jth corps, which had suffered heavily, but the 16th and 20th corps made fair progress. The 9th corps remained on the Grand Couronné east of Nancy and sent out detachments toward the northeast.

On Aug. 16 the Germans continued their retreat and the French followed rapidly as far as Morhange, northwest of Donnelay. On the 17th the army was to swing around to the northwest toward Delme-Chateau Salins-Dieuze. The 16th corps progressed without difficulty; the 1 jth occupied Marsal, but could not bring its main body beyond the Seille; the 20th corps, in possession of Château Salins, reconnoitred toward the north. Rearguard fights only were expected, but on Xug. 18 the 16th corps from the early morning met the enemy in strength. The German artillery held the 15th corps in the valley of the Seille and prevented it from occupying Dieuze. The 16th corps had to fall back on Angviller, and only the 20th advanced to the north of Morville-les-Vic and Chbteau Salins. In spite of the loss of the 9th corps, sent to the 4th army on Aug. 18. De Castelnau ordered for the 19th the continuation of the offensive in the direction of Loudrefing, Bensdorf and Morhange.

Retreat: Aug. 19–20.—From the morning of Aug. 19 the 16th corps was stopped on the Salines canal; the 1 jth could not pass Zommange and Vergaville; and only the 20th could make a real advance, pushing a brigade as far as Morhange. The 68th reserve division, which had relieved the 9th corps, insufficiently covered the left of the 20th corps. De Castelnau ordered for Aug. 20 a combined attack by the two other corps on the line Cutting-Dommon-Bassing; the 20th was to consolidate its positions, ready to march to the north or northeast. On the 20th the corps on the right, instead of progressing, was attacked and even thrown back. The 20th, having attacked and not having improved its position. was stopped by De Castelnau, but the Germans, taking the offensive in turn, threw the left back on Chbteau Salins. The right followed this movement on Lidrequin and the 65th division resumed its position of the previous day. At 4 P.M. the general ordered a retirement, which began during the night and continued through Aug. 21 under the protection of the 20th corps and the 68th division. In spite of the arrival of two new reserve divisions and the 2nd cavalry corps. De Castelnau had to retire to the west of the Meurthe, his left to St. Nicholas. To the north. three divisions held the Grand Couronné.

Dubail's Action. — On Aug. 23, Dubail's army commenced a three-weeks' battle destined to stop the enemy and aid De Castelnau, who was heavily attacked. To effect this it took the offensive on Aug. 24 and 25, while De Castelnau's army threw back the Germans to the northeast. From the 28th to the 31st the Germans held up Dubail's advance, and their 6th and 7th armies even aimed at forcing "the gap of Charmes," in such a manner as to carry out an enveloping movement to the west of the Vosges. This action was helped by the French 21st corps being dispatched to take part in the battle of the Marne.

From these circumstances there resulted a series of very confused fights extending over a large front between the Grand Couronné and the Vosges. On Sept. 6 the 7th German army, facing Dubail, was broken up, divided between the 6th army, and the main German right wing was then engaged on the Ourcq against Gen. Michel Joseph Maunoury. But Dubail's army was also enfeebled by the removal, westward also, of the 13th corps; and at the same time De Castelnau lost the 18th division and the 15th corps. Clearly both sides had given up the idea oi striking seriously in Lorraine. After having gloriously held its positions to the east of Nancy and on the Meurthe, De Castelnau's army was itself to be broken up. to be reconstituted on the left of the French armies in the "race to the sea."

Thus, after checks resulting from an inopportune offensive, Dubail's and De Castelnau's armies had been first able to stop the German progress, then to throw the enemy back to the frontier. Moreover, their merit was all the greater as they had been constantly weakened by the withdrawal of their best units. During the battle of the Marne they provided the unshakable pivot of the vast movement undertaken by the Allies. It was because of their efforts that that movement succeeded. But they had paid the price. A single reserve division between Aug. 24 and Sept. 12 lost 140 officers and more than 5,000 men.

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III. BATTLE OF THE ARDENNES

On the outbreak of World War I, the 3rd, 4th and 5th French armies concentrated toward the frontier. west of the Meuse. On hearing of the German attack on Liége, Gen. Joseph Joffre decided to post the 5th army (Gen. Charles Louis Lanrezac) toward the Sambre and to direct the 4th army, which he had grouped between Vitry-le-François and Sainte-Menehould, in the region of Stenay. The concentration, which had scarcely begun on Aug. 8, was nearly finished on the 14th. Until the commander in chief had all his iorces at hand, the covering troops were not to be drawn into an important action. The German high command had made a similar decision, hence the battle of the Ardennes was the "battle of the two blind men."

French Plan of Attack. — The German plan of operations placed the 5th army between Thionville and Tintigny, the 4th between Tintigny and the Meuse de Dinant (the Meuse between Mezières and Namur), the 3rd army between Dinant and the Sambre, the and on the Sambre, and the 1st in the neighbourhood of Mons. The 3rd army was still in the Ardennes behind the 4th and the 1st army was hastening toward Brussels and Antwerp, when on Aug. 22 Joffre decided to attack. It was certainly a strategic success to bring about a battle with all his forces in the Ardennes, while the 3rd German army was unable to take part in it. Joffre had disposed his 3rd and 4th armies in echelon. the left in front. so that he could face the north or east as he wished. On Aug. 16 he decided to attack toward the north with these two armies massed, while the 7th cavalry division reconnoitred toward Thionville. and the 4th and 9th cavalry divisions to the north toward the Meuse. The result was that in front, and almost everywhere, the army corps had only weak and insufficient cavalry for reconnoitring purposes.

During the night of Aug. 20–21 the whole mass moved forward. The only instructions given by Joffre were "to attack the enemy wherever met." He estimated that the 4th army would have almost nothing in front of it, and yet it was precisely there that the Germans had their 4th and 3rd armies. the 3rd being behind the 4th. The French Lorraine army. which consisted of groups of reserve divisions. was placed under the command of General Maunoury with orders to defend the Hauts de Meuse. or eventually, in the event of the advance of the 3rd army, to besiege Metz and Thionville. These reserve divisions were mobilized after the active forces, the men were elderly, they had few officers, and their staffs were inexperienced, so that the 3rd army could get little help from them.

On the evening of Aug. 21, after a long period, during which only patrols had been encountered, the 3rd army arrived on the line Conz-Lagranville-Tellancourt-Virton. At Virton, the left corps tried to get in touch with the right of the 4th army. The line continued by Villers-la-Loue, Geronville, Florenville and the Semoy. The 4th army (De Langle de Cary) was to push on toward the north, while the 3rd army was to cover its right against any attack coming from the north or east. Everywhere the advance was made in divisions except for one corps, which marched entire on a single road.

On Aug. 22 all the columns started in a fog at a very early hour for a long march with the idea of "attacking the enemy wherever met." To march quickly rather than to take precautions was the order of the day, and almost every\\-here the presence of the Germans was only discovered by receiving shell fire. In the 3rd army. the jth corps sent its infantry to the attack without the support of artillery. and it suffered such terrible losses that the leaders became completely unnerved, and Gen. Paul Grossetti, chief of the staff, had to intervene to prevent a precipitate retreat. In the 4th army the Colonial corps exposed a division a column-of-route to the German guns. The 17th corps also suffered from a sanguinary surprise. But the most serious danger arose on the right wing of the 4th army, uncovered by the premature check of the 4th corps at Virton, and on the exposed right wing of the 3rd army.

Fortunately, the 2nd corps was in a single column, so that the rear division was able to make up for the absence of the 4th corps. On the right of the 3rd army there was a leader, General Hache. who with his heroic division gained the necessary time for the other divisions to fall back. The Germans did not exploit their tactical success but remained practically stationary in their positions. This battle of the Xrdennes taught the French the necessity for co-operation of all arms in the field of battle. On Aug. 23, 24 and 25 the two armies retired slowly without being disturbed.

Lorraine Army Dissolved.——On the morning of Aug. 25, the right of the 4th army retired between the Chiers and the Meuse; the 3rd ariny also approached the Meuse facing eastward. Thus the two armies practically became one, and it is regrettable that from this time they were not placed under one leader. On the same day, the 4th corps (3rd army) suffered a severe reverse at Marville and they feared they would lose their corps artillery, but the 2nd corps came to their assistance and convoyed this artillery to Stenay, where they crossed the Meuse. This shows how intimate was the co-operation between the two armies. It was on Xug. 25 also that Joffre decided to reinforce the left of the Allied armies and to lose ground in order to gain the necessary time for his strategic plans. The Lorraine army was dissolved; one group of divisions was to defend the Hauts-de-hleuse; the jjth and 56th divisions were entrained for Montdidier. Gen. Maunoury had in these two divisions the nucleus of that 6th army which determined the victory of the Marne.

On the morning of Aug. 26 the entire 4th army was on the left bank of the Meuse, with cavalry connecting it with the 5th army. On its right flank it was in immediate contact with the 3rd army. So much feared was the envelopment of the 3rd army's right, that a cavalry division was sent to the rear to Dombasle, between

Verdun and Clermont, as if an extensive enemy movement was expected to take place south of Verdun. The 3rd army took no part in the battle of the bleuse.

Defense of the Meuse.—On Aug. 26 the orders ran: "From tomorrow the 4th army will fight a decisive battle on the Meuse . . . The corps will make every effort to prevent any attempt of the enemy to cross the river." Generally speaking, this army was some distance from the left bank. Its object was to carry out vigorous counterattacks against German infantry who had passed the river before its artillery could come to its support. The colonial corps was somewhat driven back by the Germans. who had crossed at Inor and Pouilly, but the arrival of reinforcements from the 2nd corps soon checked this. The struggle was severe on the whole front. On the right wing the 2nd corps had decided successes, three times throwing the Germans back into the river at Cesse and Luzy. On the left wing, the success was still more marked.

There the 11th corps, reinforced by two reserve divisions, gained the battle of La Marfée. A German division, making the same mistake as did the French at the battle of the Ardennes, advanced in massed formation without artillery and was crushed.

On the evening of Xug. 27, De Langle de Carp gave the following order: "At all costs the Germans must be thrown back into the river Meuse." However, Aug. 28 was not so active as the previous day; the Germans scarcely attacked at all, and the orders given by Joffre for the coming retirement to the Xisne kept the 4th army to its ground. On the 29th the retirement towards the Aisne commenced—the battle of the Meuse was ended. The French 4th army had repulsed the German 4th army.

Battle of **Signy l'Abbaye.**—The French 5th army, having been beaten by the German and army on Aug. 22 and 23, had to retreat, leaving a gap 25 mi. wide between it and the 4th army. The Germans of Hausen's 3rd army poured into this open space. Gen. Dubois was ordered to fill up this gap and to cover the left of the 4th army, and was given command of the 9th corps, composed of the 17th division, the Moroccan division: and the 9th cavalry division. Two roads led to the region occupied by the Germans at Rethel. The road Mezières-Rethel was barred by the 17th division and the 9th cavalry division at Guignicourt, the road from Rocroi to Rethel by the Moroccan division at Signy l'Abbaye and Launois.

On Aug. 28, the 17th division, hearing the guns from La Marfée, had its attention drawn in that direction. On the same day, at 3 A.M., the advanced posts of the Moroccan division were attacked by the 12th (Saxon) corps. At 11 A.M. the Moroccan division was turned in the west by the enemy, who seized Signy l'Abbaye and so opened up the way to Rethel. But the Germans did not exploit their success and allowed themselves to be checked at Novion-Porcien. The battle manoeuvres lasted through Aug. 29 and 30. Dubois, by clever movements, brought his forces to the north of Rethel, having thus accomplished his difficult mission.

(L. E. V. C.)

IV. BATTLES OF CHARLEROI AND MONS

The series of encounters between the Allied left and German right wings in southern Belgium during the third week in Aug. 1914 may be subdivided into the battle of Charleroi, in which the French jth army was attacked and defeated by the German 2nd and 3rd armies, and the battle of Mons. subsequent to which the British expeditionary force retired southward before the German 1st army.

1. THE PRELUDE TO THE BATTLES

(a) German Movements Prior to the Battles.—The German plan of campaign in 1914, which in its general lines followed that drawn up some ten years before by Schlieffen, the then chief of the great general staff, involved an advance with a strong right wing through Belgium. so as to turn the fortresses on the French eastern frontier, and with the centre through the Belgian Ardennes and Luxembourg, pivoting on the fortified area Thionville-Metz. The three German right-wing armies concentrated in the area between the German western frontier with Holland, Belgium and Luxembourg, and the line of the lower Rhine and Moselle from Duisburg to Treves. The 1st army (Kluck) on the extreme right, compr'ising four first-line corps and two second-line corps, assembled to the northeast of Aix-la-Chapelle; the and army (Bülow) on its left, comprising three first-line corps and three second-line corps, to the east and south of Aix-la-Chapelle; the 3rd army (Hausen), comprising three first-line corps and one second-line corps, to the east of the line St. Vith-Bitburg. Two cavalry corps were also allotted to the right wing, together with certain ancillary troops. In all, the three armies therefore comprised 20 first-line and 12 second-line infantry divisions and j cavalry divisions, and their concentration was completed by Aug. 14. The fall of the last forts of Liége early on the 16th having opened the way for their advance, the 1st and 2nd armies crossed the Meuse between the Dutch frontier and Huy during the course of the next few days, and came into contact with the main body of the Belgian army deployed behind the line of the Geete between Diest and Tirlemont. By the evening of the 20th the Belgians had been forced to seek shelter in Antwerp; the 1st army had occupied Brussels and the country to the south as far as Waterloo; the 2nd army on its left continued the line southeastward toward the Belgian fortress of Namur, nhich its two left-wing corps were observing; and the 3rd army east of the Meuse, having made its way through the northern Ardennes, was approaching the line of that river between Namur and Givet. At the headquarters of Bulow, who had been placed in general control of the operations of both the 1st and 2nd armies, it was believed that strong French forces (about five corps) were moving forward into the angle between the Sambre and the Meuse. that the British would shortly complete their landing at Boulogne and move thence on Lille, though their arrival in the near future was not to be expected. On the morning of the 20th Bülow received orders from the German supreme command that his two armies should co-operate with the 3rd army in an attack on the French forces west of Namur; the details of the combined attack were left to be mutually arranged between him and Hausen.

(*b*) French Movements Prior to the Battle of **Charleroi.**—The French 5th army, the role of which as laid down in plan 17, was to act offensively in conjunction with the 4th and 3rd armies on its right, to the north of the line Verdun-Metz against the enemy right wing, concentrated on the Franco-Belgian frontier between Longwy and Hirson; it comprised four corps (each of two divisions), two Algerian divisions, and a cavalry corps of three divisions.

The army commander. Gen. Lanrezac. from the first believed that the main strength of the forces opposed to him was to be expected north of the Meuse. and that the projected offensive across that river through the Ardennes would therefore be impracticable, and he took every opportunity of impressing this view on Gen. Joffre. The latter, on the other hand, adhered to his plan for an offensive across the Meuse into the Ardennes, nhich he estimated would break in the enemy's centre, nullify any advantage gained by their right wing in Belgium, and even force its withdrawal. All he considered necessary was to extend the left wing of Lanrezac's army to the north toward Namur and place a group of three reserve divisions behind it around Vervins. A hostile attack on Dinant on Aug. 14 and increasing evidence of the great German strength north of the Meuse finally induced him, while still maintaining his project for an offensive by the 3rd and 4th armies, to move Lanrezac's army northward to the area Mariembourg-Philippeville, so as to be in a position to meet the danger from the north.

Between Aug. 16 and 20, therefore, Lanrezac's army carried out a change of front and a flank march which brought it to a new position south of the Sambre between the western defenses of Namur and Thuin, with advanced guards holding the bridges, and one corps (1st) facing east along the Meuse between Givet and Namur to guard its right flank. Its further action as laid down by Joffre on the 18th nas, in conjunction with the British and Belgian armies, either directly to oppose a hostile advance astride the Meuse betneen Givet and Brussels, or, if the main enemy strength lay south of that river, to act against his right flank in the northern Xrdennes. On the zoth, however, it became known that the Belgian army was in full retreat on Antwerp, while Sir John French had informed Lanrezac at an interview on the 17th that the British expeditionary force would not be ready for action before the 24th. As regards the enemy, Lanrezac believed them to have nine or ten corps available for active operations against him north of the Meuse and another two in the angle southeast of Namur. His intention was now to close up his army on the 21st and 22nd, establish himself in a defensive position, and cross the Sambre early on the 23rd.

(*c*) British Movements Prior to the Battle of **Mons.**—The mobilization of the British expeditionary force (B.E.F.) was completed by Aug. 9 and the transport across the channel of its four infantry divisions and five cavalry brigades took place without interruption betneen the 12th and 17th. Field Rlarshal Sir John French, the commander in chief, had received instructions to co-operate with the French but as an independent commander only, and to be cautious of exposing his small and precious force to serious danger or losses. After a series of conferences with Joffre and Lanrezac, it was agreed that the B.E.F. should take part in Lanrezac's offensive, moving on the left of Lanrezac by Soignies on Nivelles, and as a preliminary should move forward from its concentration area east of the general line Maubeuge-Landrecies-Bohain to a position of assembly about Mons.

2. THE BATTLE OF CHARLEROI

(a) Aug. 21.—During the 21st .the German 1st army continued its southwesterly advance and the 3rd army closed up to a line a few miles east of the Meuse. Bdlow's orders for the 21st were that the and army on the 21st would continue its advance to the Sambre, but as the 3rd army was not yet in position, it was agreed between the two commanders that the combined attack by the two armies against the enemy southwest of Namur should not take place until the 23rd. The right wing of the 2nd army reached the line of the Canal du Centre west of Gosselies, driving back the French cavalry. while the left began operations against the eastern forts of Namur. The centre, however, early in the afternoon came into contact with the right of the French 5th army on the line of the Sambre and forced its way across the river. Thus on the evening of the 21st the German 2nd army secured the crossings both of the Canal du Centre and of the Sambre, and was in position ready to carry out its part in the combined attack arranged with the 3rd army for the 23rd.

The French right on this evening had taken up a new defensive position running from Fosse to Marchienne au Pont. The left was approaching Thuin. with the cavalry covering its western flank. Of the group of three reserve divisions which had detrained around Vervins, one was on its way to relieve the 1st corps. still guarding the army right on the Meuse south of Namur; the other two were moving north and had reached Avesnes. In these positions Lanrezac decided to await further hostile attacks.

(6) **Aug.** 22.—Buloa's orders for the zznd envisaged nothing more than a general closing up of the and army on the north bank of the Sambre and preparations for an advance across that river on the 23rd, so as to open the passage of the Meuse for the 3rd army. The 1st army was directed to close up to a position whence it could support the right of the 2nd army. News which arrived at 2nd army H.Q. in the course of the morning, however, caused a radical change of plan; it appeared from this that the French immediately south of the Sambre were chiefly cavalry and that their main forces were no farther north than the line Beaumont-Philippeville. Bülow, faced with the alternative of throwing overboard his prearranged scheme of co-operation with the 1st and 3rd armies, or of losing so apparently favourable a chance of securing the passage of the Sambre at little cost, decided about noon to attack forthwith. Orders were accordingly issued to all corps; the 3rd army was asked also to push forward.

The right of the 2nd German army encountered no very serious opposition, and by the evening, had succeeded in setting foot on the right bank of the river. In the centre, however, the struggle was much more severe. In the early morning the French right wing launched a series of counterattacks in the hope of regaining the ground lost on the 21st; these met with only partial success, and were finally beaten back with heavy loss. A stand was made on the line Fosse-Gerpinnes; where for some hours the fight swayed to and fro without any decided success on either side.

Finally, however, the Germans succeeded in breaking into the positions held by the French, who were driven back once more to the line St. Gerard-Nalinnes, where they reorganized and prepared for a new defense on the morrow. Their left wing was not seriously attacked and maintained its positions.

For the 22nd, the German 3rd army had been ordered merely to close up on the east bank of the Meuse, and began preparations for the passage of the river on the morrow. During the day news came in to Hausen that the and army, contrary to its commander's previous arrangement with him, had crossed the Sambre that day and asked urgently for his co-operation by an advance across the Meuse. Orders were therefore issued for the 3rd army to force the passage of the river early on the morrow.

(c) Aug. 23.—The morning of the 23rd passed without any renewal of fighting on the French 5th army front; Biilow was apparently waiting till the effects of the 3rd army attack should make themselves felt. It was not till afternoon that his centre began to work forward toward Mettet and forced back the French line some little distance by nightfall. Fighting on the left was more serious and sustained; the Germans forced the passage of the Sambre in this sector, and after repeated attacks drove back their opponents some miles to the south, On the extreme left the troops of the reserve divisions, relieving the cavalry, came into line along the south bank of the Sambre between Merbes le Chateau and Maubeuge.

Despite the progress made by the 2nd army during the fighting of the last three days, the view of the situation taken at Biilow's headquarters on this evening was gloomy. The expected co-operation of the 1st army had failed to materialize, and that of the 3rd army seemed to have had little effect. The enemy was believed to be in superior force on the army front; he had fought well and might be expected at any time to undertake a general counteroffensive, which the German troops, exhausted by three days' incessant fighting, could hardly hope to resist. Nevertheless, the army orders for the 24th laid down a continuance of the attack.

The 3rd army had begun its attack east of the Meuse early in the morning. The French positions were strong and well adapted for defense, and their resistance stubborn; but before noon the German left had effected a crossing and observed signs of a hostile retirement, which were attributed to the effect of the 2nd army's victorious advance. In accordance, therefore, with an order from the German supreme command, Hausen instructed his left to move on Fumay so as to cut off the hostile retreat to the south. But the task of the army was far from accomplished; its centre met with fierce resistance at Dinant and only got across late in the day; the left, pushing forward to Onhaye, was counter-attacked and driven back by part of the 1st French corps, sent back to restore the threatening situation on this front; while the column sent toward Fumay, by reason of the natural difficulties of the route, failed to reach its objective. Still, the 3rd army was across the Meuse, and Hausen had ordered it to undertake a pursuit next day in a southwesterly direction, when a staff officer from the 2nd army arrived bearing an urgent request for his assistance in the form of an advance due west against the flank of the 5th French army. To this alteration of his plan Hausen consented and issued new orders directing his right wing on Mettet.

Meanwhile, Lanrezac, on his side, in view of the threat to his flanks and rear afforded by the fall of Namur, the advance of the 3rd army and the defeat of the French in the Ardennes, fearing for his left where the B.E.F. had been engdged all that day, with superior enemy forces, and realizing the state of moral and material exhaustion among his own troops, decided that he had no choice but to retreat. Orders were issued that morning for a withdrawal to the line Givet-Philippeville-Merbes-le

Chateau; which was carried out on the 24th unmolested by the Germans. Their 2nd army advanced only a few miles to the southward; the right of their 3rd army, advancing due west, found no enemy before it, and its left column, resuming its advance on Fumay, was unable to cross the Meuse there until the 28th, when it was too late to interfere with the French retirement.

The battle of Charleroi had thus terminated in a definite German success, the scope and effects of which, however, were so unduly exaggerated in the reports of army and corps commanders, as to assume, quite without warrant, the dimensions of a decisive victory.

3. THE BATTLE OF MONS

On Aug. 21 the British expeditionary force began its advance into the line of battle. The cavalry preceded the advance, followed by the 2nd corps (Smith-Dorrien) and the 1st corps (Haig) in that order. Reports from aircraft and cavalry on the 21st and 22nd established the presence of hostile cavalry about Nivelles. and of the main enemy forces between Enghien and Charleroi. In rear of the cavalry the British corps closed up to the line Binche-Mons-Condé canal, the 1st corps on the right as far as Villers St. Ghislain, the 2nd corps on the left behind the canal line; one cavalry brigade covered the right of the army, while later in the morning the cavalry division fell back from before the front to a new position southeast of Condé in rear of its left. Sir John French knew on the evening of the 22nd that the French on his right, after heavy fighting, had been forced back from the line of the Sambre, and that strong enemy forces, reckoned at three or four corps, were approaching his own front; he therefore determined to abandon all idea of an offensive, and to stand for battle next day in the positions then held by his army. In view of this, a request from Lanrezac for a British counterstroke against the flank of the enemy then attacking him could not be complied with; the most that French could promise was that he would hold his ground for at least 24 hours.

On the German side the 1st army, on the evening of Aug. 21, received orders from Bulow to be prepared next day to afford direct support to the 2nd army. To this scheme Kluck saw serious objections in view of the uncertainty as to the whereabouts of the British, and a prolonged discussion took place which resulted in the 1st army commander yielding his point, and agreeing to swing his army on the zznd more to the south to the line Lessines-Soignies. During this day contact was established, as has already been related. with the British cavalry and Kluck now realized that the B.E.F. was advancing to join the left of the French on the Sambre. Once more there arose a divergence of views; Kluck wanted to carry out a wide turning movement to envelop the British left; while Bulow considered he could not dispense with his direct support on the Sambre. Eventually orders were issued for the 1st army to advance on the 23rd across the Canal du Centre to the general line north of Maubeuge, northeast of Condé, a movement which was bound to bring them into conflict with the British.

Early on the morning of the 23rd, the latter had taken up their positions for battle—the 1st corps on the right facing northeast between the Sambre and the Haine southeast of Mons, the 2nd corps and the 19th infantry brigade facing north along the line of the Canal du Centre from Mons to just east of Condé (which was held by part of the 84th French territorial division), and the cavalry division in rear of the 2nd corps left. The whole front was a very long one—about 27 mi.; the ground along the line of the canal was enclosed and much built over, but the heights to the southeast of the Haine afforded strong second positions farther in rear. About 9 A.M. the battle opened on the 2nd corps' right, but it was not till 11 A.M. that the action became general all along its front. This pause was due to the fact that early in the morning Kluck, alarmed by a false report that strong hostile forces were detraining at Tournai, well out on his right flank, had ordered his army to halt until the situation there was cleared up—which did not occur till about midday. The German attack at first made little progress and suffered heavy casualties from the effective British fire, but in the early afternoon the right of the British corps was forced to evacuate Mons and the canal bend north of it, and retire to its second position, while a gap in its centre also caused some temporary anxiety. By nightfall it had every here fallen or was about to fall back to this new position about 2 mi. south of the canal. Neither the 1st corps on the right nor the 19th brigade and the French on the extreme left had been seriously attacked during the day, since the German right wing, which was moving on Condé, failed to reach the battlefield; the British losses had been slight and the morale was excellent. Nonetheless. Sir John French, on receipt of news from the French G.O.C. and Lanrezac's French army of the situation on his flanks and the greatly superior enemy force available for use against him, realized that he could not continue to hold his position, and issued orders for a retirement next day to a line running east and west through Bavai, with its right covered by the fortress of Maubeuge.

This withdrawal, commencing before dawn on the 24th, was successfully executed, though not without local fighting in which the B.E.F. actually suffered more heavily than in the previous day's battle. The 1st corps and the right of the 2nd corps fell back unmolested, but at Frameries and Elouges the centre and left of the 2nd corps and cavalry divisions were hard pressed by the enemy, who succeeded in cutting off and capturing the greater part of one battalion at Elouges after a gallant resistance. Nevertheless, by the morning of the 24th the B.E.F. stood, wearied but intact, on the line allotted to it on either side of Bavai. The German 1st army, apart from its pressure on the rear guards of the 2nd corps, made little attempt to follow up or molest the retirement. Kluck believed the British would stand fast on this day and await his further attack, arrangements for which he had laid down in his orders issued late on the 23rd; it was not till next morning that he realized the true position, and then it was too late to carry out that enveloping movement with his right wing which alone could have enabled him to secure decisive success. In fact, the results of the two days' fighting around Mons were, from the German point of view, disappointing; the retirement of the British before it was mainly attributable to the course of events elsewhere and in particular to the ill success of the French 5th army farther east, and there was at no time any question of a true tactical victory on the German 1st army front.

General Considerations.—The operations above described had thus resulted in a serious Allied defeat which laid open the whole northern frontier of France to invasion. The weight and velocity of the German offensive had been too great and unexpected for the French countermeasures to be effective in stemming its progress; such a result was only to be expected in view of the fact that on this sector of the front the Germans had a numerical superiority of 11 divisions (28 as against 17). The Allies, moreover, were incompletely concentrated for battle and the arrangements for co-operation between them were by no means satisfactory. The 5th army moved forward to the Sambre too late to assist the Belgians and too soon to be able to count on British support, and became involved in an encounter battle before it had time to establish itself in a suitable defensive position. Moreover, its indifferent tactical handling allowed the Germans to make full use of their superior armament, which took heavy toll of the hasty and ill-prepared attacks in which the French at this period of the war were too prone to indulge. The French failure at Charleroi, moreover, nullified the effect of the temporarily successful resistance of the British at Mons against an enemy who had ample additional troops at hand to continue his offensive. The immediate retreat of the whole Allied left wing therefore became the only means of escape from a critical situation.

Fortunately for the Allies, the Germans on their side failed to reap the full fruits of a success so real that it might well have been made decisive. This failure must be attributed to several causes: inadequate information, which lead them unduly to disperse their forces prior to and during the battles; defective organization of command, which placed the general control of the operations in the hands of one army commander who was bound to be unduly influenced by events on his own immediate front; and faulty leadership, which indulged in sudden and ill-considered changes of plan, and let slip its chance of completely destroying its weaker adversary.

It seems that while the Allies were fortunate to escape as lightly as they did, for the Germans Charleroi and Mons were at once a real victory and a lost opportunity.

V. BATTLE OF LE CATEAU

In view of the withdrawal of the whole of the French centre and left wing which Sir John French had been informed was to be continued on Aug. 28, the British commander in chief ordered on the evening of the 24th a further retirement of the B.E.F. from the Bavai area to a position on either side of Le Cateau. In order to carry out this movement it was necessary to split the army and send the 1st corps to the east and the 2nd corps and cavalry to the west of the great Mormal forest, which lay right across the line of retreat and through which no practicable roads were believed to exist. The 1st corps completed its movement unmolested by the enemy, though not without difficulty and trouble owing to the great heat and the presence of French troops along its allotted route, and went into quarters for the night around Landrecies. Here late in the evening a collision took place with German advance guards, which after some confused fighting were beaten off.

On the other flank, however, the 2nd corps and the cavalry, who were joined in the afternoon by the 4th division, just detrained at Le Cateau, had considerable fighting.

The commander of the German 1st army, who had expected the British to stand for battle, realized in the early morning that they were in fact retiring, but concluded as the result of an erroneous air report that the direction of their retreat was not southwestward but eastward with a view of seeking shelter under the guns of Maubeuge—a course of action which Sir John French had in fact considered, but on recollection of the fate of Bazaine in similar circumstances in 1870, had rejected. As a consequence of this inaccurate appreciation of the situation, the 1st army column was switched off from 'its first direction of advance southwestward toward a new southward direction, and it was not till the afternoon that the error was recognized and the original direction resumed. By that time, as we have seen, the British 1st corps had got a good start of its adversaries; but the 2nd corps and cavalry, partly owing to the passage of the French 1st cavalry corps across their rear to the new position allotted to it on their left, were much delayed in starting their retirement, and the German 2nd and 4th corps early got contact with their rear guards; so that the retreat of the British left wing resolved itself into a running fight with a vigorously pursuing enemy. The 4th division, which had just arrived from England and had taken up a position north of Solesmes, effectively assisted the withdrawal, but the bulk of the troops of the 2nd corps were unable to reach the positions allotted to them west of Le Cateau until late that night, and some not even till next morning. The 4th division and the cavalry were in little better position, the former, which was deficient of many essential units, being unable to fall back from Solesmes to its new positions till long after dark, while the cavalry, being scattered on both flanks of the 2nd corps, was much exhausted.

About 9 P.M. General Smith-Dorrien, G.O.C. 2nd corps, received orders from British G.H.Q. that the army was not to stand to fight on its present position next day, as expected, but was to continue its retreat to the area Busigny-Beaurevoir-Le Catelet. He now found himself called on to make a critical decision. According to reports from his subordinates, his force could not possibly resume its retreat till well after dawn on the 25th; and as the enemy were, according to information from the cavalry, in force close to his front, to attempt a retirement by daylight and over roads encumbered with transport and refugees would probably lead to a disaster. Moreover, the 1st corps was believed to be engaged with the enemy, and the 2nd corps, by falling back, would expose its flank and rear. To continue his retirement next day, as ordered, he therefore considered impossible. By standing to fight in conjunction with the 4th division and the cavalry he might hope to check the hostile advance for a time and utilize the first opportunity to resume his withdrawal before he could be attacked and overwhelmed by greatly superior forces. On this latter course, therefore, Smith-Dorrien eventually decided; and in this decision G.H.Q. concurred. Accordingly, orders were got out for the British left wing to stand for battle, on the heights south of the Le Cateau-Cambrai high road between Le Cateau and Esnes.

The German 1st army halted for the night of the 25th–26th on the general front, east and south edges of Mormal forest—Solesmes-Bouchain, and its orders for the morrow were to continue the pursuit southwestward so as to cut off the British line of retreat between Cambrai and St. Quentin. About 6 A.M. on the 26th, the 4th division was suddenly attacked by German cavalry and suffered severely before it could effect it withdrawal to its battle position on the line Ligny-Esnes, and there check the German progress. Meanwhile, on the opposite flank the 5th division in and west of Le Cateau were as suddenly assailed and forced back to the heights southwest and west of the town. An attempt to get round its right in the Selle valley was, however, foiled with the help of the cavalry on that flank; and with the assistance of troops sent up from corps reserve the British positions were maintained intact in this part of the field till noon. The 3rd division in the centre had not been seriously attacked. Before Iong, however, the situation became serious, one fresh German corps, moving west from about Landrecies, was approaching the field and threatened to envelop the British right; while on the left another uhich had arrived on the field to support the cavalry, resumed the attack in the sector held by the 4th division. Under these circumstances Smith-Dorrien, at 1:40 P.M., ordered a general retirement commencing with the right, and as soon as these orders reached the troops, about 3 P.M., the withdrawal commenced. On the 5th division front considerable difficulties were encountered. and some guns had to be abandoned but the bulk of the troops succeeded in getting away. The 3rd division had no difficulty in effecting their retreat, and the 4th little more, since the attention of the German 2nd corps, which, after driving back French territorial troops through Cambrai, was preparing to fall on the British left, was distracted by the opportune arrival about Crèvecoeur, of the French cavalry corps, whose artillery effectively prevented the German attack from developing till the 4th division had got well away to the south. On the whole front small parties which had not received orders to retire or had received them too late, fought on till finally overwhelmed, and their stubborn resistance prevented any pursuit of the main bodies by the enemy. Marching far into the night despite its intense exhaustion and great congestion and confusion on the various lines of retirement, Smith-Dorrien's command finally halted in the area between Bohain and Le Catelet. It had lost nearly 8.000 men and 38 guns, but was still a fighting force. Its escape from the critical position in which it stood on the morning of the battle may be attributed partly to its adversaries' failure to exploit to the full their great superiority in numbers and means; partly to the invaluable help rendered first by the French territorials and later by their cavalry corps in securing its exposed left flank thoughout the day; but most of all to the fine qualities of its leadership and its own soldierly virtues, which made of Le Cateau an episode more creditable than many a victory.

With the conclusion of the battle the crisis through which the B.E.F. had passed since Mons may be said to have ended. Its retreat was continued on the 27th and 28th unmolested by the German 1st army, which now had to swing westward to deal with a new enemy in the shape of French forces assembling in the Somme valley. The 2nd corps, 4th division and cavalry moved via St. Quentin and Ham behind the line of the Somme and then behind the Oise, where touch was established with the 1st corps, which, after a series of rear-guard encounters with the right wing of the Germany 2nd Army, had successfully effected its retreat by may of Etreux and Guise. Thus, on the 29th, the whole of the B.E.F. stood once more united on the south bank of the Oise between La Fere and Noyon, where it was afforded a short respite to reorganize and refit.

VI. THE BATTLE OF GUISE

Between Aug. 24 and 27 the French 5th army carried out a steady retirement southward from the area south of the Sambre to south of the Oise, and on the evening of the 26th stood with outposts on the line of that river and the Thon between Aubenton and Guise, and its main bodies farther back. The German 2nd army, which had bought its victory at Charleroi at a heavy price in casualties, had followed it up and had reached on a line from east of Bohain to La Capelle; it was now reduced to four corps, the other two having been sent off to the eastern front, where the situation had become menacing for the Germans. No serious contact had taken place between the adversaries during this period.

Meanwhile Joffre, in view of the Allied failure in the frontier battles and the rapid progress of the German right wing, proposed to strengthen his own left wing by the formation of a new 6th army about and south of Amiens, to check the enemy advance on the general line Laon-La Fere-St. Quentin-the Somme, and ultimately assume the offensive with the 5th, 6th and British armies. But the retreat of the B.E.F. as a result of Le Cateau rendered it necessary in his opinion for some immediate assistance to be given to it if it were to be kept in being as a fighting force, and on the 27th the 5th army received orders for an immediate attack northwestward toward St. Quentin against the enemy who were following up the British on the west bank of the Oise. Accordingly, the French corps on the 28th closed to their left in preparation for the attack on the 29th, the left wing facing northwest along the Oise between Origny and Mons, the right guard facing north between Guise and Rumigny. The co-operation of the British 1st corps had been asked for and promised by its commander, but Sir John French Intervened to forbid this. Meanwhile, Biilow, as before the battle of Charleroi, had come to the conclusion early on the 28th that he had only strong rear guards in front of him south of the Oise. On the 28th, therefore, he pushed his left wing up and over that river between Guise and Étréaupont, while his right was sent off far to the southwestward beyond St. Quentin toward the upper Somme so as to keep touch with the 1st army and assist it to cut off the retreat of the British. His orders for the 29th dealt mainly with the preparatory measures for the attack on the out-of-date fortress of La Fkre, the importance of which seems to have obsessed him unduly; the right wing, however, was to continue its advance southwestward.

The French advance across the Oise toward St. Quentin thus came as a complete surprise to the Germans; and their right wing, thus menaced on its left flank, was at once checked in its progress and faced hurriedly southeastward to meet the unexpected threat. At first only part of one corps was available to stave off the advancing French, who got to within 4 mi. of St. Quentin, while the wide gap between Bulow's wings for a time caused him grave anxiety. Eventually the arrival of the remainder of his right wing relieved the German situation in this part of the field; the French having received orders that the attack on St. Quentin was not to be pressed, maintained their ground till nightfall, and then fell back east of the Oise.

The reason for this order lay in the changed situation on the northern part of the field, where the German left wing, advancing southward, had driven in the French forward troops opposed to them, and menaced the flank of columns about to cross the Oise about Mt. d'Origny. Lanrezac's reserve was thrown in; a general counterstroke took place which not only put a stop to the enemy's advance, but forced him to give ground; and by nightfall the progress of the German left wing had been checked definitely.

The object of the French counteroffensive having been achieved, Joffre ordered Lanrezac to resume his retreat on the 30th, to the line originally laid down, and this movement, which commenced early in the morning, was safely completed under cover of strong rear guards. The Germans did not attempt to resume their attack during the morning, but their right wing, having called up to its assistance a division of the 1st army, advanced in force later in the afternoon across the Oise and established itself on the east bank by nightfall; the left wing also moved forward level with it, By this time the French main bodies had got clear away and no pursuit was undertaken, the 2nd army, which was much exhausted, was ordered a rest day on the 30th, leaving to the 1st army the task of following up the retiring enemy by an advance across the Oise south of La Fkre

In truth the battle of Guise, if a *victoire sans lendemain* for the French, was a bad setback for the Germans, and in it was to be found a presage of the turn of the tide a week later on the Marne.

See French, British and German official *Histories;* also Lord French, *1914,* 2nd ed. (1919); C. W. P. v Biilow, *Mein Bericht zur Marneschlacht* (1919); H. R. A. v. Kluck, *The March on Paris,* Eng. tran. (1920); M. C. L. v. Hausen, *Erinnerungen an den Marnefeldzug* (Leipzig, 1920); C. L M. Lanrezac, *Le Plan de Campagne Français* (1920), H. J. v Kuhl, *Die Marnefeldzug* (1921); H. L. Smith-Dorrien, *Memories of Forty-eight Years' Service* (1925); B. H. Liddell Hart, *Reputations* (1928). (E. W. S.)

FRONTINUS, SEXTUS JULIUS (c. A.D. 35–c. 103), Roman soldier and writer, was the author of the *De aquis urbis Romae,* a history and description of the water supply of Rome, including the laws relating to its use and maintenance and other matters of importance in the history of architecture. In 70 he was city praetor, and about five years later succeeded Petilius Cerealis as governor of Britain. He subdued the Silures, a tribe in southeast Wales, and held the other tribes in check until he mas superseded by Agricola (78). In 97 he was appointed superintendent of the aqueducts *(curator aquarum)* at Rome. His treatise *De re militari* is lost. His *Strategematicon libri iii.* is a collection of examples of military stratagems from Greek and Roman history; a fourth book, the plan and style of which is different from the rest (more stress is laid on the moral aspects of war; *e.g.,* discipline), is the work of another writer known as Pseudo-Frontinus. Extracts from a treatise on land surveying ascribed to Frontinus are preserved in C. Lachmann's *Gromatici veteres* (1848).

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FRONTO, MARCUS CORNELIUS (c. A.D. 100–170), Roman grammarian, rhetorician and advocate, was born of an Italian family at Cirta in Numidia. He came to Rome in the reign of Hadrian, and soon won fame as an advocate and amassed a large fortune. Antoninus Pius appointed him tutor to his adopted sons Marcus Aurelius and Lucius Verus. In 143 he was consul for two months, but declined the proconsulship of Asia on the ground of ill health. His talents were greatly admired by his contemporaries, a number of whom formed themselves into a school called after him Frontoniani, whose avowed object it was to restore the ancient vigour of the Latin language. The authors recommended include Ennius, Plautus and Sallust. Till 1815 the only extant works ascribed (erroneously) to Fronto were two grammatical treatises, *De nominum verborumque differentiis* and *Exempla elocutionurn* (the last being really by Arusianus Messius). In that year, however, Angelo Mai discovered in the Ambrosian library at Milan a palimpsest manuscript from St. Columba at Bobbio (and, later, some additional sheets of it in the Vatican), on which had been originally written some of Fronto's letters to his royal pupils and their replies. These were published at Rome in 1823. The correspondence with Antoninus Pius, Marcus Aurelius and Lucius Verus shows their character in a very favourable light. The collection also contains letters of recommendation to friends, treatises on eloquence, some historical fragments and literary trifles on such subjects as the praise of smoke and dust, of negligence, and a dissertation on Arion. Fronto's style is "a laborious mixture of archaisms, a motley cento," the forerunner of the Latin of Apuleius.

The best edition of his works is by S. A. Naber (1867), with an account of the palimpsest; *see* also G. Boissier, "Marc-Aurèle et les lettres de F.," in *Revue des deux mondes* (April 1868); R. Ellis. in *Journal of Philology* (1868) and *Correspondence of Fronto and M.*

Aurelius (1904); and the full bibliography in the article by Brzoska in the new edition of Pauly's *Realencyklopadie der classischen Altertumswissenschaft,* iv, pt. i (1900). Edition with English translation by C. R. Haines, Loeb series (1919); *see* also *M D* Brock, *Studies in Fronto and His Age,* Girton Coll. Studies, V (1911)—a more favourable view of Fronto's style.

FROSINONE, a town of Italy (anc. Frusino) and the capital of a province, 53 mi. E.S.E. by rail from Rome. Pop. (1951) 14,035. The town is picturesquely situated on a hill of 955 ft. above sea level, but contains no buildings of interest. It was a Volscian, not a Hernican, town; a part of its territory was taken from it and sold about 306–303 B.C. by the Romans, later becoming an unimportant colony. It was situated a little way above the Via Latina.

FROSSARD, CHARLES AUGUSTE (1807–1875), French general, was born on April 26, 1807, and entered the army from the École Polytechnique in 1827, being posted to the engineers. Napoleon III made him in 1867 chief of his military household and governor to the prince imperial. He was one of the superior military authorities who in the period 1866–70 foresaw and endeavoured to prepare for the inevitable war with Germany, and at the outbreak of mar he was given by Napoleon the choice between a corps command and the post of chief engineer at headquarters. He chose the command of the 2nd corps. On Aug. 6, 1870, he held the position of Spicheren against the Germans until the arrival of reinforcements for the latter and the nonappearance of the other French corps compelled him to retire. He took part in the battles around Metz, and was involved with his corps in the surrender of Marshal A. F. Bazaine's army. General Frossard published in 1872 a *Rapport sur les opérations du 2 corps.* He died at Château-Villain, Haute-Marne, on Aug. 25, 1875.

FROST, EDWIN BRANT (1866–1935), U.S. astronomer, specialist in stellar spectroscopy, was born in Brattleboro, Vt., on July 14, 1866, and graduated from Dartmouth college, Hanover, N.H., in 1886. In 1898 he became professor of astrophysics at The University of Chicago and astrophysicist at the Yerkes observatory, Williams Bay, Wis., of which he served as director for the period 1905–32.

Frost's chief contributions were in the field of stellar spectroscopy, especially the spectrographic determination of velocities of stars.

FROST, ROBERT LEE (1874–), U.S. poet, might never have become "the poet of New England" had not his father made a dying request to be buried in his native New England. So it happened that Mrs. William Prescott Frost took her son Robert, born in San Francisco, Calif., March 26, 1874, and a younger daughter Jeanie, across the continent from San Francisco to Lawrence, Mass., for the interment of her husband in 1885. No funds were available for the return trip and the widow settled with her children in Salem, N.H., where Mrs. Frost earned a living for several years by teaching school.

Entering Dartmouth college in the fall of 1892, Robert Frost so intensely disliked formal study that he remained there less than one semester. During the next two years, he earned a living in miscellaneous ways while sending poems to uninterested editors. In 1894, to celebrate his first sale of a poem ("My Butterfly"), he privately printed six of his poems in a booklet entitled *Twilight,* an edition limited to two copies, one for his affianced, Elinor White, and one for himself.

After his marriage in 1895, Robert Frost taught for two years at his mother's private school in Lawrence and then spent the next two years as a special student at Harvard. In 1900, for reasons of health, he moved to a small farm in Derry, N.H.. and conducted a small poultry business there until 1905. Failing as a farmer, he taught various subjects in the Pinkerton academy at Derry from 1905 to 1911 and then moved to Plymouth, N.H., where he taught psychology for a year in the New Hampshire State Normal school.

Still intent only on achieving success as a poet, he sold his Derry farm and with the proceeds took his family to England, where he devoted his time entirely to writing. During that extremely important three-year stay in England (1912–1915), he published his first two books of poetry: *A Boy's Will* (1913) and *North of Boston* (1914). The cordial praise given those poems by British men of letters won him lasting friendships in England and attracted the surprised attention of critics and editors in his native land. When he returned to the United States in 1915, his first two books had been reissued in New York, and *North of Boston* soon became a best seller.

Although the Frost family bought and settled on a small farm in Franconia. N.H., immediately after the return from England, the poet found himself in unexpected demand for public readings and lectures. Thus began the habit which gradually made his genial personality as well known and loved as his poetry. When he found that not even success as a poet afforded adequate financial returns, he accepted various invitations to teach' from colleges and universities—Amherst (1916–20, 1924, 1926–38, 1949–), Michigan (1921–23, 1925), Harvard (1939–43) and Dartmouth (1943–49). He was awarded the Pulitzer prize for poetry in 1924, 1931, 1937 and 1943.

After his first two works mentioned above, his major works include *Mountain Interval* (1916), *New Hampshire* (1923), *West-Running Brook* (1928), *A Further Range* (1936), *A Witness Tree* (1942), *A Masque of Reason* (1945), *A Masque of Mercy* (1947), *Steeple Bush* (1947) and *Complete Poems* (1949).

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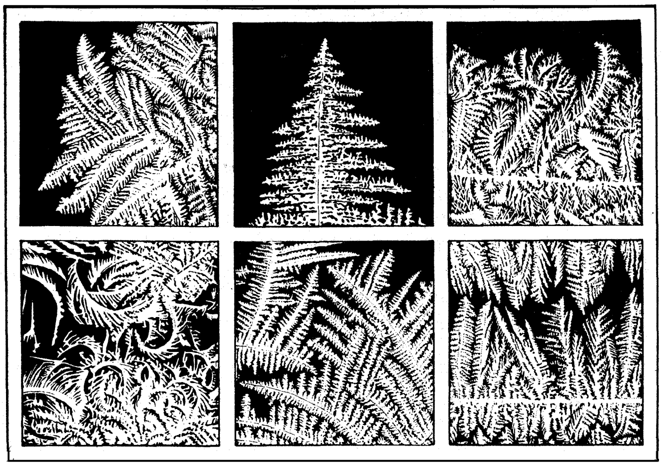
FROST, a term used in two senses: (1) atmospheric water directly crystallized on the ground and on exposed objects; and (2) the occurrence of subfreezing temperatures affecting plants and crops. Frost crystals, often called hoarfrost in the aggregate, form by the passing of the invisible water vapour of the atmosphere into the ice crystal phase without going through the liquid phase. Hoarfrost lightly covers fields and roof tops under conditions that would form dew (*q.v.*) if the temperature were above freezing at the point of formation. Sometimes the freezing temperature will be reached after dew has already formed, producing frozen dew, but this usually cannot be readily distinguished because crystals ordinarily will start forming at about the same time the freezing starts. Pertaining to plant culture, frost refers to the freezing of the aqueous solutions in the plant cells causing these to burst and destroy the plant. Only plants containing plentiful and dilute solutions in their leaves, fruits, etc., are easily damaged. The occurrence of a killing frost without a hoarfrost deposit is sometimes popularly called a black frost.

In physiography and technology the term frost is applied to a variety of freezing processes. Thus, one speaks of the depth of frost penetration in the soil, meaning depth of frozen ground, frost action in the erosion of rocks, frost heaving of soils, frosting of surfaces by other vapours as well as nater, frost damage to structures, newly laid cement, etc.

The most important aspect of frost in relation to plants is its determination of the length of the growing season, which is defined as the period from the last killing frost in spring to the first killing frost in autumn, with reference to the tenderest crop plants. There are regions of the earth mhere the season reaches critically short proportions for the maturing of most usable crops and others where the season is so long that more than one planting of such crops as corn (maize) and alfalfa can be brought to harvest. In regions where frost is rare or absent, other factors take on more importance.

One of the most critical situations for frost is encountered in the citrus fruit regions. There the few killing frosts likely each winter are combated by heating the groves with crude oil heaters called smudge pots or by mixing the air with huge fans to prevent the cold air from settling down. The smoke from the smudge pots reduces the heat losses of outgoing radiation to some extent but the smoke nuisance in most localities offsets this advantage and local legislation or campaigns are directed toward use of cleaner, more efficient burners.

In citrus growing regions the government meteorological offices developed special frost-warning services with a high degree of usefulness to growers in the United States. In the Pacific coast fruit regions the service was extended to make it possible to prevent frost damage to deciduous fruit crops such as peaches, apricots, almonds, pears and even apples during the period of blossoming both in the United States and in Canada. Protection of orchards was undertaken less extensively in the eastern deciduous fruit regions. Atlantic coast and Wisconsin cranberries are protected from frost at critical times of the growth cycle by flooding



SOME OF THE FORMS ASSUMED BY HOARFROST ON WINDOWPANES

the cranberry bogs n·ith water.

The crystalline and other forms of frost deposit are a subject of aesthetic as well as scientific interest. The structures differ in some respects from those of snow (*q.v.*). Granular forms Froduced by the freezing of droplets of liquid water carried in the air at temperatures below freezing, technically called supercooled droplets, form rime. It is best developed on mountain tops enveloped in supercooled clouds.

Rime is a common form of icing on aircraft. It also occurs in steam fogs around open springs, streams, lakes or ponds in very cold weather and in extreme conditions around chimneys from the water vapour condensed in the flue gases. True crystalline hoarfrost is of two classes, that which assumes columnar forms and that which assumes tabular forms. Generally the crystals of these two classes do not occur together on a single night; rather, one or the other will greatly predominate. Columnar forms usually comprise the majority of hoarfrosts of spring and autumn. The columns are. in their best-preserved state, hexagonal in cross section. hollow and variable in size and slenderness.

Tabular or platelike hoarfrost crystals are most common at low temperatures such as those of midwinter. They resemble snow plates, but since they must grow outward in segments from some supporting object they rarely assume the perfect symmetry of many snow crystals. Over ice-covered ponds and rivers, beautiful clusters or rosettes of fernlike or jewel-like frost collect on the surface of the ice. At very low temperatures cubical crystals are sometimes found.

Children and adults alike in cold climates have been fascinated by the beautiful and varied frost forms found on the inner surfaces of windowpanes in buildings. In most cases with heated rooms the vapour condenses as a liquid first. but if the conditions are right, such as in an unheated room, the delicate pure crystalline forms are predominant. These will resemble fairy forests of fir trees, ferns, starry skies and castles or submarine gardens with corals. starfish and plants. Some of the designs. especially those that form along otherwise obscure scratches or strictions in the glass, are repeated from one occasion to the next. Factors affecting the design are the presence of films, dust particles, oily marks and irregularities on the glass. The tiny eddy currents of air over the glass and the nearness of other frost crystals also have an effect. (H. R. B.)

FROSTBITE is an injury to the skin or underlying tissues or both. resulting from exposure to cold of such severity and duration that actual freezing (ice formation) occurs. Air temperatures must be below 32° F. for frostbite to occur. Unprotected areas of skin exposed to very cold mind can freeze in less than one minute. but usually freezing occurs only after longer exposure. Parts of the body most commonly frozen are toes, fingers; ears and nose. Mild true frostbite produces only swelling and reddening of the skin; severe frostbite may affect deep tissues, including bone, and may culminate in gangrene (*q.v.*) and loss of the frozen part. Reddening or blanching of the skin from mere chilling instead of freezing should not be called frostbite. Cold injuries without actual freezing, such as chilblain (*q.v.*), immersion foot and trench foot, are frequently confused with true frostbite; these injuries occur as the result of exposure for many hours in air or water at temperatures above freezing. Experiments conducted during World War II and later showed that frostbite should be treated by very rapid thawing of the still frozen part in warm water. The frozen part should never be rubbed with snow. (F. A. FN.)

FROSTWEED (*Helianthemum canadense* or *Crocanthemum canadense*), a North American plant of the rockrose family (Cistaceae). which is native to dry rocky places and sandy soils from Maine to Ontario and Wisconsin southward to North Carolina and Missouri.

It is a slender, sparsely branched, slightly woody perennial, with small, narrow, nearly stalkless leaves and showy yellow flowers, $\frac{3}{4}$ in. to $1\frac{3}{4}$ in. across. usually borne singly or rarely two together, the petals soon falling. These are followed later by small short clusters of cleistogamous (self-fertilized in the bud stage, or at least without opening) flowers. without petals. borne in the axils of the leaves. The plant is remarkable in that late in autumn crystals of ice sometimes shoot from the fissured bark at the base of the stem, whence the popular name.

The hoary frostweed (H. *majus* or *C. majus*), a similar species but of more western and southern range, exhibits the same peculiarity.

FROTTOLA, an Italian choral form, popular about 1490–1530. consisted of four parts: the melody in the highest voice: a bass harmonic and two inner parts of lesser importance. Sometimes a lute or other instrument took one of the minor parts, but usually the frottola was unaccompanied. The same music was repeated for several verses in a fashion simpler than the madrigal proper. which succeeded it. The music of the frottola was less contrapuntal than that of the madrigal, and the words usually were humorous or sentimental.

O. Petrucci of Venice published 11 books of frottole from 1504 to 1514, 10 of which remain.

FROUDE, JAMES ANTHONY (1818–1894), English historian, son of K. H Froude, archdeacon of Totnes, was born at Dartington, Devon, on April 23, 1818. He was educated at Westminster and Oriel college. Oxford, then the centre of the ecclesiastical revival, and was elected a fellow of Exeter college *(1842)*. Froude joined the High Church party and helped J. H. Newman, aftenvard cardinal, in his *Lives of the English Saints*. He was ordained deacon in *184;* By that time his religious opinions had begun to change, he grew dissatisfied with the views of the High Church party and came under the influence of Thomas Carlyle's teaching. Signs of this change first appeared publicly in his *Shadows of the Clouds* (1847), published under the pseudonym of "Zeta." and his complete desertion of his party was declared a year later in his *Nemesis of Faith*.

On the demand of the college he resigned his fellowship at Oxford. The first two volumes of his *History of England from the Fall of Wolsey to the Defeat of the Spanish Armada* appeared in 1856, and the work was completed in 1870. Froude held that the office of the historian was simply to record human actions and that history should be written as a drama. Accordingly he gives prominence to the personal element in history. His work is often marred by prejudice and incorrect statements. The keynote of his *History* is contained in his assertion that the Reformation was "the root and source of the expansive force which has spread the Anglo-Saxon race over the globe." Hence he overpraises Henry VIII and others who foruarded the movement, and speaks too harshly of some of its opponents. A strong anticlerical prejudice is manifest in his historical work generally, and is doubtless the result of the change in his views on church matters and his abandonment of the clerical profession. Carlyle's influence on him may be traced both in his admiration for strong rulers and strong government, which led him to write as though tyranny and brutality were excusable, and in his independent treatment of character. His rehabilitation of Henry VIII was a useful corrective, but his representation of him as the minister of his people's will is founded on the false theory that the preambles of the acts of Henry's parliaments represented the opinions of the educated laymen of England. He was not a judge of evidence, and seems to have been unwilling to admit the force of any argument or the authority of any statement which militated against his case. He worked diligently at original manuscript authorities at Simancas, the record office and Hatfield house; but he used his materials carelessly, and evidently brought to his investigation of them a mind already made up as to their significance. He was constitutionally inaccurate. and seems to have been unable to represent the exact sense of a document which lay before him, or even to copy from it correctly.

Few more brilliant pieces of historical writing exist than Froude's description of the coronation procession of Anne Boleyn through the streets of London, few more full of picturesque power than that in which he relates how the spire of St. Paul's was struck by lightning; and to have once read is to remember forever the touching and stately nords in which he compares the monks of the London Charterhouse preparing for death to the Spartans at Thermopylae. Proofs of his power in the sustained narration of stirring events are abundant; his treatment of the Pilgrimage of Grace, of the sea fight at St. Helena and the repulse of the French invasion, and of the murder of David Rizzio are among the most conspicuous examples of it. Nor is he less successful when recording pathetic events, for his stories of certain martyrdoms and of the execution of Mary queen of Scots are told with exquisite feeling and in language of well-restrained emotion. And his characters are alive. We may not always agree with his portraiture, but the men and women whom he saw exist for us instinct with the life with which he endows them and animated by the motives which he attributes to them. His successes must be set against his failures. At least he wrote a great history, one which can never be disregarded by future writers on his period, be their opinions what they may, and which attracts and delights a multitude of readers and is a splendid example of literary form and grace in historical composition.

On the death of his adversary E. A. Freeman in 1892, Froude was appointed to succeed him as regius professor of modern history at Oxford. His lectures on Erasmus and other 16th-century subjects were largely attended. He died on Oct. 20, 1894. His long life had been full of literary work. For 14 years he was editor of *Fraser's Magazine.*

Froude was one of Carlyle's literary executors, and brought some sharp criticism upon himself by publishing Carlyle's *Reminiscences* and the *Memorials of Jane Welsh Carlyle,* for they exhibited the domestic life and character of his old friend in an unpleasant light. Carlyle had given the manuscripts to him, telling him that he might publish them if he thought it well to do so, and at the close of his life agreed to their publication. He also wrote *Thomas Carlyle: a History of the First Forty Years of His Life* (1882) and *Thomas Carlyle, a History of His Life in London* (1884); *Short Studies on Great Subjects* (1867–82); and a historical novel, *The Two Chiefs of Dunboy* (1889).

Froude was taice married. His first wife, a daughter of Pascoe Grenfell and a sister of Mrs. Charles Kingsley, died in 1860. His second wife, a daughter of John Warre, M.P. for Taunton, died in 1874.

See H Paul, *Life of* **J.** *A. Froude* (1905).

FROUDE, WILLIAM (1810–1879). English engineer and naval architect, who founded the modern science by which the forces on a ship are predicted from experiments with geometrically similar models, was born at Dartington, Devon, on Nov. 28, 1810. He was educated at Westminster school and Oriel college, Oxford. He worked as a railway engineer until 1846, after which he began the pioneer work on ship hydrodynamics for which he is famous. In 1868 he served on a committee appointed by the British association to study naval design. The other committee members were agreed that tests with models could not be relied upon for predicting the performance of ships, but Froude advocated a more thorough investigation of the laws governing the extrapolation from model to full scale. He was invited to explain his proposals to the admiralty, and this led, in 1870, to a grant for the construction of a ship model testing tank. This, the forerunner of the model tanks which are now to be found in all maritime countries, was built at Froude's home near Torquay. Here he found that the chief components of resistance to motion were skin friction and wave formation, and showed how the total resistance of a ship could be extrapolated from the results of model experiments.

His methods in all probability inspired pioneers in aerodynamics to adopt model testing and thus contributed to the rapid development of aircraft design. In 1870 he was elected a fellow of the Royal society, whose royal medal he received in 1876. He died on May 4, 1879, while on a visit to South Africa. His many published papers were reprinted in one volume by the Institution of Naval Architects in 1955. (S. J. P.)

FROZEN FOODS: *see* FOOD PRESERVATION.

FRUCTOSE: *see* CARBOHYDRATES.

FRUGONI, CARLO INNOCENZO (1692–1768), the most prolific of the Italian Arcadian poets *(see* ITALIAN LITERATURE). Born at Genoa, Nov. 21, 1692, he took monastic vows at the age of 17. In 1716 he formed an Arcadian society and was later recommended by Cardinal Cornelio Bentivoglio as poet laureate to Antonio Farnese, duke of Parma. He dedicated sonnets to the duchess of Parma, Philip V of Spain and, in 1734, a pindaric ode to the French ambassador. Having obtained remission of his monastic vows, he lived in Venice in great poverty, but after the peace of Aix-la-Chapelle was appointed poet of the court theatre in Parma. He died at Parma, Dec. 20, 1768.

Frugoni wrote over 1,000 sonnets and 250 lyrical odes besides a large number of poems in free verse. His work was admired less for its originality than for its facility and elegance. He was also known for his translations from the French and for his librettos for two operas by Tommaso Traetta, adapted from the librettos of Rameau's *Hippolyte et Aricie* and *Castor et Pollux.*

Frugoni's works were published in 10 vol. (1779) and 15 vol. (1779–80). *See* also C. Calcaterra, *Storia della poesia frugoniana* (1920); A. Equini, *C. I. Frugoni alle covti dei Farnesi e dei Borboni di Parma* (1919–20).

FRUIT, in its popular sense is any product of the soil that can be enjoyed by man or animals; in the Bible the word is often extended to include the offspring of man and of animals; *e.g.,* in such expressions as "the fruit of the womb." "fruit of thy cattle" in the Authorized Version of the Bible (Deut. xxviii, 4). More often it is employed to denote a group of edible parts of plants, as contrasted with another group termed vegetable. But the term is a loose one, including, for example, the stalks of the rhubarb.

In its strict botanical sense the fruit is developed from the ovary of the flower as a result of the fertilization of the contained ovule or ovules. In a somewhat broader sense the fruit of angiosperms consists of the mature ovary and any closely associated parts. Fertilization induces various changes: the anthers and stigma wither, the petals drop off and the sepals may be shed or undergo modifications; the ovary enlarges and the ovules develop into seeds, each containing an embryo plant. Normally no fruit is produced unless fertilization is effected; but in certain plants, mostly cultivated varieties, this is not the case (*e.g.,* the seedless orange and grapes, the banana and the cucumber).

The production of fruit without fertilization is known as parthenocarpy, and as early as 1902 attempts were made to develop such fruits artificially by treating the pistil with pollen extracts and with various chemicals. After 1934, considerable progress was made in this work, and successful results were obtained with the tomato, petunia, pepper, gladiolus, holly and salpiglossis. Among the compounds that gave promise in inducing parthenocarpy experimentally are naphthalene acetic acid, indoleacetic acid, indolebutyric acid and B-naphthoxyacetic acid.

Functions of Fruit.—The fruit protects the developing seeds and may aid in their distribution when mature. This latter function is very important, and numerous devices secure a wide and effective dispersal. These may be classified according to the agents employed as animate and inanimate. To the second group belong those methods by which the plant itself propels the seed forcibly from the fruit. Some plants employ a combination of the two. Thus in the gorse the seeds are shot out by the splitting and curling of the pod in which they are contained, and they must then be buried by ants in order to germinate. Violent dehiscence occurs in many plants (fig. 28). In the squirting cucumber the walls of the pericarp exert pressure on the pulpy contents in which the seeds are placed. In the balsam (Impatiens) also, the seeds are actively expelled. Other inanimate agents are water and wind. Fruits or seeds are sometimes sufficiently buoyant to float for a long time in water. Thus the coconut may be carried hundreds of miles in the sea; the fruits and seeds of West Indian plants are sometimes throun up by the Gulf stream on the coasts of Europe and will often germinate; in the water lily and many other aquatic plants, the seeds float for a time before sinking to the bottom. In many cases the wind plays a part in distrtbution. In the poppy and many Caryophyllaceae (figs. 6, 7) there is a capsule opening by pores borne on a long stalk which sways in the wind. thus jerking out the seeds. In the pine, sycamore (fig. 22), ash (fig. 1) and many others, there is a winglike development; in numerous Compositae the fruit is crowned by a plumose pappus (*e.g*, dandelion, thistle); in the clematis, the style becomes feathery, while the seeds of the willow and poplar bear tufts of silky hairs. The fruit of the bladder senna (Colvtea) is easily rolled by the mind, while in the rose of Jericho (*Anastatica hierochuntica*), the whole plant dries up after developing its fruits and forms a mass, easily rolled over the dry ground by the wind A notable example of dissemination of seed by the whole plant is the Russian thistle (Salsola Kali var. *tenuifolia*). Introduced into the United States in 1873 with flaxseed, it invaded a large part of the western states.

Birds and mammals are also utilized as dispersal agents by plants. The mistletoe develops a sticky layer around the seeds which stick to the bill of the bird that eats the berries; these may be wiped off on the bark of trees, thus transporting the embryo to a new host. More commonly, the fruit develops hooks which become entangled in the fur or feathers. Such are the fruits of cleavers (Galium *aparine*), *Ranunculus arvensis* (fig. 21), etc. In some cases the inner portion of the fruit, the endocarp, forms a hard covering surrounding the seed while the remainder of the pericarp is succulent and often brightly coloured. Thus the seed can pass through the alimentary tract of an animal without injury; *e.g.*, plum, cherry (fig. 5). The true fruit may be provided with stiff hairs, which cling to the beak of the bird which eats the fleshy receptacle; *e.g.*, rose (fig. 3).

Classification and Structure.— There are several systems of classifying fruits. On the basis of the texture of the pericarp, and accessory parts when present, they may be classified as dry, dry-fleshy or fleshy. In the dry types the pericarp becomes desiccated as it matures; while in the fleshy forms it becomes wholly or in part succulent. In the intermediate dry-fleshy types. part of the pericarp becomes desiccated and frequently hardened while the other portions of the ovary wall are fleshy and succulent. The dry types are called indehiscent if they do not open at maturity, and dehiscent if the pericarp opens in some manner to liberate the mature seeds. The former are usually single-seeded, the latter commonly contain two to many seeds. These types may be further subdivided on the basis of the number of carpels and accessory structures that comprise the fruit (see Table I).

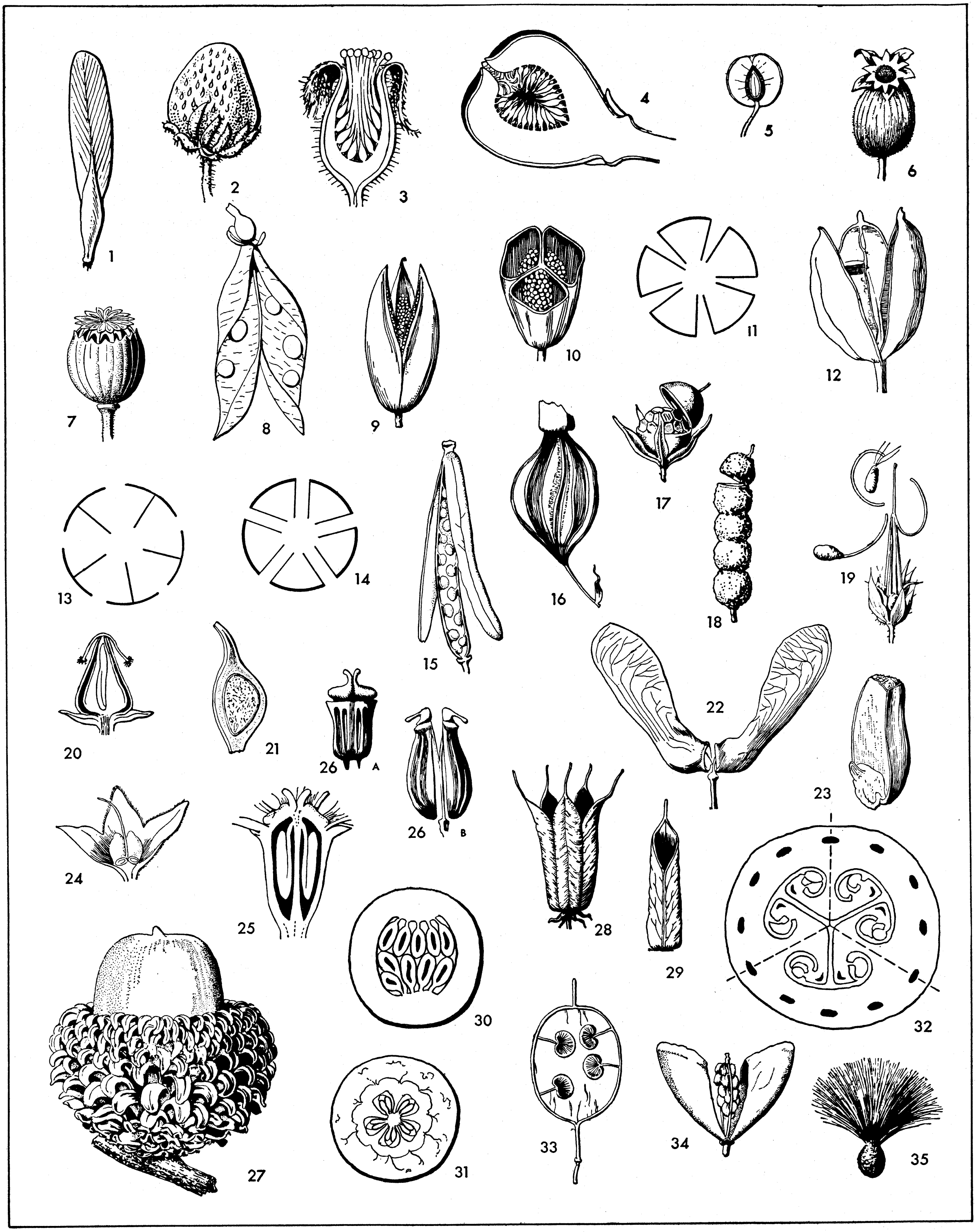
The principal indehiscent dry fruits are the caryopsis or grain, the achene, the schizocarp and the nut. The caryopsis contains a single seed and develops from one or more carpels. In its development the integuments become so closely appressed to the pericarp that the two structures cannot be separated readily in the mature fruit. The fruits of cereal crops and other members of the Gramineae belong in this group. In the achene the pericarp is closely applied to the seed but can be separated from it. This type of fruit may develop from a single carpel. as in the Ranunculaceae, or from two carpels, as in the Compositae. in which the receptacle is also a part of the fruit. Achenes are borne singly in the dock; aggregated in the buttercup (fig. 21); on a fleshy receptacle, which may be convex as in the strawberry (fig. 2) or concave, as in the rose (fig. 3). Thus what is popularly called the fruit of these last three is really the enlarged receptacle with the carpels. In Clematis the style, and in many Compositae the specialized calyx remain adherent to the fruit. The limb of the floral tube is frequently plumose and is then termed the pappus. The schizocarp consists of two or more carpels, each of which forms an indehiscent achenelike fruit known as a mericarp and contains a single seed. Examples of this are found in the Geraniaceae, in which the mericarps separate from below upward (fig. 19) and in the Umbelliferae, in which the ripe mericarps are usually suspended from a unique structure called the carpophore. Rlericarps or achenes in which the pericarp is extended to form a winged appendage, as in the ash (fig. 1) and sycamore (fig 22), are called samaras or key fruits. A nut has a hardened pericarp often surrounded by bracts at its base formed from the involucre as in the acorn (fig. 27). Other examples are the hazelnut and chestnut. The term has been popularly applied to other fruits (almond, walnut); to seeds (Brazil nut); and to legumes (peanut) which do not belong to this type on the basis of structure.

The principal dehiscent dry fruits are the follicle, the legume or pod, the capsule, the silique and the silicle. In the follicle, there is a single line of dehiscence which usually occurs along a suture on the adaxial surface. The fruit is formed from a single carpel, but usually several fruits are aggregated; e g., columbine (figs. 28, 29). A legume or pod differs in dehiscing along both sutures. This is characteristic of leguminous plants. such as the pea (fig. 8). A few legumes are indehiscent as in the peanut, *Arachis*, nhere the fruit is developed underground. Hedysarum and others have a pod that separates transversely into single-seeded mericarps (fig 18); such a structure is called a lomentum and may be regarded as a specialized indehiscent legume. In Erythrina monosperma there is only one seed. In the Cruciferae (wallflower, cabbage, shepherd's-purse) the characteristic fruit is

Table I.—*Classification of* ***Fruits***

Major Types	Structure			
	One carpel	Two or more carpels	Two or more carpels plus stem axis or floral tube	Carpels plus stem axis or floral tube and accessory parts
Dry Indehiscent	Caryopsis (grain) corn, wheat, grasses Achene buttercup, anemone Legume peanut	Silique radish Samara (key-fruit) ash, elm, maple Nut acorn, hazelnut, chestnut	Achene aster, sunflower, dandelion Schizocarp carrot, fennel	
Dry Dehiscent	Follicle milkweed, columbine, marsh marigold Legume pea, bean	Capsule onion, lily, poppy Silique rock cress, cabbage Silicle shepherd's-purse, pepper-grass	Capsule iris	
Dry-Fleshy	Drupe plum, peach, almond, cherry	Drupe coconut	Pome apple, pear, quince, hawthorn Aggregate raspberry, strawberry	Multiple (pseudocarp) fig, mulberry
Fleshy	Berry May apple	Berry tomato, grape Hesperidium orange, lime	Inferior berry blueberry Pepo squash, cucumber, pumpkin, watermelon	Multiple pineapple

FRUIT



1. Fruit of ash. **2.** Strawberry. 3. Fruit of rose. 4. **Fig fruit.** **5.** Cherry. **6.** Seed vessel of camplon. 7. Poppy capsule. 8. Pea pod. 9 and 10. Meadow saffron capsules and seeds. **11.** Diagram of **pentalocular** capsule. **12.** Flower-de-luce capsule. **13.** Diagram showing **loculicidal** dehiscence. **14.** Diagram showing septicidal dehiscence. **15.** Seed vessel of wallflower. **16. Orchid** capsule. **17.** Seed **vessel** of ***Anagallis arvensis.*** **18.** Lomenturn of ***Hedysarum.*** **19.** Geranium fruit. 20. Dry one-seeded dock fruit. **21.** Achene of *Ranunculus* arvensis. **22.** Samara of maple. **23.** Section of wheat grain. **24.** Comfrey fruit. 25. Ovary of Foeniculum officinale. 26A and **26B.** ***Carum carvi*** fruit. **27.** Quercus ***aegilops,*** acorn. **28.** Columbine fruit. **29.** Single follicle. **30.** Section of gooseberry. **31.** Section of apple. **32.** Section*of melon. 33. Honesty, septum of fruit: **34. Silicle** of shepherd's-purse. **35.** Asclepias seed a silique which is long and narrow; if short and broad it is termed a silicle (fig. 34). In both of these types carpels dehisce by two valves from below upward, the valves separate from the placentas and leave them united by a false septum. In a few cases (radish) the fruit is indehiscent. The capsule is formed from two or more carpels and may include a portion of the axis as in Iris (fig. 12). The dehiscence of the capsule may occur by means of pores as in the poppy (fig. 7) and *Campanula,* or by means of a lid as in the pimpernel (fig. 17).

The dry-fleshy fruits include the drupe, aggregate, pome and some of the multiple forms. To this group belong many edible fruits. In the drupe, as shown by the cherry (fig. 5), plum, etc , the endocarp is usually hard and the mesocarp pulpy and succulent, though in the almond it is tough and in the coconut fibrous. In the aggregate fruit, such as the raspberry and strawberry, several small drupes or achenes develop on the receptacle which in the case of the latter is fleshy and edible. In the pome the fleshy outer portion consists of the undiverged floral parts which are more or less adnate to the carpels. Examples of this type are the apple (fig. 31), pear and quince. The multiple fruit or pseudocarp differs from the aggregate fruit in that it results from the conjoint development of several flowers while the latter is the product of several pistils of a single flower. Thus in the mulberry the fruit is formed by the coalescence of a spike of flowers. Each flower produces a fruit that is nutlike and surrounded by fleshy floral parts. In the fig (fig. 4) the whole inflorescence is within a hollow receptacle nhich may contain both staminate and carpellate flowers, each of the latter forming a true fruit. The pineapple is a fleshy type of multiple fruit in which the entire inflorescence is involved; the individual pomelike fruits are borne in the axils of more or less fleshy bracts, and the axis of the inflorescence is also somewhat fleshy.

The principal fleshy types are' the berry, hesperidium (specialized berry), and the pepo (inferior berry). The berry has a fleshy pericarp at maturity. It develops from an hypogynous flo er which often has two or more carpels as in the tomato, but it may be produced from a single carpel as in the May apple, *Podophyllum.* The hesperidium is a specialized berry in which the dorsal walls of the carpels form a thick rind and from the inner surface of which fleshy succulent hairs arise and more or less fill the carpellary cavities. The citrus fruits, orange, lemon, lime, etc., belong in this group. The pepo develops from an epigynous flower and is similar in structure to the pome except that the outer portions frequently become very hard as in some squashes and pumpkins. The edible part consists of the carpels and a portion of the enveloping receptacle. See ANGIOSPERMS; FLOWER; SEED. (H. E. HD)

Dwarf Fruit Trees. — In horticultural practice the dwarf fruit tree is produced by grafting a variety of apple, peach, pear or plum to a closely related and compatible plant, called the rootstock, which inherently makes small growth and in a corresponding manner restricts the growth of the variety grafted on it. A fruit tree can also be dwarfed by restricting root development; *e.g.,* by growing the tree in a pot.

Rootstocks used to dwarf fruit trees originate from individual seedlings having dwarfing tendencies and are propagated by vegetative means, as by layering or by taking cuttings and rooting them. Each plant propagated from the original is identical with it. In the production of dwarf apple trees two rootstocks are used, Malling No. IX and Malling No. VII. The former has the greater dwarfing ability and induces the tree to bear fruit at the earliest age. Pear trees are dwarfed by grafting the variety to a quince rootstock. *Prunus* besseyi and a selected plum stock known as St. Julien Malling Selection A serve as dwarfing stocks for peach and plum varieties.

Dwarf trees are grown as various forms. The bush tree, having a go-in.-long trunk nith several lateral branches arising from it, is the most popular and easiest to grow. The pyramid type, with a central stem 8 ft. long from which branches arise in successive tiers 20 in. apart, is more difficult to train. The cordon, consisting of a single stem 10 ft. in length on which the fruit spurs are arranged, is grown in a vertical position or can be trained to grow at an angle. The espalier trained on trellises or walls has a central stem from which arise horizontal tiers of branches that carry the fruit spurs. The fan-trained tree has a permanent framework of branches arranged in the shape of a fan when training is completed. The bush tree is adapted to all the different tree fruits, whereas pyramids. cordons and espaliers are best suited for apples and pears. The fan-trained tree is preferred for growing peaches and plums against walls or trellises. (K. D. B.)

FRUIT BAT: see BAT; FLYING-FOX.

FRUIT COOKERY. Though certain fruits. *e.g.,* breadfruit, dates, figs, form the staple food of various tropical peoples, fruits are used by nations in the temperate zones mainly as an agreeable means of introducing liquid into the system; for their mixture of salts and vegetable acids; *e.g.,* tartaric, malic, citric; for their slight laxative properties; as an antiscorbutic; and as a valuable medium for supplying the body with vitamins. Fruits can be classified as small fruits, including currants, raspberries, blackberries, strawberries, etc.; apricots, plums, cherries, etc.; citrus fruits; *i.e.,* oranges, tangerines, lemons, grapefruit, etc.; orchard fruits, apples, pears, etc.; vine (grapes) ; and a few fruits which do not come into any of these categories, as for instance, pineapple, avocado, olive. etc. Fresh fruit is used as a first course and as dessert and for fruitades.

Methods of Cooking. — There are innumerable ways of serving fruit. and because of the great variety of fruits at the disposal of mankind it is possible to employ every known method of cookery in preparing fruit dishes (see PRESERVING AND BOTTLING).

Stewed Fruit. — A great number of fruits can be cooked by stewing either by a waterless method or with the addition of a little water and sugar. By the waterless method the fruit is placed in a stone jar (with or without sugar according to taste) in a pan of boiling water. In this way, all the juices of the fruit are conserved without loss of flavour. Where water is added this should be as little as possible with due consideration for the amount of water (generally about 80%) already contained in the fruit. If desired to keep the fruit whole it is wiser to boil the sugar and water before adding the fruit. All fruit should be stewed slowly. Overheating causes the pectin in fruit to jelly. Dried fruits should be soaked before stewing in order to restore the water.

Baked Fruits. — Apples may be cored, filled with sugar and cooked in a baking dish. A compote of fruit is baked fruit to which is added a sugar syrup.

Fried Fruit. — A number of fruits may be dipped in batter and fried in deep fat and served as fritters. In this case, the fruit, if large, is cut into suitable portions, or if small. is left whole in a sugar syrup for a short time before frying. Certain fruits may be sliced and pan fried as a vegetable.

Fruit Salads. — These may be sweet or savoury and are made by mixing different fruits together with certain flavourings, *e.g.,* liqueurs, essences, oil, vinegar, etc., to form a salad. When raw fruits are used they are usually soaked in a marinade of their own juices and the flavourings for some time before dishing.

Fruit Molds. — When hot stewed fruit is thickened with a liaison of corn flour, tapioca, sago, etc., or when mixed with jelly powders, gelatin, agar agar, etc., it can be turned out into a wet mold and allowed to cool and served as a blancmange. Dried fruits may be thickened with starch liaisons but it is best to use gelatin or jelly for setting soft small fruits, as this does not spoil the colour of the fruit.

Fruit Ices. — These differ from ice creams in that they possess no cream or custard foundation and are made with a fruit syrup which may, in some cases, be thickened with gelatin to give a smooth appearance. (J. A. SI.)

FRUIT FARMING. The subject of fruit farming deals with the intensive culture of perennial plants whose fruits have economic significance. It is a part of the subject of horticulture (*q.v.*), which also encompasses vegetable growing and the production of ornamentals and flowers. This article places further arbitrary limitations — it takes in neither perennial nut crops, nor a number of very important perennial fruit crops including the coconut and oil palms, vanilla, coffee, cacao and the tung tree (whose problems were once considered beyond the pale of horticulture) which are dealt with in separate articles, as NUT; OIL PALM: etc., and in the articles on OIL PLANTS and TROPICAL AGRICULTURE. See also separate articles on the various fruits discussed in this article. as BANANA; PINEAPPLE. etc.

The first section of this article deals nith fruit farming from the standpoint of economics and geography, and the second section with basic problems and practices of fruit farming.

ECONOMICS AND GEOGRAPHY

Table I gives information on the world production of some of the most important fruit crops. The data are very incomplete because they can only be concerned with commercial movement. Many fruits are used locally in large quantity without going beyond the village markets; mango and banana are examples of such fruits and both are of crucial importance in the diets of very large populations in the regions of production. It seems reasonably certain, however, that the five most important fruits are grape, orange, banana, apple and mango. In second rank of importance are olive, pear, peach and plum; and these are followed by date. fig. pineapple, apricot, avocado, strawberry. the brambles and bush fruits and many others of lesser significance.

TABLE I.—*World Commercial Production of 15 Major Fruits*

Climatic zones of production and fruits grown	Average annual production (000 tons)		Ratio × 100 1955/previous
	Previous*	1955	
Tropical:			
Banana	8,100†	12,300	152
Pineapple	1,310§	1,660	127
Subtropical:			
Date	1,090†	1,480	136
Citrus			
Grapefruit	1,200†	1,900	158
Lemon and lime	1,200†	1,700	
Orange and mandarin	8,700†	14,500	142
Total citrus	11,100	18,100	167
Warm temperate:			
Apricot	600‡	600	101
Fig (fresh basis)	1,230†	1,180	06
Crape	34,600†	40,100	116
Olive	5,100†	4,300	84
Peach	2,100‡	2,500	125
Plum and prune	2,200‡	2,600	118
Cool temperate:			
Apple (excl. cider)	6,800†	9,600	141
Cherry (sweet and sour)	620‡	1,100	178
Pear (excl. perry)	2,300†	3,120	136

*j-year average. †1934–38. ‡1935–39. §1948–52.
Sources: Food and Agriculture Organization of the Uniterl Nations, *Yearbook of Food. and Agricultural Statistics: Production* (1957); U.S. Department of Agriculture, *Foreign Crops and Markets* (Jan. 23, 1958).

Table I illustrates the general increase in world fruit production that has taken place in the middle of the 20th century and shows the dramatic rise in importance of commercial fruit growing in the tropics and subtropics, due largely to increases in output of bananas and citrus fruits. Improvements in technology and consolidation of the industries in the most favoured climates have been responsible for a steady increase in yield per unit of land during this period, so that the total acreage devoted to fruit crops has not risen in proportion to the rise in production.

The geography and main products of the more important of these varied enterprises are briefly discussed below.

FRUITGROWING ENTERPRISES OF THE TROPICS

Although the principal perennial fruit plants of these warm regions differ in many ways. most of them are evergreen and are seriously injured or killed by temperatures below freezing.

Banana.—The banana. which originated in southeastern Asia, is now cultivated throughout the torrid tropics (see Table II for principal regions of production). The ease with which this giant herb may be propagated from pieces of rhizome (rootstock) has made it possible for vast acreages of a few seedless varieties to be planted in widely separate regions. Important among these varieties are Gros Michel. Cavendish and Mysore. Although the fruit is very perishable, its ability to develop good eating quality after having been harvested green has permitted the growth of intricately co-ordinated plantation, shipping and marketing agencies that bring bananas to the temperate zone cities of the western world throughout the year. Perhaps three-quarters of the bananas for these distant markets originate in Central America, northern South America and the islands of the Caribbean. Dried banana "figs" and other palatable products are made, but most of the fruit is sold for consumption unprocessed.

TABLE II.—*1955 (or other Comparable) Production of Bananas and Pineapples in Selected Countries of the Different Principal Regions of Commercial Production*
(000 tons)

Region and country	Bananas	Pineapples
North America:		
Mexico	207	138
Central America and Caribbean:		
Costa Rica	456	—
Honduras	637	2
Dominican Republic	277	—
British West Indies	271	—
South America:		
Brazil	4,086	188
Colombia	344	—
Ecuador	613	—
Asia:		
China (Taiwan)	85	71
India	1,883	—
Malaya	290	77
Philippine Islands	223	97
Africa:		
French West Africa	107	9*
Union of South Africa	15	71
Oceania:		
Australia	120	84
Hawaii	3	803

*1948–52 average.
Source: Food and Agriculture Organization of the United Nations, *Yearbook of Food and Agricultural Statistics: Production* (1957).

Pineapple. — The pineapple is indigenous to the warm regions of northern South America and has been distributed around the norld in the humid tropics during relatively recent times (Table II). A small semiherbaceous perennial with the drought-resistant leaves of an epiphyte, or air plant, it can be cultivated successfully in somewhat drier and cooler tropical areas than the banana. Easy vegetative propagation from slips or suckers has permitted heavy concentration on a few seedless varieties, the most important of which are Smooth Cayenne. Red Spanish and Queen. At present about half the norld's commercial production originates in the Hawaiian Islands and a third in the Caribbean islands, Central America and northern South America. Although shipments of the fresh fruits, harvested a little green, are considerable the canned fruit is the most important commercial product for distant markets, accounting for practically all of the Hawaiian output.

Mango. — The mango tree probably originated in southern India and has been under cultivation in the tropical areas there, in Malaya and in Africa for many centuries. In India alone. there were about 2,200,000 ac. occupied by mango trees in the second half of the 20th century. During the past two centuries the mango has been introduced to the Philippines and to the American and Australian tropics; in the 20th century a small industry was begun in the United States in southern Florida. This large evergreen tree is most apt to be productive in tropical regions with a considerable dry season which coincides with the annual period of bloom. Many varieties have been selected and propagated by graftage: among the most important of which are Mulgoba, Saigon, Carabao: Haden and Julie. In spite of its great importance as a food and dessert in the regions where it is grown there are no reliable statistics on world production. The extreme perishability of the fresh fruit, and special problems with harvesting and storage curtailed its exploitation as a crop for shipment to distant markets. In the second half of the 20th century no appreciable volume of the fruit was processed commercially as a canned or frozen product. although considerable quantities were used for preserves and chutney.

Avocado. — The avocado tree is native to the cool tropical regions of Central America. and was under primitive culture at the time of the Spanish conquests, hoth on the isthmus and on some of the Caribbean islands. During the 20th century intensive selection of superior varieties formed the basis for small commercial industries producing 40,000 to 50,000 tons annually in the United States. in southern California and Florida. These selections are now distributed widely throughout the tropics and may result in further exploitation oi this nutritious salad fruit. Narrow limitations in climatic adaptability and inherent problems of harvesting and postharvest care may continue to limit the avocado's commercial outlets to the luxury bracket, insofar as distant markets are concerned. Among the most important varieties in the second half of the 20th century were Fuerte, Zutano, Lula and Booth 8.

FRUITGROWING ENTERPRISES OF THE SUBTROPICS

Perennial fruit species successful in subtropical regions are able to develop some resistance to injury from freezing temperatures during the winter months, and are benefited in one way or another by the slight seasonal periodicity of the climate. Like species of the tropics they are usually evergreen.

Date. — The majestic date palm is native to the oases in the desert region of the Persian gulf and for thousands of years the fruit has been an essential part of the diet of indigenous populations living in suitable climates of the eastern Mediterranean basin and North Africa. Although the palm has been distributed widely in modern times, nine-tenths of the commercial production emanates from the areas of ancient culture (see Table III). This may result largely from three circumstances: (1) a desert climate with no rainfall during most of the period of fruit development is essential for a marketable product, yet there must be ample soil moisture during this same period; (2) the product is stable and there is a sufficient output in the indigenous region to satisfy most of the world demand at moderate prices; (3) propagation of the superior varieties must be by offshoots from relatively young palms, and the supply is so limited as to make establishment of new date gardens in distant countries very slow and expensive. In spite of these facts a small industry based on old-world varieties, of which Deglet Noor is the most commonly planted, was established in the Coachella valley desert region of California during the 20th century.

Date varieties selected over the past centuries may be divided into three classes according to their physical properties and their sugar content. Dry dates. sometimes called "bread" dates. which are firm and relatively low in sugars are important locally in the old-world desert regions for daily nourishment; the variety Thoory is an example. Semidry varieties soften at maturity, but being firm enough to pack and ship well. are the most important commercially; Deglet Noor, Dayri and Zahidi are examples of this type. Soft dates, used mainly as confection, are most difficult to handle; examples of this kind are Barhee, Khadrawy and Hayany.

TABLE III.—*1955 (or Other Comparable) Production of Dates and Citrus in Selected Countries of the Different Principal Regions of Commercial Production*
(000 tons)

Region and country	Dates	Oranges and tangerines	Lemons and limes	Grapefruit
North America:				
United States	23	5,360	490	1,616
Mexico	8	595	81	
South America:				
Argentina	—	488	81	17
Brazil	—	1,456	20	—
Europe:				
Greece	—	151	44	—
Italy	—	727	333	—
Spain	—	1,141	37	2
Asia:				
Iran	100	—	—	—
Iraq	445	—	—	—
Saudi Arabia	173	—	—	—
India	—	424	270	8
Africa:				
Algeria	87	341	15	5
Egypt	329	327	38	—
Union of South Africa	—	273	5	13
Oceania:				
Australia	—	148	16	6
New Zealand	—	—	2	2

Source: Food and Agriculture Organization of the Unit~ Nations, *Yearbook of Food and Agriculture Statistics: Production* (1957).

Citrus. — Introduced to the western world by traders from southeastern Asia over the period from the 1 nth to the 18th century A.D., the most important citrus fruits are now produced in large quantity in the subtropics and tropics throughout the world. Orange, mandarin (tangerine) and grapefruit trees are most productive and develop the best quality in regions where there is some seasonal periodicity of climate. Since they are able to withstand exposure to a few degrees below 32° F. in midwinter, they may be intensively cultivated in regions n-here occasional light frosts occur as well as in the milder subtropirs. Table III summarizes the statistics on production, showing the great importance of the orange industry on all the continents. Grapefruit, on the other hand, is mainly significant in the United States and the Caribbean region, close to the point of its probable hybrid origin in Jamaica. The lemon and lime are less able to nithstand freezing temperatures than the orange; as a result they are planted in more protected parts of the subtropics, and a larger proportion of lemons and limes are found in the tropics than of oranges.

In the United States, commercial citrus growing is confined largely to central Florida, southern and central California, southern Texas and Arizona. In Florida, which produces 60% of the nation's oranges, the four principal varieties are Parson Brown, Hamlin, Pineapple and Valencia; the first two are sent to the early fresh-fruit market whereas perhaps half of the Pineapple and Valencia crops are sold for fresh fruit and the rest are processed for frozen concentrate. California is responsible for most of the rest of the orange crop, with the two varieties, Washington Navel and Valencia accounting for practically all the acreage. Most of these oranges are sold as fresh fruit. Grapefruit production comes from four states: Florida. Texas, California and Arizona. The main varieties are Marsh Seedless, Foster. Ruby and Duncan. About half the crop is marketed fresh and the rest is either processed for canned sections or for juice. Practically all the mandarins are produced in Florida and are of one variety, the Dancy tangerine. The small lime industry of the United States is located in southern Florida, and has depended in recent years on two relatively large-fruited varieties, Tahiti and Barss; the "Key" lime. grown extensively on the Florida Keys has gradually disappeared as a dominant factor. Lemons are produced almost exclusively in the more protected citrus areas of southern California. The main varieties are Lisbon, Eureka and Villafranca. Most of the fruit is sold fresh but an increasing proportion of it has been processed for frozen concentrate or canned juice.

FRUITGROWING ENTERPRISES OF THE WARM TEMPERATE ZONE

Most of the perennial fruit species adapted to the warm temperate zone are deciduous, passing the winter leafless, although a few, of nhich the olive is one, are evergreen. Practically all of these species are capable of developing resistance to temperatures below 20° F. during winter dormancy. Most of them cannot be grown commercially in the subtropics or tropics because exposure to a considerable period of chilling temperatures below 45° F. is required for normal growth and flowering. On the other hand, this chilling requirement is relatively short, winter hardiness is not great and a long, warm growing season may be necessary for satisfactory productivity and fruit quality; hence, they are not well adapted to the cooler temperature regions.

Grape. — The old-world grapevine (*Vitis* vinifera) is by far the most important perennial fruit plant. It has been cultivated for thousands of years in the Mediterranean basin and southwestern Europe. Although, as Table IV shows, more than two-thirds of the world's grapes still come from those areas, there is now important production on all continents in the milder parts of their temperate zones, whether north or south latitude (see Table IV). In the United States practically all the vinifera grapes are produced in the great central valley of California, with small acreages in the southern part of the state and in Arizona.

The fruit from this species may be consumed fresh, dried for raisins or used for wines and alcoholic distillates. By far the largest part of the European and Mediterranean production goes to the mine press and only a small proportion is eaten fresh or as raisins. The California vinifera industry, on the other hand. dries more than half its production, ships 10% to 15% as table and canning stock and uses the remaining third for fermented products. The important varieties differ in their versatility for these uses. Sultanina (Thompson Seedless) and Muscat of Alexandria are grown in quantity for all three purposes; the Flame Tokay and several others are used both for fresh fruit and for specialty wines.

On the other hand. Zante currant is grown only for its raisins. and a number of varieties including Zinfandel. Carignane and Alicante Bouche are produced exclusively for fermentation.

Several species native to North America contribute to two other grape growing enterprises of the United States. The larger of these accounts for about 10% of the total U.S. production and is based on hybrids between V. vinifera and native species. Most important varieties of this labruscana group are Concord, Delaware and Catawba. They are hardier than vinifera varieties and less subject to humid climate diseases; hence the industry is centred in New York and Michigan. The principal product is unfermented Concord grape juice, with some outlet for wines. In addition, in the Gulf states the native species V. *rotundifolia* is the basis for minor production of grapes, mainly for muscadine wine. See also WINE.

TABLE IV.—*1955 (or Other Comparable) Production of Grapes, Figs and Olives in Selected Countries of the Different Principal Regions of Commercial Production*
(*000* tons)

Region and country	Grapes	Figs	Olives
North America:			
United States	2,940	80	33
South America:			
Argentina	1,832	5	28
Brazil	357	11	—
Chile	494*	—	3
Europe:			
France	9,371	—	20
Greece	977	111	496
Italy	9,278	274	1,153
Portugal	1,671	120†	—
Spain	2,779	167	1,350
Asia:			
Lebanon	70	20	17
Syria	266	50	29
Turkey	1,895	100	200
Africa:			
Algeria	1,852	78	122
Morocco	297	52*	82
Union of South Africa	563	1†	—
Oceania:			
Australia	385	1	—

*1954. †1948–52 average.
Source: Food and Agriculture Organization of the United Nations, *Yearbook of Food and Agriculture Statistics: Production* (1957).

Olive.—The olive tree was under cultivation in the warm temperature parts of the eastern Mediterranean basin 3,000 years ago and its spread into North Africa and southern Europe was undoubtedly completed during the Arab invasions if not before. Introductions to the new world were made by Spanish colonists and have resulted in small industries in South America and California, but as Table IV shows the world's supply of this important fruit and its oil depends almost entirely on the countries bordering the Mediterranean. Although evergreen and able to grow normally under subtropical conditions, the tree does not flower unless exposed to temperatures below 45° F. for a considerable period of time. The unusual tolerance to freezing winter temperature, hot summer weather and rather severe moisture deficiency have caused it to be planted in many situations not suitable for other fruit crops. The principal outlets for the fruit are as olive oil (*q.v.*), pickled in brine or canned ripe. Most of the European production is used for olive oil, although in Spain, particularly, there is substantial production of pickled olives. Because of high labour costs, olive oil is mostly considered a by-product market of the small United States industry and the major concentration is on production for ripe canned or for pickled olives. Examples of important olive varieties are: Manzanillo, Barouni and Mission. Only varieties high in oil are useful for extraction, and the others are processed as fruit.

Fig.—Like the olive and grape, the fig tree was under cultivation in the warm temperate climate of the Mediterranean basin long before the time of Christ. Some of the varieties of that region have probably been carried down to modern times by vegetative propagation for over a thousand years. Table IV shows that practically all of the commercial production still comes from the area of ancient culture with the United States contributing about 7% of the total and small additional production from Australia. Italy, Spain, Turkey, Greece and Algeria are the leading producing countries.

The tree is able to withstand cold temperature to 15° F. but has a relatively short chilling requirement; in fact some varieties grow and fruit satisfactorily in the tropics. Where the crop is sun-dried after harvest and because the maturing fruit is subject to infection from fungus and bacterial diseases, the most favourable climate is semiarid with available irrigation water and no rain during the period of fruit maturation and drying. Some varieties are grown under humid conditions, however, for local sale or to be used in canning. Thus, in the United States the main production area is the irrigated central valley of California nith rainfall ranging from 10 in. to 20 in. annually, and a long hot growing season. The most important varieties of that region are Calimyrna (Lob Injir), Adriatic, Mission and Kadota (Dottato). The first two of these varieties constitute three-quarters of the production and practically all are dried. Mission may be dried or marketed fresh and Kadota is canned in light sirup. In the Gulf states—Louisiana. for instance—the varieties Brunswick and Celeste are dominant. In that humid climate most of the limited production is marketed fresh and a small proportion is canned.

Apricot, Peach, Plum and Prune.—These three kinds of fruit grow on small deciduous trees of the genus *Prunus* whose climatic requirements are satisfied in the warm temperate zone and whose culture extends to the milder parts of the cool temperate zone. All of them are cultivated widely in the climatic regions of the world to which they are adapted, as Table V shows.

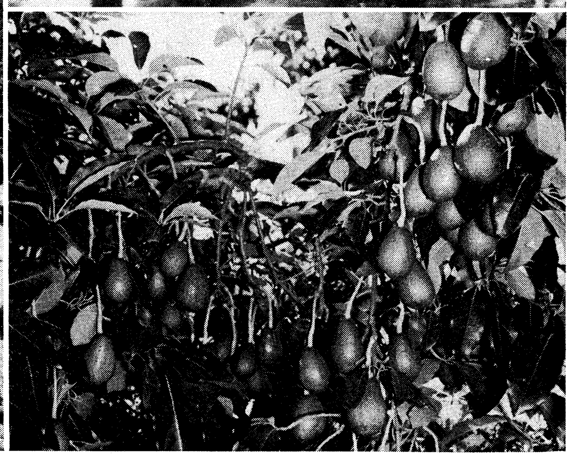
The apricot is somewhat more restricted climatically than the other two partly because it has a shorter chilling requirement and therefore blooms earlier, and partly because its great susceptibility to a fungus disease (brown rot) makes culture difficult in regions where rainfall is high during the growing season. In the United States and Canada most of the apricots are found in semiarid districts of the coastal and interior valleys from California to British Columbia. Local climatic conditions determine whether the main outlets are for fresh fruit, drying or canning; these outlets. in turn may determine the varieties and cultural practices. Thus in limited areas of California where an early harvest season gives the industry opportunity to exploit a premium market for fresh fruit, the main variety has been Royal (similar to Blenheim). In the semiarid hot California regions that have midseason harvest the drying outlet predominates and the Tilton variety has been most important. In the cooler, more northern sections where canning and late market are the dominant outlets, Moorpark, and Large Early Montgamet are important.

Although peach varieties adapted to climates ranging from the subtropics to the milder parts of the cool temperate zone are available, the most important peach regions of the world have long hot growing seasons and mild winters lasting at least three months during which freezing temperatures occur frequently. In the United States these conditions occur in the semiarid central valley of California and along the coastal plain and the lower piedmont region of the east, from northern Georgia to Maryland; California, Georgia and South Carolina produce more than half the nation's

TABLE V.—*1955 Production of Apricots, Peaches and Plums (Including Prunes) in Selected Countries*
(*000* tons)

Region and country	Apricots	Peaches	Plums and prunes
North America:			
Canada	4.6	69.2	20.7
United States	281.4	1,244.4	518.5
South America:			
Argentina	15.9	166.1	47.2
Chile	3.4	32.7	16.8
Europe:			
France	44.1	171.8	142.8
Germany	1.4	37.9	233.0
Italy	36.6	532.5	106.6
Spain	65.9	84.8	62.1
Yugoslavia	26.5	16.5	996.5
United Kingdom	—	—	115.9
Asia:			
Syria	15.4	0.6	1.3
Turkey	12.1	22.1	56.7
Japan	—	86.9	58.0
Africa:			
Union of South Africa	0.9	2.8	
Oceania:			
Australia	33.6	62.4	18.9
New Zealand	3.7	146	3.3

Source: U.S. Department of Agriculture, *Foreign Crops and Markets.*

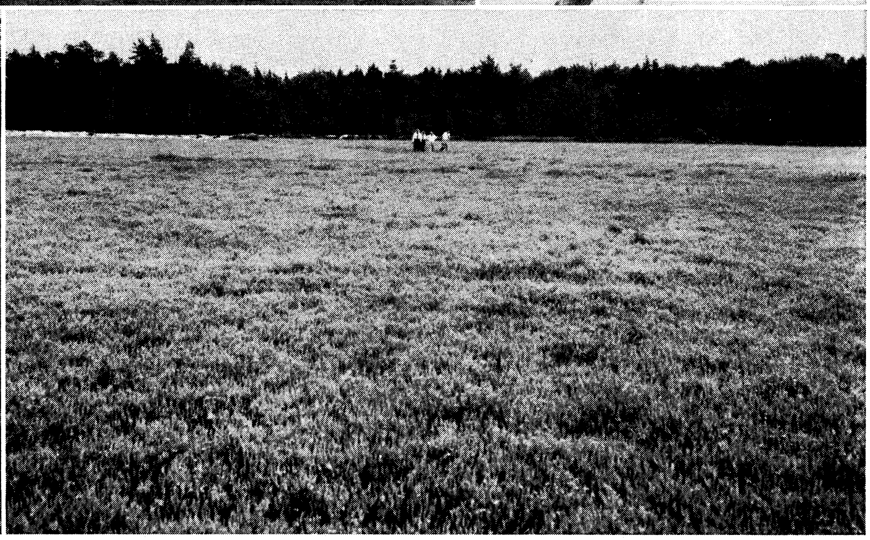


BY COURTESY OF (TOP LEFT) FLORIDA SUBTROPICAL EXPERIMENT STATION, (TOP RIGHT) UNITED FRUIT COMPANY, (CENTRE LEFT) HAWAIIAN PINEAPPLE COMPANY, LTD., (CENTRE RIGHT) U.S. DEPT. OF AGRICULTURE, (BOTTOM RIGHT) CALAVO GROWERS OF CALIFORNIA; PHOTOGRAPH, (BOTTOM LEFT) EWING GALLOWAY

COMMERCIAL FRUITS OF VARIOUS CLIMATES

Top left: Tropical. Five-year old Zill mango tree in flower
Top right: Tropical. Maturing bunch of bananas on a Gros Michel tree
Centre left: Tropical. Field of maturing pineapples, Hawaii
Centre right: Subtropical. Commercial date garden, rows of 15-year-old Deglet Noor palms separated by irrigation ditches
Bottom left: Subtropical. Young (foreground) and mature orange trees in a Florida grove
Bottom right: Subtropical. Thick cluster of avocados on a Fuerte tree. Foliage of the tree has been pulled back to expose the fruit for the photograph

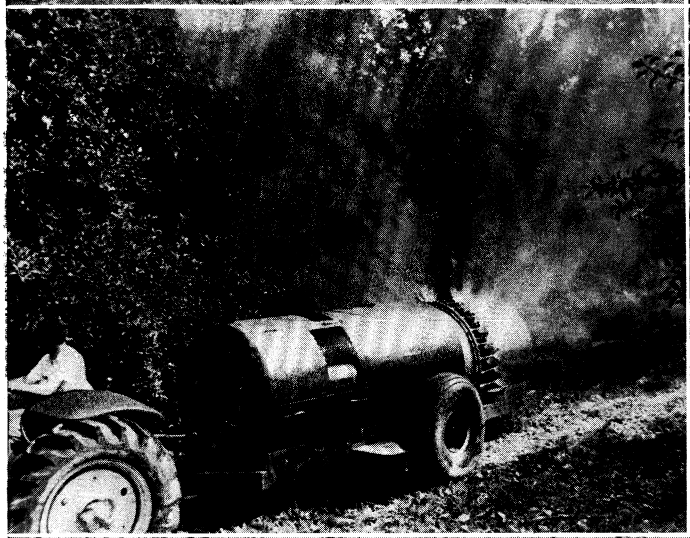
FRUIT FARMING



BY COURTESY OF (TOP LEFT) WINE INSTITUTE, SAN FRANCISCO, (TOP RIGHT, ABOVE AND BELOW) CALIFORNIA FIG INSTITUTE PHOTOS BY R M WARNER, (CENTRE LEFT) H T HARTMANN, UNIVERSITY OF CALIFORNIA, (CENTRE RIGHT) EAST MALLING RESEARCH STATION, (BOTTOM RIGHT) NEW JERSEY AGRICULTURAL EXPERIMENT STATION. PHOTOGRAPHS, (CENTRE, BOTTOM LEFT) JOHN TOPHAM LTD

CHARACTERISTIC FRUITS OF WARM-TEMPERATE AND TEMPERATE CLIMATES

Top left: Warm-temperate. Vineyard of Tokay grapes in early spring as leaves are beginning to form
Top right: Warm-temperate. Kadota fig trees before ***(above)*** and after pruning ***(below)***
Centre left: Warm-temperate. Old Mission olive trees showing the grooved bases of the trunks
Centre: Temperate. Sheep grazing in a cherry orchard, Kent, Eng.
Centre right: Temperate. Fruiting branch *of* black currant
Bottom left: Temperate. Semi-dwarf Cox apples
Bottom right: Temperate. New Jersey cranberry bog



BY COURTESY OF (TOP RIGHT) NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, CORNELL UNIVERSITY, GENEVA, N.Y.. (CENTRE LEFT) JOHN BEAN DIV., FOOD MACHINERY & CHEMICAL CORPORATION, (BOTTOM LEFT, BOTTOM RIGHT) "AMERICAN FRUIT GROWER"; PHOTOGRAPHS (TOP LEFT, CENTRE RIGHT) JOHN TOPHAM LTD.

ORCHARD MANAGEMENT AND FRUIT FARMING PRACTICES

Top left: Soil management. Tractor pulling grass mowers in a cherry orchard, Kent, Eng.

Top right: Soil management showing (A) an untreated row and (B) a row of Concord grape vines after receiving an application of Karmex herbicide to control weeds and grasses

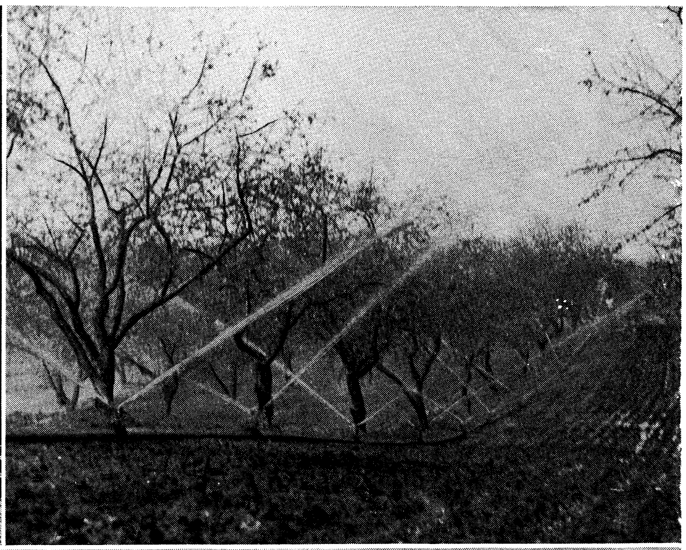
Centre left: Spraying. Speed sprayer in operation

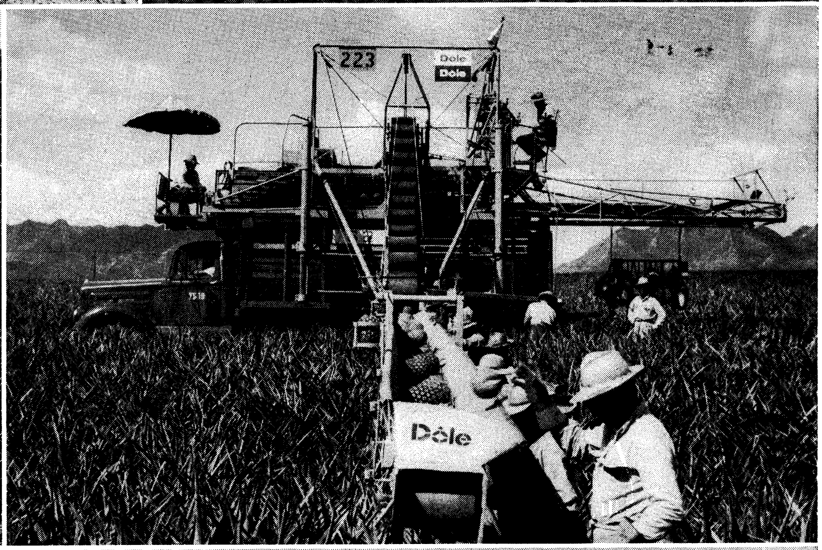
Centre right: Spraying. Testing an airflow sprayer, a two-stage blower powered by an automobile engine

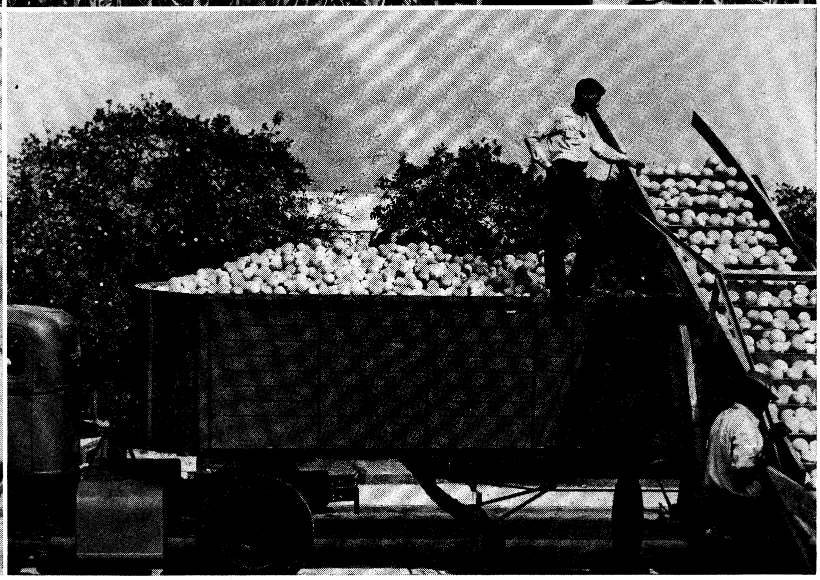
Bottom left: Pruning. Trimming an apple tree with pneumatic pruning shears

Bottom right: Pruning. Hydraulically operated lift cage which permits efficient pruning without danger to the worker or tree

FRUIT FARMING







BY COURTESY OF (TOP LEFT, TOP RIGHT) F. I VEIHMEYER, (CENTRE LEFT) UNIVERSITY OF CALIFORNIA, RIVERSIDE, (CENTRE RIGHT) HAWAIIAN PINEAPPLE COMPANY, LTD., (BOTTOM LEFT) U.S. DEPT. OF AGRICULTURE. (BOTTOM RIGHT) FLORIDA STATE NEWS BUREAU

FRUIT FARMING PRACTICES

Top left: Irrigation. Furrow irrigation in an orchard
Top right: Irrigation. Sprinkler irrigation, more suitable than furrowing for hilly land conditions
Centre left: Heating. Propellor-style wind-moving machine and oil heaters in an orange grove
Centre right: Harvesting. Pineapple operation in Hawaii. Pickers place fruit on conveyor belt which carries it to truck
Bottom left: Pollination. Date orchard worker placing strands of male flowers into a female cluster. At left is a tied cluster after pollination
Bottom right: Harvesting. Bulk loading of grapefruit on to a truck for shipment

peaches. As with apricots there are three outlets for this fruit and varieties differ in accordance with them. Clingstone varieties of which Phillips. Paloro and Halford are examples, are used exclusively for the large canning industry of California. Although drying is also a by-product or distress outlet for other varieties in California, Muir and Lovell are especially desirable because of their relatively high dry matter content. The fresh-fruit market is served by a long list of delicious freestone varieties including Elberta, Halehaven and Golden Jubilee.

The world's plum and prune industries are based mainly on two species of different origin and adaptation. The Japanese plum, *Prunus salicina,* is a small, vegetative tree with approximately the same climatic requirements as the apricot. It is most successful in semiarid irrigated warm-temperate climates. Because the fruit is very high in moisture and soft, it is not useful for canning. Difficulties of handling and storage limit the opportunities for large-scale exploitation in fresh fruit markets. The principal European species, *Prunus domestica* is responsible for most of the commercial plum and prune production of the world. The climatic adaptability of the tree straddles the warm and cool temperate zones, and it is tolerant both to semiarid and humid climates. The most important varieties produce fruit that may be harvested in a firm condition and that has storage and shelf life of a month or more. Some varieties are very high in total solids and may be dried for prunes.

In the United States practically all the Japanese plums are grown in the irrigated valleys of California. Examples of important varieties are Beauty, Santa Rosa and Duarte. European plums are an important crop in Oregon, Idaho and Washington, as well as California. California produces all of the dried prunes of the United States; the variety French Prune accounts for most of them. Italian Prune is the main plum variety in the northwestern states for use in canning and fresh-fruit markets. Other varieties including President and California Blue are also shipped for fresh fruit.

In the south of England, several varieties of the Green Gage group are prized for their dessert qualities and such varieties as Czar, Giant Prune and Victoria are used for culinary and dessert purposes.

Fruitgrowing Enterprises of the Cool Temperate Zone

The perennial fruit species best adapted to this zone are deciduous and have relatively long chilling requirements, are able to withstand subzero (F.) temperatures when dormant and can produce fruit of satisfactory quality in a growing season of six months or less.

Apple.——As Table VI indicates, the apple tree is grown commercially in cool temperate climates throughout the world. Over the centuries of culture thousands of varieties have been named and the selections that are now cultivated in different countries represent the tastes of their citizens and conform to the climatic and commercial requirements of each area. In the United States, about one-quarter of the total production originates in the irrigated semiarid valleys of Washington. There the varieties Red Delicious and Winesap are most important. Tno eastern regions are responsible for another quarter of the crop. They are: (1) the slopes of the Shenandoah-Cumberland valleys from Virginia to Maryland mhere Stayman Winesap and Red Delicious dominate; and (2) the New York and New England areas where McIntosh and Rhode Island Greening are most important. Perhaps one-quarter of the United States production is canned or frozen and the rest moves in fresh-fruit markets.

In the United Kingdom most of the apples are grown in the south of England; in Kent, Sussex and Essex, the varieties Cox's Orange, Allington Pippin and Bramley Seedling are very important. Most of these apples go to the fresh-fruit market for dessert or culinary uses. In addition there is a thriving cider apple industry which uses large quantities of varieties suitable for production of a sparkling fermented cider.

Pear. — The European pear tree, *Pyrus communis* is most successful in the milder apple regions and in regions climatically adapted to prune culture. It is extremely susceptible to bacterial fire blight and this limits opportunity for culture of the best varieties in humid climates mhere the causal organism is established—as, for instance, in eastern Sorth America. Table VI shows that there is significant commercial production on all the continents, with Europe and North America most important. More than 90% of the pears grown in the United States are found in the irrigated region5 of California, Oregon and Washington and one-half the total are produced in California. Bartlett (Williams Bon Chrétien) is the dominant variety with significant production of Beurre Bosc and Buerre d'Anjou. Because the Japanese sand pear, P. *serotina,* has marked resistance to fire blight, it has been hybridized with the European pear and several varieties, among them Kieffer, have been found to have increased resistance and to be acceptable for processing in these humid regions. About one-half the Bartlett crop of California is canned commercially, the rest and other varieties are sent to fresh-fruit markets.

In the United Kingdom pears are grown in the same areas in the south of England as apples and plums. The varieties Conference, Williams Bon Chrétien and Comice are important. On the continent, there is large production of a number of varieties of local origin for fresh-fruit consumption. A special group of varieties contributes the fruit for a fermented cider called perry.

Table VI.—*1955 Production of Apples, Pears and Cherries in Selected Countries*
(*000* tons)

Region and country	Apples (excl. cider)	Pears (excl. perry)	Cherries (sweet & sour)
North America:			
Canada	391	34	19
United States	2,333	659	263
South America:			
Argentina	256	95	4
Chile	32	4	2
Europe:			
France	437	188	92
Germany (western)	779	355	175
Italy	1,213	439	160
Spain	191	78	42
Yugoslavia	249	56	88
United Kingdom	407	51	28
Asia:			
Syria	8	2	1
Turkey	109	84	44
Japan*	390	129	4
Africa:			
Union of South Africa	81	35	—
Oceania:			
Australia	257	86	6
New Zealand	56	10	—

*Mostly P. *serotina,* Japanese sand pear.
Sources: U.S. Department of Agriculture, *Foreign Crops and Markets;* Food and Agriculture Organization of the United Nations, *Yearbook of Food and Agricultural Statistics: Production* (1957).

Cherry. — The sweet and sour cherry also are found in the milder apple regions throughout the world (*see* Table VI). Because sweet cherry fruits are subject to cracking damage if exposed to rain at the end of the maturation period, orchards of that species are more limited to semiarid climates than are sour cherry orchards. In the United States sweet cherry production is about 45% that of sour cherry. Some 85% of the sweet cherries are grown under irrigation in California, Washington, Oregon and Idaho, whereas more than 90% of the sour cherry production originates in New York, Michigan and Wisconsin. The principal sweet cherry varieties are Bing, Lambert, Windsor and Napoleon (Royal Ann); all but the last, which is used mostly for canning and artificial maraschino cherries, are sold chiefly in the fresh-fruit markets. Montmorency is the basis of the sour cherry industry; frozen and hot-pack preservation for pie stock stabilizes the greatest part of this crop for year-round marketing.

Cherry culture in England is concentrated mostly in Kent where the summer rainfall atmospheric conditions are reasonably favourable; there are venerable sweet cherry orchards whose trees date back more than 100 years in that locality. Practically all of the fruit is consumed fresh. 'The most important varieties include Early Rivers, Napoleon and Noir de Guben.

Strawberry. — The cultivated strawberry, probably the most cosmopolitan of all perennial fruit plants, is cultivated from the cool tropics to the arctic zone. Its great climatic range results partly from the fact that it is evergreen but at the same time so small that it can be protected from the coldest winter temperatures, and partly from the fact that different varieties exhibit special adaptabilities to the various environmental conditions in this broad area. No summary of the production over the world is available.

Table VII groups the main producing areas by harvest seasons. While it is impossible to assert that one climate or another is the best for strawberries the fact that annual yields of more than ten tons per acre are obtained from plantings of the variety Lassen in the Watsonville area of California suggests that this may be the ideal climate for the species. On the other hand, as the table shows, strawberry growing is a sound commercial business in the cooler parts of the United States and in the United Kingdom. It is also a good business on the continent as far north as Denmark, Sweden and Norway. In the United States there are two principal outlets: as fresh fruit and for frozen pack. The perishability of the fresh fruit and the excellence of the frozen pack caused the latter to increase in importance greatly as this industry perfected its procedures. In addition appreciable quantities of strawberries are preserved as jams and some are canned. The following varieties are very important: winter and early spring, Missionary and Klonmore; mid-spring, Blakemore and Temple and (from California) Lassen and Shasta; late spring, Catskill and Sparkle. In the United Kingdom, Royal Sovereign and Climax are examples of important varieties.

TABLE VII.—*Acreage and Production of Strawberries, Brambles, Bush Fruits and Cranberries in the United States and in England and Wales*

Fruit	United States*		England and Wales†	
	Acreage (000 acres)	Production (000 tons)	Acreage (000 acres)	Production (000 tons)
Strawberries	—	—	16.5	27.0
Winter and early spring areas	10.4	7.6	—	—
Midspring	41.7	109.7	—	—
Late spring areas	53.2	107.9	—	—
Raspberries	23.9	22.5	3.8	6.2
Blackberries and related species or hybrids	17.3	28.1	1.2	2.2
Currants:				
Red	1.1	2.5	1.2	2.4
Black	—	—	13.0	20.0
Gooseberries	0.4	0.7	6.7	14.0
Blueberries (cultivated and wild)	42.8	23.0	—	—
Cranberries	22.3	51.3	—	—

*1954–55. †1953–54.
Sources: U.S. Department of Agriculture statistics; U.S. Department of Commerce, *1954 Census* of Agriculture (1955); British Ministry of Agriculture and Fisheries statistics.

Raspberry and Blackberry.—Raspberries and blackberries (*see* Table VII) are produced by a number of deciduous species of the genus *Rubus* called biennial because the canes fruit in their second growing season, and then die. These canes may require support by trellis or stake or they may be erect. The different species vary in climatic requirements but the most important belong in temperate regions that do not have either extremely hot summers or extremely cold winters. For this reason they do very well in the south of England and on the western slope of the coast range in Oregon and Washington in the United States and in British Columbia. Some species are also cultivated in Europe as far north as Denmark, Sweden and in other similar climates. Red raspberry varieties of importance in the United Kingdom are Lloyd George and Norfolk Giant. In the United States, Cuthbert, Washington and Newburgh are excellent varieties. The black and purple raspberry are less common, and their culture is mostly confined to eastern United States. All these fruits are marketed fresh locally and are processed frozen or in preserves. Several trailing and semitrailing blackberry species are important in Europe and hybrids among them or with raspberry have contributed large fruited, juicy berries very satisfactory in preserves and canned. Among the most exploited of these are the Himalaya berry, the Oregon Evergreen blackberry, Boysenberry and Youngberry.

Currant and Gooseberry.—Currants and gooseberries are hardy deciduous bushes well adapted for fruitgrowing in the cool temperate zone. Their culture is particularly important in Great Britain, as Table VII indicates, but there are small industries in most countries with suitable climates. These fruits are used primarily in preserves, but gooseberry also is an important culinary fruit in Britain and on the continent, and black currant juice has special dietary uses. Among the important varieties are: red currant, Wilder, Red Lake; black currant, Mendip Gross, Seabrook's Black, Baldwin; gooseberry, Poorman, Careless. Lancashire Lad.

Blueberry.—Several species of blueberry indigenous to North America are harvested in the wild and a rapidly expanding intensive industry developed during the 20th century, based on varieties of a hybrid of the two hardiest of them, *Vaccinium corymbosum* and *V. pennsylvanicum* (*see* Table VII). Although these bushes have rather special soil requirements productive plantings have been established in New Jersey, North Carolina, Michigan and western Washington. Examples of important varieties are Concord, Jersey, Stanley and Dixi.

Cranberry.—The cranberry is the smallest intensively cultivated perennial fruit plant, and one species, *Vaccinium macrocarpon,* is the basis of a unique fruitgrowing enterprise of North America. Culture is confined to drained bogs whose substratum is acid in reaction; the most productive of these bogs may be flooded at will in order to give control over temperature and certain pests. Commercial acreages are found in Massachusetts, New Jersey, Wisconsin apd western Washington (*see* Table VII). Among the important varieties are Early Black and Howes.

BASIC PROBLEMS AND PRACTICES OF FRUIT FARMING

Although fruitgrowing enterprises cover great ranges of climates and plant materials their technologies are bound together by problems and practices that have much in common. The most significant of these are discussed below.

THE VARIETY, ITS PROPAGATION AND IMPROVEMENT

The first step in establishing a fruitgrowing industry is the selection of individual plants having high productivity and with fruit of superior acceptability in the market place. Such an individual is a horticultural variety. If it is multiplied vegetatively from rooted cuttings, from root pieces that throw shoots or by graftage, the entire group of resulting plants is a single clone, each plant identical with the others. All perennial fruit crops considered in this article are clonally propagated; *i.e.,* their varieties are multiplied vegetatively by one means or another.

Many important varieties of fruit plants were selected generations ago, and some are hundreds of years old. The Sultanina (Thompson Seedless) grape, the Lob Injir (Calimyrna) fig and the Gros Michel banana are examples of fruit varieties of obscure origin, planted by the millions since selection, with each subsequent specimen actually a vegetative continuation of the selected individual growing on an independent root system. But regardless of the age of a fruitgrowing industry or the perfection of some of the selected varieties continuing search for new varieties is essential because there is always room for improvement in climatic adaptability, in insect and disease resistances and in the solution of special horticultural or marketing problems.

Not only is varietal selection and improvement a continuing need. but so also is the maintenance of existing varieties. Although vegetative mutation of a variety is exceptional, the opportunities for accidental multiplication of degenerate mutants increase in proportion to the number of specimens of the variety. As a result, care is taken to propagate a clone only from superior individuals and in the case of citrus where mutation is unusually common, further precautions are necessary. There are, of course, occasional mutations that improve a variety and these may be selected and propagated.

The most effective technique of vegetative propagation varies with the kind of fruit plant. Date, banana and pineapple are multiplied by use of offshoots or suckers. Grape. fig, olive, currant and blueberry are usually propagated from cuttings. Strawberry and black raspberry reproduce vegetatively by special organs—the former are stolons, the latter tip layers. Many kinds of fruit tree must be grafted or budded on specially grown rootstocks because the species to be multiplied self-root with difficulty; apple, pear, peach, mango and citrus are examples of this group. *See* also ARBORICULTURE; PLANT PROPAGATION.

With most fruit species a period of one to two years intervenes between the time that a cutting is rooted and the plant is ready for setting in the field, or between graftage or budding and field planting. During this interval the plants are held in a nursery where they can be given intensive culture in rows. Strawberry, raspberrry, pineapple and banana planting materials do not require the intervention of a period in the nursery before field planting, however.

The grower's problem in choosing varieties of the fruits he intends to produce has two aspects: (1) to recognize the relative adaptabilities of available varieties to the climatic and soil conditions of his farm; and (2) to select from those best adapted to his conditions a group that satisfy both his management needs and the market demands. For instance, an apple producer in northeastern United States may depend on four varieties: Milton, McIntosh Red, Red Delicious and Rome Beauty. The main harvest seasons for these succeed each other at about two-week intervals, and this helps him to extend the period of harvest. The first two cross-pollinate satisfactorily, and so do the last two. The first of these varieties is usually marketed without storage, and the cold-storage seasons of the others are of increasing length; this helps him to exterid the marketing period.

The Site

The site of a fruitgrowing enterprise is as significant in determining its success as the varieties grown on it. In fact, variety and site together set the ceiling of productivity and profit that may be attained under the best management. In most developed fruit regions microclimatic and soil conditions, that is, climatic conditions as influenced by slight differences in soil, soil covering and elevation. and soil conditions are the two components of a site that determine its desirability for a fruitgrowing enterprise. Sometimes, particularly with very perishable fruits, transportation problems must also be considered.

Local conditions of a site exposing it to unusual frost hazard are as detrimental to citrus in Florida as they are to peach trees in New Zealand and apple trees in the south of England. In regions and sites where temperatures during the season of concern may drop no more than 4° or 5° F. below freezing, artificial frost protection is sometimes used (see FROST).

For highest productivity most fruit trees need to be able to root extensively to a depth of four feet or more. Heavy subsoil or other conditions causing imperfect internal drainage may result in shallow, weak root systems that are unable to exploit the soil efficiently for water and nutrients. In semiarid and arid regions it is not uncommon for accumulation of saline salts in a subsurface layer to limit rooting of fruit trees as well as to cause leaf scorching and abnormal defoliation symptoms. Tiling and surface ditching help to decrease the accumulation of water in poorly drained subsoils, and are beneficial in dealing with wet spots in otherwise satisfactory sites. Special control of irrigation procedures and periodic leaching may alleviate the worst salt effects in saline soils. Choice of tolerant species, varieties and rootstocks may make exploitation of imperfectly drained or mildly saline sites economic, but it is rare that the performance of the plants is up to that on sites free from these inherent difficulties.

Once a site is selected it is prepared by clearing and cultivation of the surface and installation of such permanent drainage, irrigation and road systems, as may be required. In rolling or sloping terrain where contour planting is needed to control erosion and conserve moisture, the locations of the plant or row positions are determined by the contour intervals established. In old lands, where there are residual nematode or other pest populations that make fumigation desirable, this must also be done before the new plants are set. In very infertile sites or where the physical condition of the surface soil is poor, it is sometimes useful to apply fertilizer and lime and to grow a succession of leguminous cover crops for a year or more before planting.

Planting and Spacing Systems

Growth, flowering habits and light requirements on the one hand, and management problems on the other, determine the most satisfactory planting plan for a fruitgrowing enterprise.

Such crops as strawberry and pineapple having compact plants close to the ground are usually managed in beds containing several rows or in less formal matted rows. In an acre of strawberries, 200,000 or more plants may occupy the matted rows. A pineapple plantation with two-row beds, having plants a foot apart in rows two feet apart contains 15,000 to 18.000 plants per acre. Intense competition within such dense populations for light, water and nutrients causes the production of the individual plant and the size of the average fruit to be less than they would be if more space were provided; but the total yield per unit of land is usually greater than it would be with lower plant numbers. There may also be indirect benefits from these high populations; for instance, the problem of hand weeding or hoeing may be substantially decreased by the shading effects of the fruit plants.

The spacing of grapevines along a trellis row, and of trees in an orchard involves the same group of problems. Maximum vineyard production frequently results with vine distances of 8 to 9 ft. (600 per acre). Peach trees set 20 ft. apart (100 per acre) and apple trees 40 ft. apart (27 per acre) are apt to attain maximum acre yields at full maturity.

With those species and varieties that require cross-pollination by the agency of insects, the planting plan must take their special pollination needs into account. This is a problem with apple, pear, plum and sweet cherry orchards. At least two varieties that cross-pollinate successfully must be planted in association with each other.

Training and Pruning

Pruning, the removal of parts of a plant in order to influence growth and fruitfulness of the rest, is an essential fruitgrowing practice. In the first few years after fruit trees or vines are planted, primary attention is given to form, because that may influence the strength and longevity of the mature plant as well as the efficiency of other practices; this kind of pruning is called training. Subsequently, as the plant approaches maximum fruitfulness and fills its alloted space. maintenance pruning for various purposes becomes increasingly important.

The grape responds favourably to heavy pruning by one of two groups of training systems: those that involve cutting the growth of the previous season (canes) to short spurs and those that permit the canes to remain relatively long. Whether a spur system or a long cane system is to be followed depends on the flowering habit of the particular variety (see GRAPE). Relatively small trees that respond favourably to severe annual pruning, such as the peach, apricot and Kadota fig are usually trained to systems creating an open-centred tree with a scaffold of four or five main branches that originate on a short trunk constituting the head of the tree. These main branches are in turn branched a number of times so that they permit fruiting. Annual renewal pruning can be reasonably efficient under these circumstances. Larger trees which do not respond favourably to heavy annual pruning may often be best trained to systems which encourage the original main leader branch to grow erect to a height of eight to ten feet, with four or five main branches at intervals on its sides forming the scaffold which carries fruiting wood up and out; this is called a modified leader system.

The principal reasons for maintenance pruning are: (1) to permit efficient spraying and harvesting operations; (2) to maintain satisfactory light exposure for most of the leaves; (3) to create a satisfactory balance between flowering and leaf surface. Maintenance pruning to regulate crop size is largely confined to species whose fruitfulness is directly related to vegetative vigour. The grape is this kind of a plant, and pruning of it is primarily to regulate crop size; peach and apricot are also pruned heavily in order to reduce the number of fruits. See also ARBORICULTURE: PRUNING.

Soil Management, Irrigation and Fertilization

Two soil management practices, clean cultivation and permanent sod culture, illustrate contrasting purposes and effects. In clean cultivation, the surface soil is stirred periodically throughout the year in order to prevent establishment and growth of vegetation that competes with the fruit crop for nutrients, water and light.

The stirring increases the decomposition rate of soil organic matter and thereby releases nitrogen and other nutrients for the use of the fruit crop. It may also provide transient improvement in water penetration. On the other hand, laying bare the soil surface exposes it to erosion; destruction of organic matter results in lowered fertility and degeneration of structure. Sod culture minimizes the destructive processes and may permit modest increase in fertility, but the sod itself competes with fruit plants for water and nutrients and may compete for light. As a result, permanent sod culture is practical only with tree crops that are normally rather low in vegetation — apple, sweet cherry and mango, for instance; and competition from established sod is detrimental with extremely vegetative fruit plants like grape. peach and raspberry.

Because each of these soil management systems has advantages and disadvantages, three modifying or complementary practices are used under many circumstances: cover cropping: mulching and chemical control of vegetation. Cultivation combined with winter cover cropping is used widely in grape, peach, cherry, bush fruit and citrus plantings, as well as with other species. Mulching is the addition of undecomposed plant materials such as straw, hay or processors' refuse to the soil in the fruit planting. In orchards mulching materials are most often applied under the branches of trees maintained in permanent sod. Chemical control of vegetation has come into increasing use as a supplement to or substitute for cultivation.

In semiarid and arid regions irrigation is necessary. Probably the maximum demand occurs in date gardens, because they expose a very large leaf surface the year around. under conditions of very high evaporation and practically no rainfall. Irrigation in humid climates is generally limited to shallow-rooted fruit crops such as strawberry and blueberry. There are a few exceptions, however, and the banana appears to be one. Large acreages of this species are irrigated on coastal lowlands of the torrid tropics where annual rainfall exceeds 60 in. Various procedures for irrigation are used in fruit plantings; of these furro , basin or sprinkler systems are most common. *See* IRRIGATION.

Needs of perennial fruit plants for fertilizers depend partly on the natural fertility of the soil supporting them and partly on their special requirements. Of the essential elements, supplemental nitrogen is almost always needed and potassium supplements may be commonly needed. Although phosphorus responses of strawberry. grape and a few fruit tree species have been reported occasionally, phosphorus deficiency is rather rare, and it is evident that perennial fruit plants are more efficient in absorption of this element than are many other plants. Calcium deficiency has seldom been reported. even in very acid soils, but limestone and hydrated lime are sometimes desirable because of indirect benefits. Lack of magnesium, on the other hand, has been noted by workers studying a wide range of fruit species. Of the trace elements, zinc, iron and boron are most apt to be lacking. Iron deficiency is difficult to control in orchards in soils of high pH, or acidity. Three other trace element nutrients, manganese, copper and molybdenum, are sometimes deficient in fruit plantings. *See* also FERTILIZERS AND MANURES.

POLLINATION

The stimulus of pollination and seed formation are needed for normal development of most of the fruits. (Banana, pineapple and some citrus and fig varieties are exceptions.) Transfer of pollen from anthers to stigmas is accomplished in nature either by movement in air or by agency of insects. With the possible exception of olive and grape and some varieties of citrus and fig, the perennial fruit plants considered here are benefited either by insect pollination or by artificial or hand-pollination. *See* POLLINATION and articles on individual species, as APPLE; FIG; etc.

THINNING

Removal of flowers of young fruits (thinning) is done for two purposes: (1) to permit the remaining fruits to grow more rapidly and (2) to prevent the development of so large a crop that the plant is unable to flower in subsequent years.

Thinning may be done by hand or chemically. With date, the pistillate flower cluster is reduced in size at the time of hand-pollination. In the case of certain table grape varieties, some clusters may be removed shortly after they appear, and in addition parts of clusters may be cut off. Young peach fruits may be thinned by striking the branches with a padded pole. Hand thinning of young apple and peach fruits once was also a common practice, but because of the expense and difficulty there has been increasing use of chemical sprays as a substitute. Two kinds of treatment may be used: (1) mildly caustic sprays applied during bloom and (2) sprays of growth-regulating substances applied shortly after bloom. These two kinds of treatment have been used with varying success but they have been successful enough to permit chemical thinning to find a place as one of the supplementary fruit growing practices. *See* SPRAYS AND DUSTS IN AGRICULTURE.

PEST CONTROL

In many fruit enterprises, pest control is the most expensive and time-consuming occupation of the grower, and where the concentration of fruit farms in an area warrants it, individual efforts are complemented by legislative measures including quarantine regulations and by technical and advisory services from public agencies. Sometimes the most economic control procedures are biological in nature. Selection of varieties that are immune, resistant to attack or tolerant to specific pests is a biological control procedure widely used. Parasites or other enemies of pests also have been used to control those pests. Chemical control procedures, however, are relied on most heavily. For discussion of these measures of pest control *see* ENTOMOLOGY: *Principles of Insect Control;* FUMIGATION; PLANT QUARANTIXE; SPRAYING AND DUSTING MACHINERY; SPRAYS AND DUSTS IN AGRICULTURE.

HARVESTING AND POSTHARVEST PRACTICES

The different fruits vary greatly in the way they ripen both as to the specific changes that take place during maturation and the rates at which they occur. Each kind of fruit has a characteristic pattern of cumulative increase in volume, and by the time physiological maturity has been reached the rate of growth is relatively slow. As this time is approached the colour changes to that of the mature fruit, and the ultimate chemical composition is approached. There is a tendency for the fruit of many species, including apple, pear, orange, lemon and grapefruit, to drop from the tree during the last part of the maturation period. Preharvest drop of these fruits is delayed by application of dilute sprays of growth regulating substances like naphthalene acetic acid. These same sprays increase the rate of ripening somewhat.

Most kinds of fruit are harvested as close to the time that they are eating ripe as possible so that they will attain the best quality when they do ripen. But a few, of which banana and pear are outstanding, may be harvested very immature and still ripen satisfactorily. Orange, grapefruit and some varieties of avocado may be held on the tree for several months after they attain good quality; this property is helpful in permitting convenient storage over a long marketing period.

The actual harvesting for these fruits involves hand-picking, except for prunes to be dried and olives for processing ripe. Thus mechanization can only be used to improve the efficiency of the handling operation after the fruit is off the plant. With soft or easily bruised kinds, rather little can be done to speed the handling procedures. With citrus, however, bulk handling has helped to reduce handling costs appreciably; large open containers on trailers are used for collecting fruit from pickers, and mechanized lifting equipment empties them into trucks which in turn are emptied by gravity.

The maximum life of the fresh fruit after harvest varies greatly depending on the kind and on the storage' conditions. Strawberries last for no more than two weeks in the best storage environment whereas apples or lemons can he held for more than six months. Cold temperature storage is the most common means of prolonging the life of fruit. Most temperate zone fruits can be held safely at 32° to 35° F., but many subtropical and tropical fruits, including the lemon, avocado, banana and mango, show chilling injury after prolonged exposure to temperatures below 40° to 45° F. Storage life is extended on several fruits, including apple, pear and banana by holding them in sealed refrigerated rooms in which internal atmospheres are modified to contain less oxygen and somewhat more carbon dioxide than normal air. For some apple varieties storage in an atmosphere containing 2% oxygen and 5% carbon dioxide by volume increases the life several months. Another important way of extending the storage life of some fruits is the removal of ethylene and other volatiles from the atmosphere.

Drying is a standard means of stabilizing dates, figs, raisin grapes, prunes and apricots; canning is of paramount importance to the pineapple, peach and pear industries; and freezing is a means of stabilizing some of the most perishable fruits including strawberry, raspberry and blueberry. *See* also CROP DRYING AND PROCESSING; COCOA; COFFEE; VANILLA; and articles on other individual plants.

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See also *Horticultural Abstracts* (quarterly) for world coverage of technical articles on temperate and tropical fruit crops; *Journal of Horticultural Science* (annual); *Proceedings of the American Society for Horticultural Science* (annual) In the United States, the Department of Agriculture and State Agricultural Experiment Stations publish bulletins on the culture of fruits, on insect and disease problems and on economic and marketing problems. Similar information is published by the British Ministry of Agriculture for fruit crops important in Great Britain. (D. Bs.)

FRUIT FLY, any member of the families Trupaneidae and Drosophilidae of the order Diptera (*q.v.*). The Trupaneidae (Trypetidae, Tephritidae) contain many species of economic importance. Most damage is caused by the larvae living in fruits. The Mediterranean fruit fly *(Ceratitis capitata)* infested Florida in 1929, and its eradication required several years. The pest reappeared in that state in 1956, however. The Mexican fruit fly, *Anastrepha ludens,* attacks citrus fruits in Central America and south Texas. *Rhagoletis pornonella,* the apple maggot or railroad worm, and *R. cingulatus,* the cherry fruit fly, cause enormous damage. Other species attack walnuts. The currant and gooseberry fruit fly and the melon fly are sometimes serious pests in North America. In Europe the asparagus fly, *Platyparea, poeciloptera,* destroys the edible shoots of asparagus. In Australia, *Chaetodacus tryoni,* the Queensland fruit fly, is a serious pest, while the olive fly. *Dacus oleae,* attacks olives in the Mediterranean region and in Africa. Control of these pests is difficult and varied according to the habits of each. Against some, use of poisoned bait to kill the adults, destruction of infested fruit and clean cultural methods are effective. The celery fly of Europe and the parsnip leaf miner of North America make mines in the leaves of umbelliferous plants; species of *Eurosta* and allies make galls on the stems and roots of goldenrod; others bore in stems or live in the developing seeds of the Compositae, especially of thistles and goldenrods. The Drosophilidae. now generally called small fruit flies, are attracted to fermenting sap, decaying vegetation and ripe fruit. They are believed to feed chiefly upon fungus developing in such places. Several species are used in the study of heredity. *(See* GENETICS; DROSOPHILA.) (C. H. CN)

FRUIT PRESERVATION: *see* CANNING, COMMERCIAL; JAMS AND JELLIES; FRUIT COOKERY.

FRUIT SUGAR: *see* CARBOHYDRATES; SUGAR.

FRUMENTIUS (*c.* 900–c. 360), the founder of the Abyssinian church. traditionally identified in Abyssinian literature with Abba Salama or Father of Peace *(see* ETHIOPIA, ORTHODOX CHURCH OF*)*, was a native of Phoenicia. According to Rufinus (x, 9), who gives Aedesius as his authority. a certain Tyrian, Meropius, accompanied by his kinsmen Frumentius and Aedesius, set out on an expedition to "India." but fell into the hands of Ethiopians on the shore of the Red sea and was put to death. The two young men were taken to the king at Axum, where they obtained. in time, great influence. With the help of Christian merchants who visited the country Frumentius gave Christianity a firm footing. In 326 he was consecrated bishop of Axum by Athanasius of Alexandria who in his *Epistola ad Constantinum* mentions the consecration and gives details of Frumentius' work.

FRUNDSBERG, GEORG VON (1473–1528), German soldier. was born at Mindelheim on Sept. 24, 1473. He fought for the German king Maximilian I against the Swiss in 1499, and in the same year was among the imperial troups sent to assist Ludovico Sforza, duke of Milan. against the French. Still serving Maximilian, he took part in 1504 in the war over the succession to the duchy of Bavaria-Landshut, and afterwards fought in the Netherlands. Frundsberg assisted Maximilian to organize the *Landsknechte* (*q.v.*), and at the head of bands of these formidable troops he was of great service to the empire and the Habsburgs. In 1509, 1513 and 1514 he gained fresh laurels against the Venetians and the French. When the struggle between France and the empire was renewed he took part in the invasion of Picardy (1521), and proceeding to Italy brought the greater part of Lombardy under the influence of Charles V through his victory at Bicocca in April 1522. He was partly responsible for the great victory over the French at Pavia in February 1525, and, returning to Germany, assisted in suppressing the Peasants' Revolt, using on this occasion, however, diplomacy as well as force. He died at Mindelheim on Aug. 20, 1528. Frundsberg was a capable and chivalrous soldier, and a devoted servant of the Habsburgs. With his grandson the family became extinct.

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FRUNZE (formerly PISHPEK), the chief town of the Kirghiz A.S.S.R., situated on the Chu river in 42° 45' N. lat.. 74° 45' E. long. Its chief industries are brewing and the manufacture of tobacco *(makhorka)*.

A branch line from the Chkalov-Tashkent railway, passing through Chimkent and Aulie-ata, reaches the town. In 1928 a line to the densely peopled Tokmak region, northwest of Lake Issyk-kul, was commenced, and the Turksib (Turkistan-Siberian) railway linking Frunze and Semipalatinsk was completed in 1930. This opened up the corn-growing region round Lake Balkhash, and enabled the Central Asiatic republics to depend on imported instead of homegrown grain and thus to increase the area under cotton. Pop. (1959) 223,831

FRUSTRATION. The technical, psychological meaning of the term frustration has much in common with its more general lay meaning. In both cases, frustration refers to the interruption of an episode of behaviour before its completion. However, not every interruption of behaviour is frustrating. A man hard at work on a hot afternoon will not usually be frustrated if his employer interrupts him and says, "I want you to quit now, but I'll pay you for a full day's work." To define frustration more adequately requires a brief consideration of a point in psychological theory.

Some kinds of behaviour can be explained only in terms of such a concept as motive (or desire, purpose, want, need. instinct, sentiment or psychological tension). Motive refers to an inferred state of the individual that is presumed to organize and direct behaviour in relation to existing conditions until a more-or-less particuiar goal is reached. When such an episode of behaviour is interrupted before an appropriate goal is achieved, frustration results. Interruptions of behaviour that do not interfere with goal attainment, or which expedite it, are not frustrating.

During the operation of a motive the individual is active, his behaviour is organized, and, when the motive is conscious, he experiences a hunger for the goal. When the goal is attained, the individual experiences satisfaction or satiation. If the goal-directed behaviour is interrupted. *ie.,* if frustration occurs, a great variety of behaviour resultants may appear.

The basic fact about frustration is that it has effects which are often widespread. The behaving person is not like a rolling billiard ball which, when its movement is stopped. remains motionless. The interruption of a directed action changes behaviour but does not stop it. What the changes are depends upon a number of factors, some of which are the following:

Source of Frustration.— The chief causes of behaviour interruption are: (1) motor, intellectual or perceptual inadequacies; (2) physical obstacles or social prohibitions; and (3) conflict of motives.

Completeness of the Interruption.—Interruption of goal-directed behaviour may be complete and irrevocable as when a beloved person dies, or it may appear to be equivocal as when an attractive apple is barely out of reach on the tree.

Distance to the Goal.—Interruption of a directed action may occur at any point in the temporal course of the episode. immediately after beginning the action, intermediate in the action or just before its completion.

Nature of the Motivating State.—Three factors of importance are: (1) whether the motive is fundamental to the personality (often unconscious), or is of superficial importance (usually conscious); (2) the strength or degree of the motive; and (3) the content of the goal behaviour to which the motive directs behaviour.

Strength of Restraining and Control Mechanisms.—There are great differences in the ability of persons to organize and control the forces of motives. Terms such as strength of character, self-control, superego and force of habit are used to describe these differences.

Exploratory **Behaviour.**—An immediate effect of frustration, whatever its source and whatever the nature of the motive. is the occurrence of exploratory behaviour. This may be overt behaviour, as when a person searches for an opening in a wall which obstructs his path, or argues with a traffic officer who will not allow him to enter a certain street. If the exploration is successful, a detour is discovered and the directed action proceeds on its course. If the detour is short and simple, it may be learned immediately and become a permanent part of the individual's repertoire of behaviour; if it is long or complicated, it will be more slowly learned; and if it is too difficult, it will never be learned.

Thinking and **Planning.**—If immediate overt physical or social exploration is not successful, it is followed by subjective exploration; *i.e.*, thinking, planning, analyzing and problem solving. This behaviour is functionally similar to overt exploration.

Phantasy.—If frustration is long-continued, is of obscure origin or involves strong motives, phantasy frequently occurs. Phantasy is closely related to planning and thinking, but it differs from them in that the solutions and substitutes it provides cannot be achieved overtly. Phantasy reflects motives less distorted by external conditions than either thinking or overt exploration; in phantasy a person is free.

Substitute **Behaviour.**—The acceptance of more-or-less satisfying substitutes for inaccessible, original goals frequently occurs.

Dissociation.—When an individual is unable to achieve goals that are highly regarded by his social group, he may continue to avow his acceptance of them while making no effort to achieve them. Such dissociation of motive from directed! overt behaviour provides considerable social acceptance; merely subscribing to socially approved goals brings social prestige.

Emotional Reactions.—Emotional behaviour accompanies many of the other behavioural resultants of frustration. The stronger and the more basic the motive, the more extreme the emotional accompaniments. In some cases, complete disruption of goal-directed behaviour occurs.

Regressive **Behaviour.**—Under conditions of strong and persisting frustration, behaviour becomes primitive in many respects; it becomes like behaviour which normally occurs at an earlier developmental level. Regression occurs in connection with behavioural techniques used to achieve goals (instrumental regression); it occurs with respect to goals (goal regression); and it occurs in connection with motives (motivational regression). Much neurotic and psychotic behaviour involves goal and motivational regression, usually implemented by unconscious mechanisms.

Lowering Aspiration Level.--One kind of goal regression has been subject to successiul experimental study. In cases of relatively superficial and weak motives it has been found that a goal of high attractiveness but impossible of attainment for the individual may be abandoned ior a goal of lower attractiveness which is within the range of the individual's abilities. This is a common occurrence when the source of the frustration is attributed by the individual to his own lack oi ability; *i.e.*, when the individual experiences failure. This kind of regression, or lowering of the level of aspiration, as it has been called, has an important mental-hygiene significance. It means that great numbers of people are able to experience success in most of their efforts, ior when they do not experience success they change their goals to a level appropriate to their ability. Lowering the level of aspiration is not usually pathological (neurotic or psychotic).

Abandonment.—One common reaction to irustration, particularly when motives are superficial and weak and when the interruption occurs early in the behaviour episode, is the abandonment oi the course of action and the relinquishment of the possibility of achieving the goal. This is probably not possible with basic motives that ramify widely throughout hehaviour. Such motives cannot be abandoned without a drastic change in mode of living which is resisted by the social group in which the person lives and by his other motives.

Withdrawal.—During frustration temporary ceasing of goal-directed actions and turning to other activities without abandoning the motivating state is frequent.

Repression.—Frustration of fundamental motives may be too painful for the person to iace, or a social prohibition may be so strong that even the admission of the motive to transgress it may be impossible. In these cases the motive may he obliterated irom consciousness. It mas one of the great discoveries of the early 20th century that motives can be consciously avoided, yet continue to influence hehaviour. Repression of strong central motives is considered to be one oi the principal sources of neurotic and psychotic behaviour.

Lowered Attractiveness of Goals.—One way of avoiding the pain oi irustration is to depreciate the value oi the unobtainable goal, for serious frustration is not experienced in relation to unimportant things. The "sour-grapes" reaction is an important self-protective adjustment to frustration.

Enhanced Attractiveness of Goals.—When goal-directed behaviour is interrupted, but not irrevocably so, the value oi the goal may be enhanced. A considerable number of iolk sayings describe this phenomenon: "the grass on the other side of the ience is greener"; "absence makes the heart grow fonder."

Aggressive **Behaviour.**—The initial reaction to an interruption of goal-directed behaviour is frequently an energetic effort to proceed in spite of the interruption. This will take the form of physical, social or intellectual effort depending upon the nature oi the interruption. Such "aggressive" hehaviour may be one aspect oi exploration in its early stages; *i.e.*, a testing of the strength of the obstacle. If the individual becomes emotional or regresses, his behaviour will become more primitive and this often involves violent, direct physical and social approaches which will commonly he described as aggressive.

The reactions to frustration given above are not mutually exclusive or independent; they are on quite different levels of significance. An important problem of scientific psychology is to describe them more adequately and systematically, and to determine their causation.

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FRUSTUM, a term in geometry for the part of a solid figure, such as a cone or pyramid, cut off by a plane parallel to the base or lying between two parallel planes; and hence in architecture a name given to the drum of a column.

FRY, ELIZABETH (1780–1845), English philanthropist, and, after Howard, the chief promoter of prison reform in Europe, was born in Norwich on May 21, 1780. Her father, John Gurney, afterwards of Earlham Hall, a wealthy merchant and banker, represented an old family which for some generations had belonged to the Society of Friends. While still a girl she showed the benevolence of disposition, clearness and independence of judgment, and strength of purpose, for which she was afterwards so distinguished. In Aug. 1800 she became the wife of Joseph Fry, a London merchant.

Amid increasing family cares she was unwearied in her attention to the poor and the neglected of her neighbourhood; and in 1811 she was acknowledged by the Society of Friends as a "minister." She had made several visits to Newgate prison as early as February 1813, but the great public work of her life dates effectively from the formation of the association for the improvement of the female prisoners in Newgate in April 1817. Its aim was the much-needed establishment of some of what are now regarded as the first principles of prison discipline, such as entire separation of the sexes, classification of criminals, female supervision for the women, and adequate provision for their religious and secular instruction, as also for their useful employment. The ameliorations effected by this association, largely by the personal exertions of Mrs. Fry. led to a rapid extension of similar methods to other places. In 1818 she, with her brother, visited the prisons of Scotland and the north of England. The publication (1819) of the notes of this tour, and the cordial recognition of the value of her work by the house of commons committee on the prisons of the metropolis, led to an extensive correspondence with persons interested in prison reform in Italy, Denmark and Russia. Through a visit to Ireland, which she made in 1827, she was led to direct her attention to other houses of detention besides prisons; and her observations resulted in many important improvements in the British hospital system, and in the treatment of the insane.

In 1838 she visited France, where she conferred with many of the leading prison officials, and personally visited most of the houses of detention in Paris, Rouen, Caen and other places. In 1839 she obtained an official permit to visit all the prisons in that country; and her tour, which extended from Boulogne and Abbeville to Toulouse and Marseilles, resulted in a report which was presented to the minister of the interior and the prefect of police. Before returning to England she had included Geneva, Ziirich, Stuttgart and Frankfort-on-Main in her inspection. The summer of 1840 found her travelling through Belgium, Holland and Prussia on the same mission; and in 1841 she also visited Copenhagen. In 1842, through failing health, Mrs. Fry was compelled to forego further travels, but she had the satisfaction of hearing from almost every quarter of Europe that the authorities were giving increased practical effect to her suggestions. She died on Oct. 12, 1845. She was survived by a numerous family, the youngest of whom was born in 1822.

Two interesting volumes of *Memoirs, with Extracts from her Journals and Letters*, edited by two of her daughters, were published in 1847. *See* also G. King Lewis, *Elizabeth Fry* (1910).

FRY, ROGER ELIOT (1866–1934), British art critic and painter, was born in London, and educated at Cambridge university. He studied painting under Francis Bate and then in Paris. His landscapes are marked by deep feeling for form and a scholarly sense of design and technique. An active member and exhibitor of the London group, he gave an exhibition of his paintings in 1920. With his wide knowledge and acute sensibility. Fry became a recognized art critic in England and abroad. He published a study of *Bellini* (1899) and edited Reynolds' *Discourses* (1905), but is best known by his championship through much opposition and prejudice, of Cézanne and the Postimpressionists. His *Cézanne* (1927) is a study of the master. Among other publications are *Vision and Design* (1920); *Architectural Heresies of a Painter* (1921), a book of travel impressions; *A Sampler of Castile* (1923); and *Transformations* (1926). In 1933 he was appointed Slade professor of fine art at Cambridge.

See Virginia Woolf, *Roger Fry:* a *Biography* (1940); and E. M. Forster, *Abinger Harvest* (1936; 1955), which contains an essay on Fry.

FRYATT, CHARLES (1872–1916), British seaman, was born at Parkeston, Essex, on Dec. 2, 1872. He entered the service of the Great Eastern Railway Co., and in 1904 became chief officer in their service of vessels plying between Harwich and Rotterdam. In 1913 he was promoted captain. At the end of July 1916, it was announced that his ship, "Brussels" had been captured and the captain himself arrested and tried by court martial. on a charge of having attempted, on March 28, 1915, to ram a German submarine. The German authorities stated that Captain Fryatt had confessed that he had acted under orders from the British admiralty; but the trial was hurried and secret, no intervention on the part of neutrals being allowed. The captain was condemned to death and shot at Bruges on July 27, 1916. The body was, on July 7, 1919, brought from Belgium to England and was buried at Dovercourt, near Harwich.

FRYDLANT or FRIEDLAND, an old town in Liberec, Czech., occupied in 1938 by Germany. It has local administrative functions supplemented by small but thriving textile and engineering factories, paper mills and pottery works. The old castle situated on a small hill commanding the town epitomizes its stormy history. Pop. (1950) 4,447. It must be distinguished from Frydlant in Ostrava, a small town of about 4,000 inhabitants.

FUAD I (1868–1936), king of Egypt, born at Gizeh palace, Cairo, on March 26, 1868, was the youngest son of the khedive Ismail. After his father's deposition he went to Italy, returning permanently to Egypt only in the 1890s when he became aide-de-camp to the khedive Abbas II. He remained quietly in Egypt, occupying himself largely with charitable activities. When, in 1914, Egypt was declared a British protectorate, Abbas deposed and the khediviate abolished, Fuad's elder brother, Husain Kiamil, became ruler with the title of sultan. The sultan's son, Prince Kemal ed-Din, having renounced his rights of succession, Fuad became sultan on his brother's death in 1917. On May 25, 1919, he married the princess Nazli, daughter of Abdel-Rehitn Sabri Pasha, who gave birth on Feb. 11, 1920, to an heir, Prince Farouk.

When Great Britain relinquished the protectorate and acknowledged Egypt as an independent kingdom, Fuad was proclaimed king (March 16, 1922) and became at once an important factor in Egyptian politics. The popular demand for an even greater degree of national independence was sponsored principally by the Wafd, the major political party; and after 1922 Egyptian political life was largely dominated by the struggle for power between the Wafd and the new palace parties centred around the king. In this duel the British government made a number of interventions, some favourable to the Wafd (since it was anxious to negotiate a settlement which would not be repudiated by the most popular party), others to the palace (by reason of the periodic outbreaks of anti-British violence to which the Wafd-inspired nationalist enthusiasm gave rise). *(See* EGYPT; *History.)*

Fuad retained his active interest in charitable and, particularly, in educational matters and was a prime mover in establishing the first Egyptian university of the western type, the Fuad I university in Cairo (1925). In 1927 he paid state visits to London and Rome. He died on April 28, 1936.

See G. A. Lloyd, Baron Lloyd of Dolobran, *Egypt since Cromer,* 2 vol. (1933–34); Ikbal 'Ali Shāh, *Fuad, King of Egypt* (1936).

(H. S. D.)

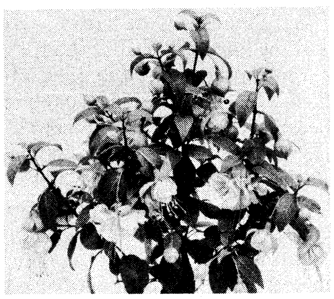
FUAD PASHA (1815–1869), Turkish statesman, was the son of the poet Kechéji-zadé Izzet Molla. He was educated at the medical school and was at first an army surgeon. He became secretary of the embassy in London; was employed on special missions in the principalities and at St. Petersburg (1848), and was sent to Egypt as special commissioner (1851). He was five times foreign minister. During the Crimean War he commanded the troops on the Greek frontier and distinguished himself by his bravery. He was Turkish delegate at the Paris conference of 1856; was charged with a mission to Syria in 1860; grand vizier in 1860 and 1861, and also minister of war. He died at Nice in 1869. Generally regarded as the partisan of a pro-English policy, he served his country well by his able management of foreign affairs, and not least by his efficacious settlement of affairs in Syria after the massacres of 1860.

FUCHOW: *see* FOOCHOW.

FUCHSIA, a genus of plants of the family Onagraceae (*q.v.*), characterized by entire, usually opposite leaves, pendant flo ers, a funnel-shaped, brightly coloured, quadripartite, deciduous calyx, four petals, alternating with the calycine segments, eight, rarely ten, exserted stamens, a long filiform style, an inferior ovary and fruit, a fleshy ovoid many-seeded berry. All the members of the genus, except a few New Zealand species, are natives of Central and South America—occurring in the interior of forests or in damp and shady mountainous situations. The various species differ not a little in size as well as in other characters; some, as F. *parviflora,* being dwarf shrubs; others, as F. *arborescens,* attaining a height of 12 to 16 ft.; while others are treelike and have stems several inches in diameter.

F. coccinea was the first species cultivated in England, where it was long confined to the greenhouse. The numerous hybrid fornis now existing are the result chiefly of the intercrossing of long-flowered with globose-flowered plants. In some varieties the blossoms are variegated, and in others they are double. There appears to be little limit to the number of forms to be obtained by careful cultivation and selection.

Ripe seed is sown either in autumn or about February or March in light, rich, well-drained mold, and is thinly covered with sandy soil and watered. A temperature of 70° to 75° F. has been found suitable for raising. The seedlings are pricked off into shallow pots or pans, and when three inches in height are transferred to three-inch pots, and are then treated the same as plants from cuttings. Fuchsias may be grafted readily, preferably by the splice or whip method, the apex of a young shoot being employed as a scion; but the easiest and most usual method is by cuttings.



BY COURTESY OF CHICAGO NATURAL HISTORY MUSEUM

FUCHSIA (FUCHSIA)

Among the more hardy or half-hardy plants for borders in California and southern England are varieties of F. *magellanica,* a tree up to 20 ft. high, but lower as cultivated. A native from Peru to southern Chile, it is the parent of most garden varieties.

For greenhouse culture may be mentioned F. *corymbiflora* (Peru), q to 6 ft. high, with scarlet flowers nearly 2 in. long in long terminal clusters; F. *julgens* (Mexico), 4 to 6 ft.. with drooping apical clusters of scarlet flowers; F. *procumbens* (New Zealand), a pretty little creeper, the small flowers of which are succeeded by oval magenta-crimson berries which remain on for months, and F. *splendens* (Mexico and Guatemala), 6 ft. high, with very showy scarlet and green flowers. These wild species, however, cannot compare in beauty or freedom of blossom with the numerous horticultural varieties.

The berries of some fuchsias are subacid or sweet and edible. From certain species a dye is obtainable.

The so-called native fuchsias of southern and eastern Australia are plants of the genera *Correa* and *Epacris.*

FUCINO, a lake bed of the Abruzzi, Italy (Lat. Lacus Fucinus), in the province of Aquila, 2 mi. E. of the town of Avezzano. The lake was 37 mi. in circumference and 6j ft. deep. From the lack of an outlet, the level of the lake was subject to great variations. As early as A.D. 52 the emperor Claudius. realizing a project of Julius Caesar, constructed a tunnel 33 mi, long, with 40 shafts at intervals, by which the surplus waters found an outlet to the Liris. No less than 30,000 workmen mere employed for 11 years in driving this tunnel. In the following reign the tunnel was allowed to fall into disrepair, but was repaired by Trajan. Still preserved in modern times, it is, however, no longer in use.

Various attempts to reopen it from 1240 onward were unsuccessful. By 1852 the lake had gradually risen until it was 30 ft. above its original level. In 1854–75 Prince Alessandro Torlonia, the Roman banker, drained the lake at the cost of about £1,700,000, becoming proprietor of the site in return. The outlet by which it was drained was 4 mi. long and 24 sq.yd. in section.

FUEL CELL. The idea of using electrochemical processes for generating and for storing electrical energy in flashlight batteries and storage batteries is familiar to most people; the conception of deriving electrical energy directly from normal oxidizable fuels is not so familiar. From the time of Sir Humphrey Davy the idea has attracted attention since the prize to be won is the generation of electricity without using any form of the heat engine with its thermodynamic and mechanical losses. It is theoretically possible to achieve very high conversion efficiencies with a corresponding saving in fuel.

Thermodynamics. — Provided the energy change in a fuel cell resulting from the chemical reaction of oxidation takes place with the production of electrical energy and no liberation of heat and in a thermodynamically reversible manner, then it may be represented by the Gibbs-Helmholtz equation:

$$\Delta H = \Delta G - \frac{T\,\delta(\Delta G)}{\delta T}$$

where T is the absolute temperature, ΔH is the heat of combustion and ΔG is the free energy change representing the maximum energy available. Free energy changes are known from many reactions and consequently efficiencies can be calculated. For example, the reaction $C + O_2 = CO_2$ has a value of ΔG at 25° C. which is equal to 94.2 kg.cal. per gram molecule or 4.136 kw.hr. per pound of carbon. At 1,000° C. this value is only altered by 0.0270. Thus the second term in the Gibbs-Helmholtz equation is negligible and the theoretical efficiency of conversion of heat of chemical energy to electrical energy is nearly equal to the heat of combustion. The voltage per cell is of the order of one volt on open circuit, falling as current is drawn from the cell.

Applications. — The fuel cell holds promise of application in industry. Since direct current is produced it would not seem feasible for large-scale power generation in competition with high-voltage alternating current. The characteristic of the fuel cell is falling efficiency with increasing load, which is favourable for traction applications where full load is only required for starting and climbing gradients. The good torque characteristics of direct-current motors can be used immediately. For local use the fuel cell's generation of direct current at low voltage is favourable for electrometallurgical and electrochemical processes, particularly if it is fed with industrial or natural gas.

Modern Developments. — Most progress was made after World War II in Great Britain, the U.S.S.R. and western Germany. The main work was on industrial gases rather than solid or liquid fuels. Three main types of cell were investigated: (1) the cell in which aqueous electrolyte is fed between the electrodes, the fuel gas being fed to one electrode and oxygen to the other; (2) the fused salt cell in which molten salt is used as the electrolyte; this is commonly based on carbonates having ionic conductivity; ionic solid electrolytes were also considered; and (3) the redox ("reduction-oxidation'!) cell in which oxidation of the fuel by one redox agent and oxidation of another redox agent by oxygen or air both take place outside the cell, the two redox agents providing the necessary electrical energy when brought together in the cell, but separated by a semipermeable membrane.

The Bacon team at Cambridge university developed a hydrogen-oxygen cell in which the electrolyte is a caustic potash solution. The cell operates at about 200° C. and 600 pounds per square inch with treated nickel electrodes, and gives varying outputs up to 1,000 amp, per square foot for long periods. In Germany E. Justi reported success on a low-pressure hydrogen-oxygen cell and fused carbonate cells using carbon monoxide and hydrogen. Following the work of E. Baur in Zürich, Switz., O. K. Davtyan in the U.S.S.R. reported promising results on high-temperature cells using alkali carbonates. These results were improved upon in the Netherlands and Great Britain.

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(C. G. CY.; X.)

FUELING STATIONS, NAVAL: *see* BUNKERING OF SHIPS.

FUELS. Fuel is a term applied to materials used to produce heat by combustion in air. Man alone among living creatures has discovered ways of creating heat and power by the use of fuel. He has thereby improved his means of procuring food, has adapted himself to live and flourish on almost the entire area of the globe and has secured an immeasurably increased standard of comfort. Modern civilization could not exist if fuel supplies failed or became exhausted.

Following are the main divisions of this article:

I. FUEL CONSTITUENTS

Generally speaking, the bulk of natural fuels such as coal, wood, peat, oil and natural gas are made up of compounds of carbon, hydrogen and oxygen in association with small proportions of nitrogen and sulfur, in addition to moisture and mineral ash but in special circumstances such elements as phosphorus and the more readily oxidizable metals such as magnesium and aluminum may be utilized as fuel.

When the constituent elements of a fuel burn or unite with oxygen, heat is evolved, and a fuel is completely burned only when all of its combustible components are oxidized to the highest possible degree. In the process a definite quantity of heat is produced which can be calculated approximately from the chemical composition of a fuel. Thus one pound of carbon in complete combustion to carbon dioxide (CO_2) produces about 14,500 B T U. (British thermal units), but only about 4,400 B.T.U. are produced in burning to the lower oxide. carbon monoxide (CO). If, however, this is subsequently burned to CO_2, the balance of about 10,100 B.T.U. is liberated. Hydrogen burns to water vapour, about 62,000 B.T.U. being produced per pound of hydrogen burned. The value of a fuel depends primarily upon its potential heat-producing capacity per unit mass or calorific value. but the calorific intensity, or the temperature to which this amount of heat can raise the products of combustion without excess air, is also important. The impurities in a fuel affect both its calorific value and calorific intensity.

II. SOLID FUELS

Solid fuels may be divided into two main groups, natural and manufactured. In the former category are coal. wood, peat and other vegetable matter, and in the latter such products as coke and charcoal, obtained by destructive distillation (heating the raw material in the absence of air, by which gas and tar are also produced). Such processes form the basis of the manufacture of both metallurgical coke and gas, two important industries.

A. Coal and Related Fuels

The reserves of coal; which may be expected to last more than 1,000 years at the rate of consumption in the early 1960s, are far above those of any other combustible. Coal is a stratified sedimentary rock that has been formed by the action of decay, heat and pressure upon accumulations of vegetable and woody or cellulosic matter laid down in bygone ages. It varies widely in composition and properties. Although the proportions of the elements present in any particular variety of coal and its behaviour under various forms of treatment are known, the fundamental causes of the differences between the different types have not yet been placed upon a really rational basis. A knowledge of the true constitution of coal: which is being sought by many research workers, could not fail to be of great assistance to those responsible for the proper utilization of a vast but irreplaceable store of fuel.

1. Classification. — Many classifications of coal have been suggested — by geologic age, coking properties, commercial application, chemical composition, etc. There is, however, no sharp distinction between any one coal and its nearest relation, but rather an innumerable family with characteristics changing gradually from one extreme to the other. Four main divisions are given in the classification of the American Standards association: (1) anthracite; (2) bituminous; (3) subbituminous; and (4) lignite and brown coal.

Table I.—Approximate Chemical Composition of Solid Fuels
(moisture free)

Fuel	Carbon (C)	Hydrogen (H)	Oxygen (O)	Nitrogen (N)	Sulfur (S)	Ash
Cellulose (forms the bulk of plant structure)	44.4	6.2	49.4	...	...	...
Wood	48.5	6.0	43.5	.5	...	1.5
Peat	58.0	6.3	30.8	.9	Trace	4.0
Lignite	67.0	5.1	19.5	1.1	1.0	6.3
Coal (bituminous)	77.0	5.0	7.0	1.5	1.5	8.0
Coal (anthracite)	90.0	2.5	2.5	.5	.5	4.0

From Table I it will be seen that the transition from cellulose to anthracite is marked by elimination of oxygen and a corresponding increase of carbon.

Henri Victor Regnault and E. Gruner were among the first to formulate methods for the classification of types of coal. which they grouped according to flaming characteristics and the nature of the coke residue. S. W. Parr proposed a classification by rank (in the natural series from anthracite to lignite) based upon the heat value of the true coal substance "unit coal," free from ash or sulfur, that is, mineral matter-free (mm-free), according to fixed carbon on the dry basis or B.T.U. on the moist basis. The Parr formula for the latter is:

$$\text{Moist, mm-free B.T.U.} = \frac{\text{B.T.U.} - 50S}{100 - (1.08A + 0.55S)} \times 100$$

where S and A are the percentages of sulfur and ash, respectively. Another method of classification is that of C. A. Seyler, in which coals are divided according to their hydrogen content into five groups uhich are further subdivided according to the carbon content. This classification has been used by the British geological survey in publications on the coals of south Wales.

For carbonization purposes one of the most important properties of bituminous (soft) coals is their ability to form coherent coke and the extent to nhich they swell or shrink during this process. This behaviour forms the basis of a useful subclassification of such coals. S. R. Illingworth and others classed coals according to the temperatures at which certain constituents decompose.

2. Tests on Carbonaceous **Materials.**—Accurate tests are available for such characteristics of coal as its calorific value or ultimate chemical composition. and independent determinations of these should agree closely. Tests of an empirical nature, such as proximate analysis, and special tests. such as determinations of the free-swelling index or caking characteristics, are less specific but equally important. Since in such cases variation of method might produce divergent results, the same procedures must be adopted by different workers.

In 1920 the British Fuel Research board appointed a committee to examine methods of analysis, including (1) proximate and (2) ultimate analysis, (3) determination of caking index and (4) measurement of calorific value. The following methods of analysis, which have since been essentially followed, were adopted:

Proximate Analysis.—This consists of the determination of moisture, ash. volatile matter and fixed carbon in a sample of coal ground to pass a standard sieve of 60 meshes to the inch and air-dried.

1. Moisture. This is given by the loss in weight of one to two grams of coal when heated for one hour at a temperature of 105°–110° C. Coals especially liable to oxidation should be heated in a current of dry nitrogen.

2. Ash. One to two grams of the coal in a platinum or silica dish are heated gradually in air to about 800° C. When combustion is complete the residue is cooled and weighed.

3. Volatile matter. One gram of the coal is heated for seven minutes at about 925° C. in a platinum crucible of special shape closed by a well-fitting lid. The loss of weight is taken conventionally to represent the volatile matter.

4. Fixed carbon. The value of fixed carbon is obtained by subtracting the sum of the percentages of ash, volatile matter and moisture from 100.

Ultimate Analysis.—This consists of determining the proportions of the various constituent elements of the coal. The carbon and hydrogen are determined by the combustion of 0.2 g. of coal in a current of oxygen. The products of combustion are passed over copper oxide at 800° C. and then over granular lead chromate at 600° C. to absorb sulfur compounds. The carbon dioxide and water produced are weighed separately and from these weights are calculated the percentages of carbon and hydrogen in the coal. Nitrogen is determined by digesting one gram of coal with sulfuric acid according to the method of J. Kjeldahl. The nitrogen is thereby changed into ammonia, which after distillation is titrated with standard solutions. The sulfur is determined by conversion into sulfate by heating the coal gently with a fusion mixture of lime and magnesia (Eschka's method). Detailed procedures for carrying out these tests, as later modified, are covered in *A.S.T.M.* Standards *on* Coal *and* Coke (American Society for Testing Materials, 1957).

Caking Index.—There is no laboratory test that will give completely satisfactory information as to the caking or coking action of coal in its utilization. The free-swelling index, however, gives valuable guidance on many utilization problems. This smelling test consists in heating one gram of pulverized coal in a silica crucible over a gas flame under prescribed conditions to form a coke button. which is compared in size and shape with a series of standard profiles numbered one to nine. These profiles are intended to cover the size and shape of buttons obtained from coals covering a wide range in plastic properties. The number of the standard profile with which the maximum cross-sectional area of the button most nearly corresponds is recorded as the swelling index.

Calorific Value.—The heat evolved by complete combustion of a fuel may be determined in various ways, but the most accurate method uses the bomb calorimeter. One gram of finely powdered coal is pressed into a cylindrical pellet, accurately weighed and inserted in a strong metal bomb with an airtight cover. This is filled nith oxygen to a pressure of about 25 atm. and immersed in a calorimeter vessel containing water.

The pellet is ignited by passing a momentary current of electricity through a thin wire within the bomb; the heat evolved by combustion of the coal is measured by the rise in temperature produced, proper cooling corrections being applied. The accuracy obtainable is of the order of two or three units in the fourth significant figure. The calorific value of dry coal varies from 10.000 to 15,000 B.T.U. per pound, according to the type. Approximate values in the same units for dry fuels may be taken as: wood 8,000; peat 10,000; lignite 11,000; bituminous coal 13,800; and anthracite 13.500.

The heat obtainable from a fuel is always less in practice than in theory, since losses caused by imperfect combustion and by heat carried away in the flue gases, in clinkers and in ashes can never be entirely avoided. Further, in fuels containing hydrogen the calorific value measured in the calorimeter and used generally for scientific purposes (the gross calorific value) is higher than that obtainable under working conditions (the net calorific value) by an amount equal to the latent heat of vaporization of the water formed.

3. Constitution **of** Coal.—Since coal is derived from vegetable matter, it is to be expected that among its major constituents will be degradation products of cellulose and lignin, together with small proportions of resinous bodies and compounds containing nitrogen and sulfur. The more important methods employed in investigating the constitution of coal may be briefly enumerated as: (1) extraction by solvents; (2) action of reagents (*e.g.,* controlled oxidation, hydrogenation, chlorination. methylation, etc.); (3) carefully regulated destructive distillation; (4) microscopic examination of thin sections or etched surfaces; and (5) examination by X-rays.

One investigation has been to determine the effect of hydrogen under high pressure upon the coal substance, by which it has been found possible to confer caking properties on coals that are normally noncaking. Even anthracite has yielded to this treatment, and the substance of certain types of coal has been converted into a mineral oil. By extracting coal with benzene under high pressure. F. Fischer in Germany and W. A. Bone in England were able to separate the constituents in which the caking properties of a coal appear to reside. Similar results were obtained by Parr in the U.S. by the use of phenol and xylene as solvents.

Bone obtained a considerable yield of mellitic and other benzene carboxylic acids in the oxidation products of the residue from the benzene extraction, and concluded that a considerable proportion of the coal substance has a six-carbon ring structure; each carbon atom of the ring is connected to other carbon atoms.

According to R. V. Wheeler, bituminous coal consists essentially of insoluble ulmins (organic substances) in which organized plant tissues are dispersed. By mild oxidation (for example, with hydrogen peroxide or with air at 100°–150° C.) the ulmins are rendered soluble in alkali and may thus be separated from the organized plant remains. Fossil plant cuticles and other tissues have been recognized in this residue. The ulmins, when oxidized by dilute nitric acid, yield oxalic, succinic, picric and pyromellitic acids. indicating that the ulmin molecules consist of benzenoid groupings linked by such structures as pyrrole and furan or their derivatives.

The results of the destructive distillation of coal have proved difficult to interpret from the point of view of the constitution of the coal substance because of overlapping of the various decomposition processes taking place. Examination of the oils produced by hydrogenation of coal seems to confirm the views of Bone and Wheeler on the six-carbon ring structure of the coal substance. By microscopic study of thin sections, Marie Stopes identified four main ingredients in British banded bituminous coal, which she designated vitrain, clarain, durain and fusain. G. Thiessen, on the other hand, considered that U.S. coals contain three main ingredients which he termed mother of coal, attritus and anthraxylon. Seyler applied the methods of metallography (*q.v.*) to microscopic examination of coal surfaces and nas able thereby to identify directly many forms of plant tissue in the coal.

4. Peat.—Vast accumulations of peat occur in Europe, North America and northern Asia, but the industry has been developed only in regions deficient in coal. In Ireland millions of tons are consumed annually; the U.S.S.R. Sweden, Germany and Denmark also produce and use considerable quantities, and peat is used locally in England and Scotland. Peat bogs are formed chiefly in temperate humid climates by the accumulation and partial decomposition of vegetable remains under conditions of deficient drainage. in which the immersion excludes air and prevents complete decay.

Winning of Peat.—A chief use of peat is as a domestic fuel, usually hand cut, although progress has been made in the excavation and spreading of peat by mechanical methods. In many bogs roots and tree trunks are found, but such obstructions do not necessarily preclude the successful application of mechanical winning. Peat is cut by spade in the form of blocks which are spread out on the bog to dry, and when dry weigh from three-quarters of a pound to two pounds each. In one method of machine winning a dredger or excavator digs the peat from the drained bog and delivers it to a macerater which extrudes the peat pulp through a rectangular opening; the pulp is then cut into blocks. which are spread upon the surface of the bog. After a meek or two these are collected into small piles or footings and after further drying are built in open order into small clamps. Maceration tends to more uniform shrinkage and a denser and tougher fuel; it also accelerates drying under unfavourable weather conditions.

Hydraulic excavating can also be used and is especially applicable to bogs containing roots and tree trunks, the peat being washed down by a jet of water under a pressure of about 150 lb. per square inch and the pulp run to a sump. There. after slight maceration, it is pumped to a draining ground in a layer about nine inches thick. which, after partial drying, can be cut up. Complete drying is effected in the usual manner.

Composition of Peat.—Peat varies from a light. spongy material mainly composed of sphagnum moss in the upper layers to a dense, brown, more humified substance at the bottom of thick bogs. In its natural state it contains 90% to 95% water, but by draining this may be reduced to 88% or 91%. The water ratio (the ratio of water to dry peat substance) of peat containing 95% water is 19:1, that of peat containing 90% water; 9:1. The latter will thus contain more than twice as much solid matter although its water content has only been reduced by 5%. The moisture may be reduced by: (1) air-drying; (2) evaporation by heat with partial heat recovery; (3) mechanical pressure; or (4) electrical osmosis. Many methods involving combinations of these have been tried. but air-drying is used in all schemes working on a commercial basis. By air-drying the water may be brought down to about 25%, the calorific value then being about 7.000 B.T.U. Peat thoroughly dried by heat takes up about 16% of water on exposure to air; it is thus useless to dry it artificially below this limit. The density of air-dried cut peat is about 0.5; that of macerated machine-cut peat is 0.85 to 1.0.

The ash in peat varies considerably, from about 1% to 8%. and usually increases with depth. The nitrogen likewise increases with the depth, from 1% to 2%. The proximate analysis of a good Irish peat, air-dried, may be taken as: moisture 20.2%; organic volatile matter 49.5%; fixed carbon 26.8%; and ash 3.4%. Peat burns readily with a smoky flame and a characteristic odour. The ash is powdery and light. except in certain varieties high in ash through the inclusion of sand, etc. Peat is used for domestic purposes and forms a fuel suitable for boiler firing in either the briquetted or pulverized form; it also has been used in gas producers, and the coke from carbonized peat forms a suitable fuel for small producers such as are sometimes used for motor-transport purposes.

5. Lignite.—It has been estimated that about 50% of the world's total coal reserves are lignitic. Being inferior in some ways to bituminous coal, these reserves have not been exploited to anything like the same extent. However, in some areas the growing urgency of the fuel problem led to extensive developments, especially in Germany, where the production of lignite has exceeded that of bituminous coal. Schemes for its utilization. particularly by hriquetting, have received attention in Australia, Canada, the United States. New Zealand and other countries.

Lignite is intermediate in properties between peat and bituminous coal, containing when dry about 60% to 75% of carbon and a variable proportion of ash. Raw lignite conforms to two types, brown or amorphous and black or pitchlike; it is characterized by a high water content, which may amount to as much as 60% in the brown varieties. Upon weathering, a proportion of this moisture is given up; and disintegration or crumbling of the material occurs, reducing its value as a fuel. Lignite tends also to disintegrate during combustion; hence the losses through a grate may be relatively high. It requires special care in storing, is uneconomical to transport long distances and is liable to spontaneous combustion. Against these drawbacks, many of the beds lie close to the surface and are of great thickness, sometimes more than 100 ft.; they are. therefore, easily worked, and the cost of production is low. (See also LIGNITE.)

6. Subbituminous Coals.—These coals are a gradation between lignitic and bituminous coals. They are noncoking, weather readily and have a B.T.U. value on a moist mineral matter-free basis of from 8,300 to 13,000. In general, such coals are utilized in about the same manner as noncoking bituminous coals but are more difficult to store.

7. Bituminous Coals.—A large variety of coals are included under the term bituminous. These coals have more than 14% volatile content on a dry mineral matter-free basis (which causes them to burn with a smoky yellowish flamej and in general resist weathering. The moisture content is lower than that of the subbituminous and lignitic coals, often being as low as about 3%. There are noncoking and coking varieties, the latter serving for metallurgical-coke manufacture. Such coals vary over a wide range in ash content, in hardness and in their tendency to heat spontaneously.

8. **Anthracite.**—Anthracites are characterized by their low percentage of volatile matter and high carbon content. Their lack of smoke production and relatively slow speed of burning make them particularly adaptable for domestic use. They are also used for steam raising and are often mixed with bituminous coals to reduce smoke production; they are blended in small percentages with coking bituminous coals for coke manufacture.

9. **Coke.**—When a raw carbonaceous fuel is distilled or carbonized by heating it in the absence of air, gas and tar vapours are evolved and a residue known as coke remains. The characteristics of a coke vary with the type of coal treated, the temperature and time of carbonization and the peculiarities of the plant in which the operation is carried out. Coke may, however. be broadly divided into two classes—metallurgical and gas. The former is the main product of the carbonization of coal at about 2.000° F. in coke ovens. the tar and gas obtained usually being considered as by-products. It is used for the reduction of iron ore and for various other metallurgical processes, its essential property being strength to withstand the heavy loads placed upon it in the blast furnace. The properties desired in coke are frequently obtained by blending coals having properties complementary to each other. At about 2.000° F. gas coke is also the most important by-product of carbonization of coal in vertical or horizontal retorts for gas manufacture. Its chief uses are as a metallurgical furnace fuel and in the production of gas. It is also used for steam raising and to a small extent for domestic fuel.

TABLE 11.—*Analyses of* ***Coke*** *Types*

Ingredient	Metallurgical coke	Gas coke: Horizontal	Gas coke: Vertical	Lon-tern-perature coke
Proximate analysis:				
Moisture	.7	.9	.6	2.0
Volatile matter	2.6		3.5	7.5
Fixed carbon	88.2	86.9	86.4	80.0
Ash	8.5	6.5	9.5	10.5
Ultimate analysis (dry coke):				
C	88.0	85.8	85.4	78.7
	.5	.6	.8	2.5
H	1.0	1.2	1.2	1.5
N	.9	1.9	1.8	1.0
S	.9	.6	1.0	j.6
Ash	8.7	9.9	9.8	10.7

Production of coke by carbonization at about 1,100° F. has attracted considerable attention This low-temperature coke retains about 10% to 15% of volatiles compared nith only 1% or 2% in gas or metallurgical coke. and so can be readily ignited, burning freely. It thus forms an excellent smokeless substitute for household coal but it is lighter and more friable than ordinary cokes. The gas yield is less from Ion-temperature carbonization than from high, but the tar yield is increased.

From one ton of coal the yields of coke vary widely; a rough approximation is as follows:

Metallurgical by-product coke	
Gas coke	1,300 to 1,400 lb.
Low-temperature coke	1,400 to 1,500 lb.

The analyses given in Table II are typical of cokes produced by the three methods under conditions of proper quenching. If the coke has been badly quenched or stored in the open the moisture will be much greater.

The physical characteristics of coke have an important bearing upon its suitability for different uses. The cell structure of coke appears to be due to the formation of bubbles during the fusion of certain portions of the coal substance and their subsequent perforation. Its exact nature depends largely upon the conditions of heating, the type of coal dealt with and the fineness to which it is ground before carbonization. Thus the dense coke made from finely divided coal of suitable coking properties consists of minute cells of uniform structure; but dense cokes can. be produced, even from strongly swelling coals, by blending or by pressure during carbonization.

In addition to the chemical tests already described, which are applicable to any solid fuel, certain special tests have been devised for investigating other properties of coke. Those most usually relied upon are determinations of specific gravity (apparent and true) and porosity. Strength is measured by the shatter test in which 50 lb. of two-inch screened coke are dropped four times from a height of six feet onto an iron plate and the proportion broken determined. Reactivity to carbon dioxide is also important.

10. Briquettes. — Fuels prepared from fines and dust by molding under pressure either with or without a binding material are called briquettes. Pitch and coal tar are the binders commonly used, the amount required depending upon the characteristics of the coal. usually somewhere between 6.5% and 10%. An expensive factor in the preparation of briquettes is the cost of binder; hence; materials such as clay, tar, crude oil, peat, silicate of soda, molasses: sulfite liquor, starch, etc., have been tried. Binders have also been prepared by the fermentation of waste straw, farmyard manure or seaweed; the last has the advantage of being smokeless but is difficult to make waterproof. In Europe large quantities of briquettes are made from lignite by pressure alone.

Briquetting offers a means of utilizing quantities of small coal which, though of good quality, is unsalable because of its fine size. Special processes are required for absolutely noncoking materials, such as anthracite fines, since these disintegrate on the fire through the melting out and burning of the binder. Germany occupies first place in the briquetting industry, using mainly brown coal; but briquetting is also carried on in France; Austria, the United States and Wales. Coal briquettes are used for domestic and industrial purposes; lignite briquettes, which do not stand transport well, are chiefly employed as household fuel in the neighbourhood of their manufacture.

Briquettes may be rectangular, varying in weight up to about 28 lb. Smaller egg-shaped or ovoid briquettes are produced in roll presses for domestic purposes. High-quality briquettes are uniform in composition and weight, of high calorific value, strong, waterproof and able to bear transport or storage without disintegration. Density is about 1.3, the same as that of lump coal. The ash content where pitch or a similar binder is used is less than that of the original coal, but when inorganic binders such as clay or lime are adopted the incombustible constituents of the binder are added to the ash of the coal. The calorific value is affected by the binder, but in pitch briquettes the calorific value is slightly greater than that of the raw coal.

Briquetting under pressure, either at ordinary temperatures or at temperatures high enough to cause incipient fusion of some of the constituents, is sometimes adopted as a preliminary process in the carbonization of blends of finely ground coal. It not only aids production of a homogeneous fuel but simplifies the retorting process. (C. H. L.; L. C. McC.)

11. Pulverized Coal. — When solid fuels such as coal are finely pulverized and suspended in air, they can be burned in much the same manner as atomized liquid fuels. The technique of burning pulverized coal progressed so rapidly after 1920 that by the second half of the 20th century this method of firing was universally employed for large furnaces such as cement kilns and central station steam generators. Attempts to burn pulverized coal at high rates in very restricted spaces, such as diesel-engine cylinders, locomotive fireboxes and marine boilers, met with little success because of the harmful effects of the ash inherent in all types of coal.

The burning rate of solid fuels depends primarily upon the amount of surface exposed to oxygen. A one-pound lump of bituminous coal (approximately 22 cu.in.) would have about 48 sq.in. of surface area. If the lump is pulverized until all of the fragments pass through a 200-mesh sieve (.0029-in. opening), more than 1,000,000,000 particles will result, and their surface area will exceed 50,000 sq.in. The lump would require many minutes to burn completely, whereas the pound of powder, suspended in approximately ten pounds of air and injected into a large, hot furnace, would burn in a fraction of a second.

The procedure of burning powdered coal includes: (1) pulverizing the coal; (2) conveying the pulverized coal to the furnace in a stream of "primary air"; (3) mixing the fuel with additional "secondary air" in a burner; and (4) blowing the mixture into the furnace where it is burned in suspension. Ignition is accomplished with an auxiliary oil or gas flame, which can be extinguished after the coal flame is established.

Since coal does not occur naturally in particles fine enough to be burned efficiently, it must be pulverized at some point between the coal seam and the furnace. Drying is also necessary in most applications, since wet coal is difficult to handle in bunkers, feeders and pulverizing mills. Drying and pulverizing are usually done at the point of use, because of the cost and complexity of transporting and storing powdered coal. The first successful installations, such as those at the Lakeside station of the Milwaukee Power and Light Co. (1924), used the bin-and-feeder system, in which the coal was dried, pulverized and stored in large bunkers from which it was conveyed to the furnace as required. Virtually all modern plants use the unit pulverizer system, in which the coal is dried and pulverized in the mill and conveyed to the furnace immediately by preheated air, thus eliminating the need for pulverized-coal collectors, bunkers, air cleaners, etc.

Many types of mechanical and pneumatic mills have been developed to pulverize lump coal by impact and attrition among the coal particles and the mill elements. Mechanical mills are almost universally employed because of their relatively low power consumption, 10 to 20 kw.hr. per ton of coal pulverized. The fineness required for good combustion depends largely upon the volatile content of the coal; increased fineness is required for low-volatility fuels. By proper choice of fineness, burner and furnace, coals of any volatile content, from anthracite to lignite, can be burned satisfactorily.

Pulverized coal burns with such intensely hot and radiant flames that ordinary refractory furnace linings must be replaced by specially cooled walls. In the early days of pulverized-coal firing, erosion or melting of firebrick linings was a major limitation. This difficulty was overcome by lengthening the flame path, increasing the furnace volume and circulating boiler feed water through the furnace walls. Modern steam generators with water-cooled walls burn more than 75 tons of coal and produce more than 1,500,000 lb. of steam per hour.

Ash, always present in coal to some extent, constitutes the major problem in pulverized-coal combustion. In a pulverized-coal flame, the ash exists in the form of tiny molten spheres, which freeze into fly ash as the flame is chilled below the ash-fusion temperature. If the flame impinges upon a surface, the spheres coalesce and become slag. In cement kilns, the ash is discharged with the cement, but in boiler furnaces the ash constitutes a nuisance which cannot be ignored. The fusion temperature of coal ash ranges from 1,800° to 2,900° F., depending upon the chemical analysis of its constituents. Coals with low ash-fusion temperatures are usually burned in "wet-bottom" furnaces, from which much of the ash is drawn off as molten slag. For coals with high ash-fusion temperatures, "dry-bottom" furnaces are used in which the ash is chilled and carried out of the furnace by the combustion gases. Precipitators are required to prevent the fly ash from being discharged to the atmosphere.

Pulverized-fuel firing has a number of advantages over other methods of burning solid fuel in large furnaces. Greater flexibility of fuel choice is a major asset, as is the fact that a powdered-coal furnace can also burn gas or heavy oil with little modification. Time required for starting up and shutting down is relatively short, and load changes can be made almost instantaneously. Since relatively little excess air is needed for complete combustion, and the air can be preheated to a high temperature, boiler efficiency is higher than with stoker firing. Finally, there is virtually no limitation on furnace capacity, since any desired number of mills and burners can be used to supply a single steam generator. (J. I. Y.)

B. Wood

1. Wood as a Fuel.—Although in industrial countries the use of wood as fuel has been almost entirely superseded by the use of coal, oil and gas, large quantities are still employed in less developed or outlying areas. Wood cannot be economically transported great distances by rail, and its use is generally contingent upon its being at hand more or less in a waste form, as, for example, in portions of woodlands unsuitable for timber. Large quantities of waste wood are produced in the process of converting timber into lumber; some of it is used for producing industrial power or for domestic purposes or is distilled for making charcoal, acetate of lime and wood alcohol.

The structural basis of wood is cellulose, of which the simplest form may be given as $C_6H_{10}O_5$. The composition of wood tissue has been expressed by E. Schultze and N. Schuppe as "an aggregate of cellulose and a lignone complex," $5C_6H_{10}O_5$, $C_{19}H_{18}O_8$ or, in percentage composition, C = 49.66, H = 5.74, O = 41.60. The water content of green wood ranges from 50% to more than 200% of the weight of dry fibre; in other words, wood may contain as much as two parts of water to one part of fibre, according to the species, the position in the tree and age. On air-drying this is reduced to about 15% to 20%, or still further by artificial drying. Dried wood, however, may under certain conditions reabsorb moisture.

Both the inflammability and the calorific value of wood are greater in the soft resinous varieties such as pine, fir and spruce than in hardwoods like oak and elm, the calorific value after air-drying varying from 6,500 to 9,000 B.T.U. per pound. The temperatures attained, however, are comparatively low because of the high moisture and hydrogen content. On this account raw wood is unsuitable for metallurgical operations, but before the days of coke manufacture large quantities of wood charcoal were used in the iron industry.

2. Charcoal.—Charcoal is the solid residue of the destructive distillation of wood. Formerly it was manufactured for smelting purposes by the charring process, in which large heaps of wood, covered with earth and turf and provided with flues, were set on fire and allowed to smolder until the volatile matter was completely driven off, no by-products being recovered. In many countries of Europe and Asia charcoal was still prepared in earth kilns into the second half of the 20th century. Where concentrated supplies of waste wood are available it is prepared in retorts. In such instances the charcoal becomes practically a by-product of the wood alcohol and acetic acid industries.

Charcoal is a brittle, porous material retaining the original shape of the wood while its microstructure preserves the vegetable cell structure. It is used for heating and coking and for cooking, in the U.S. especially for grilling, barbecuing, etc., out of doors; other uses are for the manufacture of gunpowder, absorbent and decolorizing agents and heat-insulating materials and for hop drying, casehardening steel, etc. (see also CHARCOAL). Good charcoal is deep black and breaks with a bright fracture. It rings when struck and burns without smoke. In the dry state the apparent specific gravity ranges from about 0.11 for a softwood to 0.20 for a hardwood. The true specific gravity of charcoal substance varies between 1 and 2. Charcoal is comparatively low in ash and ranges from 12,000 to 14,000 B.T.U. in calorific value. The charcoals prepared at low temperatures are exceedingly inflammable, imperfectly charred pieces often being used in Europe for kindling purposes.

C. Utilization of Solid Fuels

Because of the great differences in uniformity, composition and characteristics of the various solid fuels and of any individual type of solid fuel, the problem of efficient utilization has involved years of technological study of composition and structure, experimental work and development of equipment. Tests on quantities from one gram to thousands of tons have been made. From this work, besides knowledge of the fuel, many different types of equipment and operating procedures have been evolved. This work has had a great impact on the commercial movement of fuel, its proper choice, specifications and methods of purchase and the relative competitive position of the various types. Since the actual amount of heat that can be produced and utilized is usually the main objective, the B.T.U. value of a fuel is given prime consideration. However, other characteristics have great bearing on how much of the heat produced can be utilized and also on how rapidly the heat can be produced.

The annual world production of bituminous coal, anthracite and lignite was more than 2,000,000,000 tons in the 1950s. An idea of its relative consumption by different users in a large industrial country can be gained from the following statistics on use of coal in the United States. These figures are fairly typical, although the proportions vary from year to year: electric power utilities 33%; coke plants 25%; other industries 22%; retail deliveries 13%; railroads 4%; cement mills 3%; steel and rolling mills 1%.

1. The Combustion of Solid Fuel.—The combustion of a solid carbonaceous substance is an exceedingly complex process, taking place in several stages and involving the interaction of gases, water vapour and solid carbon. The theoretical amount of air necessary to burn a fuel completely to carbon dioxide and water vapour can be calculated from a knowledge of its ultimate analysis by the use of the equations: (1) $C + O_2 = CO_2$; and (2) $2H_2 + O_2 = 2H_2O$. From (1) it follows that 12 lb. of carbon will require 32 lb. of oxygen and from (2) that 1 lb. of hydrogen will require 8 lb. of oxygen for complete combustion; thus, to burn the carbon and hydrogen in 1 lb. of coal of composition

$$C = 73.1\%,\ H = 5.5\%,\ O = 8.7\% \quad (\text{net } H = 5.5 - \frac{8.7}{8} = 4.4\%)$$

will take $\frac{0.731 \times 32}{12} + 0.044 \times 8 = 2.30$ lb. of oxygen or about 9.9 lb. of air.

In a similar manner, the percentage of carbon dioxide in the flue gases corresponding to the theoretical proportion of air can be calculated. The equations, however, tell nothing regarding the manner in which gases are given off from the raw material and interact among themselves and with oxygen and water vapour before the final products of complete combustion are formed. The mechanism of combustion is still a matter for research.

A complex mixture is involved, containing simple gases, such as hydrogen and carbon monoxide, in addition to molecules of greater complexity which are less directly acted upon by oxygen than the simpler ones. The combustion of the heavier hydrocarbons presents great difficulty, since the action of heat causes them to form still denser aggregates. Even the combustion of such a comparatively simple gas as methane (CH_4) was shown by Bone to proceed in stages involving the entry of successive atoms of oxygen. Methyl alcohol is first formed, but this is subsequently oxidized to an unstable compound which breaks up into formaldehyde and steam. Under certain conditions of slow combustion further stages are involved before complete oxidation is effected, but under high-temperature conditions the formaldehyde is decomposed into carbon monoxide and hydrogen, which then burn directly to carbon dioxide and steam.

In the lower layers of a fuel bed, it is not definitely known whether solid carbon burns directly to carbon dioxide or whether it proceeds first to carbon monoxide (CO) and so to carbon dioxide (CO_2). Three possible reactions are involved:

$$C + O_2 = CO_2$$
$$C + \tfrac{1}{2}O_2 = CO$$
$$CO_2 + C = 2CO$$

An older theory held that the carbon mas first burned to carbon dioxide which was subsequently reduced to carbon monoxide by contact with heated coke. Later studies indicate that carbon monoxide is the initial product.

By circulating air or oxygen at temperatures from 100° to 900° C. over purified nood charcoal, T. F. E. Rhead and R. V. Wheeler were led to the conclusion that CO, and CO are formed simultaneously from an unstable physicochemical complex, C_xO_y, which is the first product of the action of oxygen on carbon (see CARBON, OXIDES OF). Irving Langmuir's experiments appear to show that the first gaseous product of the interaction between carbon and oxygen is carbon dioxide, as he was unable to detect the presence of carbon monoxide. On passing upward the two oxides, in the presence of carbon, react upon each other in accordance with the reversible reaction $C + CO_2 \rightleftharpoons 2CO$; the final products are formed in definite relative proportions that depend upon the conditions, such as temperature and concentration of the various gases present, and also upon nhether enough time has elapsed for equilibrium to be established. In the reaction quoted above, equilibrium is established at 8j0° C., when the percentages of CO_2 and CO are 6.23 and 93.77, respectively. and at 1,200° C., when they are 0.06 and 99 94. Cnder perfect fuel-bed conditions the gas leaving the incandescent bed will thus be composed almost entirely of carbon monoxide. With coal firing this carbon monoxide is consumed. nith the gases of distillation, by the secondary air; but even a coke fire, although smokeless, may give off carbon monoxide if the supply of secondary air should be deficient or badly distributed.

When a raw carbonaceous material is burned, it must first be heated to the point of decomposition. The gases evolved at this stage vary in composition but consist chiefly of hydrocarbons, hydrogen. carbon monoxide, water and tarry vapours, mixed with a certain amount of solid carbon in a finely divided state. As the combustion proceeds, the fuel is freed from volatile matter and converted into coke.

Distillation takes place in the upper layers of an ordinary fuel bed, and to burn the gas and smoke secondary air must be supplied at some point above the fire bed. The solid coke burns in the loner portions of the fire, primary air for this purpose passing through the bed from under the grate. Thus, combustion of both solid carbon and volatile matter is involved. Special devices are sometimes used to force the volatile products through the incandescent coke; for example, by downdraft in which the flue gases are drawn anay below the grate or by downward combustion in which the raw fuel is introduced at the bottom of the fire. In practice, air in excess of that theoretically necessary for complete combustion is required. In best boiler practice 20% of excess air is about the minimum necessary to ensure absence of smoke and fairly complete combustion. Too much air is undesirable, since by cooling donn the gases it may retard combustion, aggravate the production of black smoke and increase heat losses. Best furnace conditions are obtainable with mechanical methods of continuous firing in which the air supply is under more exact control than can be obtained when the firing door has to be opened frequently for hand charging.

2. Solid Fuel for Domestic Purposes.—The manner of use of solid fuels for domestic purposes, such as heating. hot water and cooking, varies widely according to climate and custom. All types of such fuel are used. In Great Britain, nhere extremes of temperature are rare but rapid changes common, the open-grate fire persists. but to cope with the more severe winters of parts of North America and Europe, closed stoves or central heating are widely used. There are many types of fireplaces and central-heating furnaces. Solid fuels are hand fired to some extent, but automatic fuel-burning equipment for central heating is preferred by many householders. Some of this equipment has been developed to feed the fuel from the bin. automatically controlling the fire and depositing the ashes into a container.

3. Solid Fuel for Industrial Purposes.—All types of solid fuel are burned for industrial purposes. Automatic fuel-burning equipment permits great saving in fuel and labour. Such equipment for burning coal takes many forms, depending upon the quantity of fuel to be burned per hour and many other factors. such as the fuel most cheaply available, the size and type of the boiler. load conditions, the area in which the plant is located and the type of labour available. Types of equipment include traveling-grate stokers, underfeed stokers, spreader stokers, cyclone furnaces and pulverized-fuel-burning equipment (see also Pulverized Coal, above). Stokers using bituminous coal usually burn slack coal which is run-of-mine coal with the larger sizes removed; under some conditions, particularly with the smaller stokers, small-sized coal nith the fines removed is used. The largest boilers use the cyclone furnace or pulverized-fuel-burning equipment. Coal for the cyclone furnace, a furnace where burning takes place in a relatively small cylindrical furnace, is ground to pass a small-size screen. Coal for pulverized-fuel-burning equipment is ground to a fine powder and burns somewhat as a gas does.

4. The Blast Furnace.—Coal and coke are used not only for heat production but also for chemical purposes, such as the smelting of iron ores. where carbon effects the removal of oxygen. so producing metallic iron. The process is an ancient one, but until the middle of the 18th century the fuel used was charcoal. By far the greater proportion of smelting furnaces have. however, adopted coke. The blast furnace in which pig iron is produced consists of a hollow shaft with an internal diameter increasing from the top and bottom to the centre. At the bottom is a hearth upon nhich the superincumbent column of coke and iron ore rests. The exact lines of a blast furnace are important and vary with the types of ore. Heated air under pressure is blown in through tuyères (nozzles) in the lower portion of the furnace.

The ores used may be either oxides or carbonates of iron. The reactions occurring are complex. In the lower portion of the furnace near the tuyères the fuel is burned by the blast to carbon monoxide, nhich effects the reduction of the ore in the upper portion of the shaft where spongy iron impregnated with carbon and carbon monoxide is produced in a series of reactions of which the following is the resultant: $Fe_2O_3 + 3CO = 2Fe + 3CO_2$ (ferric oxide and carbon monoxide react to form iron and carbon dioxide). This spongy iron is melted as it passes through the lower layers and can be drawn off from time to time through tapping holes. Limestone is added to the charge to assist in fluxing.

Blast-furnace practice mas greatly influenced by the work of Sir Lowthian Bell, who in 1872 applied the laws of mass action to the reactions in the blast furnace and came to the conclusion that the practical limit for the ratio of CO to CO_2 in the gases leaving the furnace could not be reduced below 2:0. In modern blast furnaces a ratio of 1:7 has been reached, but in average practice a ratio of 3.0 is more common. Bell's argument, however, remains valid, although imperfections in scientific measurement affected the accuracy of his calculation. It will thus be seen that fuel economy in iron and steel practice depends essentially upon finding uses for the combustible gases (having about 90 to 100 B.T.L.) uhich are necessarily rejected in large quantities from the shaft. These may be used either for heating the blast or for power and heat requirements in the subsequent treatment of the pig iron. Concentration of coke ovens, blast furnaces and steelmaking in the same works permits the fuel consumption per ton of finished steel to be reduced to a minimum, from 2,000 to 2.600 lb. of coal per ton of finished steel. (See also BLAST FURNACE.)

III. LIQUID FUELS

Liquid fuels made from vegetable oils, animal oils and petroleum were used in ancient times to provide light and sometimes heat. They were so used to a limited extent until early in the 19th century, when the sperm-oil lamp came into wide use. Whaling fleets provided the supply of oil for several years, but needs increased beyond the ability of whalers to supply them. The modern oil industry began about 1847, when James H. Young took out a patent for making oil from oil shales, or oil rocks, in Scotland. By 1859 numerous companies in continental Europe, England and the U.S. were producing illuminating oil (coal oil) from shale, from coal and from petroleum found in seepages. In 1859 the United States saw the beginning of the petroleum era in the drilling of an oil well in Pennsylvania. The rapid development of the petroleum industry stopped most production of oil from shale and coal, although some was obtained from these solids in the second half of the 20th century in a number of places including Scotland, Europe. Africa and South America. The quantity is insignificant in total volume when compared with liquid fuels from natural petroleum.

A. Petroleum

Natural petroleum, or crude oil, as it is widely known, is the basis of practically all industrial liquid fuels. The advent of internal-combustion engines and motorcars meant an ever-increasing demand for fuels. The availability of the heavier portions of crude oil at a cheap price fostered their use for heating purposes. Lubricating oils for all kinds of machinery also come from crude oil.

Petroleum is a mixture of hundreds of different hydrocarbons—compounds composed of hydrogen and carbon—together with small amounts of other elements such as sulfur: oxygen and nitrogen. The carbon content of most crude oils varies from 84% to 88% by weight, hydrogen from 11.5% to 14.5% and the total minor constituents from 0.5% to 4.5%.

Petroleum, usually associated with water and natural gas, is found in voids or open spaces in porous sedimentary rock where the geological formation is such as to allow the oil to collect from a wide area. Impervious rock usually overlies the petroleum-containing formation in the form of an anticline (concave downward), with natural gas above the oil and dissolved in the oil and water below the oil. Other oil deposits occur in other kinds of formations in sedimentary shales, limestones and sandstones.

Recovery of crude oil through oil wells never reaches 100% of the oil present in the formation. Some fields yield only 20% of this oil, others will produce 50% or more of the oil in place, and injection under pressure of air, gas or water in certain instances can allow production of more oil than the oil field could ever produce naturally. Some heavy, thick oils will not flow through wells to the surface and can be recovered by mining, as is done in a number of countries; *e.g.,* France. Oil is produced in more than 51 countries throughout the world.

1. Petroleum **Resources.**—World production of crude petroleum was in excess of 7,000,000,000 bbl. of 42 U.S. gallons annually by the end of the 1950s, continuing the steady increase shown in nearly every year since 1859. The United States was producing about 37% of the world total, followed by the middle east countries (combined). Venezuela and the U.S.S.R. Other important producers were Canada, a newcomer to the large producing areas, Mexico, Indonesia, Columbia, British Borneo and Argentina. Estimates of the amount of oil already discovered and available for production continue to increase from year to year. When the cost of finding and producing petroleum becomes too high, oils can be produced from oil shales, oil sands and coal in quantities greater than the present known resources of petroleum.

2. Preparation of Fuel Oils.—In the early days of oil, the average refining plant made only a few products and processed only about 100 bbl. of crude oil a day. A large modern refinery can handle 400,000 bbl. a day and can furnish more than 1,000 separate products. Few refineries handle less than 10,000 bbl. a day. The larger plants are huge and complex and cost many millions of dollars to build. The principal products are few in number but account for more than 95% of the total. These are gasoline (motor spirits or petrol), kerosene, distillate fuels, residual fuel oils. lubricating oils and asphalt. Gasoline remains the big volume product, accounting for 40% of total refinery output. Kerosene and the distillate fuel oils take about 25%, with another 25% in the heavy residual fuels. Lubricating-oil requirements are satisfied with less than 2% of the total production.

Crude oil, after some preliminary treatment to remove water and other undesirable substances such as sulfur, is fractionated by distillation in the refinery into portions according to a distillation temperature range, leaving an undistilled portion as a residual. Some of these fractions are used directly as the finished product but most of them are subjected to additional refinery processes.

The heavier distillates can be cracked by heating to high temperatures to yield gasoline fractions or can be catalytically cracked or reformed by passage at elevated temperatures over catalysts, generally solid particles that hasten and direct the change of the heavier hydrocarbons into lighter and more volatile hydrocarbons. The residual material likewise can be cracked to produce more desirable materials and coke; it can be used directly as industrial fuel oil or certain types can be treated to produce asphalt (used principally for road or highway surfaces). The ultimate goal of the refinery is the production of tailored products of the highest quality in the proper amounts according to seasonal demand. Gasoline production decreases and fuel-oil production for heating increases in winter.

Most countries have adopted standard specifications for all types of petroleum products, including seasonal variations to ensure proper fuels at the proper times. International co-operation in fixing these standards ensures, as an example, that airplanes can refuel anywhere in the norld with assurance of uniform quality of product.

The gross calorific value of fuel oils ranges from about 18,500 to 20,000 B.T.U. per pound. The calorific value varies according to the hydrocarbon type composition. so that an oil of high specific gravity and comparatively low calorific value may produce more energy per unit volume than one of low specific gravity and high calorific value. Where storage space is at a premium. as in airplanes, the high-specific-gravity fuels may be the more desirable. Calorific value is related almost directly to specific gravity.

The flash point of an oil is the temperature at which, under specified conditions, a momentary flash is produced when a flame is passed over the oil surface. Gasolines have flash points below atmospheric temperatures. Standards and laws generally set a minimum flash point of 125° F. for distillate fuels and burner oils. Kerosene, the lighter burner oils and diesel fuels for light diesel equipment, such as buses, have flash points of 125°–130° F. The medium-weight burner oils and diesel fuels for heavier moving equipment and for railroad diesel engines have flash points near 145° F., and the heavier oils range upward in flash point from 170° F. The temperature of a liquid fuel that will vaporize enough oil to support continuous combustion. known as the fire point, is generally about 20° F. higher than the flash point.

The viscosity of oil, which changes rapidly with temperature, is determined by its resistance to flow as measured by the amount passing through a standard orifice in a prescribed time. The formation of solid paraffins or waxes may cause difficulty in pumping oil through pipes at low temperatures. Some crudes and fuels even at atmospheric temperature must be preheated to reduce their viscosity to allow ready atomization in the burner.

Further information on petroleum production and resources will be found under Petroleum.

B. Substitute Liquid Fuels

Several processes are feasible for converting solid and gaseous fossil fuels to products that are interchangeable with liquid fuels of petroleum origin. Although large plants have been built, they have not always been commercially successful, especially where petroleum is plentiful. However, interest in such processes is increasing, not only for supplying motor fuel for certain areas or for emergency use, but also as sources of organic chemicals.

1. Carbonization.—Destructive distillation at low temperatures of solid fuels (coal. lignite, oil shale, tar sand, gilsonite) yields crude tars and oils that may be converted to liquid fuels. Carbonization processes recover only about 15% of the total energy of coal in producing 20 gal. of crude oil per ton, compared with the recovery of about three times as much energy and up to

80 gal. of crude oil from other methods described below. Thus, low-temperature carbonization of coal is more efficient for producing combustible gases and by-products other than liquid fuels.

Commercial distillation of oil shale was first practised in France (1838), followed by Scotland (1850), Canada (1860) and Australia (1865). Industrial shale retorts are operated in France, Germany, China, the U.S.S.R., Scotland, South Africa and Sweden. The oil yield from shales in these countries varies between 10 and 130 gal. per ton. Highly mechanized underground mining procedures, applicable to massive deposits, have been developed in the United States. Crushed shale is fed into retorts that crack the organic material (kerogen) with gas or steam at 350° to 500° C. to produce crude oil similar in character to petroleum but containing higher percentages of sulfur, nitrogen and oxygen. Underground retorting, without mining except for preparing adits, also has been practised. Finished products are refined, by methods similar to those developed for treating petroleum, for use in internal-combustion engines. Sulfur and nitrogen compounds and waxes are valuable by-products, and the spent shale may be used in building aggregates.

2. Gas Synthesis.—A mixture of hydrogen and carbon monoxide (synthesis gas) may be reacted catalytically to make predominantly liquid fuels, combustible gas, waxes or organic chemicals. The synthesis gas may be made by reforming methane (CH, from natural or refinery gases), but large-scale installations normally gasify coal with steam according to the water-gas reaction, $C + H_2O \rightleftharpoons CO + H_2$. A number of methods have been studied, of which the Fischer-Tropsch synthesis and its variants have received the greatest attention. In this process synthesis gas at about 230° to 330° C. and 1 to 20 atm. is contacted with a suitably prepared catalyst that may contain predominantly cobalt, nickel or ruthenium, although iron is the usual major constituent. Fixed beds of catalyst (dry or submerged in oil), slurries of fine catalyst in oil and fluidized beds have been used, the main engineering problem being quick removal of the heat of reaction. In isosynthesis, a German laboratory development of World War II, the same gas is passed over metal oxides (for example 85% thoria and 15% alumina) at 400° to 450° C. and 300 to 600 atm. to produce primarily isobutane and isobutene, raw materials for aviation gasoline.

3. Coal **Hydrogenation.**—F. Bergius first investigated a process of adding hydrogen to coal at elevated temperatures and pressures. thus splitting the coal molecules and adding enough hydrogen to increase the hydrogen-carbon ratio of at least a fraction of the coal to that prevailing in petroleum. As carried out on a large scale in Germany before the end of World War II, coal hydrogenation consisted of two steps: (1) liquid-phase hydrogenation at about 200 atm. and 450° C. of a coal and oil paste to which a catalyst (usually a compound of tin or iron oxide) was added; and (2) vapour-phase hydrogenation of middle oil—the major product from the first step—under similar conditions of pressure and temperature on a bed of catalyst such as molybdenum sulfide, tungsten sulfide or (later) ammonium sulfomolybdate impregnated on a carrier. Later, hydrogenation in a single step at about 510° C. and also in a fluidized bed of coal at only 60 atm. were studied in laboratory equipment. A commercial plant in West Virginia adopted a modification of the liquid-phase process as a source of aromatic chemicals. Hydrogenation of U.S. bituminous coal making primarily gasoline yields about 4.3 bbl. of gasoline and 0.8 bbl. of liquefied petroleum gases per ton of moisture- and ash-free coal.

C. Utilization of Liquid Fuels

Liquid fuels derived from petroleum may be utilized either by combustion in furnaces or to produce energy directly in the cylinders of internal-combustion engines. Both light and heavy oils are applicable to the internal-combustion engine; the former can be ignited by a flame or spark while, with heavier oils, vaporization and ignition are effected by the high temperature developed on the compression stroke.

In furnaces oil must be changed from the liquid to the gaseous state before actual combustion. In general, a mixture of heavy and light gaseous hydrocarbons is formed and for smokeless combustion these must be brought into contact with a large enough supply of air to allow complete burning at the best efficiency. It requires 18 to 20 lb. of air per pound of fuel oil to burn the oil. best results generally being obtained when 10% to 20% excess air is used.

1. Oil Burners.—Oil-burner types are classified as vaporizing or atomizing. Each of these types can be used with a natural air draft or with a mechanical forced-air draft. Domestic burners for home heating use the light distillate oils and can be manually or automatically controlled. Commercial burners for space heating in commercial buildings, apartment houses and the like use the light and middle distillate oils—sometimes the residual oils. Industrial burners for industrial or power steam generation ordinarily use any heavy grade of oil to supply the heat. In many industrial installations the burners are designed to be fired with coal or oil or even with coal, oil or gas. This allows the choice of the most economical fuel from year to year.

Mechanical draft burners use a fan or blower to supply the air needed for combustion and can be of the vaporizing or the atomizing type.

Atomization breaks the fuel into fine particles that mix with the combustion air, giving a clean flame and good burning. Atomization allows the use of heavier, cheaper grades of fuel oil and is well adapted to large industrial burners, although it does require power to produce the atomizing and first costs are comparatively high. Some burners use steam to assist atomization because of simple design requirements, low installation cost, ability to use heavy oils and flexibility of operation.

2. Advantages of Liquid Fuels.—Liquid fuel has many advantages over solid fuel. It weighs about 30% less per unit volume than coal and occupies only 50% of the space required for an equivalent amount of coal. Liquid fuels are usually readily available. can be stored conveniently, produce high heats in less furnace space, begin to burn instantly and cleanly, require little or no ash removal and need relatively little attention. For marine use, these and other advantages are readily apparent.

3. Fuels for **Light** Internal-Combustion Engines.—Motor gasolines are rather complex mixtures of light-hydrocarbon blending stocks tailored for best utilization in all motorcars in all seasons and climates. The refiners change the characteristics to fit these requirements. Motor gasolines distill within the temperature range of 100° to 400° F. Aviation gasolines are simpler blends of high-octane-number stocks produced to rigid specifications and boil in the 100° to 325° F. range. Four grades supply the requirements of virtually all conventional aircraft. These four grades are based on the octane-number requirements of the various aircraft engines. Fuels for jet turbine engines boil in the 100°–600° F. range and have no octane-number requirement.

The above fuels) except for the jet turbine, are vaporized more or less completely and mixed with air in their passage through carburetors in the engines, and are distributed to the individual engine cylinders through suitable manifolds. The efficiencies obtained in these internal-combustion engines are a function of compression ratio, engine design and fuel characteristics. "Knocking" in such engines indicates some unbalance in the three factors indicated above and generally results from too low an octane number in the fuel used. After the 1920s octane numbers for motorcar gasolines increased from about 50 to more than 90. Small quantities of the metallo-organic compound tetraethyl lead (one to three millilitres per gallon) are used to achieve part of this increase in octane number; the rest has come through improved refining processes. *(See* also Gasoline.)

4. Liquid Fuels for Heavy Engines.—The diesel engine, unlike the gas or gasoline engine, draws in air during the suction stroke without mixture with oil. Oil is injected mechanically in the form of a spray and mixes with the air already in the combustion chamber; the resultant mixture is ignited from the heat generated by the compression stroke of the engine. The diesel engine is the most efficient liquid-fuel engine. Modern developments in metal strengths and engine design allowed increased use of diesel engines in buses, trucks and small prime movers; diesel-engine

application by railroads led to sharply decreased operating costs. Such engices are ideal for marine installations and many large stationary engine requirements. Stationary diesel equipment can be designed to use either oil or gas or a combination as economics dictates.

Standard specifications in world-wide use allow refiners to satisfy 90% of fuel requirements with not more than four grades of diesel fuel. Fuel composition and boiling range, plus cetane number, are important fuel' characteristics. Cetane number is a measure of the time required for the fuel to ignite after fuel injection. A short delay period is indicated by a cetane number from 40 to 70, a long delay by a cetane number below 40, on an empirical scale from 0 to 100. Most engines operate satisfactorily on fuels in the 40 to 50 cetane-number range. The boiling range for the light distillate oils is 350° to 550° F., for the medium diesel oils 370° to 650° F. and for the heavier fuels 400° to 700° F.

IV. GASEOUS FUELS

A. Types of Gaseous Fuels

Before final combustion all liquid and most solid fuels are first converted to the gaseous state. In this section fuels that already exist as gases at room temperature and atmospheric pressure will be considered separately. Gaseous fuels are composed of one or more simple gases in varying proportions and may also include some inert gases and oxygen. The simple combustible gases are most commonly hydrogen (H_2). carbon monoxide (CO), rntthane (CH_4), ethane (C_2H_6), ethylene (C_2H_4), propane (C_3H_8), propylene (C_3H_6), butane (C_4H_{10}), butylene (C_4H_8), benzene (C_6H_6) and acetylene (C_2H_2); the inert gases are generally carbon dioxide (CO_2) and nitrogen (N_2). As the once important use of gas for illuminating purposes lost its significance, the development of gas cooking and heating made calorific value by far the most important criterion for evaluating gaseous fuels. The most common commercial gases are described below more or less in the order of increasing calorific value.

1. Blast-Furnace Gas.—In blast-furnace operations a gas is derived from the various reactions occurring throughout the furnace. The principal combustible constituent is carbon monoxide, resulting from the partial combustion of the coke in accordance with the reaction: $2C + O_2 = 2CO$. The gas contains relatively high percentages of inert gases. Depending on the quality of the coke, as well as on the other materials charged to the furnace, the gas may range in calorific value between 90 and 110 B.T.U. per cubic foot. A typical percentage composition of the gas is: CO_2, 11.5; H,, 1.0; CO, 27.5; and N_2, 60.0; with a gross calorific value of 92 B.T.U. per cubic foot and a theoretical flame temperature of 2,650° F. with no excess air. A modern blast furnace producing 1,000 tons of iron a day and consuming 1,800 lb. of coke per ton of iron produces about 127,000,000 cu.ft. of gas a day. Because it has the lowest heating value of all commercial gases. blast-furnace gas cannot be economically transported long distances. Accordingly, it is used in the steel mills for preheating the air required for the blast, as fuel for driving the blowers, underfiring the coke ovens. generating steam, heating the soaking pits and other miscellaneous purposes.

2. Producer Gas.—Outside of the steel mills, producer gas is perhaps the cheapest to manufacture for many industrial purposes. It is produced by blowing air or a mixture of air and steam through an incandescent fuel bed, which may be composed of coke, coal, lignite, peat or wood. When air alone is blown through incandescent carbon, the principal reactions are $C + \frac{1}{2} O_2 = CO$, $CO + \frac{1}{2} O_2 = CO_2$ and $CO_2 + C = 2CO$. For each volume of oxygen, 3.76 vol. of nitrogen are introduced with the air. If all of the carbon dioxide were converted to carbon monoxide, the resulting gas would be composed of CO, 34.5% and N_2, 65.5% and would have a maximum calorific value of 110 B.T.U.per cubic foot. In practice complete conversion of carbon dioxide to carbon monoxide does not take place and the gas, sometimes referred to as Siemens's gas, generally has a lower calorific value. This, coupled with operating difficulties frequentiy encountered by the excessive liberation of heat, is a serious disadvantage. As the reaction of incandescent carbon mith steam according to the equations $C + H_2O = CO + H_2$ and $C + 2H_2O = CO_2 + 2H_2$ absorbs heat, a sufficient quantity of steam is added to the air so that the heat liberated by the carbon-oxygen reactions is balanced by the carbon-steam reactions. A secondary reaction of considerable importance in producer-gas operation is $CO + H_2O = CO_2 + H_2$.

The quality of the gas depends largely on the kind of fuel charged to the producer and ranges from 120 to 180 B.T.U. per cubic foot. Typical percentage compositions of producer gas are as follows. With buckwheat anthracite, CO_2, 8.0; O_2, 0.1; CO, 23.2; H_2, 17.7; CH_4, 1.0; and N_2, 50.0. The gross calorific value is 143 B.T.U. per cubic foot and the theoretical flame temperature 3,040° F. With bituminous coal, CO_2, 4.5; O_2, 0.6; CO, 27.0; H_2, 14 0; CH_4, 3.0; and N_2, 50.9. The gross calorific value is 163 B.T.U. per cubic foot and the theoretical flame temperature 3,175° F. With coke, CO_2, 6.4; O_2, 0.0; CO, 27.1; H_2, 13.3; CH_4, 0.4; and N_2, 52.8. The gross calorific value is 135 B.T.U. per cubic foot and the theoretical flame temperature 3,010° F.

Producer gas. because of its low calorific value, cannot be transported economically over any appreciable distances. Its use is therefore generally for industrial operations, such as for underfiring coke ovens, heating open-hearth furnaces, glass-melting furnaces, lime kilns, brick kilns, ceramic kilns and the like, where the producer plant is integrated with the industrial plant.

3. Blue Gas or Water Gas.—Blue gas or water gas is produced by alternately blasting an incandescent fuel bed with air and with steam. The respective reactions between the carbon and air and the carbon and steam are similar to those taking place in producer-gas operation but follow each other cyclically instead of occurring simultaneously. The cycle is balanced so that the heat liberated during the air blast and stored in the fuel bed is enough to provide the heat absorbed during the steam blast. The gases produced during the air blast, containing the nitrogen admitted with the air, are discharged to the atmosphere, while the gases generated during the steam blast provide the useful fuel gas. Depending on the character of the fuel, blue gas ranges in calorific value from 285 to 335 B.T.U. per cubic foot. A typical blue gas produced from coke has a percentage composition of CO_2, 5.4; O_2, 0.7; CO, 37.0; H_2, 47.3; CH_4, 1.3; and N_2, 8.3. The gross calorific value is 287 B.T.U. per cubic foot and the theoretical flame temperature 3,670° F. Blue gas may also be produced in continuous operation by substituting oxygen for air in gas producers. This results in a producer gas that is practically nitrogen-free. Blue gas as a fuel is used industrially in large manufacturing establishments for heating in forge-welding operations, but the major uses of blue gas. without enrichment, are as synthesis gas for the production of ammonia and methanol and other chemical operations.

4. Carbureted Water Gas.—For domestic and commercial cooking and heating, blue gas or water gas is usually enriched with hydrocarbon gases produced by thermal cracking of oil which takes place simultaneously mith the blue-gas production. The principal components of a carbureted water gas machine are the generator, carburetor, superheater and wash box or seal. The blue gas is produced in the generator. During the air blast the gas leaving the generator is burned in the carburetor arid superheater to heat the malls and checker-brick provided for storing the heat. As the products of combustion leaving the superheater retain an appreciable quantity of heat, they may be passed through a waste-heat boiler for steam generation. or they may be discharged directly to the atmosphere. During the steam blast. oil is vaporized in the carburetor and partly cracked in the stream of blue gas flowing frorn the generator, and the mixture then flows through the superheater in nhich the hydrocarbon vapours are fixed—that is, converted to permanent gases—and finally through the wash box or seal to a gasholder. Depending on the availability of natural gas or liquefied petroleurn gases, the heating value of blue gas is frequently increased by what is known as cold enrichment by mixing with these gases in their normal state. The degree of enrichment of carbureted water gas is controlled by the relative amount of oil, natural gas or liquefied petroleum gas used under the particular conditions of operation. The calorific value of carbureted water gas ranges from 425 to 57j B.T.U. per cubic foot. A typical per-

centage composition of carbureted water gas is CO_2, 4.3; C_2H_4, 4.7; C_6H_6, 2.3; O_2, 0.7; CO, 32.0; H_2, 34.0; CH_4, 15.5; and N_2, 6.5. The gross calorific value is 534 B.T.U. per cubic foot and the theoretical flame temperature 3,700° F. Carbureted water gas is widely distributed in city gas mains for general use either alone or in a mixture with other gases with which it is interchangeable.

5. Coal Gas.—Coal gas is produced by destructive distillation of bituminous coal, during which it is heated in retorts in the absence of air. Coal-gas retorts vary considerably in design and may be horizontal, inclined or vertical.

The quality and yield of gas vary with the type of coal, the temperature and time of carbonization, the type of retort and other factors. A typical gas from horizontal retorts has the percentage composition: CO_2, 2.4; C_2H_4, 1.32; C_6H_6, 1.73; O_2, 0.75; CO, 7.35; H_2, 47.95; CH_4, 27.15; and N_2, 11.35. It has a gross calorific value of 542 B.T.U. per cubic foot and a theoretical flame temperature of 3,600° F. Vertical retorts are often operated with the introduction of steam for the purpose of producing blue gas by the reaction with the hot coke. This in effect cools the coke before discharging and provides a larger yield of gas, although the calorific value of the gas is lower than that of straight coal gas. A typical percentage composition of gas from steamed vertical retorts is: CO_2, 3.0; C_2H_4, 1.5; C_6H_6, 1.3; O_2, 0.2; CO, 10.9; H_2, 54.5; CH_4, 24.2; and N_2, 4.4. It has a gross calorific value of 532 B.T.U. per cubic foot and a theoretical flame temperature of 3,645° F.

6. Coke-Oven Gas.—This is gas produced by the distillation of bituminous coal (see COKE, COKING AND HIGH-TEMPERATURE CARBONIZATION). A typical coke-oven gas has the percentage composition: CO_2, 2.2; C_2H_4, 3.5; C_6H_6, 0.5; O_2, 0.8; CO, 6.3; H_2, 46.5; CH_4, 32.1; and N_2, 8.1. It has a gross calorific value of 574 B.T.U. per cubic foot and a theoretical flame temperature of 3,610° F. The distillation products leaving the coke ovens are drawn through hydraulic mains and coolers by exhausters and passed through tar extractors. saturaters, light-oil scrubbers, purifiers and other equipment designed for successively removing the tar, ammonia, light oil and sulfur compounds. (See also COAL TAR.) The specific procedures for the recovery of individual constituents vary from plant to plant.

7. Oil Gas.—Gas may be made entirely from the cracking of oil by innumerable methods and variations of equipment. A typical method of producing oil gas employs cyclic operation. in which oil atomized by steam is sprayed on previously heated checker-brick, where the oil is cracked and the steam reacts with some of the deposited carbon to form water gas, the resulting mixture being similar to carbureted water gas. The checker-bricks are heated by the combustion of oil with an excess of air, which also consumes the carbon that failed to react with the steam. This method permits the production of gases having a very wide range of calorific values. 525 to 1,100 B.T.U. per cubic foot. The operation can therefore be adjusted to produce gas which may be interchangeable with carbureted water gas, coal or coke-oven gas or natural gas. Oil gas may also be produced by catalytic cracking methods either in continuous or in cyclic operation. In continuous operation oil vapours and steam flow through a bed of catalyst inside of externally heated tubes. In cyclic operation the catalyst is alternately heated by the combustion of some of the oil and cooled by the cracking of the oil and the reaction of the carbon with the steam. Oil gas may also be generated continuously by partial combustion with air or oxygen.

8. Reformed Natural Gas.—Natural gas is frequently decomposed by thermal or catalytic cracking or partial combustion processes to lower its heating value to render it suitable for mixing with carbureted water gas, oil gas, coal or coke-oven gas. Thermal cracking may be done in the fuel bed of a blue-gas generator or in the checker-brick of an oil-gas generator. Catalytic cracking or partial combustion is accomplished in equipment essentially similar to that employed for the cracking or partial combustion of oil. A typical percentage composition of reformed natural gas is: CO_2, 1.4; C_2H_4, 1.3; C_3H_6, 0.8; O_2, 0.2; CO, 9 7; H_2, 46.6; CH,, 37.1; and N_2, 2.9. The gross calorific value is 599 B.T.U. per cubic foot and the theoretical flame temperature 3,615° F.

9. Natural Gas.—Natural gas is the ideal fuel gas where it is available for use in homes, buildings and industries or where industries can be located economically at the source of supply. It is usually found associated uith crude petroleum or in areas where petroleum has been found. Geologic conditions favourable for oil generally are favourable for natural-gas occurrence. Exploration for oil in the United States led to the discovery and utilization of vast quantities of gas. Other natural-gas deposits have been found in Canada. Argentina, Mexico, France, the U.S.S.R., the middle east and elsewhere. Only in the United States has the immense supply available been put to full use. Thousands of miles of steel pipelines carry natural gas to virtually all parts of the country.

The predominant hydrocarbon in natural gas is methane, and many natural gases can be used without treatment as they are produced at the well. Others must be processed to remove the heavier hydrocarbons present (yielding large quantities of liquefied petroleum gases) and to remove other undesirable constituents such as carbon dioxide, hydrogen sulfide and other sulfur compounds. The calorific values can vary between 700 and 1,500 B.T.U. per cubic foot. In commercial pipeline operations, these variations reduce to from 900 to 1,200 B.T.U. A typical delivered natural gas has a percentage composition: CH_4, 83.4; C_2H_6, 15.8; and N_2, 0.8. Its gross calorific value is 1,129 B.T.U. per cubic foot and the theoretical flame temperature 3,562° F.

See also GAS INDUSTRY; NATURAL GAS.

10. Acetylene.—Acetylene for fuel purposes is produced by the chemical reaction of calcium carbide and water; $CaC_2 + 2H_2O = C_2H_2 + Ca(OH)_2$. Acetylene has a gross calorific value of 1,499 B.T.U. per cubic foot. When burned with air the theoretical flame temperature is 4,210° F., but when burned with 1.4 vol. of oxygen for each volume of acetylene, as in welding operations, the calculated flame temperature is 6,000° F.

Acetylene gives a highly luminous flame and is used to furnish emergency, temporary or portable lighting needs. Acetylene burned in air is used in soldering and brazing operations and with oxygen for cutting and welding operations in which the highest flame temperature of any known mixture of gases is of great advantage. Acetylene is distributed to small users in cylinders under pressure but is generated directly and distributed through pipes on the premises of large consumers. Acetylene is also used widely for producing a variety of chemicals. For this purpose, the acetylene is frequently produced by the conversion of natural or refinery gases. (See also ACETYLENE.)

11. Liquefied Petroleum Gases.—Liquefied petroleum gases (LP gases) are derived from gases produced in petroleum-refining operations or from natural gas (*q.v.*). Propane, C_3H_8, has a gross calorific value of 2,572 B.T.U. per cubic foot and a theoretical flame temperature of 3,660° F. A typical commercial butane is composed of 93% butane (C_4H_{10}) and 7% propane and has a gross calorific value of 3,225 B.T.U. per cubic foot and a theoretical flame temperature of 3,640° F. For efficient transportation, storage and use, propane and butane are liquefied under pressure. Liquefied petroleum gases are distributed in cylinders to isolated consumers for domestic water heating, cooking, refrigeration and space heating. In small communities liquefied petroleum gases are distributed from a central point in place of manufactured gas.

B. UTILIZATION OF GASEOUS FUELS

1. Combustion of Gases.—The advantages of gaseous fuels are: (1) ease of distribution; (2) high thermal efficiency of utilization; (3) no smoke or ash; and (4) ease of control giving either oxidizing or reducing flames and flames of varying temperatures.

The general question of combustion has already been dealt with, but certain special considerations are applicable to gaseous combustion. In the burning of gases both rapidity of combustion and length of flame can be controlled by suitable adjustment of the gas rate and the primary and secondary air supplies.

2. Gas Burners.—Gas burners vary widely, but most types can be divided into two main classes, according to whether or not air is mixed with gas before it reaches the point of combustion. A relatively long flame, which may be suitable for certain types of

furnace work, is produced by burning gas without primary air. On the other hand, burners of the well-known Bunsen type can, if desired, be adjusted to give a rapid rate of combustion with relatively short flames, such as are necessary where the combustion space is limited or maximum flame temperatures are required.

3. Submerged Combustion. — With a view to obtaining increased efficiency in water or steam heating. attempts have been made to develop a type of burner in which gas can be consumed under water. For such submerged combustion it is obviously essential that enough primary air for complete combustion should be intimately mixed with the gas.

4. Surface Combustion. — Sir Humphry Davy, in the early 19th century, discovered that a warmed platinum wire when introduced into a nonexplosive mixture of air and coal gas became incandescent and continued to glow until virtually all of the oxygen mas consumed. Further experiments, particularly by P. L. Dulong, T. Thomson and J. W. Döbereiner, showed that many other substances had the same power. Before commencing work on this subject in 1902, Bone proved: (1) "that the power of accelerating gaseous combustion is possessed by all surfaces at temperatures below the ignition point in varying degrees, dependent upon their chemical characters and physical texture": (2) "that such an accelerated surface combustion is dependent upon an absorption of the combustible gas, and probably also of the oxygen by the surface, whereby it becomes 'activated' (probably ionized) by association with the surface"; and (3) "that the surface itself becomes electrically charged during the process." Bone also pointed out that "there are experimental grounds for the belief that not only does the accelerating influence of the surfaces rapidly increase with the temperature, but also that the differences between the catalyzing powers of various surfaces, which at low temperatures are often considerable, diminish with ascending temperatures until at bright incandescence they practically disappear." This accelerated combustion nas applied by Bone to various industrial heating appliances as a means of increasing the efficiency of heating operations In these a mixture of air and gas in correct proportions is caused to burn without flame in contact with incandescent surfaces. The advantages are: (1) accelerated combustion; (2) concentration of combustion where required; (3) minimum excess air; (4) high temperature; (5) rapid heat transfer by radiation. Surface combustion has been applied to some extent to gas furnaces, gas cookers and heaters, etc., gas and air being forced by slight pressure through a porous diaphragm of refractory material, the mixture burning on the exit surface and maintaining it at incandescence without flame.

For further information reference should be made to the following articles. Under COAL AND COAL MINING will be found a general survey of the world's coal resources and of the methods of coal mining; cognate articles will be found under COKE. COKING AND HIGH-TEMPERATURE CARBONIZATION; CARBONIZATION, LOW-TEMPERATURE; LIGNITE; and PEAT. Mineral oil is treated under PETROLEUM; SHALE, OIL; GASOLINE; and KEROSENE. *See* also GAS INDUSTRY; NATURAL GAS. (C. H. L.; L. C. McC.)

V. ATOMIC FUELS

Atomic or nuclear fuels are substances capable of producing heat (in conjunction with other forms of energy such as radiation) as the result of the splitting or fission of their atomic nuclei. In this respect they differ from the conventional fuels such as coal, mood, petroleum and gas, which furnish heat through the chemical process of combustion. The energy which can be obtained from nuclear processes is in vastly greater concentration than that which can be obtained from ordinary combustion, a pound of the fissionable material uranium-235 being capable of producing 3.3×10^{10} B.T.U. or roughly 2,600,000 times the amount of heat produced from burning a pound of coal. For further discussion *see* ATOMIC ENERGY; NUCLEAR ENGINEERING: Fuels and Fuel *Recovery*. (W. L. C.)

VI. ROCKET AND OTHER HIGH-ENERGY FUELS

Special fuels with performance characteristics superior to those shown by hydrocarbon fuels are required to send rocket-powered vehicles into space and to propel aircraft and missiles faster, farther and with heavier pay loads. Aircraft and missiles powered by air-breathing jet engines require a fuel having one set of properties. Rocket-propelled vehicles must travel in space containing no oxygen shortly after launching; their fuel requirements are different and provision must be made to carry both fuel and oxidant aboard the vehicle.

TABLE III.—*Energy Content of Some High-Energy Fuels Compared With Jet Fuel*

*Liquid †Gas ‡Solid

Fuel requirements for high-performance jet aircraft involve prime consideration of energy content on the basis of both unit volume and unit weight. Other factors such as ease of handling, inflammability limits. corrosiveness, toxicity and availability also must be considered, and may be of overriding importance. A listing of the energy content of some chemical fuels is shown in Table III with JP-4 hydrocarbon jet fuel included for purposes of comparison. Research by the armed forces in co-operation with industry has resulted in the selection of boron compounds as the base for high-energy fuels for jet-propelied weapon systems. The exact nature of the fuels is classified, but it is known that the toxic and explosive nature of the boranes has been reduced by the substitution of carbon-containing groups for some of the hydrogen, as illustrated by the alkylboranes.

For rocket systems, performance is based on the parameters of size, pay load, velocity at burnout and distance of travel, vertical or horizontal. All of these are related to fuel performance, which is measured in terms of a common factor, specific impulse. Specific impulse is defined as the pounds force of thrust developed per unit mass of propellant per second. The thrust developed by a rocket engine depends not only on the type and energy content of the fuel, but also on the type of oxidizer used and the average molecular weight of the combustion gases issuing from the rocket nozzle. In the mathematical expression of specific impulse, the important term is contributed by the ratio of the combustion-chamber temperature to the average molecular weight of the combustion products. Some examples are listed in Table IV.

TABLE IV.—*Examples of Performance Factors of Liquid Fuel-Oxidizer Systems*

*Operating pressure, 500 lb per square inch.

The use of hydrogen as a fuel and fluorine as an oxidant offers theoretical advantages, including combustion products of low molecular weight. However, difficulties of keeping hydrogen in liquid form and the corrosiveness of fluorine present formidable problems.

Solid-fuel rockets are used chiefly for short and intermediate ballistic missiles. Development for long-range missiles has been handicapped by the lower thrust of available solid fuels and by difficulties of controlling their burning rate. A solid rocket propellant is made up of oxidizer particles dispersed in a binder that serves as the fuel. The binder is usually a plastic, resin or synthetic rubber compound. The specific impulse for solid propellant systems is in the range of from 180 to about 225 pound-seconds per pound. Advantages of solid-fuel rockets are their high reliability, convenience in storage and quick availability.

See also AIRCRAFT PROPULSION; JET PROPULSION; PROPELLANTS; ROCKETS: *Rocket Motors; Rocket Propellants.*

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FUENTERRABÍA (formerly sometimes FONTARABIA; Lat. FONS RAPIDUS), a town in north Spain, Guipúzcoa province, near the Bay of Biscayand on the French frontier. Population of the municipality (1950) 7,334. It is on a hillside on the left bank of the Bidassoa, near the point where its estuary begins, and it became popular near the end of the 19th century as a resort for visitors from the interior of Spain. The town has a tiny harbour and makes cider, fishing tackle and pickles fish.

Fuenterrabia formerly possessed considerable strategic importance, and it has frequently been taken and retaken in wars between France and Spain. Unsuccessful attempts to seize Fuenterrabia were made by the French troops in 1476 and again in 1513. In 1521 they captured it but it was retaken in 1524. The prince of Condé sustained a severe repulse under its walls in 1638, and the town then received from Philip IV the rank of city, a privilege which involved some measure of autonomy. In 1719 Fuenterrabia surrendered to the duke of Berwick and his French troops and in 1794 it again fell to the French, who so dismantled it that it has never since been reckoned by the Spaniards among their fortified places. It was by the ford opposite Fuenterrabia that the duke of Wellington, on Oct. 8, 1813, forced a passage into France. Severe fighting also took place there during the Carlist War in 1837 and early in the civil war of 1936–39.

FUERO, a Spanish term, derived from the Latin *forum* (*q.v.*). The Castilian use of the word in the sense of a right, privilege or charter is perhaps to be traced to the Roman *conventus juridici* (assize towns), also known as *jurisdictiones* or *fora,* in Pliny's time already numerous in the Iberian peninsula. In each of these provincial *fora* the Roman magistrate paid all possible deference to the established law of the district; and every free subject could demand that he should be judged in accordance with the customs and usages of his proper forum. It is highly probable that the old administrative arrangements of the provinces: and especially of the towns, remained practically undisturbed at the period of the Gothic occupation of Spain.[1] The Theodosian Code and the Breviary of Alaric alike seem to imply a continuance of the municipal system established by the Romans; the later *Lex Visigothorum* does not appear to have contemplated any marked interference with the former *fora.* During the Arab occupation the Christians were, sometimes at least, judged according to their own laws in separate tribunals presided over by Christian judges;[2] and the mere fact of the preservation of the name *alcalde* (*q.v.*), an official whose functions corresponded so closely to those of the *judex* or *defensor civitatis,* suggests that the old municipal *fora,* if much impaired, were not even then in all cases wholly destroyed. When the word *forum* (or *forus,* Ducange) begins to appear in documents of the 10th century in the sense of a liberty or privilege, it is generally implied that the thing so named is nothing new.

The earliest extant written fuero is probably that granted to the province and town of León by Alfonso V in 1020. It emanated from the king in a general council of the kingdom of León and Castile, and consists of two parts, the "fuero general" applying to the kingdom at large and the "fuero municipal," a mere municipal charter. The "fuero general" does not profess to supersede the *consuetudines antiquorum jurium* or Chindaswint's codification of these in the *Lex Visigothorum;* the "fuero municipal" is for the most part but a resuscitation of usages formerly established. Almost contemporaneous with it was that granted to Nájera by Sancho el Mayor of Navarre (d. 1035), and confirmed, in 1076, by Alfonso VI.[3] In the fuero of Cardefia, granted by Ferdinand I in 1039, reference is made to a previous forum Burgense (Burgos), which, however, has not been preserved, if, indeed, it ever had been reduced to writing at all. The fuero of Sepúlveda (1076) points back to a remote antiquity. Among the later fueros of the 11th century, the most important are those of Jaca (1064) and of Logroño (1095). The former, unusually large in its concessions, rapidly extended to many places in the neighbourhood, while the latter, given also to Miranda by Alfonso VI, was extended in 1181 by Sancho el Sabio of Navarre to Vitoria, thus constituting one of the earliest written *fora* of the "Provincias Vascongadas." In the 12th and 13th centuries the number of such documents increased rapidly; that of Toledo, granted to the Mozarabic population in 1101, but enlarged and extended by Alfonso VII (1118) and later sovereigns, was the basis for many other Castilian fueros.

Latterly the word fuero came to be used in Castile in a wider sense, as a general code of laws; thus about the time of Saint Ferdinand the old *Lex Visigothorum* was translated into the vernacular and called the Fuero Juzgo; and among the compilations of Alfonso the Learned were an *Espejo de Fueros* and the *Fuero de las leyes,* or *Fuero Real.* The famous code known as the *Ordenamiento Real de Alcald,* or *Fuero Viejo de Castilla,* dates from a later period. As the power of the Spanish crown mas gradually concentrated and consolidated the local fueros slowly yielded before the force of imperialism; and only those of Navarre and the Basque provinces *(see* BASQUE) managed to survive. At the death of Ferdinand VII in 1833, these rights were set aside by Castaños. The result was a'civil war, which terminated in a renewed acknowledgment of the fueros by Isabel II (1839). The provisional government of 1868 also promised to respect them, and similar pledges were given by the governments which succeeded. In consequence, however, of the Carlist rising of 1873–76, the Basque fueros were finally extinguished in 1876. The history of the *Foraes* of the Portuguese towns! and of the *Fors du Béarn,* is analogous to that of the fueros of Castile.

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FUERTES, LOUIS AGASSIZ (1874–1927), U.S. artist and naturalist who specialized in portraying bird life, was born at Ithaca, N.Y., on Feb. 7, 1874. He was educated at Cornell university and received art training from Abbott H. Thayer. As a painter of birds he was pre-eminent in the U.S. during a period of 30 years from 1897 to 1927. Enthusiastic and industrious, he produced abundantly, mainly as an illustrator of popular and technical ornithological books. He painted also a limited number of large pieces, some of which are owned by the New York Zoological society. His most extensive work was a series of large plates illustrating "The Birds of New York," published by the state and covering practically every species of eastern North America. A similar work for the state of Massachusetts was incomplete at his death. His work is characterized by a fidelity to nature involving not only objective but subjective accuracy. His genius lay in the power to reproduce subtle, fleeting and intangible qualities of birds which reflected their individuality to a remarkable degree. This was quite as much the result of a highly sympathetic and very extensive knowledge of birds in their haunts as it was of technical skill. His travels covered a wide field in North America,

[1] *See* Savigny, *Gesch.* d. rom. *Rechts,* especially i. pp. 154, 259 *seq.*

[2] *Cf.* Lembke u. Schafer, "Geschichte von Spanien," in *Geschichte der europäischen Staatcn* i. 314; ii., 117.

[3] "Mando et concedo et confirmo ut ista civitas cum sna plebe et cum omnibus suis pertinentiis sub tali lege et sub tali foro maneat per saecula cuncta. Amen. Isti sunt fueros quae habuerunt in Naxera in diebus Sanctii regis et Gartiani regis." (I order and permit and confirm that this town with its people and all that pertains to them shall remain under such law and such *forum* for all time. Amen. These are the fueros which they held in Naxera in the days of King Sancho and King Garcia.)

Mexico, West Indies, South America, Europe and Africa. His field experience, therefore, was of the widest.

He died on Aug. 22, 1927, at Unadilla, N.Y.

FUERTEVENTURA, an island in the Spanish archipelago of the Canary islands (*q.v.*). Pop. (1950) 14,229; area 666 sq.mi. Fuerteventura lies between Lanzarote and Grand Canary. It has a length of 52 mi., and an average width of 12 mi. Lava streams and other signs of volcanic action abound, but there has been no igneous activity since the Spaniards took possession. The highest peak reaches 2,500 ft. In external appearance, climate and productions, Fuerteventura greatly resembles Lanzarote. La Oliva (pop. 2,875 [mun.]) is a small town. Cabras (pop. 4,029 [mun.]) on the eastern coast is the chief port.

FUGGER, the name of a famous German family of merchants and bankers. The founder of the family was Johann Fugger, a weaver at Graben, near Augsburg, but its real greatness was established by his grandsons, Andreas and Jakob, who greatly extended the business in Augsburg, which they inherited from their father. Andreas, called the "rich Fugger," had several sons, among them being Jakob, who was granted the right to bear arms in 1452, and who founded the family of Fugger vom Reh, which died out in 1583. Jakob Fugger died in 1469, and three of his seven sons, Ulrich (1441–1510), Georg (1453–1506) and Jakob (1459–152j), men of great resource and industry, inherited the family business and added enormously to the family wealth. In 1473 Ulrich obtained from the emperor Frederick III. the right to bear arms for himself and his brothers, and about the same time he began to act as the banker of the Habsburgs, a connection destined to bring fame and fortune to his house. Under the lead of Jakob the Fuggers were interested in silver mines in Tirol and copper mines in Hungary, while their trade in spices, wool arid silk extended to almost all parts of Europe. Their wealth enabled them to make large loans to the German king, Maximilian I., who pledged to them the county of Kirchberg, the lordship of Weissenhorn and other lands, and bestowed various privileges upon them. Jakob built the castle of Fuggerau in Tirol, and erected the Fuggerei at Augsburg, a collection of 106 dwellings, which were let at low rents to poor people and which still exist. Jakob Fugger and his two nephews died without direct heirs, and the family was continued by Georg's sons, Raimund (1489–1535) and Anton (1493–1560), under whom the Fuggers attained the summit of their wealth and influence.

Jakob Fugger's florins had contributed largely to the election of Charles V. to the imperial throne in 1519, and his nephews and heirs maintained close and friendly relations with the great emperor. In addition to lending him large sums of money, they farmed his valuable quicksilver mines at Almaden, his silver mines at Guadalcanal, the great estates of the military orders which had passed into his hands, and other parts of his revenue as king of Spain; receiving in return several tokens of the emperor's favour. In 1530 Raimund and Anton were granted the imperial dignity of counts of Kirchberg and Weissenhorn, and obtained full possession of these mortgaged properties; in 1534 they were given the right of coining money; and in 1541 received rights of jurisdiction over their lands. Continuing their mercantile career, the Fuggers brought the new world within the sphere of their operations, and also carried on an extensive and lucrative business in farming indulgences. Both brothers found time to acquire landed property, and were munificent patrons of literature and art. Before this time the total wealth of the family had been estimated at 63,000,000 florins. The Fuggers were devotedly attached to the Roman Catholic Church. Jakob had been made a count palatine *(Pfalzgraf)* and several members of the family had entered the church; one, Raimund's son, Sigmund, becoming bishop of Regensburg.

In additicn to the bishop, three of Raimund Fugger's sons attained some degree of celebrity. Johann Jakob (1516–1575), was the author of *Wahrhaftige Beschreibung des osterreichiscken und habsburgischen Nahmens,* which was largely used by S. von Bircken in his *Spiegel der Ehren des Erzhauses Österreich* (Nuremberg, 1668), and of a *Geheim Ernbuch des Fuggerischen Geschlechtes.* He was also a patron of art, and a distinguished counsellor of Duke Albert IV. of Bavaria. Another of Raimund's sons was Ulrich (1526–1584), who became a Protestant and took refuge in the Rhenish Palatinate; greatly interested in the Greek classics, he occupied himself in collecting valuable manuscripts, which he bequeathed to the university of Heidelberg. Raimund's other son was Georg (d. 1579), who inherited the countships of Kirchberg and Weissenhorn, and founded a branch of the family which still exists, its present head being Georg, Count Fugger of Kirchberg and Weissenhorn (b. 1850).

Anton Fugger left three sons, Marcus (1529–1597), Johann (d. 1598) and Jakob (d. 1598), all of whom left male issue. Marcus was the author of a book on horse-breeding, *Wie und wo man ein Gestiit von guten edeln Kriegsrossen aufrichten soll* (1578), and of a German translation of the *Historia ecclesiastica* of Nicephorus Callistus.

Johann Fugger had three sons, Christoph (d. 1615) and Marcus (d. 1614), who founded the families of Fugger-Glött and Fugger-Kirchheim respectively, and Jakob, bishop of Constance from 1604 until his death in 1626. The family of Kirchheim died out in 1672. That of Glott was divided into several branches by the sons of Otto Heinrich and of his brother Johann Ernst (d. 1628). These lines, however, have gradually become extinct except the eldest line, represented in 1909 by Karl Ernst, Count Fugger of Glott (b. 1859). Anton Fugger's third son Jakob, the founder of the family of Wellenburg, had two sons who left issue, but in 1777 the possessions of this branch of the family were again united by Anselm Joseph (d. 1793), Count Fugger of Babenhausen. In 1803 Anselm's son, Anselm Maria (d. 1821), was made a prince of the Holy Roman Empire, the title of Prince Fugger of Babenhausen being borne by his direct descendant Georg (b. 1889). On the fall of the empire in 1806 the lands of the Fuggers, which were held directly of the empire, were mediatized under Bavaria and Wiirttemberg. The heads of the three existing brariches of the Fuggers are all hereditary members of the Bavarian Upper House.

Augsburg has many interesting mementoes of the Fuggers, including the family burial-chapel in the church of St. Anna; the Fugger chapel in the church of St. Ulrich and St. Afra; the Fuggerhaus, still in the possession of one branch of the family; and a statue of Johann Jakob Fugger.

In 1593 a collection of portraits of the Fuggers, engraved by Dominique Custos of Antwerp, was issued at Augsburg. Editions with 127 portraits appeared in 1618 and 1620, the former accompanied by a genealogy in Latin, the latter by one in German. Another edition of this *Pinacotheca Fuggerorum,* published at Vienna in 1754, includes 139 portraits. See *Chronik der Familie Fugger vom Jahre 1599,* edited by C. Meyer (Munich, 1902); A. Geiger, *Jakob Fugger, 1459–1525* (Regensburg, 189j); A. Schulte, *Die Fugger in Rom, 1495–1523* (Leipzig, 1904); R. Ehrenberg, *Das Zeitalter der Fugger* (Jena, 1896); K. Habler, *Die Geschichte der Fuggerschen Handlung in Spanien* (Weimar, 1897); A. Stauber, *Das Haus Fugger* (Augsburg, 1900); and M. Jansen, *Die Anfänge der Fugger* (Leipzig, 1907); R. Ehrenberg, *Capital and Finance in the Age of the Renaissance: A Study of the Fuggers and their Connexions* (Eng. trans. by H. Lucas, 1928).

FUGITIVE SLAVE LAWS, a term applied in the United States to the statutes passed by Congress in 1793 and 1850 to provide for the return of negro slaves who escaped from one State into another or into a public territory.

The first specific legislation on the subject was enacted on F'eb. 1, 1793; by its provisions any Federal district or circuit judge or any State magistrate was authorized to decide finally and without a jury trial the status of an alleged fugitive. The measure soon met with strong opposition in the northern States, and Personal Liberty laws were passed to hamper officials in the execution of the law; Indiana in 1824 and Connecticut in 1828 providing jury trial for fugitives who appealed from an original decision against them. In 1840 New York and Vermont extended the right of trial by jury to fugitives and provided them with attorneys. As early as the first decade of the 19th century individual dissatisfaction with the law of 1793 had taken the form of systematic assistance rendered to negroes escaping from the South to Canada or New England — the so-called "Underground Railroad" (*q.v.*). The decision of the Supreme Court of the United States in 1842 that State authorities could not be forced to act in fugitive slave cases, but that national authorities must carry out the national law, was followed by legislation in Massachusetts (1843), Vermont (1843), Pennsylvania (1847) and Rhode Island (1848), forbidding State officials to help enforce the law and refusing the use of State gaols for fugitive slaves.

The demand from the South for more effective Federal legislation was voiced in the second Fugitive Slave Law, enacted on Sept. 18, 1850, as a part of the Compromise measures of that year. Special commissioners were to have concurrent jurisdiction with the U S. courts in enforcing the law; fugitives could not testify in their own behalf; no trial by jury was provided; penalties were imposed upon marshals who refused to enforce the law or from whom a fugitive should escape, and upon individuals who aided negroes to escape; the marshal might raise a *posse comitatus;* a fee of $10 was paid to the commissioner when his decision favoured the claimant and only $5 when it favoured the fugitive; and both the fact of the escape and the identity of the fugitive were to be determined on purely *ex parte* testimony. The severity of this measure led to gross abuses and defeated its purpose; the number of abolitionists increased, the operations of the Underground Railroad became more efficient, and new Personal Liberty laws were enacted in Vermont (1850), Connecticut (1854), Rhode Island (1854), Massachusetts (1855), Michigan (1855), Maine (1855 and 1857), Kansas (1858) and Wisconsin (1858). These Personal Liberty laws forbade justices and judges to take cognizance of claims, extended the *habeas corpus* act and the privilege of jury trial to fugitives, and punished false testimony severely. These State laws were one of the grievances officially referred to by South Carolina (in Dec. 1860) as justifying her secession from the Union Attempts to carry into effect the law of 1850 aroused much bitterness. The arrests of Sims and of Shadrach in Boston in 1851; of "Jerry" M'Henry, in Syracuse, N Y., in the same year; of Anthony Burns in 1854, in Boston; and of the two Garner families in 1856, in Cincinnati, with other cases arising under the Fugitive Slave Law of 1850, probably had as much to do with bringing on the Civil War as did the controversy over slavery in the Territories.

For some time after the beginning of the Civil War the Fugitive Slave Law was considered still to hold in the case of fugitives from masters in the border states who were loyal to the Union government, and it was not until June 28, 1864 that the Act of 1850 was repealed.

See J. F. Rhodes, *History of the United States from the Compromise of 1850,* vols. i. and ii. (1893) ; and M. G. M'Dougall, *Fugitive Slaves, 1619–1865* (Boston, 1891).

FUGUE, in music, the mutual "pursuit" of voices or parts. It was, up to the end of the 16th century, if not later, the name applied to two art-forms. (A) Fuga *ligata* was the exact reproduction by one or more voices of the statement of a leading part. The reproducing voice *(comes)* was seldom if ever written out, for all differences between it and the *dux* were rigidly systematic; *e.g.,* it was an exact inversion, or exactly twice as slow, or to be sung backwards, etc., etc. Hence, a rule or *canon* was given, often in enigmatic form, by which the *comes* was deduced from the *dux;* and so the term *canon* became the name for the form itself and is still retained (B) A composition in which the canonic style was cultivated without canonic restriction was, in the 16th century, called *fuga ricercata* or simply *ricercare,* a term which is still used by Bach as a title for the fugues in *Das musikalische Opfer.*

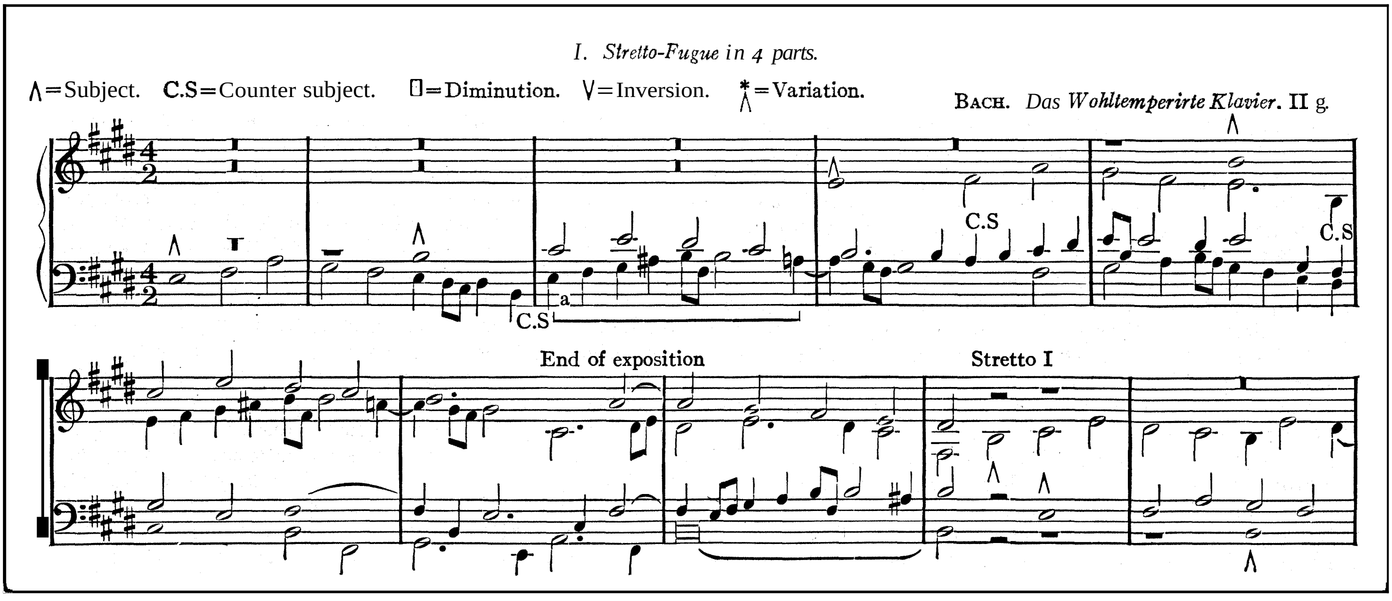
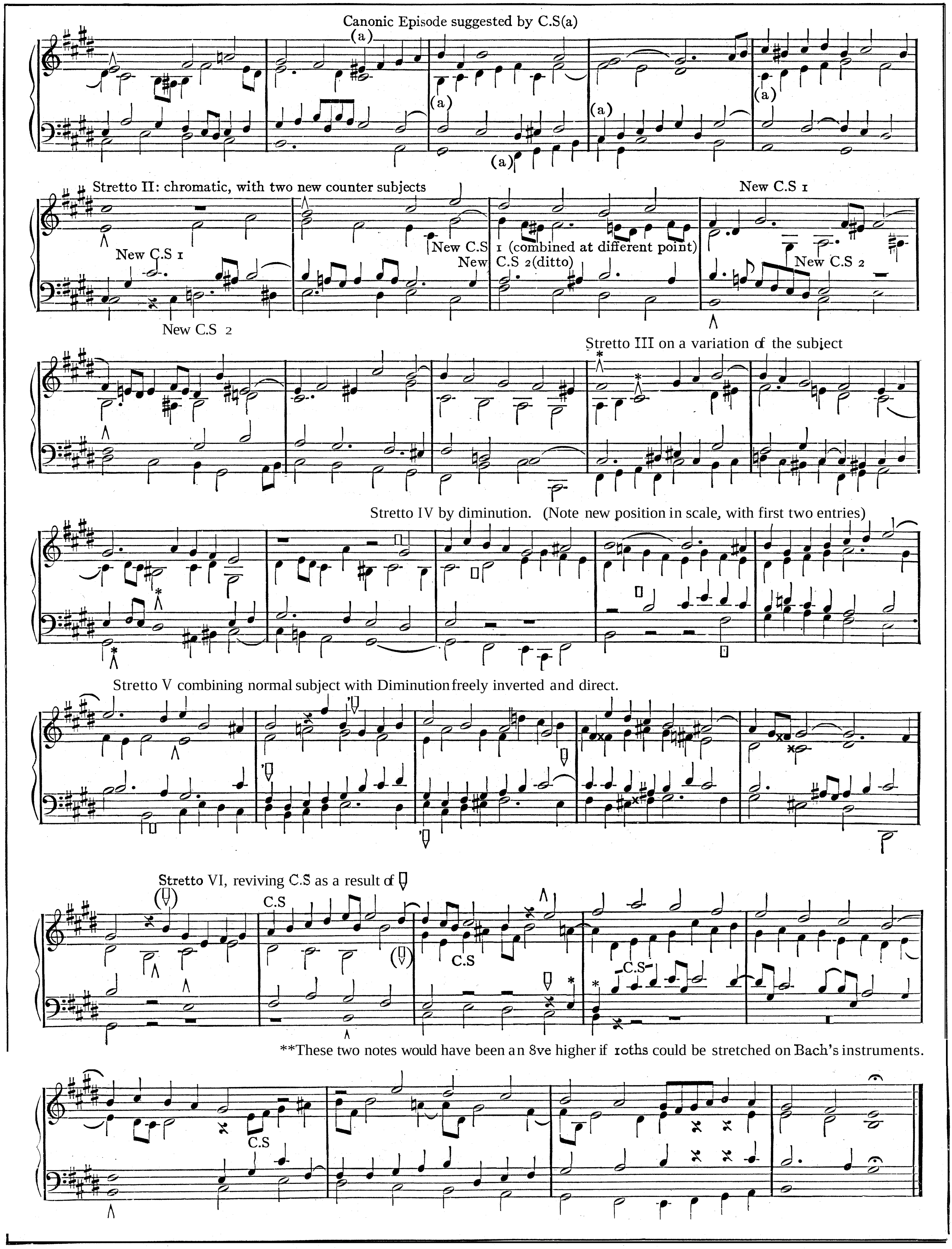
Fugue is a texture the rules of which do not suffice to determine the shape of the composition as a whole. Schemes such as that laid down in Cherubini's treatise, that legislate for the shape, are pedagogic fictions; and such classical tradition as they represent is too exclusively Italian to include Bach. Yet, strange to say, the Italian tradition in fugue style is represented by hardly any strict works at all. Under the general heading of COUNTERPOINT many facts concerning fugues are discussed; and only a few technical terms remain to be defined here.

(i.) If during the first entries or "exposition" of the fugue, the counterpoint with which the opening voice accompanies the answer is faithfully reproduced as the accompaniment to subsequent entries of the subject, it is called a *countersubject.* Obviously the first countersubject may continue with a second when the subject enters in the third part and so on. The term is also applied to new subjects appearing later in the fugue in combination (immediate or destined) with the original subject. Cherubini, holding the arbitrary dogma that a fugue cannot have more than one subject, applies the term to the less prominent of the subjects of what are commonly called double fugues, *i.e.,* fugues which begin with two parts and two subjects simultaneously, and so also with *triple* and *quadruple* fugues. It is remarkable that Bach (with only three known exceptions) never writes this kind of double fugue, but always introduces his new subjects later.

(ii.) *Episodes* are passages separating the entries of the subject. There is no reason for distinguishing episodes that occur during the exposition from later episodes. Episodes are usually developed from the material of the subject and countersubjects; they are, when independent, conspicuously so.

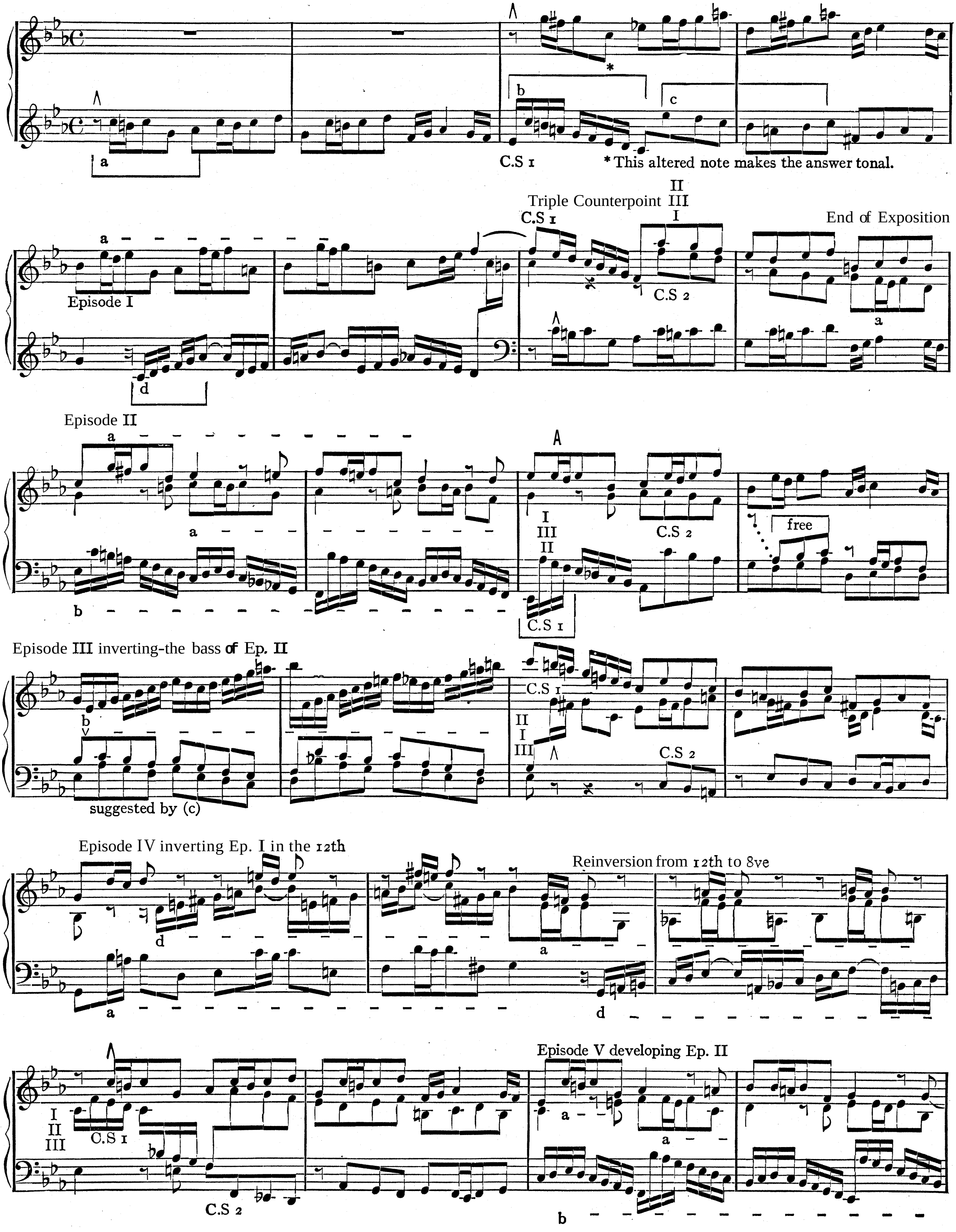
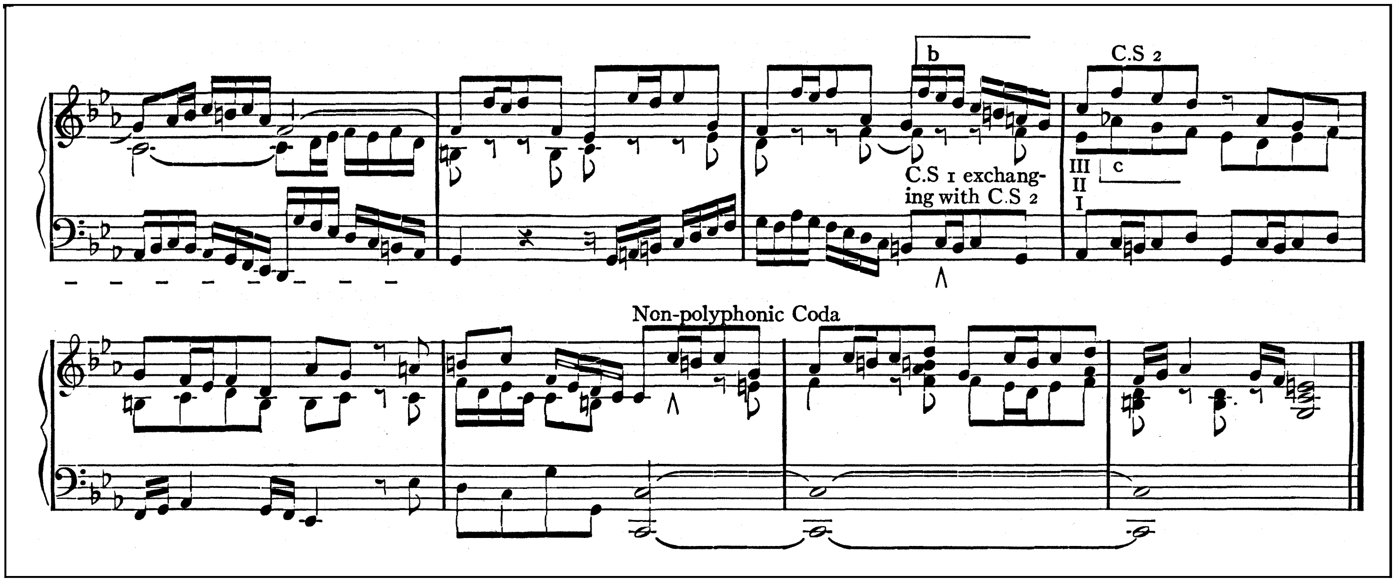
(iii.) *Stretto* is the overlapping of subject and answer. *A stretto maestrale* is one in which the subject survives the overlapping. The makers of musical terminology have no answer to the question of what a non-magistral stretto may be.

(iv.) The distinction between *real* and *tonal* fugue is a matter of detail concerning the answer. A fugal exposition is not intended to emphasise a key-contrast between tonic and dominant. Accordingly the answer is (especially in its first notes and in points that tend to shift the key) not so much a transposition




Canonic Episode suggested by C.S(a)
(a)
Stretto II: chromatic, with two new counter subjects
New C.S 1
New C.S 2
New C.S 1 (combined at different point)
New C.S 2(ditto)
New C.S 2
Stretto III on a variation of the subject
Stretto IV by diminution. (Note new position in scale, with first two entries)
Stretto V combining normal subject with Diminution freely inverted and direct.
Stretto VI, reviving C.S as a result of
C.S
**These two notes would have been an 8ve higher if 10ths could be stretched on Bach's instruments.

II. *Fugue in* 3 *parts, with* 2 *countersubjects and highly organized episodes.*

BACH. *Das Wohltemperirte Klavier* I 2.



of the subject to the key of the dominant as an adaptation of it from the tonic part to the dominant part of the scale or vice versa; in short, the answer is as far as possible on the dominant, not *in* the dominant. This is effected by a kind of melodic foreshortening on principles of great aesthetic interest but difficult to reduce to rules of thumb. The rules as often as not produce answers that are exact transpositions of the subject; and so the only kind of "real" fugue (*i.e.*, fugue with an exact answer) that could rightly be contrasted with the tonal fugue would be that in which the answer ought to be tonal but is not.

The term "answer" is usually reserved for those entries of the subject that are placed in what may be called the "complementary" position of the scale, whether they are tonal or not. Thus the order of entries in the exposition of the first fugue of Das Wohltemperirte *Klavier* is subject, answer, answer, subject, a departure from the usual rule, according to which subject and answer are regularly alternated in the exposition.

The nature of fugue and of polyphony as building harmony in "horizontal" melodic threads instead of in "vertical" chordal lumps is all summarized by Milton, during no classical period of polyphony, but in the chaotic time half-way between the death of Frescobaldi and the birth of Bach.

His volant touch,
Instinct through all proportions, low and high,
Fled and pursued transverse the resonant fugue.
Paradise Lost, book *XI.*

(D. F. T.)

FUHRICH, JOSEPH VON (1800–1876), Austrian painter celebrated for his portrayals of scriptural episodes, was born at Kratzau in Bohemia on Feb. 9, 1800. His sacred subjects were transferred in numberless repetitions to the roadside churches of the Austrian state. Fiihrich has been fairly described as a "Nazarene," a romantic religious artist whose pencil gave shape to countless incidents of the Gospel and scriptural legends. He composed with great skill, especially in outline. His mastery of distribution, form, movement and expression was considerable. He had, however, no feeling for colour; and when he produced monumental pictures he was not nearly so successful as when designing subjects for woodcuts. Fiihrich's illustrations to Tieck's Genofeva, the Lord's Prayer, the Triumph of Christ, the Road to Bethlehem, the Succession of Christ according to Thomas a Kempis, the Prodigal Son, and the verses of the Psalter, became well known. In 1834 he was made custos and in 1840 professor of composition in the academy of Vienna. After this he completed the monumental pictures of the Church of St. Nepomuk. In 1872 he was pensioned and made a knight of the order of Franz Joseph. He died on March 13, 1876.

FUJI SAN or FUJIYAMA, a celebrated quiescent volcano of Japan, standing 70 mi. W.S.W. of Tokyo. It rises to a height of 12,385 ft. and its southern slopes reach the shore of Suruga bay. It is a cone of beautifully simple form, the more striking to view because it stands isolated; but its summit is not conical, being broken by a crater about 2,000 ft. in diameter. *See* JAPAN.

FUJIWARA NO SADAIE (the characters for Sadaie can also be pronounced, in Sino-Japanese, as TEIKA, and he is commonly so called) (1162–1241), Japanese poet and critic, was probably responsible, more than any other person, for the formation of Japanese literary taste. The son of the celebrated poet Shunzei (1114–1204), Teika while still in his 20s gained renown both for his poetic genius and for his rare acumen in judging the poetry of others. His early works were in a clear, classical style, but gradually Teika's poems took on the symbolic and suggestive qualities of his mature work. One of his most famous *waka* (see JAPANESE LITERATURE), written when he was 37, is characteristic:

The floating bridge
Of the dream of a spring night
Had shattered;
In the sky a bank of clouds
Was drawing away from the peak.

In this poem Teika suggests that what he sees is not merely a cloud meaninglessly drifting in the sky, but an indication, a symbol, of some truth glimpsed perhaps in his dream.

Teika's poetry in this vein at first aroused opposition and even derision, but he acquired a powerful protector in the emperor Gotoba (1180–1239), himself a distinguished poet. The *Shinko*-kinshu (New Collection of Ancient and Modern Poetry), compiled in 1205 at Gotoba's command, was largely a product of Teika's style and taste. It is a superb collection and one that influenced later Japanese poets enormously, as indicated by the comment of a 15th-century critic: "Those who adversely criticise Teika's poetry will never know Heaven; their crime will surely be punished."

The compilation of *Hyakunin Isshu* (Hundred Poets, a Poem Each), a collection known by heart by almost every Japanese, is generally credited to Teika. His influence was not restricted to poetry: most of the important works of Heian prose that are still extant were edited by him, and our picture today of that glorious period is conditioned by his judgments.

See *Guide to the Composition of Poetry,* in De Bary, *Sources of the Japanese Tradition* (1958); *A Hundred Verses From Old Japan,* trans. by Porter (1909). (DD. K.)

FUKIEN, one of the three maritime provinces of south China between Chekiang on the north and Kwangtung on the south. Area 46,376 sq.mi. Its western boundary follows the crest of the high ranges which form the water parting between the Kan section of the Yangtze basin and streams flowing eastward to the China sea. These ranges effectively separate it from its western neighbour Kiangsi and form the boundary zone between Mandarin, spoken in that province, and the Fukien dialects, of which there are about seven main varieties. Topographically isolated on the landward side and with a distinct group of languages, Fukien has marked individuality. The province is mountainous and, apart from its border ranges, is crossed by several ridges with the southwest-northeast axis characteristic of the eastern portion of the south China highlands. A longitudinal system of drainage parallel to. these ridges has been tapped by coastal streams of which the most important is the Min, which drains two-thirds of the province. These streams are invaluable for floating timber. In the valleys, two crops of rice are harvested yearly, the first in June and the second in September. The forests are still of great importance and, as a source of timber, Fukien is only rivaled by Manchuria and Hunan in all China. The most important woods are fir, pine and rosewood. The camphor of Fukien was formerly of great importance.

Fukien became a great tea-growing province, a special feature being its production of flower-scented teas.

In addition to its agricultural and timber resources, Fukien has considerable and varied mineral wealth, including coal, iron, copper, gold, silver, graphite and good clay for porcelain. Mines are scattered widely over the province.

Foochow, on the navigable lower Min and the outlet for the northern and central interior, is the largest city. Amoy, where another system of valleys finds its contact with the sea, is the great regional centre for the south. There are several smaller intermediate ports and in the extreme north is Funing.

The great majority of the population of Fukien, (1953) 13,142,-721, lives in the coastal zone. A number of Chinese from Fukien and especially from Amoy emigrated to countries of southeast Asia, where they form the majority of the oversea Chinese.

After the outbreak of war, 1937, the Japanese occupied Amoy and, in 1941, temporarily Foochow. In 1949 the province fell to the Chinese Communists.

FUKUI, Japanese coastal prefecture on the Sea of Japan in central Honshū. Area 1,647 sq.mi.; pop. (1960) 752,696. The Wakasa bay coast west of Tsuruga, an important port, has many deep embayments and peninsulas, while the main inhabited lowland, Fukui plain, lies on the northern coast backed by high mountains. Wet-rice agriculture on the plains and forestry in the mountains are leading occupations, and Fukui is noted for its silk and rayon textile manufacturing. The capital, Fukui, and smaller towns of the Fukui plain are the main textile centres. Optical goods, cement and chemicals are also produced on a small scale. (J. D. EE.)

FUKUI, capital and largest city of Fukui prefecture, Japan, located in the central Fukui plain along the Asuwa river. Pop. (1960) 149.823. Famed as the rayon capital of Japan, Fukui traces its modern origins to the early 17th century. when it was a thriving castle town. Silk weaving developed rapidly after 1871, and between 1920 and 1935 rayon cloth became a specialty. The manufacture of machinery and the processing of foodstuffs are also important. About one-third of the city's labour force is employed in textiles, dyeing and other textile-supply industries. The city was burned badly in 1945 and was virtually destroyed by an earthquake in 1948, but has rebuilt. (J. D. EE.)

FUKUOKA, Japanese prefecture of northern Kyūshū, facing on the Inland sea (northwest), Shimonoseki strait (north), Tsushima strait (west): and the Ariake sea (south). Pop. (1960) 4,006,679; area 1.892 sq.mi. Rivers draining seaward have built up extensive habitable plains. The west coast is heavily indented. Fukuoka is important industrially especially in coal mining. The main coal fields, industria! and transportation centres, R'akamatsu, Yawata, Moji (*qq.v.*), Tobata and Kokura, are concentrated in northern Fukuoka. Fukuoka is the prefectural capital. Southern Fukuoka is mainly agricultural except for Kurume (silk textiles) and Omuta (coal and chemicals). (J. D. EE.)

FUKUOKA, capital city of Fukuoka prefecture, northwestern Kyūshū, Japan, and the largest and most important city of Kyūshū. Pop. 11960) 647.122. The city lies along the southern coast of Hakata bay on a river delta. Here developed the port city of Hakata, which in ancient times had many continental contacts; after 1600, the castle town of Fukuoka was established. Separated only by the Naka river, the two amalgamated in 1878. In the early 1940s incorporation of Hakozaki increased the city's area. Physically removed from the northern Kyūshū coal fields and industrial belt and poorly located for trade with the rest of Japan, Fukuoka has grown as a regional commercial, administrative and cultural centre. It has many large department stores and wholesale-retail establishments. In addition to prefectural offices, there are regional offices of a number of federal government agencies. Fukuoka is the seat of Kyūshū university (in Hakozaki) founded in 1910. The modernized port has a depth of about 30 ft. and is one of Japan's best equipped and most active fishing ports. Although the city's industries include shipbuilding and heavy chemicals, consumer goods are the main products. (J. D. EE.)

FUKUSHIMA (FUKUSHIMA-KEN) , Japanese prefecture of northeastern Honshū. Pop. (1960) 2,051.137; area 5.320 sq.mi. It is mostly mountainous and human activity is concentrated in small interior basins and along the Pacific coast. Essentially agricultural. it produces rice surpluses and such cash crops as tobacco, mulberry (silk), fruit (apples, pears and cherries) and vegetables. Forestry and fishing are important but modern industry has developed only in a few cities (Kōriyama the main centre)

FUKUSHIMA, the capital and largest (pop 1960, 138,961) city of Fukushima prefecture, is located on the Abukuma river in the Fukushima basin. Once a castle town, it is the prefectural administrative, commercial and educational hub. It serves as the silk mart of northern Honshii and has excellent railway facilities. (J. D. EE.)

FUKUZAWA YUKICHP (1834–1901), Japanese educator, author and publisher, one of the foremost 19th-century advocates of modernization in Japan, was born in Osaka of a low-ranking military family on Dec. 15, 1834, 20 years before Matthew Perry's arrival. He entered a school in Osaka to study the Dutch language and Dutch medicine, and this acquaintance with western civilization produced in him great enthusiasm for modernization. Fukuzawa went abroad three times, in 1860, 1861 and 1867, traveling in the U.S. and Europe. He returned to write in simple language and vigorous style the first of a large number of books exhorting the Japanese people to modernize their politics and society. In the course of his life he wrote over 100 volumes explaining and advocating parliamentary government, popular education, language reform, women's rights and a host of other causes. In 1871 he founded Keiō university, to provide the kind of education he advocated in a great university independent of government domination. His newspaper, the *Jiji Shimpō,* founded in 1882 and dedicated to enlightenment of the people, also was written in simple language and style and was for years one of Japan's most influential newspapers. To the end of his life Fukuzawa insisted on promoting his beliefs by private efforts, and he consistently refused to accept any government office. He died on Feb. 3, 1901.

See **Fukuzawa Yukichi,** *Autobiography.* (T. C. SH.)

FULANI, a long-headed white race of pastoralists of disputed origin with considerable intermixture of other blood, calling themselves *Fulbe* (sing. *Pullo*), distributed from the upper Nile to Senegal. They have regular features and narrow nose, wavy hair, light complexion; are long-limbed, highly strung. They live independently, or near cultivators whose cattle they herd, and in certain districts constitute the ruling class, as in the theocratic states of Fouta Djallon, Guinea. They conquered the Hausa states of Nigeria about 1804; and maintained precarious power up to the establishment of the British Protectorates (1904). Some have taken up cultivation. They are usually Moslems and observe the Koranic code; a small proportion are Animists (Senegal, Mali and on the Niger).

See Arcin, *La Guinée Française* (1907); Delafosse, *Haut Sénégal Niger* (1912); **Meek,** *The Northern Tribes of Nigeria* (1925).

FULBERT, SAINT, OF CHARTRES (c. 960–1028), bishop of Chartres and educator, whose pupils called him Socrates because of his encyclopaedic knowledge and determined pursuit of truth, was born in Picardy. During his education at Reims his teacher was Gerbert, later Pope Silvester II. Robert, later king of France, was a fellow student and good friend. In ggo Fulbert was appointed chancellor of the cathedral of Chartres, which under his direction, became one of the most vigorous schools in Europe. As bishop of Chartres from 1006, Fulbert used his friendship with the king of France and the duke of Aquataine to advantage. He was sent on diplomatic missions to Rome by both parties. In 1020 Fulbert began to rebuild the burned cathedral of Chartres, but he died on April 10, 1028, before its completion. His feast is April 10.

See Loren C. MacKinney, *Bishop Fulbert and Education at the School of Chartres* (1957); Hilda Johnstone, "Fulbert, Bishop of Chartres," *Church Quarterly Review,* 102:45–67 (1926). (E. G. RN.)

FULCMER OF CHARTRES (1059–*c.* 1130), French chronicler, was a priest who was present at the council of Clermont in 1095, and accompanied Robert II, duke of Normandy, on the first crusade in 1096. He became chaplain to Baldwin, king of Jerusalem. His *Historia Hierosolymitana* or *Gesta Francorum Jerusalem expugnantium,* one of the most trustworthy sources for the history of the first crusade, covers the period between the council of Clermont and 1127, and the author only details events which he himself had witnessed. It was used by William of Tyre. Fulcher died after 1127, probably at Jerusalem. He has been confused with Foucher of Mongervillier (d. 1171), abbot of St.-Père-en-Vallée at Chartres, and also with another person of the same name who distinguished himself at the siege of Antioch in 1098.

FULDA, a town and episcopal see of Germany, in the *Land* of Hesse, between the Rhon and the Vogel-Gebirge, 60 mi. N.E. from Frankfurt am Main by rail. Pop. (1950) 42,213.

Fulda owes its existence to its abbey, and became a town in 1208. In the middle ages there were many struggles between the abbots and the townsfolk. It came finally into the possession of Prussia in 1866. From 1734 to 1804 Fulda was the seat of a university, and latterly many assemblies of German bishops have been held in the town.

The great Benedictine abbey of Fulda was founded in 744 at the instigation of St. Boniface by his pupil Sturm, who was the first abbot, and became a missionary centre. It was liberally endowed with land and soon became one of the most wealthy establishments of its kind. About 968 the pope declared its abbot the primate of Germany and Gaul, and later he became a prince of the empire. The school at Fulda was the centre of theological learning in the early middle ages. Among its teachers were Alcuin. Hrabanus Maurus, who was abbot from 822 to 842, and Walafrid Strabo. Early in the 10th century the monastery was reformed by monks from Scotland, but had declined considerably before the Reformation. In 1752 the abbot was raised to the rank of a bishop, and Fulda ranked as a prince-bishopric. This mas secularized in 1802. In 1816 the greater part of the principality was ceded by Prussia to Hesse-Cassel, a smaller portion being united with Bavaria. Sharing the fate of Hesse-Cassel, this larger portion was annexed by Prussia in 1866. In 1829 a new bishopric was founded at Fulda.

The present cathedral was built early in the 18th century on the model of St. Peter's at Rome, but it has an ancient crypt, restored in 1892. Opposite the cathedral is the former monastery of St. Michael, now the episcopal palace. The Michaelskirche, attached to it, is a small round church built, in imitation of the Holy Sepulchre, in 822 and restored in 1853. The library, the palace, the former Benedictine nunnery (founded 162j, and now used as a seminary), and the Minorite friary (1238) now used as a warehouse, may be noted. Industries include weaving and dyeing, the manufacture of linen, felt and tapestry. There are also railway works in the town, and trade is in cattle.

FULGENTIUS, SAINT, OF RUSPE (*c.* 467–532/3) was born in Telepte, Byzacium, a province of Roman Africa, of a pious mother, Mariana. After a short career as fiscal procurator of the province, he became a monk residing successively in Africa, Sicily and Rome. He accepted the bishopric of the little African town of Ruspe about 507. The Arian Vandal king, Thrasimund, exiled the Catholic bishops, and 60 of them retired to Sardinia with Fulgentius as their leader and spokesman. Thrasimund recalled Fulgentius about 515, but because of Fulgentius' intransigent Catholicism, he was exiled again. Hilderich, successor of Thrasimund, was pro-Catholic and allowed the triumphal return of Fulgentius to Africa, where he died in 532/3. His liturgical feast day is Jan. 1.

The importance of Fulgentius lies in his theological work. The suggestion has been made (but not widely accepted) that he wrote the Athanasian creed. His writings are numerous but not original. He faithfully reproduces the thought of St. Augustine, whom he admired, and he has been called the "abbreviated Augustine." His writings were in large part polemical, against Arianism and Semipelagianism; his major work against the Semipelagians, a refutation of Faustus of Riez, has unfortunately been lost. *(See* FAUSTUS, SAINT.) Fulgentius' surviving writings are included in J. P. Migne (ed.), *Patrologia Latina,* vol. lxv, pp. 117–150, and vol. lxvii, pp. 887–962.

See G. Lapeyre, *L'ancienne église de Carthage,* 2 vol. (1932); G. Weigel, *Faustus of Riez* (1938). *(G. WL.)*

FULGENTIUS, FABIUS PLANCIADES (fl. *c.* late 5th and early 6th centuries A.D.), Christian Latin writer of African origin, who sought in two of his extant works to reconcile his Christian contemporaries with ancient legends. He is the author of the fantastic *Mitologiarum libri iii* containing allegorical interpretations of myths supported by absurd etymologies and of an astonishing *Expositio Vergilianae continentiae* (= contenta) *secundum philosophos moralis,* in which he makes Virgil himself appear in order to reveal the mystic meaning of the *Aeneid.* He also wrote an *Expositio sermonum antiquorum,* explanations of 62 rare Latin words supported by quotations, sometimes from authors and works that never existed, and a *Liber absque litteris de aetatibus mundi et hominis,* a strange, superficial and inaccurate work based chiefly on Bible history. As indicated by the title one letter of the alphabet is not used in each book. His youthful poems and a work entitled *Physiologus* are lost.

Fulgentius is a foolish and insipid writer. His style is luxuriant and he sometimes violates fundamental grammatical rules. Whether he is identical with Fulgentius bishop of Ruspe (467–532) is disputed.

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FULGURITE is the name given to glassy tubes produced by the fusion of sand by lightning and to superficial coatings of glass formed on rocks by the same agency (from the Latin *fulgar,* "lightning"). These may be distinguished as sand fulgurites and rock fulgurites. The former are more common.

Sand fulgurites are cylindrical, more or less branching objects which usually vary in diameter from about half an inch to several inches. In length they are mostly less than a foot, but some extend ten feet or more. The central cavity is usually lined with glass and the exterior shows adhering sand grains. The temperature reached in the melting of sand to produce the fulgurite is about 1,800° C. since lightning discharges take place in less than 100 microseconds (a microsecond is a millionth of a second). The temperature is estimated from the melting point of quartz. The silica glass of sand fulgurites was called lechatelierite by Alfred Lacroix after Henry le Chbtelier. noted French chemist. Among sand fulgurites those collected along the shores of Lake Michigan and the Atlantic coast of the United States are prominent.

Rock fulgurites usually occur about mountain summits. They have been found at Toluca, Mex., by Alexander von Humboldt, in the Caucasus by Otto von Abich and on Mt. Thielsen, Oregon, by J. S. Diller of the U.S. geological survey. (4. F. R.)

FULHAM, a western metropolitan borough of London, bounded N. and N.W. by Hammersmith, N.E. by Kensington, E. by Chelsea and S.E., S. and W. by a loop of the river Thames. Pop. (1951) 122,064. Area 2.7 sq.mi. It includes what were once the four villages of Fulham, Parson's Green, Walham Green and North End. The intervening land was built over during the last half of the 19th century and is mainly residential. Fulham lies almost entirely on a low gravel terrace and before it was built over it was one of London's chief sources of fruit and vegetables. Its only outstanding industry is pottery, first made there when John Dwight set up his kilns in c. 1670. There are many wharves along the river front. The electric power station (1936) supplies electricity to a wide area. Gas was first made in Fulham in 1829 and its gasworks are therefore one of the oldest in the world. The manor house or palace of the bishops of London stands in beautifully planted grounds near the river west of Putney bridge. It was originally surrounded by a moat, believed to be Danish, but this was filled in in 1921 and part laid out as a public park. The oldest portion of the house is the picturesque western quadrangle built by Bishop Richard Fitzjames, bishbp of London from 1j06 to 1522. The borough includes several well-known sports enclosures: Hurlingham park, where there were two polo grounds until one was built over and the other turned into a public park; Queen's club, which has tennis, rackets and other courts; the association football grounds at Craven cottage and Stamford bridge; and the Empress hall of Earl's court. The annual Oxford and Cambridge university boat race starts at Putney bridge.

Fulham, or in its earliest form *Fullanham,* is believed to signify either "the place of fowls" or "the place of dirt." The manor was bought by Waldhere, bishop of London, from Tyrhtel, bishop of Hereford, in the 8th century. There is no record of the first erection of the parish church of All Saints, but the first known rector was appointed in 1242. The four-storied tower is 14th or early 15th century work greatly restored. At the Grange in North End road Samuel Richardson lived from 1739 and Sir Edward Burne-Jones from 1867 until his death.

FULK (1092–1143), king of Jerusalem, was the son of Fulk IV, count of Anjou, and his wife Bertrada (who ultimately deserted her husband and became the mistress of Philip I of France). He became count of Anjou in 1109. Within his county he was active in asserting and recovering his powers over his vassals; outside it he played a part in the conflicts between Henry I of England and Louis VI of France. supporting each side in turn. But his ties with Henry became closer when his son Geoffrey Plantagenet married Henry's daughter Matilda. Already in 1120 Fulk had visited the Holy Land and become a close friend of the Templars. On his return he assigned to the order of the Templars an annual subsidy, while he also maintained two knights in the Holy Land for a year. In 1128 he was preparing to return to the east. when he received an embassy from Baldwin II, king of Jerusalem, who had no male heir to succeed him, offering his daughter Melisinda in marriage with the right of eventual succession to the kingdom. Fulk accepted the offer; and in 1129 he was married to Melisinda, receiving the towns of Acre and Tyre as her dower. In 1131 he became king of Jerusalem.

His reign was not marked by any considerable events. The kingdom, which had reached its zenith under Baldwin II, was quietly prosperous under Fulk's rule. In the beginning of his reign he had to act as regent of Antioch and to provide a husband, Raymund of Poitou, for the infant heiress Constance. But the great problem with which he had to deal was the progress of the atabeg Zengi of Mosul. In 1137 he was beaten near Barin and, escaping into the fort, was surrounded and forced to capitulate. A little later, however, he greatly improved his position by strengthening his alliance with the vizier of Damascus, who also feared the progress of Zengi (1140); and in this way he was able to capture the fort of Banias, to the north of Lake Tiberias. Like his predecessors in Anjou, Fulk was a great builder of castles. In southern Palestine he constructed Ibelin, Blanche Garde and Gibelin as a means of checking the Mohammedan garrison of Askalon. Belvoir was founded to survey the Jordan valley south of the Sea of Galilee, while in Trans-Jordan, Kerak was fortified by a royal vassal. Twice in Fulk's reign the eastern emperor, John Comnenus, appeared in northern Syria (1137 and 1142); but his coming did not affect the king, who was able to decline politely a visit which the emperor proposed to make to Jerusalem.

Fulk died in 1143 leaving two sons who both became kings and reigned as Baldwin III and Amalric I.

Fulk continued the tradition of good statesmanship and sound churchmanship which Baldwin I and Baldwin II had begun. Unfortunately he was unable to head a combined resistance to the rising power of Zengi of Mosul.

See J. Chartrou, *L'Anjou de 1109 à 1151* (Paris, 1928); R. Grousset, *Histoire des croisades,* vol. ii (Paris, 1935). (E. B.; R. C. SMA.)

FULK (d. goo), archbishop of Reims and support of the Carolingian dynasty, succeeded Archbishop Hincmar in 883. He was soon preoccupied in defending his territories against the Norman invaders. Personal ambition led him to support the claim to the West Frankish crown of his kinsman Guy of Spoleto after the deposition of Charles the Fat (887), but he grudgingly rallied to the cause of the successful candidate, Odo, count of Paris. Odo's failure to defend France against the Normans soon allowed Fulk to become the leader of unrest among the disgruntled nobility of the northeast.

Their instrument and the hope of all legitimists was the young Carolingian, Charles the Simple, whom Fulk crowned at Reims in 893. From 898 (when Charles, after five years of civil war, became Odo's heir) to his death, Fulk was chancellor. His efforts to keep the wealthy abbeys and benefices of his church out of the hands of the nobles incurred the hatred of Baldwin II, count of Flanders, who secured his assassination on June 17, 900.

FULK NERRA (c. 970–1040), count of Anjou, eldest son of Count Geoffrey I. Grisegonelle ("Gray Tunic"), and Adela of Vermandois, was born about 970 and succeeded his father in the countship of Anjou on July 21, 987. He was successful in repelling the attacks of the count of Rennes and laying the foundations of the conquest of Touraine (see ANJOU). In this connection he built a great number of strong castles, which has led in modern times to his being called "the great builder." He also founded several religious houses, among them the abbeys of Beaulieu, near Loches (c. 1007), of St. Nicholas at Angers (1020) and of Ronceray at Angers (1028), and, in order to expiate his crimes of violence, made three pilgrimages to the Holy Land (in 1002–03, c. 1008 and in 1039).

On his return from the third of these journeys Fulk died at Metz in Lorraine on June 21, 1040. By his first marriage, with Elizabeth, daughter of Bouchard le Vénérable, count of Vendôme, he had a daughter, Adela, who married Boon of Nevers and transmitted to her children the countship of Vendôme. Elizabeth having died in 1000, Fulk married Hildegarde of Lorraine, by whom he had a son, Geoffrey Martel (*q.v.*), and a daughter, Ermengarde, who married Geoffrey, count of Gbtinais, and was the mother of Geoffrey le Barbu ("the Bearded") and of Fulk le Réchin (see ANJOU).

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FULLER, GEORGE (1822–1884), U.S. painter, noted for his haunting, dreamlike figure paintings, was born at Deerfield, Mass., Jan. 17, 1822. At first an itinerant portraitist, he settled in New York city about 1847 and enjoyed moderate success there until 1860. Then, after a visit to Europe, he retired to Deerfield and for the next 1j years managed the family farm, painting only for his own pleasure. In 1876, however, pressed for money, he sent some paintings to Boston. They attracted much attention and he never thereafter lacked patrons. He died at Brookline, Mass., March 21, 1884. Fuller is remembered for his introspective later works, notably "The Quadroon" and "Romany Girl."

(D. H. W.)

FULLER, JOHN FREDERICK CHARLES (1878–), British soldier, military analyst and war historian, one of the earliest students of armoured warfare, was born on Sept. 1, 1878. During World War I, after holding staff appointments, he became chief genera1 staff officer of the tank corps in Dec. 1916. Armoured tactics had been given a setback by the premature use of tanks in the battle of the Somme, but Fuller introduced vigorous new concepts. He planned the surprise attack of 381 tanks at Cambrai on Nov. 20, 1917, which dates the coming of age of armoured warfare, and had a responsible share in planning the 1918 tank operations.

In 1922 Fuller became chief instructor at the Staff college and in 1926 was appointed military assistant to the new chief of the imperial general staff. Promoted major general in 1930, he retired in 1933 to devote his time to writing. His *Tanks in the Great War* (1920) was followed in 1923 by *The Reformation of War,* the first of a series of provocative books challenging many of the tenets of British military thought. Fuller's books had a devoted following of readers in Europe and the United States, though in conservative military circles he was regarded as an extremist and visionary. The lectures of his *Field Regulations* III (1932) were adopted for study by the general staffs of the German, Soviet and Czechoslovak armies. But his insistence on the potentialities of the armoured offensive for swiftly crushing an unready nation clashed with the defensive tactical doctrines of British staff officers of the 1930s, and he lost favour with Britain's allies by predicting that the Maginot line would become "the tombstone of France." Thus his controversial writings were influential chiefly in molding German and Russian tactical thought on the eve of World War II.

As correspondent for the *Daily Mail* (London), he reported the Italian invasion of Ethiopia and the Spanish civil war, and he was the only foreigner at Hitler's first maneuvers, in 1935. Fuller devoted the World War II period entirely to writing, and in 1948 he published one of the first histories of that conflict, *The Second World War, 1939–1945.* Eight postwar years were spent in the preparation of his most comprehensive work, the three-volume *Military History of the Western World* (1954–56), covering all ages of warfare from the earliest times down to the end of World War II.

Fuller's output of more than 30 books was based on a wide range of reading and research, and he was outstanding in his field for the emphasis he placed on political and economic factors shaping tactics. No other military analyst of the first half of the 20th century had such an influence on his own age, but he was criticized on the ground that his writings about World Wars I and II were coloured at times by personal prejudice. (Ln. Ms.)

FULLER, LOIE (1862–1928), U.S. dancer, achieved distinction for her innovations in theatrical lighting as well as for her invention of the "skirt dance" or "serpentine." Born Marie Louise Fuller, in Fullersburg, Ill., she made her debut as an actress at the age of four. After tours as a child prodigy, she acted in stock companies, burlesque, vaudeville and Buffalo Bill's Wild West show.

During rehearsals for a play, *Quack, M.D.,* in 1889, she received a gift of a voluminous skirt of transparent china silk. Twirling in its billowing folds, she made her first appearance as a dancer and attained instant success.

Next she experimented with "skirt dances" performed under lights of various colours, achieving spectacular effects. In her *Fire Dance* she danced on a pane of glass, illuminated from below.

Appearing at the Folies Bergère, Paris, in 1892, Fuller attracted the attention of such artists as Toulouse-Lautrec, Jules Cheret and Auguste Rodin. She had her own theatre at the Paris Universal exposition of 1900. In 1909 she toured the United States, and in 1923 staged an inferno scene for a Paris Opéra production of Berlioz' *La Damnation de Faust.* She made her last appearance in London, in 1927, in a "Shadow Ballet" employing new silhouette techniques.

A close friend of Queen Marie of Rumania, Loie Fuller accompanied her on her American tour in 1926.

See her autobiography, *Fifteen Years of a Dancer's Life* (1913), and *Chronicles of the American Dance,* ed. by Paul Magriel (1948). (Ln. Me.)

FULLER, (SARAH) MARGARET, Marchioness Ossoli (1810–1850), U.S. writer, was born in Cambridgeport, Mass., May 23, 1810. A brilliant and erudite woman, she has been remembered by later generations more for her personality than for her writing. Her father's rigorous supervision of her early intellectual training made her a "youthful prodigy." Although colleges were closed to women, she pursued her scholarly interests until she became both admired and feared for her learning.

Plagued by financial difficulties after her father's death in 1835, she taught in Bronson Alcott's Temple school in Boston, 1836–37, and in the Greene Street school in Providence, 1837–39. In 1839 she published a translation of *Eckermann's Conversations With Goethe* and in 1842 a translation of part of the correspondence of Fraulein Giinderode and Bettina von Arnim. Her most cherished project, never completed, was a biography of Goethe. In 1840 her friendship with Ralph Waldo Emerson and her critical essays in *The Western Messenger* won her the position of editor of the *Dial,* a magazine launched by the Transcendentalists. She wrote poetry, reviews and critiques for the quarterly; but in 1842 she had to relinquish the unprofitable editorship to Emerson.

For five winters, 1839–44, she conducted in Boston classes of "conversations" for women on literature, education, mythology and philosophy. This venture into adult education was apparently a great success; she was reputed to be a dazzling leader of discussion. Her professed purpose was "to systematize thought"; more generally, she attempted to enrich the lives of women and to dignify their place in society. The same purpose guided her in writing *Woman in the Nineteenth Century* (1845). This tract on feminism went far beyond the conventional demand for political equality in its ardent plea for the emotional. intellectual and spiritual fulfillment of women. It was published by Horace Greeley, who had admired her *Summer on the Lakes, in 1843* (1844), a perceptive study of frontier life in Illinois and Wisconsin.

In 1844, Margaret Fuller assumed the responsible position of literary critic on Greeley's newspaper, the *New York Tribune.* She warmly encouraged American writers and crusaded for social reforms but made her greatest contribution, she thought, as interpreter of modern European literature. Though many of her columns were hastily written, her critical principles and judgments have led to the 20th-century evaluation that she was "one of the best-equipped, most sympathetic and genuinely philosophical critics produced in America prior to 1850."

Before sailing for Europe in Aug. 1846, she selected some of her essays for publication as *Papers on Literature and Art.* This book assured her a cordial welcome to literary circles in England and France. As America's first woman foreign correspondent, she reported on her travels for the *Tribune;* the "letters" were later published in *At Home and Abroad* (1856). After settling in Italy in 1847, she was caught up in the cause of the Italian revolutionists, led by Mazzini, and was secretly married to the Marchese Giovanni Angelo Ossoli. During the siege of Rome (1849) she superintended a hospital while her husband fought. The suppression of the republic made her decide to return to America with her husband and child; they perished in a shipwreck off Fire Island on July 19, 1850, and with them was lost her manuscript history of the revolution.

Margaret Fuller's career was one of valiant endeavour to overcome obstacles of all kinds, a few of her own making. Emotional and impulsive. she was capable of the most intense attachments; her friends, however devoted, often found her too demanding in personal relationships. Hawthorne thought her a pretentious humbug. Because her books are diffuse in organization and undisciplined in style, she has not survived as a notable writer; but her earnest, idealistic efforts to civilize the taste and enrich the lives of her contemporaries make her significant in the history of American culture.

Bibliography.—The *Writings of Margaret Fuller,* selected and edited by Mason Wade (1941) has a "Bibliography of Published Writings of Margaret Fuller." Wade's *Margaret Fuller: Whetstone of Genius* (1940) lists the chief biographies to that date. Later studies are Madeleine B. Stern, *The Life of Margaret Fuller* (1942), and Faith Chipperfield, *In Quest of Love: the Life and Death of Margaret Fuller* (1957).
(W. R. Eb.)

FULLER, MELVILLE WESTON (1833–1910), chief justice of the United States, was born of a cultured New England family at Augusta, Me., Feb. 11, 1833. His grandfather, Nathan Weston, was chief justice of Maine. Graduated in 1853 with honours from Bowdoin college, Brunswick, Me., Fuller attended Harvard law school for six months, being admitted to the bar in 1855, and, after a short career on an Augusta newspaper, started, in 1856, to practise law in Chicago. He was elected as a Democrat to an Illinois constitutional convention in 1861 and to the state house of representatives in 1862, but his political career deteriorated when the people refused to adopt the constitution and the Republican governor prorogued the legislature for Civil War disloyalty. Unknown nationally, but eminent at the Chicago bar, Fuller was appointed chief justice in 1888 by Pres. Grover Cleveland. In 1897–99 he served as an arbitrator in the Venezuelan boundary controversy between Great Britain and Venezuela and from 1900 to 1910 as a member of the Hague court of arbitration. He served as chief justice until his death which occurred at Sorrento, Me., on July 4, 1910, a longer term than that of any other chief justice except John Marshall and Roger B. Taney.

As chief justice, Fuller's great success was as an administrator rather than as a jurist. A gentle, modest, moderate man, scholarly and able but not of transcendent brilliance, he won the affection of his associate justices. Justice Oliver Wendell Holmes and Justice Samuel F. Miller both declared that Fuller was the best presiding judge they had ever known. By his independence and courage, his impartiality and nonpartisanship, his human sympathy and sense of humour, his skill in suppressing acrimonious dissents and, most of all, his rare executive ability, he raised the court in professional and popular esteem. He left behind no outstanding opinions of his own except those declaring the Income Tax law of 1894 unconstitutional. (W. L. K.)

FULLER, THOMAS (1608–1661), English scholar, writer and preacher, was one of the wittiest and most prolific authors of the 17th century, but, because even his weightiest pronouncements contain amusing passages and his writings abound with epigrams, anecdotes, puns and other conceits, a name for quaintness has obscured his real merits. Fuller's fame as a popular preacher and writer never prevented him from careful attention to literary form. As a historian he made no claims to profound research, but he was a serious gatherer of facts from original sources, and his larger works are still highly regarded for the information they contain. *The Holy War* (1639), a history of the crusades, is of permanent value. *The Holy (and Profane) State* (1642), a collection of characters, now Fuller's most readable work, provides both instruction and entertainment and is important to the historian of the English essay and biography. His *Worthies,* also highly readable, is still an important work of reference for biographical details of Englishmen, arranged by counties.

Fuller was born in Aldwincle, Northamptonshire, where his father was rector, and was christened on June 19, 1608. His mother's brother, John Davenant, bishop of Salisbury, had been president of Queens' college, Cambridge, and he was entered at Queens' at 13 and at 20 became the youngest M.A. in the university. In 1630 he was appointed curate of St. Bene't's, Cambridge; in 1631 he was given a prebend's stall in Salisbury cathedral and was presented to the living of Broadwindsor, Dorset. He took his bachelor of divinity degree at Cambridge in 1635. In 1638 he married Ellen Grove; she bore him a son, John, in 1641, but died a few months later. In 1640 Fuller represented the diocese of Rristol at the first church convocation in London, and established his great reputation as a preacher in the pulpits of the city churches. In 1641 he was appointed preacher at the Chapel Royal, Savoy, London, where he officiated until Aug. 1643. An adherent of the Royalist cause, he yet preached peace: "The best and only way to purge errors out, is in a faire and peaceable way; for the sword cannot discerne betwixt truth and error; it may have two edges, but never hath an eye." Yet his moderate views did not save him from the attentions of the Parliamentarians, and he found it advisable to leave London for Oxford. From Dec. 1643 to July 1644 he acted as chaplain to the royalist army, spending several weeks with the forces besieged in Basing house, Hampshire. In May 1644 he returned to Oxford, where he preached a notable sermon entitled *Jacob's Vow*. He moved with the army to Exeter, where for nearly two years he was in attendance on the household of the infant Princess Henrietta, and there published his small book of meditations, *Good Thoughts in Bad Times* (1645), many times reprinted, sometimes with *Good Thoughts in Worse Times* (1647).

In June 1646 he returned to London and wrote *Andronicus, or the Unfortunate Politician* (1646), a satire against Cromwell. After a few months, however, he moved to Boughton house, Northamptonshire, the seat of an old friend, Lord Montagu, where he applied himself to his two great historical works, *The Church-History of Britain* (165j) and *The History of the Worthies of England* (1662); but he was soon again leading the life of a wandering scholar.

The execution of the king on Jan. 30, 1649, was to Fuller "the midnight of misery," and his *Church-History* gives a full and accurate account of the king's death and burial. In the same year he was presented to the living of Waltham abbey, Essex. He made many friends in the district, including Izaak Walton, and was given a library at Copt hall by the earl of Middlesex. Under these conditions he was able to complete a large historical work, *A Pisgah-Sight of Palestine* (1650).

In 1652 Fuller was again appointed to preach in a London pulpit at St. Clement's, Eastcheap. He married Mary Roper, who bore him two sons and a daughter, though only one, Thomas, survived infancy, and was at last able to complete his *Church-History,* to which he added a *History of the University of Cambridge* and a *History of Waltham Abbey*. *The History of the Worthies* was published posthumously by his elder son.

Probably in 1657 Fuller had to appear before Cromwell's "Tryers" to test his fitness for public preaching. He came successfully through the ordeal, but soon after resigned his living at Waltham abbey. In 1658 he was presented to the living of Cranford, near London. He continued to preach in London, and at the Restoration was again given his prebend's stall in Salisbury cathedral and became a doctor of divinity at Cambridge. He might have received a bishopric for his loyalty, but was taken ill while preaching a marriage sermon at the Savoy and died at his lodgings in Covent Garden on Aug. 16, 1661.

Fuller in his prime was described as a tall, burly man with a ruddy face and curly hair. He possessed a remarkable memory and needed little sleep, which helps to account for his great output, despite the harassed life he led. He confessed, indeed, that he had written too many books, but he loved all books for their own sake and took an interest in the physical appearance of those that he published. He has had no more sincere admirer than Charles Lamb, who made a selection of his works, for Leigh Hunt's quarterly *Reflector* (1812).

BIBLIOGRAPHY.—There is a full *Bibliography of Fuller,* ed. by S. Gibson for the Oxford Bibliographical society, with introduction by Geoffrey Keynes (1936). For his life *see* the short anonymous *Life* (1661); and J. E. Bailey, ***The Life*** of ***Thomas Fuller*** (1874). (G. L. K.)

FULLER'S EARTH, an important industrial clay used primarily as an absorbent, so named from its use by fullers, that is, textile workers who fulled or scoured, cleansed and thickened cloth, to remove grease from it. It was increasingly employed in the second half of the 20th century as a carrier for insecticides and fungicides and in drilling mud. As these uses increased, its former use as a colour remover in mineral oil and vegetable oil refining declined. The decolorizing action of the clay is not a filtering action but a selective adsorption by which the dark constituents of the oil are absorbed as a coating on the clay particles, leaving behind the colourless constituents. This selective property, which is mainly physical, has been explained as being connected with open bonds in the clay developed by the removal of hydrogen (H), hydroxyl (OH) or some of the cations from the component minerals. It is not limited to any one clay mineral, nor is it present to an equal degree in clays that are identical in mineralogical and chemical composition. Weathering improves the adsorptive capacity of some clays and the upper exposed portion of the deposit is superior to the lower part having the same mineralogical composition. Clays having a marked bleaching action on oils are termed adsorbent clays; these are divided into active clays (or fuller's earth) that are used without any other treatment except drying and grinding, and the activated clays that are prepared by partial bleaching with strong acids. Activated clay which includes many calcium bentonites *(see* BENTONITE), is expensive because of the added cost of the acid treatment, but it has a strong bleaching action on some oils so that a little ddes the same work as more of the cheaper naturally active clays. Other substitutes include activated bauxite, diatomite and synthetic magnesium silicate.

Two methods of treatment are used in industry: the contact method in which the ground adsorbent clay is stirred in the oil, heated and filtered; the percolation method, in which the oil percolates through a cylinder filled with dried clay ground to pass a 150-mesh screen. Some granular fuller's earth and bauxites that have been activated by heating. can be heated at a controlled temperature to drive off the colouring matter and can be reused.

The selective adsorption of fuller's earth and bleaching clay is connected mainly with the minerals of the montmorillonite group (see CLAY AND CLAY MINERALS), which are hydrous aluminum silicates containing calcium, magnesium and iron. These clay minerals have base exchange properties and are often the chief components of bentonite, a clay formed by the alteration of the glass that once constituted volcanic ash. The mineral smectite, a term used synonymously with fuller's earth in the textbooks of the 18th century. has an X-ray diffraction pattern and a chemical composition identical to montmorillonite, which is the preferred name. The smectite of Cilly, Styria, and of the Woburn sands. England, shown to be montmorillonite retaining the structure of volcanic ash, is bentonite as well as fuller's earth. Decolorizing effects on edible oils and lard have been connected with a few clays composed of kaolinite and halloysite (hydrous aluminum silicates) and hydrous micas (hydrous aluminum silicates containing potash). The fuller's earth of Attapulgas, Ga., composed of the clay mineral attapulgite, has a chain structure in place of the usual sheet structure of other clay minerals. Some glauconite (a hydrous potassium iron silicate) has natural bleaching qualities that can be further developed by acid treatment. The quality of fuller's earth can be determined only by a practical test.

Fuller's earth may occur at any geological horizon; in Surrey, Eng.. it is of Cretaceous age; near Bath it is of Jurassic Age; at Bala, north Wales, it occurs in Ordovician rocks; in Saxony it is said to be the decomposition product of a diabasic rock. In North America, Ordovician to Pliocene deposits are distributed from Mexico to Alberta, Can. In the United States the main production has been from the Eocene and Miocene of Georgia and Florida and the Eocene of Tennessee, and to a lesser extent from Mississippi, Texas, Colorado, Illinois and Utah. (V. T. A.; X.)

FULLERTON, a city of Orange county, Calif, U.S., 25 mi S.E. of Los Angeles (*q.v.*) and a part of the Los Angeles metropolitan area. Within the city limits are located one of the pioneer public junior colleges of California (established in 1913) and a state college (established in 1959). In keeping pace with the tremendous growth of Orange county during and after World War II, the industrial section of Fullerton underwent rapid but orderly development. Many of the nation's leading companies located branches there. The citrus and other agricultural industries and the production of crude oil, mainstays of the city's economy before its industrialization, continued to be important sources of revenue. Besides possessing excellent local recreational facilities, the city is conveniently located within easy driving distance of all of southern California's beach, mountain and desert recreational centres. The original townsite of Fullerton was laid out in 1887 and the city was incorporated in Jan. 1904. It was named for George Fullerton, an executive of the Santa Fe railroad, who in 1879 was allocated $50,000 to invest for the company. He purchased the land on which the city lies and incorporated the Pacific Land Improvement company to develop it. Fullerton has a council-manager form of government, in effect from 1953. Pop. (1960) 56,180. For comparative population figures see table in CALIFORNIA: Population. (WM. H. K.)

FULMAR, an arctic sea bird belonging to subfamily Fulmarinae, also containing the shearwaters (*q.v.*), in the order Procellariiformes. It is a large petrel (length 19 in.) resembling the herring gull (Larus *argentatus*) or European common gull (L. *canus*), but with primaries gray instead of black. It flies over cold northern oceans to 85° north, visiting land only to breed. It nests in vast numbers, like gulls, on rocky islets, laying one dull white egg on rocky ledges and cliffs. Its flight is slow, flapping, owllike, alternating with gliding when the wings are held out straight. It settles on the water to feed on fish, floating offal and animal debris. The Atlantic fulmar (*Fulmarus* g glacialis) breeds to Greenland, Scotland, Ireland, north into the Arctic ocean, west to Melville Island and east to Novaya Zemlya. It is replaced in the North Pacific by F. g. rodgersii, breeding from the Kuriles and Kamchatka north into the nearby Arctic ocean (Wrangel and Herald islands). Male and female in courtship simultaneously display the mauve lining of the mouth. Like many of the petrels, when handled the bird ejects oil from its mouth and tube-nostrils. Most of the fulmar's relatives live on subantarctic islands and range the southern seas. The largest near-relative is the giant fulmar (*Macronectes giganteus*) or bonebreaker, 3 ft. long and 7 ft. spread and dark sooty in colour. It lives in cold southern seas, wanders north to Peru and is very destructive to eggs and young of other sea birds on subantarctic islands. (G. F. Ss.)

FULMINIC ACID is an organic compound of formula CNOH. Its salts have been known for a long time and are of interest because they are sensitive explosives. The silver salt, fulminating silver, seems to have been obtained in the 17th century; and the mercuric salt, mercuric fulminate (*q.v.*), first prepared by E. Howard in 1799. It is obtained by the action of ethyl alcohol and nitric acid on mercuric nitrate. The salts vary in sensitivity and some are among the most sensitive explosives known, since explosions have been recorded when they have been rubbed under water with a glass spatula.

The free acid is unknown. A solution of it in ether can be obtained by acidifying an aqueous solution of the sodium salt and extracting with ether. The acid, however, is volatile with ether vapour and cannot be separated by fractional distillation. Further, it is unstable and polymerizes rapidly in both aqueous and ethereal solution to products which are mentioned below.

The constitution of fulminic acid was a matter of controversy for many years, and investigation of the problem was not made easier by the instability of the acid and the explosive nature of both the acid and its salts. The stumbling block to general acceptance of the formula CNOH for the acid was that it implies "bivalent" carbon. Wider knowledge of the modes of union of atoms removes this difficulty. It is now known that bivalent carbon in the isocyanides, RNC, is a misconception: the link which was written $-\mathrm{N}=\mathrm{C}$ shows the properties of a triple link in its length, its heat of rupture and the force constants of the oscillation of the carbon and nitrogen atoms. Bivalent carbon in these compounds is not bivalent in the sense that the atom has six valency electrons: the "lone pair" of electrons of the nitrogen atom is also involved in the linkage between the two atoms so that each has the normal number of eight valency electrons. The same is almost certainly true for fulminic acid. Its behaviour makes complete investigation difficult, but the resemblance of its chemistry to that of the isocyanides is strong evidence that its structure is correctly represented by the formula : C : : : N : OH in which the dots represent valency electrons. (T. W. J. T.; X.)

FULTON, ROBERT (1765–1815), U.S. engineer best known for his development of the steamboat, was born on a farm at Littfe Britain (now Fulton) 22 mi. S. of Lancaster, Pa. At an early age Fulton became a jeweler's apprentice in Philadelphia; in 1785 he began working independently as a "miniature painter and hair-worker." He went to England in 1786 to study under Pennsylvania-born Benjamin West (*q.v.*), the artist. He abandoned art for engineering in 1793, his principal interests being reflected in his Treatise on the *Improvement* of Canal *Navigation* (1796). Fulton tried, unsuccessfully, to interest the United States and, later, France in his canal proposals, moving to France in the spring of 1797. A few months later he submitted plans for a submarine, suggesting to the French that British warships could be destroyed by submarines attaching underwater bombs and then escaping undetected. His "Nautilus," having most of the features of David Bushnell's earlier (1775) submersible (see SUBMARINE), was launched in 1800 and performed creditably. The vessel was reconstructed with improvements in 1801, but nevertheless the project was rejected. Fulton turned now to steamboats. having formed a partnership with Robert R. Livingston (*q.v.*), then U.S. minister to France. Livingston had experimented with steamboats and held a monopoly for steam navigation on the Hudson river. The two men launched a steamboat of Fulton's design on the Seine in 1803. The British government, long having full knowledge of the submarine plans through Fulton's connivance, induced him to come to England in 1804; however, with the victory at Trafalgar in 1805, British interest in new naval weapons vanished. Fulton also tried unsuccessfully to interest President Jefferson in his submarine.

He returned to the U.S. in 1806. having been abroad for nearly 20 years. Livingston was also back in America, and a boat hull was ordered by the two. On Aug. 9, 1807, "The Steamboat" (as Fulton called it) made its trial runs powered by a 24-h.p. Boulton and Watt engine. Eight days later came the historic 150-mi. trip from New York to Albany. Commercizl schedules were established in the fall, the boat then being advertised as "The North River Steamboat." Substantially rebuilt and lengthened to 149 feet, the boat was registered as "The North River Steamboat of Clermont" (shortened to "Clermont" by the press) in 1808. Additional boats were built in the next few years. Fulton married Livingston's cousin Harriet, established an engine works in New Jersey, and developed steam ferries for the Hudson and East rivers. The first steam navigation of the central U.S. waterways was made by the Fulton-designed, Pittsburgh-built "New Orleans" on the Mississippi in 1811. Fulton's last triumph was the promotion and building of a mobile floating fort for the defense of New York harbour in the War of 1812. This ship, known both as the "Demologus" and "Fulton the First," mas launched shortly before the war ended in December 1814. Fulton died in New York on Feb. 24, 1815.

It is clear that Fulton—a clever mechanic with fertile imagination, a perennial opportunist and an astute businessman—was the leader in developing the steamboat to commercial status by the synthesis and extension of the most successful ideas of Europe and America. The steamboat patents he held were for improvements; they were not basic patents. His submarine plans were also based largely on the work cf others.

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FUMARIC AND MALEIC ACIDS, a pair of stereoisomeric unsaturated organic dibasic acids. The chemical formula for both acids is $C_4H_4O_4$. Fumaric acid (trans-butenedioic acid) is found in fumitory (*Fumaria officinalis*), various fungi (*Agaricus piperatus*, etc.) and Iceland moss. It is obtained by heating malic acid alone to 150° C. or by heating it with hydrochloric acid or hydrobromic acid. It may also be obtained by boiling monobromosuccinic acid with pyridine in aqueous or alcoholic solution, and by heating maleic acid to 210° C. Commercially, the acid is prepared by the fermentation of sugar. It crystallizes in small prisms or needles and is practically insoluble in cold water. It sublimes to some extent at about 200° C.. being partially converted into maleic anhydride and water. the reaction becoming practically quantitative if dehydrating agents are used. Potassium permanganate oxidizes it to racemic acid (see TARTARIC ACID).

Maleic acid (cis-butenedioic acid) is obtained in the form of its anhydride by distilling malic or fumaric acids, or by heating fumaric acid nith acetyl chloride to 100° C. It crystallizes in monoclinic prisms, which are easily soluble in nater, and it inelts at 130° C. to a liquid which boils at 160° C. with decomposition into water and maleic anhydride. When heated with concentrated hydrobromic or hydriodic acid, it is converted into fumaric acid. Oxidation by potassium permanganate converts it into mesotartaric acid.

Maleic anhydride is obtained by distilling maleic or fumaric acid with phosphorus pentoxide. The anhydride forms triclinic crystals nhich melt at 60° C., and it boils at 196° C. On a manufacturing scale maleic anhydride is prepared by oxidation of benzene vapour with air over a vanadium pentoxide catalyst.

Both acids yield acetylene by the electrolysis of aqueous solutions of their alkali salts, and on reduction both yield succinic acid; while by the addition of hydrobromic acid they both yield monobromosuccinic acid. From this behaviour it follows that the tno acids are structurally identical, the isomerism being caused by differences in the spatial arrangement of their constituent atoms (see STEREOCHEMISTRY), thus:

$$\begin{array}{l} H\!-\!C\!-\!CO_2H \\ \quad\ \| \\ H\!-\!C\!-\!CO_2H \end{array} \quad \begin{array}{c}\text{Maleic acid}\\ (\textit{cis})\end{array} \qquad \begin{array}{r} H\!-\!C\!-\!CO_2H \\ \| \quad\ \ \\ HO_2C\!-\!C\!-\!H \end{array} \quad \begin{array}{c}\text{Fumaric acid}\\ (\textit{trans})\end{array}$$

The foregoing formulas account fur the reactions mentioned above and also for the fact that maleic acid readily yields an anhydride, whereas fumaric acid does not.

Uses.—Both acids are of considerable industrial value, particularly in the preparation of various resins, which find their greatest use in the manufacture of lacquers, enamels and laminating varnishes.

During World War II maleic and fumaric polyesters came to be used widely as binders for glass fibres. The resin formed by the condensation of glycols with maleic or fumaric acid was dissolved in a monomeric vinyl composition such as styrene; this procedure permitted the formation of a viscous liquid which could be cured without the loss of any volatile components.

Currently these resins, together with glass fibre, are employed for the fabrication of various structural assemblies for automobiles, tank cars, furniture, complex moldings, boats,' refrigerators, as well as other large structural assemblies.

See Sir T. E. Thorpe, *Dictionary of Applied Chemistry*, 4th ed. by J. F. Thorpe and M. A. Whiteley, vol. 1–10 (1937–50). (E. L. KA.)

FUMAROLE, a vent from which volcanic vapours issue, named indirectly from Lat. *fumariolum*, "a smoke hole." The vapours from fumaroles were studied first by R. W. Bunsen in Iceland, and afterward by H. Sainte-Claire Deville and other chemists and geologists in France, who examined the vapours from Santorin, Etna, etc. The hottest vapours issue from dry fumaroles, at temperatures of at least 500° C., and consist chiefly of anhydrous chlorides, notably sodium chloride. The acid fumaroles yield vapours of lower temperature (300° to 400° C.) containing much water vapour, with hydrogen chloride and sulfur dioxide. The alkaline fumaroles are still cooler, though above 100° C., and evolve ammonium chloride mith other vapours. Cold fumaroles, below 100°, discharge principally aqueous vapour, with carbon dioxide and perhaps hydrogen sulfide. See VOLCANO; VOLCANISM.

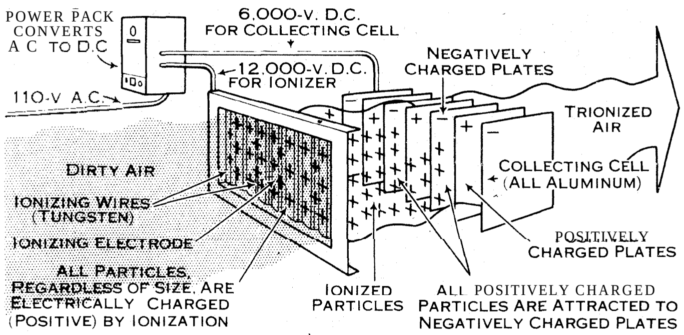
FUME PRECIPITATION, ELECTRICAL. The precipitation of smoke by electricity was described in 1824 by M. Hohlfeld. a teacher of mathematics in Leipzig, but only after it was independently rediscovered and critically studied by Sir Oliver Lodge about 1884 did it attract general attention and lead to attempts at industrial applications. At the time, however, these proved unsuccessful due to the lack of modern equipment. It was not until 1906, following experiments at the University of California, Berkeley, that the process was commercially successful.

The first installation was at the Selby Smelting works, near San Francisco, where it was used for the removal of sulfuric acid mist from about 5,000 cu.ft. of gases per minute. Although first applied purely to mitigate nuisances, the demand for the process is primarily based on a greater profit to be derived from the gases cleaned or the material removed.

Another circumstance aiding the development through friendly public interest was the creation in 1912, under the auspices of the Smithsonian institution, of the Research corporation in New York city?to hold and administer as an endowment for research most of the United States patent rights to the process.

The Process.—Technically the process consists in securing a uniform, copious but nondisruptive discharge of electricity from small electrode surfaces of one polarity into a stream of cloudy gas. The fine solid or liquid particles composing the dust, fume or smoke are immediately attracted to, and deposited on, large electrode surfaces of opposite polarity, the particles having become charged from the depletion of electrons from their surfaces; *i.e.*, ionization. The process is illustrated diagrammatically in the figure.

Dirty air is passed through a series of fine tungsten wires maintained at a positive potential of 12,000 v. This step is called the ionizing step. Immediately following this, the ionized particles flow past a set of plates spaced about ⅜ in. apart. Alternate plates are charged with a positive potential of about 6,000 v. Upon contact with the negative collecting plates the positively charged ions gain electrons. stick to the plates and fall into a bin or hopper for collection. The voltage on the wires in the ionizing chamber is regulated to secure as strong a glow as is possible without passing over into the disruptive discharge; *i.e.,* a spark or arc. The discharge electrodes are customarily nega-



BY COURTESY OF ASSOCIATION OF IRON AND STEEL ENGINEERS

THE **TRION** PRINCIPLE OF CLEANSING AIR BY COLLECTION OF **IONIZED** PARTICLES ON ELECTRICALLY CHARGED ALUMINUM PLATES

tive. because positively charged particles are easiest to produce in the ionizing chamber.

The gas treaters now in general use consist either of a multiple set of pipes, each containing an electrode. or of plates hung vertically in a flue. the wires being stretched parallel between them. The materials of construction, including the collecting electrodes, vary from iron and lead to reinforced concrete and vitrified earthenware: depending on the composition and temperature of the gas stream to be heated. The original Cottrell precipitator styles are used almost exclusively for liquid mists or fogs. Condensation of vapour to liquid occurs and the liquid drains along the walls of vertical tubes. For dry dusts or fumes the precipitator takes the form of plates similar to those shown in the figure. Gas flow is horizontal and dust collected on the plates falls to a hopper or other conveyor for easy removal. Mechanical agitation of the collecting plates often is necessary.

Factors in **Design.**—Most plants are designed with electrodes of opposite sign 2 to 6 in. apart and operating at 50,000 to 80,000 v. The size of installation is determined primarily by the volume of gas to be treated and the percentage of suspended matter to be removed; the amount, kind and size of particle of the iatter being of minor importance. If P is the ratio of outgoing to incoming suspended matter, t the average time in seconds that the gas remains between the electrodes and K a constant depending upon the apparatus, voltage. temperature and kind of raw gas, then $P=K^t$. In most commercial practice t averages about 2 sec. and K varies from 0.2 to 0.7, the gases travelling from 10 to 40 ft. through the electric field at linear rates of 3 to 15 ft. per second. Removal of 90% to 99% of the suspended matter is usually aimed it, and the energy required is 1 to 3 kw.hr. per 100,000 cu.ft. of gas treated.

Industrial Uses.—The earliest applications of the process were to the smelting and sulphuric acid industries. Equipments at cement mills were fewer in number but handled a large volume of gas and a large tonnage of precipitate. Other important applications are to the detarring of coke-oven gases, the cleaning of producer and iron blast-furnace gas, the cleaning of ventilating air in crushing, grinding and polishing mills (especially where cost of heating in minter makes recirculation of air important), the recovery of sludge acid fumes in petroleum refineries, the recovery of dust. from brown-coal dryers and the removal of ash from the stack gases of large power plants burning powdered coal. On a laboratory scale the process has also been applied successfully to sanitary atmospheric analysis and to gas masks, including the removal of bacteria from air.

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FUMIGATION, the use of gases, vapours, smoke or fumes for the destruction of organisms; the practice is derived from the early use of fumes, perfumes, smoke or vapours for ceremonies of incantation and for the purification of air. The burning of incense or other aromatic substances was closely associated with primitive religious ceremonies; it counteracted the disagreeable odours generated by the sacrifice of animals and mystified and exerted a favourable psychological influence over the religious devotees. Later, fumigation was practised in churches to purify the air in time of public sickness and to dispel the reek of the populace and of the gases arising from burial vaults beneath church floors. In medicine, the term in early times meant the exposure of the body to fumes; for example. sulfur fumes once were recommended for the treatment of scabies.

The value of fumigant chemicals for destroying organisms was known to the early Greeks and Romans: Cato in about zoo B.C. described the use of fumes from a mixture of sulfur and asphalt to control tree-infesting insects.

Chemical warfare (*q.v.*), or the use of poisonous smoke or chemicals for the destruction of man, is a form of fumigation and is helieved to have been attempted first during the wars of the Athenians and Spartans (431–404 B.C.), when the Spartans saturated wood with pitch and sulfur and burned it under the walls of Plataea and Belium in an effort to drive the defenders from their posts. Perhaps the first poison gas successfully used in war was "Greek fire" (*q.v.*), which protected Constantinople against the invasion of the Arabs in A.D. 670. This mixture of chemicals when released upon the sea burst into flames, liberating clouds of poisonous gas and setting fire to ships.

The great modern development of fumigation for the control of noxious organisms began in 1854, when the use of carbon disulfide for insect control was reported.

Characteristics of Fumigants.—Fumigation is most commonly accomplished with toxic gases. Gases have the capacity to expand or diffuse indefinitely into any volume available. This capacity, coupled with the extremely small size of their individual particles (considerably less than 0.001 micron *[p]* in diameter), enables gases to reach the tissues of organisms readily via the respiratory tract. These same characteristics enable some fumigants to exert a significant toxic effect by direct penetration of exposed skin surfaces. However, this does not apply as extensively to insects and related organisms because of their protective exterior skeletal structure. Vapours (gaseous materials very near the condensation point) have a tendency to diffuse and are entirely satisfactory for use in fumigating. However, smokes and fumes do not diffuse, and with individual particle size ranges of 0.001–0.4 and 0.1–1.0 μ, respectively, are near the limit of effectiveness for fumigation. Even less effective are aerosols, which consist of airborne liquid droplets ranging from 0.1 to 30.0 p in diameter. An idea of the effect of particle size on the respiration of air-borne materials is gained from the knowledge that. in man, there is little effective penetration of the lungs by particles larger than three microns in diameter.

Methods of Fumigation. — Fumigation for the destruction of insects and rodents is acconiplished in a variety of ways. Dry-wood termites are commonly controlled by placing a plastic tent over the entire infested building and releasing methyl bromide within it. Mills, factories, warehouses and packing plants are freed of vermin by the introduction of hydrocyanic acid gas within the structure, after first ensuring that all openings are sealed. Stores of raw and manufactured items of organic origin are routinely fumigated to eliminate contained pests,

Fumigation of packaged items is normally accomplished under vacuum in specially constructed chambers in order to ensure thorough penetration. The application of fumigants heavier than air to soils infested with destructive nematodes and insects is common practice, as is also the destruction of undesirable rodents and animal predators by pumping calcium cyanide into their burrows. This chemical is a bluish-gray powder that combines with atmospheric water to release hydrocyanic acid gas. Under certain conditions, it is possible to remove pests from living organisms with fumigants. For example. control of scale insects on citrus trees is accomplished by placing a tent over each tree and releasing hydrocyanic acid gas therein.

Extensive efforts have been made to destroy air-borne micro-organisms by the release of disinfectant vapours—glycol, for example — but there are serious limitations to the practical use of this form of fumigation. (K. L. K.; X.)

FUMITORY, any plant of the genus *Fumaria,* family Fumariaceae, comprising small, branched, often climbing annual herbs with much-divided leaves. The flowers are small, tubular. with a spurred base, and in the British species pink to purplish in colour. These are weeds of cultivation growing in fields and waste places. F. capreolata climbs by means of twisting petioles. In past times fumitory was in esteem for its reputed medicinal properties; and in England, boiled in water, milk or whey, it was used as a cosmetic.

The root of the allied species (*Corydalis tuberosa*) was known as radix aristolochia, and has been used medicinally for various cutaneous and other disorders.

About 11 alkaloids have been isolated from it. The herbage of *Fumaria officinalis* and *F. racemosa* is used in China as an application for glandular swellings, carbuncles and abscesses, and was formerly valued in jaundice.

The climbing fumitory or Allegheny vine (*Adlumia fungosa*), native to moist woods in the northeastern United States, with delicate flowers and foliage, is cultivated as an ornamental vine. It is suited only to well-shaded places in the wild garden.

FUNCHAL, the administrative centre of the Portuguese archipelago of the Madeiras; on the south coast of Madeira, in 32° 37′ N. and 16° 54′ W. Pop. (1960) 100,476 (mun.). Its whitewashed houses, in their gardens full of tropical plants, are built along the curving shore of Funchal bay, and on the lower slopes of an amphitheatre of mountains which form a background 4,000 ft. high. Numerous country houses (*quintas*), with terraced gardens, vineyards and sugar-cane plantations occupy the surrounding heights. The chief buildings include the cathedral, Anglican and Presbyterian churches, hospitals, opera house, museum and casino. In the steep and narrow streets, which are lighted by electricity, wheeled traffic is impossible; sledges drawn by oxen and other primitive conveyances are used instead (see MADEIRA). In minter the fine climate and scenery attract numerous invalids and other visitors; many foreigners engaged in the coal and wine trades also reside there permanently. The British community was first established there in the 18th century. Funchal is the headquarters of Madeiran industry and commerce (see MADEIRA). Funchal is connected by cable with Carcavellos (for Lisbon), Porthcurnow (for Falmouth. Eng.) and St. Vincent in the Cape Verde Islands (for Pernambuco, Brazil).

FUNCTION, in mathematics, an expression, rule or law which makes correspond to each value taken by one variable, called the independent variable or argument of the function, one or more values of another variable, called the dependent variable. In its most general usage in mathematics the word "function" refers to any correspondence between two classes of objects. A simple example under this general definition would be afforded by a group of people seated in a room, with the independent variable standing for any person in the room, while the corresponding value of the dependent variable is the chair in which he sits. But for most functions occurring in mathematics, the variables range over classes of numbers. For example the formula d $=\pi r^2$ gives for each positive real number r the area of the circle with radius r. The formula $w=c/\nu$ gives the wave length of radio or light waves in terms of the frequency ν. Here c is the velocity of light. The expressions

$$a + bx + cx^2,$$
$$a, + a_1x + \dots + a,x^n$$

are polynomial functions of x when the coefficients $a, b, c,$ a,, $a_1,$ . . ., a_n are given. The short symbols $f(x)$, $g(x)$, $P(x)$, . . ., are often used to stand for functions of the independent variable x, either for the sake of abbreviation. or because the nature of the function is unknown or unspecified. The quotient of two polynomials $P(x)/Q(x)$ is called a rational function. A polynomial is regarded as a special case of a rational function. The trigonometric functions sin x, cos x, tan x and others, where x is the measure of an angle, are defined geometrically in elementary trigonometry (*q.v.*). However, for practical purposes their values are given in tables. Many functions of practical importance are defined only by means of tables, as in statistics. For example, the death rate in each year over a period of years is given in mortality tables used by life insurance companies.

Inverse functions are obtained from given functions by interchanging the roles of the independent and dependent variables. Thus, if the given function is written $y=x^2$, the inverse function would be written $x=\sqrt{y}$. The two functions determine the same correspondence between the two variables. But note that when y is real and positive in the example just cited. $\sqrt{y}$ is usually understood to stand for the positive square root only, so that the inverse function, which is two-valued, should then be written $x=\pm\sqrt{y}$. The exponential function $y=10^x$ gives a value of y for each real value of x. Except when x is an integer these values are not easily computed. In this case the inverse function is written $x=\log_{10}y$, and its values are given in tables of common logarithms.

Functions of two or more variables occur frequently in applications of mathematics. For example, the formula $A=\frac{1}{2}bh$ gives the area of a triangle in terms of its base b and altitude h. The formula $E=\frac{1}{2}mv^2$ gives the kinetic energy of a moving body in terms of its mass m and its velocity v.

Functions of a Complex Variable. — In the preceding examples the variables have been thought of as real variables. The practical applications of functions of a complex variable are not so easy to illustrate, but are nevertheless very extensive. They occur, for example, in electrical engineering, in aerodynamics and in the theory of the potential. In the case of a polynomial, or, more generally, of a rational function, the variables may obviously be taken to be complex variables if desired, since the operations of addition, subtraction, multiplication and division may be performed on complex numbers (*q.v.*), and satisfy the same formal laws as they do for real numbers. However, functions of a complex variable may easily be formed in more arbitrary ways. If we represent the complex variable in the form $x=u+iv$, where i is the imaginary unit, and u and v are real, we may set $f(x)=P(u,v)+iQ(u,v)$, where for example

$$P(u,v)=u^3+v^2,\ Q(u,v)=3uv^3-v, \text{ or} \tag{1}$$
$$P(u,v)=\sin u \cos v,\ Q(u,v)=2u+3v, \text{ or} \tag{2}$$
$$P(u,v)=u^2-v^2,\ Q(u,v)=2uv, \text{ or} \tag{3}$$
$$P(u,v)=e^u \cos v,\ Q(u,v)=e^u \sin v, \tag{4}$$

where $e=2.718$ . . . is the base of the natural system of logarithms. (See LOGARITHMS.) Other less obvious and less direct methods of defining functions will be described later.

Geometric Representation of Functions. — Real-valued functions $y=f(x)$ of one real variable may be given a geometric representation by means of the analytic geometry (*q.v.*) of René Descartes. The independent variable x is plotted along a number scale on a line called the x-axis, which is usually taken as horizontal, and the dependent variable y is plotted along a number scale on another line called the y-axis which is usually taken as vertical. The graph of the function consists of the points with co-ordinates (x, y) where $y=f(x)$. For example, the graph of a quadratic function $y=a+bx+cx^2$ is a parabola. if $c\neq 0$. Some functions are given only by their graphs. Examples are the temperature. air pressure and wind velocity as recorded by weather bureau instruments.

A complex number may be plotted in a complex plane. A function of a complex variable is represented geometrically by a correspondence between two planes. but this graphical representation is not so vivid as that described above for a function of a real variable. However. it has been found suggestive and helpful to use geometric terminology in the theory of functions in both cases.

History. — The development of the theory of functions goes back to Descartes' publication of his work on analytic geometry (1637). The abscissas x and ordinates y of a plane curve are variables; the curve pictures the dependence of the one on the other. The word "function" seems first to have been used in such a sense by Gottfried Wilhelm Leibnitz (1694), who thus denoted certain lengths such as abscissas, ordinates. tangents, normals and radii of curvature, associated with the position of a point on a curve. J. Bernoulli (1698) applied the term to mathematical expressions involving variables and constants. The notation $f(x)$ was used by Leonhard Euler in 1734. His *Introductio* in *Analysin Infinitorum* (1748) may be regarded as the first treatise on the theory of functions. although its point of view would now be described as elementary and formal, As in the definition of Bernoulli. a function is identified with its analytic expression and according to the form of this expression it is classified as explicit or implicit. algebraic or transcendental.

The 18th century was a constructive period in mathematics, an epoch of discovery, when scientific accuracy played a subordinate role. The first part of the 19th century ushered in the present era of criticism. The *Théorie* des *fonctions analytiques* of Joseph L. Lagrange (1797) was a precursor of this change. Better foundations were here sought by basing the processes of the calculus on the properties of series of powers of the independent variable. Analytic expressions were still of central interest. but soon a new point of view was forced upon mathematicians by the discovery of Jean B. J. Fourier (1807) that a single analytic expression, a trigonometric series. may represent, in different domains. what had been regarded as different functions. It was believed at first that an arbitrary function could be represented by a series of Fourier. When it appeared that there were necessary restrictions. the way mas open to a treatment of functions based on their intrinsic properties. In connection with his proof of the convergence of Fourier series (1829) Pierre G. Lejeune-Dirichlet gave a definition for the term function closely akin to that at the beginning of this article (*Werke,* vol. 1, p. 135).

Among the founders of the modern theory of functions. both real and complex, three are pre-eminent, Augustin L. Cauchy (1789–1857), Georg F. B. Riemann (1826–66), and Karl Weierstrass (1815–97). To the latter is especially due the arithmetization of the subject, n-hereby all definitions are based on equalities and inequalities concerning numbers. The theory of aggregates (see SET THEORY [THEORY OF AGGREGATES]). which furnishes a necessary foundation for ideas regarding domains. and which arose from the investigations of Georg Cantor (1845–1918), has become one of the most important adjuncts of the theory of functions. (See also POINT SETS.) Its development has been connected with recent generalizations of the notion of integration by Henri Lebesgue (1902) and others.

The Notion **of** a Limit. —This is a fundamental concept in the theory of functions. A function $f(x)$ is said to have the limit L as x approaches a value c in case for every positive number e there exists another positive number 6 such that if $|x-c|<\delta$ then $|f(x)-L|<\epsilon$. If phrased in more intuitive language, this requirement states that the value of $f(x)$ remains arbitrarily near L whenever the point x is sufficiently close to c. When the variable x is real, the inequality $|x-c|<\delta$ means the same thing as the double inequality $c-\delta<x<c+\delta$. When the variable x is complex, it means that the Euclidean distance between the points of the complex plane representing x and c, is less than 6. Corresponding statements apply to the inequality $|f(x)-L|$<e. In the definition of limit it is frequently required that the point x shall never coincide with c, so that if the function has a value $f(c)$ at c, that value has nothing to do with the existence or value of the limit L. But this requirement is not essential. The same logical form of the definition of limit applies to other cases than the ones mentioned above, but one or both of the restrictions on the values taken by the independent variable and by the function may need to be changed in form. The notation $\lim_{x\to c} f(x)=\text{L}$ is used as a shorthand for the statement defined above. This symbol is to be read, "The limit as x approaches c of $f(x)$ is L." Simple examples of limits are the following:

$$\lim_{x\to 2} (x^2+5x)=14. \tag{5}$$

$$\lim_{x\to 0} x \sin (1/x)=0, \text{ if X is a real variable.} \tag{6}$$

$$\lim_{x\to 0} 1/x^2=+\infty\text{, if } x \text{ is a real variable.} \tag{7}$$

$$\text{lirn}_{x\to 0} \frac{1}{10^{1/x}+1}=0\text{, if x is a positive real variable.} \tag{8}$$

$$\text{lirn}_{x\to 0} \frac{1}{10^{1/x}+1} - 1\text{, if x is a negative real variable.} \tag{9}$$

In example (5) the value of the limit may be found by substituting 2 for x in the given expression, but this is not true for the other cases. In example (7) the inequality $|f(x)-L|<$ in the definition of limit is to be replaced by the inequality $1/x^2>1/\epsilon$. The function $f(x)=\sin(1/x)$ is one which does not have a limit as x approaches zero, since sin $(1/x)$ oscillates infinitely often between the values $+1$ and -1.

Continuity.—This is another important concept in the theory of functions. A function $f(x)$ is said to be continuous at $x=c$ in case $f(x)$ has a limit as x approaches c, which equals the value $f(c)$ of the function when $x=c$. An intuitive conception of the nature of a continuous function may be given by saying that it is one whose graph has no break. However, the theory of functions must consider continuous functions whose graphs cannot be drawn, as well as functions which are continuous at some points and discontinuous at many others. This makes the abstract logical form of definition essential. Examples (1), (2), (3), (4) and (5) are cases when the function in question is continuous for every value which may be assigned to c. The function sin $(1/x)$ is not continuous at $x=0$ because it is not defined there, but if we arbitrarily give it the value zero when $x=0$, then it becomes continuous. Such a discontinuity is called *removable*. The discontinuities of the functions sin (=/%) and $\frac{1}{10^{1\ x}+1}$ at $x=0$ are not removable.

The *derivative* of a function, when it exists, is an important aid in the study of the function. A function $f(x)$ has a derivative $f'(x)$ in case

$$\lim_{h\to 0} \frac{f(x+h)-f(x)}{h}=f'(x). \tag{10}$$

(See CALCULUS, DIFFERENTIAL AND INTEGRAL for further discussion and examples.) The derivative $f'(x)$ need not exist for all values of x for which $f(x)$ is defined. This is illustrated by the example $f(x)=x\sin(1/x), f(0)=0$.

Mathematicians formerly assumed that every continuous function of a real variable has a derivative except at isolated points, as in the example just cited. Weierstrass was the first to give an example of a continuous function of a real variable which does not have a derivative anywhere. This example was defined by means of an infinite series of trigonometric functions. From such an example it is easy to construct a function which has a continuous first derivative but has nowhere a second derivative, and so on.

Analytic Functions of a Complex Variable.—Functions of a complex variable which do not have derivatives are much more common than those which do. The functions given by (1) and (2) do not have derivatives anywhere but the functions given by (3) and (4) have derivatives everywhere. A criterion to be used in verifying the last statement will be given in the next paragraph. In applying the definition (10) of derivative to functions of a complex variable it is essential to notice that the variable h is also complex. A function $f(x)$ of a complex variable x which has a derivative at every point x sufficiently near a point c of the complex plane (including c itself) is said to be analytic at c or regular at c, and c is said to be an ordinary point for $f(x)$. All other points of the complex plane are said to be singular points. A single-valued analytic function, sometimes also called a holomorphic function, is one which is regular at some points. Every polynomial in x is a single-valued analytic function.

A function $f(u+iv)=P(u, v)+iQ(u, v)$ specified by formulas like (1) to (4) is regular at a point $c=a+ib$ if, and only if, the functions P and Q have continuous partial derivatives near the point c which satisfy the Cauchy-Riemann partial differential equations

$$\frac{\partial P}{\partial u}=\frac{\partial Q}{\partial v},\quad \frac{\partial P}{\partial v}=-\frac{\partial Q}{\partial u}.$$

It may also be proved that such a function has derivatives of all orders at points where it is regular. This is in marked contrast to the situation for functions of a real variable. By differentiation of the Cauchy-Riemann equations and elimination alternately of the function Q and then of the function P, it may be shown that the two components $P(u, v)$ and $Q(u, v)$ of an analytic function satisfy Laplace's equation

$$\frac{\partial^2 P}{\partial u^2}+\frac{\partial^2 P}{\partial v^2}=0.$$

A solution $P(u, v)$ of Laplace's equation is called a harmonic function. Every harmonic function $P(u, v)$ has associated with it another harmonic function $Q(u, v)$, called its harmonic conjugate, such that $P(u, v)+iQ(u, v)$ is an analytic function. Harmonic functions of two variables may be used to describe the electromagnetic field around a long straight wire carrying a current. If the curves $P(u, v)=$constant in the uv-plane are the curves of equipotential, the curves $Q(u, v)=$constant are the lines of force, if Q is a harmonic conjugate of P. Harmonic functions also are used in the theory of the flow around a straight aeroplane wing. Laplace's equation in three dimensions

$$\frac{\partial^2 P}{\partial u^2}+\frac{\partial^2 P}{\partial v^2}+\frac{\partial^2 P}{\partial w^2}=0$$

is satisfied by gravitational and electric potentials at the points of free space. (See SPHERICAL HARMONICS.)

A mapping or correspondence between two planes is called conformal or isogonal in case corresponding pairs of intersecting curves always meet at the same angle in the two planes. When also the sense or direction of rotation is preserved under a conformal mapping, the correspondence is determined by an analytic function of a complex variable. Conversely, every analytic function determines a conformal mapping. The notion of conformal mapping may be applied in the case of curved surfaces as well as planes. For example, a map of the earth's surface may be conformal.

Functions of a complex variable also have applications in the theory of numbers. It seems surprising at first sight that properties involving only whole numbers should be provable by means of such functions.

Formula (4) may be used to define the exponential function e^{u+iv} for complex values of the argument. The definitions of the trigonometric functions for complex arguments may then be based on the formulas of Euler:

$$\sin x=\frac{e^{ix}-e^{-ix}}{2i},\quad \cos x=\frac{e^{ix}+e^{-ix}}{2}.$$

Other methods of defining these functions will be mentioned later.

Integral of a Function $f(x)$.—This may be defined as another function $g(x)$ whose derivative $g'(x)=f(x)$. Such an integral is also called an antiderivative, an indefinite integral, or a primitive function. The possibility of finding an antiderivative for a given function is a matter of luck. A large part of elementary integral calculus is taken up with devices for finding such antiderivatives in simple cases. In order to be sure of the existence of the entity searched for, and for other reasons, it is desirable to consider other definitions of the concept of an integral, of a constructive type.

For functions of a real variable, one of the simplest of these is the one which is used in elementary calculus, which was given by Riemann, and is known by his name. Let the function $f(x)$ be defined on the interval $a\leqq x\leqq b$, and let this interval be partitioned into a finite number of parts $\Delta_i x$, of which the longest has length L. Let a point x_i be selected arbitrarily in each part $\Delta_i x$, and multiply the functional value $f(x_i)$ by the length of the corresponding part $\Delta_i x$. We may denote the sum of all such products for a particular partition of the interval from a to b by the symbol

$$\Sigma f(x_i)\Delta_i x$$

where me have used the symbol $\Delta_i x$ to stand also for the length of the part $\Delta_i x$. If this sum $\Sigma f(x_i)\,\Delta_i x$ has a finite limit **I** as the length L of the longest part approaches zero (this limit **I** being the same for all methods of partitioning the interval and choosing the points x_i in the parts) then this limit **I** is called the Riemann integral or definite integral from a to b of the function $f(x)$ and is denoted by the symbol

$$\int_a^b f(x)\, dx.$$

When $f(x)$ is continuous, it is not difficult to prove the existence of its definite integral. It is easily seen intuitively that when in addition the values of $f(x)$ are all positive, $\int_a f(x)$ dx gives the area bounded by the x-axis, the ordinates $x=a$ and $x=b$, and the graph of $y=f(x)$. It is in fact convenient to define the area as equal to this integral.

For functions of a complex variable, the definite integral becomes a line integral and its value may depend on the path of integration. Let us suppose that $x=\phi(t)$ is a continuous complex-valued function of the real variable t on the interval $c\leqq t\leqq d$, and let this interval be partitioned into a finite number of parts $\Delta_i t$. Let $\Delta_i x$ be the increment of x corresponding to the increment $\Delta_i t$, and let $x_i=\phi(t_i)$ where t_i is chosen arbitrarily in the interval $\Delta_i t$. Then the points x_i lie on separate short arcs of the curve C whose equation is $x=\phi(t)$. In case $f(x)$ is defined for x on the curve C and the sum

$$\Sigma f(x_i)\Delta_i x$$

approaches a finite limit **I** when the length L of the longest interval $\Delta_i t$ approaches zero, this limit **I** is denoted by the symbol

$$\int_C f(x)\, dx$$

and called the *line integral* of $f(x)$ along the path C. In examples (1) and (2) its value depends on the path, but in examples (3) and (4) its value depends only on the ends of the path.

The Fundamental Theorem of Integral Calculus.—For functions of a real variable, this theorem states that if $f(x)$ has an antiderivative $g(x)$, and also a Riemann integral $\int^{b} f(x)\,dx$, then the latter equals $g(b)-g(a)$. For functions of a complex variable, it states that if $f(x)$ has an antiderivative $g(x)$ (which is understood to be single-valued) throughout a region R of the complex plane, then $f(x)$ has also a line integral along any curve C in the region R, and if C begins at the point a and ends at b, then the line integral equals $g(b)-g(a)$, and so is independent of the path.

Cauchy's Integral Theorem.— This states that if $f(x)$ is an analytic function of the complex variable x in a region R which is simply connected (that is, R is all in one piece and has no holes in it), then the line integral of $f(x)$ is independent of the path. From this we find that $f(x)$ must also have an antiderivative. This theorem of Cauchy is the basis for the larger part of the modern theory of functions of a complex variable. An immediate consequence is Cauchy's formula

$$f(b)=\frac{1}{2\pi i}\int_C \frac{f(x)dx}{x-b}$$

where C is a simple closed curve enclosing the point b and lying with its interior in a region where $f(x)$ is regular. The fact shown by this formula, that the values of f at points inside the curve C are determined by its values on C, is a remarkable property of analytic functions of a complex variable. The property that analytic functions have derivatives of all orders is proved by successive differentiation of Cauchy's formula. This formula may also be used to prove Taylor's theorem, which states that near an ordinary point b an analytic function may be expressed by means of an infinite series of powers of the form

$$f(x)=a_0+a_1(x-b)+a_2(x-b)^2+\ldots$$

where $a_0=f(b),\ a_1=f'(b),\ a_2=f''(b)/2!,\ \ldots$

Singularities of Analytic Functions.— These are of various kinds. A singular point is called removable in case it becomes an ordinary point when the function is properly defined at the point. A singular point b is a pole for $f(x)$ in case there is another function $g(x)$ which is regular and not zero at b, and a positive integer m such that near b we have $f(x)=g(x)/(x-b)^m$. For convenience we say that $f(x)$ becomes infinite at a pole. All other singularities of single-valued functions are called essential singularities. The behaviour of a function near an essential singularity may be very peculiar.

By the *analytic continuation* into a region R_2 of a function $f(x)$ which is regular in a region R_1 overlapping R_2 me mean a function $g(x)$ which is regular in R_2 and such that $g(x)=f(x)$ in the common part of R_1 and R_2. If the process of analytic continuation is repeated a number of times we sometimes obtain a continuation $h(x)$ regular in the original region R_1 but having different values from $f(x)$ there. This fact makes the consideration of multiple-valued functions necessary. A simple example of such a function is $\sqrt{x}$, which has tn-o values except at the origin. If we start with the value of $\sqrt{x}$ which is positive when x is positive, and continue analytically through a sequence of regions forming a single loop around the origin, me arrive at the value of $\sqrt{x}$ which is negative when x is positive. The origin is a branch point for the two-valued function $\sqrt{x}$. This type of singularity is not encountered with single-valued functions. For the geometric representation of multiple-valued functions it is found convenient to substitute a multiple-sheeted Riemann surface for the plane of the independent variable. This is especially useful in the theory of algebraic functions and their integrals.

Methods of Defining a **Function.**—A function may be defined by means of a power series. For example the series

$$\sin x=x-\frac{x^3}{3!}+\frac{x^5}{5!}\cdots,$$

$$\cos x=1-\frac{x^2}{2!}+\frac{x^4}{4!}\cdots$$

could be used to define these functions for all complex values of x. Other types of series than power series, and also infinite products, may be used when convenient. An important case is the series of Fourier, expressing a function in terms of sines and cosines,

$$f(x)=a_0+a_1\cos x+a_2\cos 2x+\ldots$$
$$+b_1\sin x+b_2\sin 2x+\ldots$$

Such representations are of great importance in physics, in the study of wave motion and other oscillatory phenomena.

A function may be defined by the values of y satisfying an equation involving x and y. For example $y=\sqrt{x}$ is defined by the polynomial equation $y^2-x=0$. Every function $y=f(x)$ defined by a polynomial equation between x and y, such as $x^2y^3-x^3y+x=1$, is called an algebraic function. Transcendental functions may be defined by other types of equations. For example, if the function sin x is known, the function $y=\cos x$ is defined by the equation $\sin^2 x+y^2=1$ if we take the solution y which has the value $+1$ when $x=0$. The solution of $x=e^y$ for y gives the inverse function $y=\log_e x$, which is a multiple-valued function having infinitely many values when x is complex. Sometimes functions are most convenientlq- defined by means of differential equations. For example $y=\sin x$ is the solution of the differential equation $d^2y/dx^2+y=0$ having $y=0$, $dy/dx=1$ when $x=0$, and $y=\cos x$ is the solution of the same equation having $y=1$, $dy/dx=0$ when $x=0$. In special cases the solution of a differential equation may be represented as a line integral. For example,

$\log_e x=\int_1^x \frac{dx}{x}$. The value for this integral may be shomn to depend on the number of times the path encircles the origin in the complex plane. Some functions are more conveniently defined by means of definite integrals. For example.

$$\Gamma(x)=\int_0^\infty e^{-t}\,t^{x-1}\,dt.$$

It may be shown that when n is a positive integer $\Gamma(n)=(n-1)!$ Integral equations may also be used to determine functions. Thus the function $f(x)=\sin x$ for x on the interval from 0 to π is a solution of the integral equation

$$f(x)=\int_0^\pi G(x,t)\,f(t)\,dt,$$

where the kernel $G(x,t)=(\pi-x)t/\pi$ for $t\leqq x$ and $G(x,t)=(\pi-t)x/\pi$ for $t>x$. Very frequently it turns out that the various properties of a function are most conveniently studied by using srveral methods of representing it.

Abstract Function Theory.— Many of the advances in the modern theory of functions have been made possible by proceeding from the basis outlined above to a more abstract and general point of view. The functions considered in the calculus of variations (*q.v.*) are integrals such as

$$\int y\sqrt{x'^2+y'^2}\,dt$$

whose values depend on the shape of a curve $x=\phi(t)$, $y=\psi(t)$. The calculus of variations mas one influence which led to the consideration of functions whose arguments and values range over domains defined only by descriptive properties. These abstract ideas have been found to have value in such fields as ballistics and quantum mechanics. Mention should also be made of the more general theories of integration known by the names of Lebesgue and T. J. Stieltjes. These theories have been very useful in modern mathematics and its applications.

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(L. M. *G.)*

FUNCTIONAL PSYCHOLOGY: see PSYCHOLOGY, HISTORY OF.

FUNCTIONS, ANALYTIC. A function $f(z)$ is said to be analytic in a two-dimensional region if, at each point of the region, the derivative $f'(z)$ exists. Analytic functions are also called holomorphic, monogenic, regular or regular-analytic functions.

HISTORICAL BACKGROUND

The theory of analytic functions was created by A. L. Cauchy, who, in 1814, began the task of integrating between complex limits. His results were first made known in 1825. Cauchy's theory applies to functions having a unique derivative, and complex integration is the tool which gives the results. Cauchy used his new ideas to lay the foundation for a theory of ordinary and partial differential equations, including applications to problems in mathematical physics.

The other two founders of the theory of analytic functions were Bernhard Riemann and Karl Weierstrass. In 1851 Riemann outlined a theory in which the analytic function is defined by a pair of harmonic functions joined by the so-called Cauchy-Riemann equations, and in which the values of the function form a geometric entity that later came to be known as a Riemann surface. In the same paper the problem of conformal mapping was formulated.

Weierstrass lectured in Berlin from 1864 on, and by 1876 his fame was well established. He replaced intuition by logic and introduced a careful study of real numbers and limiting processes. His basic point of view was that analytic functions are defined by power series which are linked by a method of analytic continuation. Both he and Riemann devoted considerable effort to the theory of Abelian functions and integrals. (*See* COMPLEX NUMBERS; FUNCTION; FUNCTIONS, SPECIAL.)

FOUNDATIONS

Complex Numbers and the Complex Plane.—The complex numbers form a field (see FIELDS). The elements of this field are ordered pairs of real numbers (a,b) for which equality, addition, multiplication and scalar multiplication are defined by

(i) $(a,b) = (c,d)$ if and only if $a = c$, $b = d$
(ii) $(a,b) + (c,d) = (a + c, b + d)$
(iii) $(a,b) \cdot (c,d) = (ac - bd, ad + bc)$
(iv) $c \cdot (a,b) = (ac,bc)$

The associative, commutative and distributive laws hold; (0,0) acts as zero, (1,0) as unity. From (iv) the result

$$(a,b) = a \cdot (1,0) + b \cdot (0,1) = a + bi \tag{1}$$

is obtained, using the classical notation. The numbers $(a,0)$ are identified with the real numbers a so that $(1,0) = 1$, and $(0,1) = i$ may be written.

The notation (a,b) suggests the geometric representation of the complex number $a + bi$ by the point (a,b) in an ordinary Euclidean plane. The x-axis is then called the real axis, and the y-axis the imaginary one. An alternate representation is by the vector joining (0,0) with (a,b). The length r of this vector is called the absolute value of the complex number $c = a + bi$ and is written $|c| = r$. The angle θ which the vector makes with the positive real axis is called the argument, $\theta = \arg c$. Thus

$$c = r(\cos\theta + i\sin\theta) = re^{i\theta} \tag{2}$$

The point $a - bi = \bar{c}$ is called the conjugate of c. In the geometric representation of complex numbers, addition becomes vector addition. The absolute value of a product is the product of the absolute values: and the argument is congruent to the sum of the arguments (mod. 2π).

The plane used for this representation is known as the complex plane. The complex variable is usually denoted by $z = x + iy$. There is an extensive geometry of the complex numbers based on this representation. For the following discussion it is important to realize that the equation $|z - c| = r$ represents a circle with centre at c and radius r and that the inequality $|z - c| < r$ defines the interior of the circle, often called a disk.

Functions.—The idea underlying the function concept is that of a correspondence, or of a mapping of one set of objects D, called the domain, upon another set of objects R, called the range. If there is a unique definite object Q of R corresponding to every object P of D, then Q is said to be a function of P and is written $Q = f(P)$. In the present case D and R are sets of complex numbers and D will be a domain in a narrower sense, namely, an open connected set (often called a region). This means that for every point of D there is a small neighbourhood which is also in D, and that any two points of D may be connected by a broken line in D.

A function $f(z)$ defined in D may be continuous there. This means that if z is near to z_0 in D, then $f(z)$ is near to $f(z_0)$ in R. The differentiable functions form a subclass of the continuous functions. In the present case $f(z)$ is said to be differentiable at a point z_0 in D if the ratio

$$\frac{f(z) - f(z_0)}{z - z_0} \tag{3}$$

approaches a finite limit when z approaches z_0, the limit being independent of how z approaches z_0. This limit is known as the derivative of $f(z)$ at $z = z_0$ and is denoted by $f'(z_0)$ (see CALCULUS, DIFFERENTIAL AND INTEGRAL). If $f'(z)$ exists everywhere in D, the function $f(z)$ is said to be holomorphic or analytic in D. The term analytic, however, will be used below in a more general sense.

The formal rules of the calculus apply to complex-valued functions. Thus, sums and products of functions holomorphic in D are also holomorphic in D, although in the case of a quotient the points where the denominator is zero must be excepted. If n is a positive integer, z^n is holomorphic in the finite plane; this implies that every polynomial is a holomorphic function and that rational functions are holomorphic except at the zeros of the denominators.

If $f(z) = U(x,y) + iV(x,y)$ is holomorphic in D, then the real-valued functions U and V have partial derivatives with respect to x and y which satisfy the Cauchy-Riemann equations

$$U_x = V_y,\ U_y = -V_x \tag{4}$$

where the subscripts indicate differentiation with respect to x and y. Conversely, if a pair of real-valued functions has continuous partials in D which satisfy (4), then $f = U + iV$ is holomorphic in D. The functions U and V are known as conjugate harmonic or logarithmic potential functions. They satisfy Laplace's equation

$$F_{xx} + F_{yy} = 0 \tag{5}$$

This is the two-dimensional analogue of the equation satisfied by the Newtonian potential.

Power Series.—The basic class of holomorphic functions is formed by the power series; *i.e.,* series of the form

$$\sum_{n=0}^{\infty} a_n(z - a)^n \tag{6}$$

Such a series converges for a given z if the sequence of partial sums converges to a finite limit (see SERIES). This may happen only for $z = a$ or, at the other extreme, for all values of z. In general there exists a positive number R, known as the radius of convergence of the series, such that (6) converges (even absolutely) for $|z - a| < R$ and diverges for every z outside the circle $|z - a| = R$, known as the circle of convergence. The value of R is given by

$$\frac{1}{R} = \limsup |a_n|^{\frac{1}{n}} \tag{7}$$

The sum of the series in $|z - a| < R$ is a holomorphic function $F(z)$, whose derivative can be obtained by termwise differentiation of (6). The resulting power series has the same radius of convergence and may be differentiated as often as desired. Thus $F(z)$ has derivatives of all orders. According to Weierstrass, the series defines an element of an analytic function. Further elements can be obtained by elementary rearrangements of (6).

If $|b - a| < R$, write $z - a = (z - b) + (b - a)$, expand the nth power of this expression by the binomial theorem, multiply by a_n and add. Collection of terms results in a Taylor's series

$$F(z) = \sum_{k=0}^{\infty} \frac{F^{(k)}(b)\,(z-b)^k}{k!} \tag{8}$$

which converges at least for $|z - b| < R - |a - b|$. If the radius of convergence of (8) exceeds this value, then the new series defines a holomorphic function in a disk which overlaps the old one. In the intersection of the two disks the functions coincide; outside, each function defines the analytic continuation of the other. The new element (8) can be rearranged in the same manner and gives rise to further new elements. The totality of such elements (with some adjunctions, see below) constitutes the analytic function defined by (6). In this process, it is possible to get back to the starting point with an element distinct from (6). The number of distinct elements having the same centre $z = a$ is at most countable.

It may happen that (6) is not continuous outside its circle of convergence, which in this case is said to be the natural boundary of the function $F(z)$. In a certain sense this is the rule rather than the exception; the phenomenon is apt to present itself if the coefficients exhibit recurrent nonperiodic irregularities, such as very long gaps between terms, or if the coefficients have only a finite number of distinct values which do not recur periodically.

THE CAUCHY THEORY

Cauchy's Integral Theorem.— A rectifiable curve C is given by $z = g(t)$, $0 \leqq t \leqq 1$, where $g(t)$ is continuous and of bounded variation. If $f(z)$ is continuous on C, then the Riemann-Stieltjes integral

$$\int_C f(z)dz = \int_0^1 f[g(t)]dg(t) \tag{9}$$

exists. If D is a simply connected domain with $f(z)$ holomorphic in D, and if C is a simple, closed, rectifiable curve in D, then

$$\int_C f(z)dz = 0 \tag{10}$$

This basic theorem, announced by Cauchy in 1825, is the source of most of the results in analytic-function theory. First, it gives a representation of $f(z)$ in terms of its boundary values on C. If z is interior to C, then

$$f(z) = \frac{1}{2\pi i}\int_C \frac{f(t)dt}{t-z} \tag{11}$$

The integral can be differentiated with respect to z under the sign of integration as often as desired, and

$$f^{(n)}(z) = \frac{n!}{2\pi i}\int_C \frac{f(t)dt}{(t-z)^{n+1}} \tag{12}$$

Thus the existence of a first derivative implies the existence of derivatives of all orders.

Representation Theorems.— Cauchy's formula (11) can also be used to obtain expansions of $f(z)$ in infinite series. The Cauchv kernel $(t - z)^{-1}$ is expanded in a series of the desired type; multiplication by $f(t)$ and termwise integration then gives the corresponding series for $f(z)$. In this manner, for instance, Taylor's series (formula [8] with F replaced by f), which converges in the largest circle with centre at b in which $f(z)$ is holomorphic, is obtained. Laurent's series is obtained in an analogous manner:

$$f(z) = \sum_{-\infty}^{\infty} a_n(z-b)^n,\ a_n = (2\pi i)^{-1}\int_C f(t)\,(t-b)^{-n-1}dt \tag{13}$$

it is valid in the largest annulus $0 \leqq R_1 < |z - b| < R_2 \leqq \infty$ in which $f(z)$ is holomorphic. Various expansions of holomorphic functions in so-called interpolation series are obtainable by the same method.

If in (13) $R_1 = 0$, the point $z = b$ is an isolated singularity of $f(z)$. This singularity is removable if $a_n = 0$ for $n < 0$. It is a pole of order m if $a_{-m} \neq 0$ but $a_{-k} \equiv 0$ for $k > m$; it is an essential singularity in the remaining case. The coefficient a-I is known as the residue of $f(z)$ at $z = b$. In the case of a pole, $|f(z)|$ is uniformly large in the neighbourhood of $z = b$. The function $f(z)$ is assigned the value ∞ at $z = b$ and the expansion (13) is adjoined to the elements which define the analytic function. At an essential singularity no value can be assigned to the function; in fact, $f(z)$ assumes every value infinitely often, with at most one exception, in every neighbourhood of $z = b$ (Émile Picard, 1880).

Residue Theorem.— Formula (10) must be modified if $f(z)$ is not holomorphic inside C. Suppose that the only singularities are isolated and that none are on C. Then

$$\int_C f(z)dz = 2\pi i \sum a_{-1,k} \tag{14}$$

where the summation extends over the residues of the integrand inside C. This residue theorem of Cauchy also has a large number of applications. Cauchy used it to evaluate definite integrals—a problem of considerable practical importance. For example, in electrical engineering the desired solution of a system of linear differential equations with constant coefficients occurring, for instance, in network analysis, may turn out to be an inverse Laplace transform

$$f(t) = (2\pi i)^{-1}\int_{a-i\infty}^{a+i\infty} e^{zt}F(z)dz$$

where $F(z)$ is a rational function. The value of the integral is the sum of the residues of the integrand in the domain to the left of the line of integration. Cauchy also used his residue theorem for the first rigorous discussion of series expansions arising in boundary-value problems of mathematical physics, and this is still a valuable method. The residue theorem also plays a central role in the theory of elliptic functions.

Another important application of the residue theorem is the principle of the argument. Suppose that inside C there are no singularities other than poles of $f(z)$ and that no pole or zero lies on C. If the residue theorem is applied to the logarithmic derivative of $f(z)$, it is found that the change in the argument of $f(z)$ as z describes C in the positive sense equals 2π times the difference in the number of zeros and poles of $f(z)$ inside C.

SELECTED APPLICATIONS

The following paragraphs outline a few other central topics in the theory of analytic functions. Many others could be added.

Principle of the Maximum.— Let $f(z)$ be holomorphic in a domain D and let $M < \infty$ be the supremum of $|f(z)|$ in D. Then either $|f(z)| < M$ everywhere in D or $f(z)$ is a constant C, with $|C| = M$. If $f(z) \neq 0$, the same alternatives hold for the infimum of $|f(z)|$. If $U(z)$ is harmonic in D, it can have neither a maximum nor a minimum in D. Let $M(r;f)$ be the maximum of $|f(z)|$ in $|z| \leqq r$. If $M(r;f)$ is bounded for all r, then $f(z)$ is a constant (J. Liouville). In 1908 the principle of the maximum was extended by E. Phragmén and E. Lindelof to give information on the boundedness and rate of growth of $f(z)$ near singular points.

Entire and Meromorphic Functions.— A function $f(z)$ is entire (integral in British terminology) if it is holomorphic in the finite plane. It is transcendental if it does not reduce to a polynomial. In 1876 Weierstrass showed how to construct an entire function of given zeros. An entire function without zeros is of the form exp $[g(z)]$, where $g(z)$ is also entire. Entire functions are classified according to their order

$$\rho(f) = \limsup_{r\to\infty} \frac{\log\log M(r;f)}{\log r} \tag{15}$$

where $0 \leqq \rho \leqq \infty$. The order is closely related to the asymptotic behaviour of the coefficients of the defining power series and imposes an upper bound on the frequency of the zeros.

An entire function takes on every value infinitely often, with at most one exception. This theorem, proved by Picard in 1879 by use of the elliptic modular function, has been in the centre of attention ever since. Elementary proofs have been found by E. Borel and by E. Landau, and the theorem also follows from a mapping theorem due to A. Bloch (1924). It is now a simple consequence of an elaborate theory of the distribution of the values assumed by an entire or meromorphic function developed by F. Nevanlinna and R. Nevanlinna starting in 1924.

A function having only polar singularities is said to be meromorphic. The representation of such a function by partial fractions was given by G. Mittag-Leffler in 1877.

Normal Families.—A uniformly convergent sequence of holomorphic functions converges to a holomorphic limit. It suffices that the uniform convergence holds on the (rectifiable) boundary of the region. A sequence of functions $\{f_k(z)\}$ holomorphic and uniformly bounded in a domain D which converges in a point set with a limit point in D also converges to a holomorphic limit everywhere in D (G. Vitali, M. B. Porter, 1903). A uniformly bounded family of holomorphic iunctions contains a uniformly convergent sequence. The study of such "normal families" is largely due to P. Montel.

Conformal Mapping.— Every simply connected domain D having at least two boundary points can be mapped conformally onto the unit disk. This is Riemann's mapping problem, formulated in 1851 and completely solved around 1913. Such a mapping is one-to-one and angle preserving. There are important applications to the theory of wing profiles and to other problems of fluid mechanics as well as to electric and magnetic fields. A multiply-connected domain can be mapped conformally on various canonical domains of the same connectivity. *See* also ANALYSIS; ANALYSIS, COMPLEX; GROUPS, CONTINUOUS.

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FUNCTIONS, SPECIAL. In mathematics this term is commonly reserved for those functions frequently applied in various branches of mathematics, physics. chemistry and other sciences (see FUNCTION). It is customary to divide them into elementary and higher transcendental types; frequently they include only the latter. The most important elementary functions are the exponential. logarithmic and trigonometric, combinations of these, and others that are related to them (see EXPONENT; LOGARITHMS; TRIGONOMETRY).

In the past, some of the most illustrious mathematicians took a hand in the investigation of higher transcendental functions; in the 20th century, E. T. Whittaker (1873–1956) and those influenced by him developed special functions as a valuable means of attacking problems in applied mathematics. Special functions continue to be used as a valuable tool, although their importance has declined somewhat with the advent of high-speed electronic computers.

Higher transcendental functions vary greatly as to their origin. nature and applications and no adequate classification of them exists. The one large group sho ing some degree of unity consists of the hypergeometric functions and others that are related to them. These arise from ordinary linear differential equations of the second order, and their principal applications occur in connection with partial differential equations of mathematical physics.

In the following discussion some of the more important higher transcendental functions will be considered.

Elliptic and Abelian Functions.— The integral $\int R(x,y)\,dx$ can be evaluated in terms of elementary functions if R is a rational function of x and y, and y^2 is a polynomial of degree two or less in x. An evaluation in terms of elementary functions is impossible in general if y^2 is a more involved function of x.

If y^2 is a polynomial of degree three or four, the integral is known as an elliptic integral and the functions arising in the inversion of such integrals are elliptic functions (*q.v.*). These are doubly periodic and thus generalizations of the (simply periodic) trigonometric functions. If y^2 is a polynomial of degree higher than four. the integral is a hyperelliptic integral; and the integral $\int R(x,y)\,dx$ is an abelian integral if R is a rational function of x and y, while y is an algebraic function of x, *i.e.*, a root of an equation $P(x,y) = 0$ where P is a polynomial in x and y. The systematic study of such integrals was initiated by Niels Abel in 1826, Karl G. Jacobi solved (1832–34) the inversion problem for hyperelliptic integrals, and G. F. B. Riemann, Karl Weierstrass and others developed the theory of $2p$-fold periodic functions of p complex variables which are needed to solve the inversion problem for abelian integrals. The resulting functions are called abelian functions and were found to have many applications in algebraic geometry, topology, the algebraic theory of numbers and other fields of mathematics; they also influenced the development of the general theory of functions of complex variables.

The Gamma Function and Related Functions.— The gamma function originated in an attempt to generalize the factorial function (*see* COMBINATORIAL ANALYSIS) $n! = 1\cdot 2\ldots\ldots n$ to nonintegral values of n. Leonhard Euler defined (1729) the gamma function as the limit of a product from which Euler's integral of the second kind, $\Gamma(z) = \int_0^\infty e^{-t}\,t^{z-1}\,dt$ can readily be derived, $\Gamma(n+1) = n!$, $\Gamma(z+1) = z\,\Gamma(z)$. The gamma function is a meromorphic function with simple poles at $z = 0, -1, -2, \ldots$. Karl F. Gauss investigated the function $\pi(z) = \Gamma(z+1)$ (also denoted by $z!$). Weierstrass represented $1/\Gamma(z)$ by an infinite product (1856); this is an entire function with simple zeros at $z = 0, -1, \ldots$.

The gamma function is applied in combinatorial analysis. in the evaluation of infinite and improper integrals. in the solution of differential and difference equations and in many other branches of mathematics. It and related functions are ubiquitous in probability theory and statistics, and in mathematical physics and engineering mathematics.

Some of the functions related to the gamma function are (1) the beta function $\beta(p,q) = \int_0^1 t^{p-1}(1-t)^{q-1}\,dt$ (Euler's integral of the first kind) $= \Gamma(p)\,\Gamma(q)/\Gamma(p+q)$; (2) the logarithmic derivative $\psi(z) = d\log\Gamma(z)/dz$ of the gamma function; (3) the incomplete gamma functions

$$\gamma(z,x) = \int_0^x e^{-t}t^{z-1}dt, \qquad \Gamma(z,x) = \int_x^\infty e^{-t}t^{z-1}dt;$$

(4) the exponential integral, sine integral and cosine integral, which are related to $\Gamma(0,z)$; and (5) the error functions and Fresnel integrals. which are related to $\gamma(\frac{1}{2},z)$ and $\Gamma(\frac{1}{2},z)$.

Riemann's Zeta Function.— The zeta function was known to Euler (1737). The first great discoveries relating to it were made by Riemann (1859). Many results have been extended to A. Hurwitz' zeta function $\zeta(s,a) = \sum_{n=0}^{\infty} (a+n)^{-s}$, related to Riemann's zeta function $\zeta(s)$ by means of $\zeta(s) = \zeta(s,1)$.

$\zeta(s)$ has a simple pole at $s = 1$ and is regular at all other points. Euler's product. $\zeta(s) = \text{a}\,(1-p^{-s})^{-1}$ in which p runs through all primes and Re $s > 1$, shows that $\zeta(s)$ has no zeros when Re $s > 1$, and this in conjunction with Riemann's functional equation $2^{1-s}\,\Gamma(s)\,\zeta(s)\cos(s\pi/2) = \pi^s((1-s)$ shows that the only zeros of $\zeta(s)$ for Re $s < 0$ are the "trivial zeros," $s = -2, -4, -6, \ldots$. All nontrivial zeros of $\zeta(s)$ must lie in the strip $0 \leqq \text{Re } s \leqq 1$ of the complex plane, and Riemann conjectured (in 1859) that these zeros lie on the central line, Re $s = \frac{1}{2}$, of this strip. In investigating this problem mathematicians tremendously enriched mathematical analysis, discovered many important properties of $\zeta(s)$ and made some progress toward a solution; yet a full proof of Riemann's hypothesis about the zeros of the zeta function has not been given.

Arithmetical Functions, $f(n)$, are defined for all positive integers n. Examples of such functions include the number of distinct primes dividing n; the number of (positive) divisors of n; the number of nays in which n can be represented as a sum or a product of a given number of positive integers; the number of integers between 1 and n which are prime to n (Euler's function); $\mu(n) = 1$ for $n = 1$, $= (-1)^m$ if n is the product of m distinct primes, $= 0$ if n is divisible by the square of a prime (Moebius' function). Such functions have important applications in number theory, combinatorial analysis, and counting problems. Bernoulli numbers (*q.v.*), Euler numbers (*q.v.*), Stirling numbers (*q.v.*), and other numbers defined as coefficients in the expansion of generating functions are also arithmetic functions, with applications in mathematical analysis as well as in the fields mentioned above.

Hypergeometric Functions.— The hypergeometric series

$$1 + \frac{a\cdot b}{c\cdot 1}z + \frac{a(a+1)\,b(b+1)}{c\cdot(c+1)\cdot 1\cdot 2}z^2 + \frac{a(a+1)(a+2)\,b(b+1)(b+2)}{c(c+1)(c+2)\cdot 1\cdot 2\cdot 3}z^3 + \cdots$$

was known in 1769 to Euler, who discovered many of its properties; it was investigated by Gauss (in 1812, in the first adequate discussion of the convergence of any infinite series). by Riemann (in 1857), and by many other outstanding mathematicians. This series is of great historical importance since its investigation initiated far-reaching developments in the theory of convergence and the general theories of analytic functions and ordinary linear differential equations; and it is of great importance in modern mathematics since a large number of the most important special functions are related to the hypergeometric function $F(a,b;c;z)$, which is defined by the hypergeometric series.

The hypergeometric series satisfies the differential equation

$$z(1-z)y'' + [c-(a+b+1)z]\, y' - aby = 0$$

which is called the hypergeometric equation and is an important source of information for properties of the hypergeometric function. Twenty-four solutions of the hypergeometric equation can he expressed in terms of hypergeometric series, and the relations between these solutions lead to transformations of hypergeometric series. Two distinct hypergeometric series whose corresponding parameters a, b, c differ by 0, 1, or -1 are called contiguous. Any three contiguous hypergeometric series are connected by a linear relation. The derivative of the hypergeometric series is a multiple of a contiguous series and is linearly connected with the original series and a contiguous series. Of the numerous integral representations of the hypergeometric function the oldest and best known is Euler's,

$$F(a,b;c;z) = \frac{\Gamma(c)}{\Gamma(b)\Gamma(c-b)} \int_0^1 t^{b-1}(1-t)^{c-b-1}(1-zt)^{-a}dt \qquad (\mathrm{Re}\, c > \mathrm{Re}\, b > 0)$$

Generalized hypergeometric series,

$$\begin{aligned} {}_pF_q(a_1,\cdots,a_p;\, c_1,\cdots,c_q;\, z) \\ = 1 + \frac{a_1\cdots a_p}{c_1\cdots c_q\cdot 1}\, z + \frac{a_1(a_1+1)\cdots a_p(a_p+1)}{c_1(c_1+1)\cdots c_q(c_q+1)\cdot 2!}\, z^2 + \cdots \end{aligned}$$

and in particular the confluent hypergeometric series ${}_1F_1\ (a;c;z)$, have also been extensively investigated. ${}_pF_q$ satisfies the generalized hypergeometric differential equation

$$[\delta(\delta + c_1 - 1)\cdots(\delta + c_q - 1) - z(\delta + a_1)\cdots(\delta + a_p)]y = 0$$

in which $\delta = z\dfrac{d}{dz}$. Among other generalizations and related functions are the hypergeometric series of several variables and basic hypergeometric series; a sample of the latter is

$$\begin{aligned} \Phi(a,b;c;z) = 1 + \frac{(1-a)(1-b)}{(1-c)(1-q)}\, z + \frac{(1-a)(1-aq)(1-b)(1-bq)}{(1-c)(1-cq)(1-q)(1-q^2)}\, z^2 \\ + \frac{(1-a)(1-aq)(1-aq^2)(1-b)(1-bq)(1-bq^2)}{(1-c)(1-cq)(1-cq^2)(1-q)(1-q^2)(1-q^3)}\, z^3 + \cdots \cdot (|q| < 1) \end{aligned}$$

Among the tremendous number of higher transcendental functions related to the hypergeometric series we mention: Legendre functions (see SPHERICAL HARMONICS). Bessel functions and the classical orthogonal polynomials (cf. below), and among those functions arising out of differential equations related to the hypergeometric equation, Lamé, Mathieu and spheroidal functions (cf. below).

Bessel Functions. — These are solutions of the Bessel differential equation

$$z^2y'' + zy' + (z^2 - p^2)y = 0$$

and are sometimes called cylinder functions. They first appear in the investigations by Daniel Bernoulli (in 1732) and Euler (in 1764) on vibrations of a heavy chain and a stretched membrane; they are named after Friedrich W. Bessel, who used them in the theory of planetary motion. In modern times they frequently occur in connection with wave propagation problems in optics, electromagnetic theory. elasticity, fluid motion and many other fields; also in potential and diffusion problems. They are among the most useful higher transcendental functions, and many volumes of numerical tables are available for them.

One solution of Bessel's differential equation is the Bessel function of the first kind (sometimes called "Bessel function" shortly),

$$J_p(z) = \sum_{n=0}^{\infty} \frac{(-1)^n(z/2)^{p+2n}}{n!\,\Gamma(p+n+1)}$$

which can be expressed in terms of generalized hypergeometric series, either in terms of ${}_1F_1$ or in terms of ${}_0F_1$; it also can be expressed as a limit of Legendre functions or of hypergeometric series. A second solution is the Bessel function of the second kind, or Neumann function.

$$Y_p(z) = \frac{\cos(p\pi)J_p(z) - J_p(z)}{\sin p\pi}$$

and two further solutions are the two Bessel functions of the third kind or, Hankel functions, $H_p^{(1)} = J_p + \mathrm{i}\, Y_p$ and $H_p^{(2)} = J_p - i\, Y$,. If z is replaced by iz, the resulting differential equation is called the modified Bessel equation and its solutions are modified Bessel functions. These also have been extensively tabulated. If z is replaced by $i^{1/2}x$, the real and imaginary parts of the resulting functions are known as Kelvin functions.

When p is the half of an odd integer, the Bessel functions can be expressed as (finite) combinations of elementary functions, and this is the only case when such an expression is possible. When $p = \pm\frac{1}{3}$, the Bessel functions can be expressed in terms of Airy functions, $Ai(z)$ and $Bi(z)$, which were encountered, about 1838, by George B. Airy in his researches in optics.

Many functions can be expanded in series or integrals involving Bessel functions. Some of these expansions have a direct significance in physics, as in the representation of a plane wave by superposition of cylindrical waves.

Orthogonal Polynomials. — A system of polynomials $p_n(x)$, $n = 0, 1, 2, \ldots$, where p_n is a polynomial of degree n in x, is said to be orthogonal on the interval (a,b) with respect to the weight function $w(x)$ (which is assumed to be nonnegative) if

$$\int_a^b p_m(x)p_n(x)w(x)dx = 0, \text{ where } m \neq n$$

and the system is called an orthonormal system if it is orthogonal and so normalized that

$$\int_a^b [p_n(x)]^2 w(x)dx = 1$$

There is a well-developed general theory of orthogonal polynomials. Among the many special polynomials of great importance, the best knonn are the classical orthogonal polynomials, nhich are enumerated in the folloning table together with their intervals of orthogonality and weight function.

Classical orthogonal polynomials	Intervals of orthogonality		Weight function
	a	b	$w(x)$
Legendreor spherical	-1	1	1
Chebichev.	-1	1	$(1-x^2)^{\pm 1/2}$
Gegenbauer or ultraspherical.	-1	1	$(1-x^2)^{\lambda - 1/2}$
Jacobi or hypergeometric	-1	1	$(1-x)^{\alpha}(1+x)^{\beta}$
Hermite	$-\infty$	∞	$\exp(-x^2)$
(generalized) Laguerre 0		∞	$x^{\alpha}e^{-x}$

Of these, Chebichev polynomials can be expressed in terms of trigonometric functions, Jacobi polynomials (and their special cases including Legendre and Gegenbauer polynomials) in terms of hypergeometric series and Laguerre and Hermite polynomials as confluent hypergeometric series.

The importance of orthogonal polynomials is derived largely from the possibility of expanding "arbitrary" functions in series of orthogonal polynomials. Such expansions are frequently used both in pure mathematics and in problems of physics and engineering (see FOURIER SERIES).

Lamé, Mathieu, and Similar Functions occur mainly in connection with partial differential equations of mathematical physics (potential equation, wave equation, etc.) when the boundaries involved are elliptic cylinders (Mathieu functions), spheroids (spheroidal functions) or ellipsoids (Lamé functions, Lamé wave functions). They satisfy linear ordinary differential equations of the second order which may be considered generalizations of the hypergeometric equation. The theory of these functions is much less complete than that of the functions more directlv related to the hypergeometric series, and with the exception of Mathieu functions and spheroidal functions no extensive numerical tables exist.

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FUNDAMENTALISM. The term Fundamentalism is used in two related but clearly distinguishable senses: (1) to designate what is more generally called a conservative type of Christian thought. as opposed to the liberal or modernist tendencies mhich became influential in the latter part of the 19th century and still more so in the first part of the 20th; and (2) as the name of a specific conservative movement with its own organizations and agencies devoted to the propagation of a definite doctrinal program (the Five Points of Fundamentalism) which, it was claimed! constitute the indispensable elements of the true Christian faith. In the first of these senses, the term is more often used by liberals to describe conservatives than by conservatives to describe themselves. In the second sense, it lost the wide currency that it had in the first three decades of the 20th century and. though what it stands for is by no means extinct, the movement which it describes changed its methods and less frequently used that name. These two aspects of Fundamentalism will be treated separately.

Classical **Orthodoxy.**—In Fundamentalism considered merely as a reaction against the liberalizing tendencies of modern thought. there was nothing new except that it was a reaction against something new. The content of its teaching was identical with that of classical Protestant orthodoxy. Its purpose was nothing more than to preserve unchanged the presuppositions and convictions of Reformation Protestantism and also of Roman Catholicism in regard to the nature of Christianity as a redemption religion, the place of the supernatural and the miraculous in Christianity and the nature of the Bible as being in every part an authoritative revelation of the mind and purposes of God. With rare exceptions. all Christian thinkers prior to the middle of the 19th century had been Fundamentalists in this sense. The exceptions are important in the total history of religious thought, but their immediate influence was not sufficiently widespread to invalidate this generalization, especially when applied chiefly to preaching and the life of the churches.

New and disturbing elements began to enter the religious situation with the critical study of the Bible by the methods of historical and literary analysis ("higher criticism"), the popularization of the concept of evolution and its application to the interpretation of the whole process of human culture including religion. and the delayed impact of Kantian and post-Mantian philosophy on theological thought. In addition to these, or including them all, was the enhanced prestige of the scientific spirit and scientific method. It was not simply the existence of these forces and tendencies but their infiltration into the religious thought of both clergy and laity that gave alarm to those who adhered to what was now coming to be called the "older view" of the Bible and Christianity. The actual divergence of views was most clearly marked with reference to views of the nature of the inspiration of the Bible and consequently of its authority. Liberal evangelical theologians did not deny the divinity of Christ (though most of them thought "deity" was too strong a term), nor did they doubt the reality of the supernatural or of God's redemptive purpose, but they rejected the presupposition that the entire Bible is the inerrant "word of God." and insisted that, as William Newton Clarke put it, the most reverent attitude toward the Bible is to take it for what the critical and scientific study of its text and its history indicates that it actually is.

Fundamentalism Proper.— The specifically Fundamentalist movement was foreshadowed by a series of conferences in which a strict view of biblical inerrancy and a literalistic interpretation of the Bible were applied to emphasize the premillennial second coming of Christ. A Bible conference at Swampscott, Mass., in 1876 was followed in 1877 by a Prophetic conference at New York city. The notable Niagara Bible conferences had Seen held annually for nearly 20 years before putting forth the Five Points which were to become the fundamentals of Fundamentalism. The Five Points, which were the hard core oi Fundamentalist doctrine as long as that term mas used in its strict sense, were: the plenary inspiration and inerrancy of Scripture; the deity of Jesus; the virgin birth of Jesus; substitutionary blood atonement; the bodily resurrection and premillennial second coming of Christ. This Bible conierence movement, with its strong "prophetic" coloration, was vigorously evangelistic and revivalistic. A volume entitled *Jesus Is Coming,* by %" E. B.," was given a subsidized circulation oi about 2,000,000 copies in the United States and 1,000,000 abroad. Beginning in 1909 a series oi 12 books under the general title *The Fundamentals* was published and widely circulated at the expense of two wealthy brothers, Lyman and Milton Stewart, who also established and endowed the Los Angeles (Calif.) Bible institute. Other Bible institutes, notably the efficient Moody Bible institute in Chicago, Ill., took up the task of training preachers, evangelists and Christian workers who would be untouched by the modern influences which, it was believed, were contaminating the standard theological seminaries. This phase of Fundamentalism was strictly undenominational. As liberal thought permeated the seminaries, the literature and the missionary agencies oi leading denominations, the conservative forces within these denominations organized themselves for resistance and a second phase oi fundamentalism began, while the first still continued.

Baptists.— -4. G. Strong, president emeritus of Rochester Theological seminary, visited Baptist foreign missionary stations and in *A Tour of the Missions* (Philadelphia, 1918) reported his alarm at lapses from orthodoxy, especially in regard to the inerrancy of the Bible. The weekly *Watchman-Examiner* followed with a demand for an investigation of the seminaries. Suspicion in regard to the divinity school of The University of Chicago had already led to the founding of the Northern Baptist Theological seminary in Chicago (1913), and the Rochester seminary also n-as reparded as suspect. In May 1930 a Pre-Convention conference on Fundamentals of Our Faith was called by 150 members of the Northern Baptist convention. At the immediately subsequent convention, the Fundamentalist group, with J. S. Massee as principal spokesman, continued to urge scrutiny of the seminaries and the adoption of a strict statement of iaith, which was substantially the Philadelphia and New Hampshire Confessions. The majority of the convention, however, following Cornelius Woelfkin, affirmed confidence in the seminaries and the sufficiency of the New Testament as a statement of Baptist faith. The Fundamentalists formally organized their iorces in the Baptist Bible Union of America (1923), which adopted 18 articles of faith. Its triple presidency was J. Frank Norris in the south, W. B. Riley in the north and T. T. Shields in Canada. John R. Straton led in the east with his Baptist Fundamentalist League of Greater New York and Vicinity. State chapters were formed. Attack was centred largely on the boards of missions. The union disavowed any intention to "disturb existing Baptist affiliations," but at the same time it recommended the undenominational "Bible Institutes and Bible Conierences conducted by Christian Fundamentalists." The Southern Baptist convention, more conservative than the northern, contained more Fundamentalists but had less conflict because the liberal forces on the other side were so few. The energies of the Baptist Bible union as an organization mere spent by 1929. In the north. however, the Fundamentalists, after several years of agitation and preconvention sessions, separated in 1947 from the Northern Baptist convention and organized the Conservative Baptist Association of America.

Presbyterians.— The strain of Fundamentalism which appeared in the Presbyterian Church was, for the most part, only a staunch adherence to classical Protestant orthodoxy. The tensions resulting from the infiltration of biblical criticism had already been ielt and the storm period passed before the campaign oi the Fundamentalists as such had begun to affect deeply the organized life of the great denominations. A long controversy over the revision of the Confession of Faith was ended (1903) by the adoption of 11 amendments. The conservatives were pleased that the revisions were so slight and the liberals, that there mas any revision at all; peace prevailed. though the basic issues remained. On May 21, 1922, Harry Emerson Fosdick, a liberal Baptist then preaching regularly for the First Presbyterian church, New York city, delivered a sermon entitled, "Shall the Fundamentalists Win?" This precipitated lively controversy. The general assembly of 1923 directed the New Tork presbytery to see to it that the pulpit should conform to the church's Coniession of Faith and reaffirmed its own "five points" of 1910. The same assembly defeated the candidacy of William Jennings Bryan ior the post of moderator. The 1927 general assembly adopted a report of a special commission which denied that the assembly had the constitutional right to set up such formulas as the "five points" as tests oi orthodoxy. This is regarded as a crucial action, since it left room for a considerable degree of liberalism in the church. Differences both theological and administrative in regard to the policies of Princeton Theological seminary led to the withdrawal of an ultra-conservative group headed by J. Gresham Machen and to the organization of Westminster seminary, Philadelphia (1929), an Independent Board for Presbyterian Foreign Missions (1933) and, in 1936, a separate denomination, the Presbyterian Church in America, which later (1939) took the name the Orthodox Presbyterian Church.

Methodists. — Having recently had unhappy experience with two heresy cases — H. G T. Mitchell, a professor at Boston university (1895), and Borden P. Bowne (1904–08) — the Methodists were generally indisposed to a resumption of hostilities when the Fundamentalist movement arose. There was a definite slant toward a more liberal view of the Bible and toward stress upon the "social gospel." This was seen in the church's publications and in the courses of study for ministers. An organized group of militant "essentialists" opposed but could not check this tendency. The New Jersey conference was the storm centre of this protest. The question of maintaining a strict ban on "sinful amusements" was an issue, as well as biblical criticism. A conservative Methodist League for Faith and Life (1925) functioned with diminishing effectiveness for a few years. A rather high degree of theological conservatism has gone along with the denomination's characteristic emphasis on evangelism, but the antagonisms of the Fundamentalist controversy did not leave deep scars.

Disciples of Christ. — The influence of new views of the Bible and of more liberal theology was scarcely felt in this communion before 1895 and produced no wide response until several years later There has been strong, but generally unorganized, resistance to the liberal movement. The conservatives never called themselves Fundamentalists, and the issues did not prove to be identical with the Five Points of Fundamentalism. The biblical question has been central In place of a specific doctrine of the atonement and a premillennial second coming — in neither of which they took much interest — conservative Disciples substituted renewed insistence on immersion and opposition to open membership; *i.e.*, the admission of the unimmersed.

In 1916 a Bible College league was organized to clear the new learning out of the College of the Bible, Lexington, Ky., and to instigate scrutiny of other institutions. This campaign failed. About 1920 there was the beginning of heated criticism of certain missionaries, especially in China, and of the missionary society which supported them, chiefly on the ground that open membership was being practised. A Christian Restoration association became the agency of this opposition; an annual North American Christian convention, the rival of the International Convention of Disciples of Christ; and a New Testament Tract society (later merged with the Restoration association), its publishing agency. Many conservative so-called Bible colleges and institutes have been organized to train ministers opposed to co-operation through the general missionary and benevolent agencies.

Protestant Episcopal Church. — Fundamentalism in its stricter meaning had little to do with such disharmonies as have arisen in this communion Planes of cleavage appeared between the Catholic and the Evangelical party, and between those who insist on rigid adherence to the Thirty-Nine Articles and those who do not. Bishop William Lawrence's plea (Oct. 1923) for theological freedom in the church was promptly answered by a pastoral letter from the house of bishops (Nov. 1923) insisting on strict conformity. The more conservative group has so little in common with the Fundamentalists that the term has no proper application in this connection. The Episcopal Church has schools of thought and there have been tensions between them, but in general it has been able to contain them without disastrous conflict.

Antievolution. — Interdenominational Fundamentalism reached its climax of intensity and publicity in the decade during and after World War I. A huge World Bible conference (1919) in Philadelphia, Pa., led to the organization of the World Christian Fundamentals association. A campaign of great intensity was directed toward drawing a sharp line between Fundamentalists on one side and all non-Fundamentalist Christians and non-Christians on the other. Stress on the literal inerrancy of the Bible in matters of science and history inevitably brought evolution (*q.v.*) under discussion. Antievolution had long been a position held by ultraconservatives generally. The Fundamentalists attacked the teaching of evolution in the schools. Tennessee made it a criminal offense. (*See* SCOPES TRIAL, THE).

Antievolution laws were passed by three other states — Mississippi (1926), Arkansas (1928) and Texas (1929). Although the Fundamentalist associations continued to exist for several years, interdenominational Fundamentalism of this type had lost its drive. What remains is a strong body of theological conservatism in most of the great denominations, an important "neo-orthodox" movement which many regard as providing a scholarly middle way between liberalism and Fundamentalism and a considerable number of independent Fundamentalist churches. Many of these last were loosely united in the Independent Fundamental Churches of America, organized at Cicero, Ill., in 1930. This association required its member churches to sever every connection with any denomination and to subscribe to 16 articles of faith which include the original Five Points of Fundamentalism.

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FUNDY, BAY OF, an inlet of the North Atlantic, separating New Brunswick from Nova Scotia. It was first explored by the sieur de Monts in 1604 and named by him La Baye Français. It is 94 mi. long and 32 mi. wide at the mouth, but narrows toward the head, where it divides into Chignecto bay to the north (which subdivides into Shepody bay and Cumberland basinj and Minas basin to the south. The Bay of Fundy is remarkable for the great rise and fall of the tide. which at the head of the bay has been known to reach 70 ft. The incoming tide creates the well-known reversing falls at the mouth of the St. John river, and rushes up the Petitcodiac river to beyond Moncton in a bore from 3 to 6 ft. high. There is a 25-ft. rise and fall of the tide in Passamaquoddy bay, which forms part of the boundary between New Brunswick and the state of Maine. The large areas of tidal marshlands at the head of the Bay of Fundy attracted Acadian settlers before 1750. and have since been diked for agricultural use. The bay has numerous harbours. of which the chief are St. John and St. Andrews in New Brunswick and Digby (on an inlet known as Annapolis basin) and Hantsport in Nova Scotia. See also FUNDY NATIONAL PARK. (C. W. RD.)

FUNDY NATIONAL PARK, in New Brunswick. Canada, covers 80 sq.mi. on the Bay of Fundy, famous for its high and fast-running tides Along the shores of this historic bay began the earliest settlement in Canada with the arrival of Champlain and the sieur de Monts. Skirting the rugged coast for eight miles and extending nine miles inland, the park rises to an elevation of 1.000 ft. It is richly forested, and in autumn its maple-covered ridges and great expanses of rolling hills become a sea of crimson and gold. The park was established in 1950.

There are no natural bathing beaches, but a large heated saltwater swimming pool was built in the park. Other facilities include an open amphitheatre for plays, concerts and other activities, a golf course overlooking the bay, and a recreation and sports centre. Accommodations include cottages of French chalet design and a number of camp grounds and trailer parks. (J. G. P.)

FUNERARY RITES AND CUSTOMS. Rites and customs connected with the disposal of the dead are as universal as the phenomenon of death itself. Since the conscious realization of death as the inevitable end of every human life is one of the most distinctive and central features of human experience. it is only natural that every actual occurrence of death should be an occasion for the living to react to this fact by appropriate behaviour. Structures and mechanisms that may well derive from the ultimately biological instincts of self-preservation and fear of death acquire, on the human level, an "existential" significance: our very experience of life itself is determined by our awareness of its finality and its orientation toward death. The corpse, representing the human subject suddenly become a mere object, confronts every man with his own ultimate alienation from his subjective individuality. Man must deal with this threat to his existence on a psychological level; he must readjust and reaffirm himself by actualizing appropriate attitudes and by expressing them in corresponding behaviour. Not in vain has man been described by many writers as the "eternal protestant" against death, desperately and often pathetically refusing to accept its inexorable finality. On the sociological level, death represents the destruction of extant sets of intersubjective, social relationships, necessitating readjustments in various spheres. Roles of authority as well as positions of political and family status become vacant and have to be filled, "wives" become "widows," redistribution of property becomes necessary, etc. Against the elements of disruption and change introduced by death. society has to emphasize the permanence of its values, institutions and culture patterns (including the place accorded therein to the transitory and mortal individual).

Hence, death customs are susceptible of both psychological and sociological interpretations. It is the culture — often more particularly the religion — of any particular group that defines and institutionalizes the meaning of death, theoretically as well as behaviourally, by assigning specific roles to its various members and functionaries (priests, family, mourners) and by prescribing specific rites and practices. Death customs therefore generally form a complex involving a number of interrelated cultural traits which function together in a more or less consistent and meaningful way.

Whatever the rituals may do for the deceased, they certainly also perform a function for the living; *i.e.*, for the surviving potential diers. The attitude toward death and the dead reflects on the general life of the individual and the group.

It is not surprising, therefore, that funerary customs in most societies by far exceed the practical. rational minimum required for the mere disposal of the body. Not only is the actual disposal more or less ritualized, at times even very elaborately so, but it is also surrounded by a great variety of preburial and postburial rites. some of them extending over a long period after death and burial (*e.g.,* mourning, memorial customs, ancestor worship).

Variety of Customs.—The variety of death customs is immense. Even on one small Melanesian island 21 different manners of disposal of the dead have been counted. There are many descriptive and comparative accounts of funerary customs available. as well as many speculative interpretations. Only a brief and schematic survey can be attempted here. To venture beyond description to interpretation would require detailed analyses of particular groups and culture areas. That the basic problem is the same in prehistoric, illiterate, ancient, medieval and modem societies is borne out by the fact that in the 20th century death "is big business in the U.S., where more money is spent upon funerals and accessories each year than is spent on all hospitals and sanitaria" (W. M. Kephart, "Status After Death," *American* Sociological Review, vol. 15. p. 636 [1950]).

The immense variety of death customs is due to many factors and influences—geographical, cultural and historical. It is the particular combination of these factors that is distinctive and decisive. Thus mummification could originate only in areas with a dry climate (Egypt) and nith the necessary preservative materials (*e.g.,* Tibet with its salt lakes or New Mexico with its saltpetre caves). In northern areas where the ground is frozen most of the year, inhumation is obviously impossible. Prevailing notions regarding the origin of man ("dust to dust"; *cf.* Gen. iii, 19) or of the tribe or clan (hence, orientation of tomb in the appropriate direction), as well as beliefs concerning the individual's destiny and afterlife (reincarnation, judgment, reward and punishment, continued life in some faraway land or island), play an important part. Migrations, conquest and other forms of culture contact may lead to combinations of diverse or even conflicting patterns. Of course, the mythological or rational explanations offered by particular groups are not always or necessarily co rect as accounts of the past origins or present functions of their mortuary customs. But whereas general interpretations of funerary rites as such are a matter of sociological theory. the specific interpretation of details, especially uhen they are very widespread, is more often than not in the nature of unverifiable speculation.

Two Main Interpretations.— The two main types of over-all interpretation can conveniently be labeled as functionalist and structuralist, respectively. The former, deriving mainly from the anthropologist Bronislaw Malinowski, considers death customs as a social mechanism for readjustment and release of tension. Violent and conflicting emotions (*e.g.,* horror of death and love for the deceased, the desire to break the ties with the dead but also to maintain them) find normative expression in the obsequies and mourning rites "which endorse and duplicate the natural feelings of the survivors; they create a social event out of a natural fact." The rituals with their underlying religious notions counteract "the centrifugal forces of fear, dismay, demoralisation" and provide "the most powerful means of reintegration of the group's shaken solidarity, and of the re-establishment of its morale" (Malinowski). The ultimately psychological basis of this approach is rejected by the structuralists, who emphasize that ritual tends to build up tension and not merely to provide release. Émile Durkheim, the father of the structuralist approach, noted that socially prescribed demonstrations of grief (wailing, seif-laceration) might be out of all proportion to the actual strength of the individual emotions. The real function of ritual is not to release emotions but to create and manifest them and thereby to affirm the basic values of society. A widow's wailing provides no comfort, but it publicly reasserts the significance and value of the marital tie at the very moment of its suspension and dissolution by death. Even so, psychological factors no doubt also play their part, and depth psychology in particular has shown to what extent death customs may answer unconscious needs and attitudes arising out of feelings of guilt, desire for expiation. and fears (*e.g.,* due to death wishes or other repressed ambivalent relationships to the deceased, to oneself or to others).

Ambivalence Toward the Dead.—Almost all authorities have commented on the basic ambivalence underlying death customs, notably the horror of death and the dead on the one hand, and the desire to perpetuate the bond on the other. Defilement and pollution emanate from the corpse; yet a remarkable lack of dread and even positive familiarity are equally in evidence: mourners may lie down on the corpse, kiss it, or anoint themselves with the exuding fluid However. even rites intended to assist the deceased in his afterlife, to provide for his variously conceived needs (food offerings. rituals, prayers) and to speed him on his way to his ultimate destination (the land of the dead, paradise. nirvana) often imply the concurrent intention to get rid of him and to prevent his return either as body or as ghost. The treatment of the corpse (burial, cremation, breaking of bones, tying of hand and feet), the tabu on mentioning the name of the deceased, and many other customs have been interpreted in this sense. Some tribes even have a special ceremony of "burying the soul." The soul or ghost likes to linger by the body or near the living; hence it must be chased or lured away and its return prevented. Doors or windows may be opened for a moment after death but then immediately shut again; in China and Basutoland a hole is made in the roof. The corpse may have to be carried out through a specially made hole or entrance so that the ghost may not find the way back. For the same reason the mourners may return along a different route from the burial or even efface their footprints. Special precautions may be taken against haunting or "walking." The severance of the ties is, at times, effected slowly and by degrees: there may be carousing "with" (i e., in the presence of) the corpse during the preburial wake; the Koryaks (northeastern Siberia) even play cards on the corpse.

Rites of **Passage.**—Whatever specific ideas prevail regarding afterlife in the different cultures, death is generally regarded not as an absolute end but as the transition from one particular world or kind of existence to another. The attendant rituals are therefore passage rites (*q.v.*) consisting of rites of separation, rites of transition and, finally, rites of incorporation of the deceased in his new world. The burying of utensils and the destruction of property, in addition to simplifying problems of inheritance. also serve to finalize the separation of the deceased from the world of the living Yet although the purpose of mortuary rites often is to speed the ghost to the ghost-world and to implore him not to trouble the living, the opposite tendency is equally often at work. The bond, albeit on a different basis, between the quick and the dead is ceremonially re-established, the latter granting protection and blessings to the former (see ANCESTOR WORSHIP). Hence the deceased may also be preserved in whole (mummification of holy men in Tibet and their preservation in chortens as objects of veneration) or in part (*e.g.* relics, ancestor skulls kept in places of honour [Melanesia] or worn as amulets [Andaman Islands]). The dead may return and visit the living as recognized "supernaturals" or as ghosts; on such occasions they may be welcomed and entertained, either gladly or with fear accompanied by precautionary measures (Zuñi pueblo dances, Greek *anthesteria*, Trobriand *baloma* feasts). Many death customs represent a compromise between the conflicting tendencies. Hence it is often difficult to be sure of the exact significance of a rite; *e.g.,* to decide whether a particular funerary amulet was meant to protect the dead or the living. Coins placed on the corpse or in the grave may ensure that the deceased suffers no penury or can pay the boatman's fare nhen he is ferried over to the land of the dead, but they may also be meant to prevent him from returning and fetching his property.

PRE- AND POSTBURIAL RITES

It follows from the above that the actual disposal of the body is merely part of a larger sequence of actions, beginning with the onset or imminent expectation of death and ending with the final cessation of mourning (or even later). On the imminence of death. a strictly regulated procedure, varying in different cultures. is followed: family and friends are notified, and priests are called in to assist nith prayer, confession or other ministrations. In many parts of Europe it is customary to stop all clocks in the house at the moment of death. to cover all mirrors (or even windows), to extinguish the hearth fire and light a new one, etc. The corpse may be washed. shrouded, dressed up, dyed. or laid on the ground or in state; often lights and ritual objects (*e.g.*, a crucifix among Roman Catholics) are placed near it. The time that has to elapse between death and disposal is generally regulated by religion. social custom and (in some countries) law; it may be filled with nailing and other prescribed manifestations of grief. religious ceremonies, banquets and wakes (*q* v.). The manner of exit from the house and the procession to the place of disposal are similarly subject to detailed regulations. Religious obsequies may be celebrnted at the house, at the place of disposal or—between the two—at a place of religious worship. The actual disposal of the body map include the provision of the dead man's necessities, such as amulets, food and grave goods (weapons, tools, treasures). These may be given in actual fact. including the killing of a man's (usually a ruler's) wives and slaves to minister to his wants (in many ancient and some primitive civilizations) or merely symbolically (paintings or cheap imitations). Sometimes the objects or imitations are burned or destroyed so that the deceased may profit from their spiritual essence.

Disposal is followed by a more or less fixed time of mourning. varying for different mourners and relatives. and involving a number of prescribed actions and avoidances: a funerary banquet, mourning distinctive appearance and attire (disheveled hair, nearing of specific colours, such as the black crape in use until recently in Europe), prayers and offerings, food and speech tabus (among many primitive tribes), abstention from certain forms of amusement and social life, purification ceremonies and the like. Society participates with the immediate mourners: there may be obituary notices and speeches visits of condolence, attendance at the various ceremonies. The postburial rites formally end with secondary disposal, unveiling of the tombstone or similar ceremonies. though, in a sense. they may continue as long as there is anyone to perform memorial rites at the tomb or elsewhere.

Almost everywhere the proper performance of the funerary ritual or. at least, the proper disposal of the body, is held to be of the utmost importance — either to ensure the admittance of the soul to the land of the dead and to save the living from his vengeance. or simply as an act of piety. For example, where interment is the traditionally required mode of disposal, its neglect may be considered as a great misfortune for the deceased (cf. Jer. xvi, 4). preventing his soul from finding rest (Suetonius, Caligula 59) or from entering the Elysian fields (Tertullian. De *anima* Ivi). Sepulture was instituted by the gods as a sacred duty (Sophocles. *Antigone* 454 ff). and God himself buried Moses (Deut. xxxiv. 6). Burial must be given even to enemies (Euripides, *Supplices* 524–7; Pausanias. *Description* of Greece ix. 32, 9) and to unbelievers (Muslim *fiqh*), indeed to all from whom it has been withheld (II Sam xxi, 12–14). It is a particular act of charity to bury remains found in a desert or when traveling; according to Jewish law this duty even suspends the rigid rules of levitical purity applying to priests At least a symbolic gesture of burial should be made by throwing some earth on a corpse which one happens to find (Horace. Odes i. 28. 23–5). The Greeks used to give ceremonial burial "in empty clothes" to those who died at sea (Euripides. Helen 1241–43).

DISPOSAL OF THE DEAD

Different methods of disposal are practised not only by different cultures but, occasionally, also among a single people. Where this is so, the mode of disposal is usually determined by cultural and social differences: membership in a particular social group. totem or clan association; degree of initiation in a secret or ritual society; rank as commoner or chief: sex; achievements and ethico-social status (criminal, hero. saint); manner of death (suicides and women who died in childbed are given different treatment in most primitive societies. and special rules often also apply to those who died by an extraordinary "act of God." *e.g.*, being struck by lightning); special circumstances (*e.g*, twins, among the Nuer. are not buried but placed in the fork of a tree); religious persuasion (Muslims, orthodox Jews and Roman Catholics insist on inhumation; a pious Buddhist may forego cremation and prefer to feed his carcass to the animals and birds); and various other factors. Also, the details of any one particular method. the elaborateness of the funerary ritual as well as of the preburial and postburial rites. and the time taken over the ceremonies, vary according to the afore-mentioned differences. Those who do not "belong" to a recognized group or class (*e.g.*, unbaptized children or excommunicates) are treated differently from full members of the community. Among some tribes the social ascription determines even the classification "alive" and "dead": the very aged or those nho have been ill very long are considered as dead and may be buried even though still alive. The main methods of disposal are as follows:

Inhumation. — Interment is one of the oldest methods, practised at least from the Mousterian (Middle Paleolithic) onward. Usually in contracted or extended position. though at times even sitting or standing, the corpse may be placed in immediate contact with the earth or protected by matting, stone slabs, pottery jars or urns (*pithoi*), or a coffin (among seafaring people also in the form of a canoe). Alternatively the tomb may be lined with matting. bricks etc. Orientation varies according to religious and other social traditions; e g., views about the direction and location of the land of the dead, or traditions about the direction from which the ancestors (or totemic ancestor) of the clan of the deceased had come — the land of the ancestors and that of the dead being often identical. Muslims are laid on their right side, facing Mecca: Buddhists (where they bury) lie face upward with the head to the north, like the Buddha when he died; Christian tradition preferred the feet toward the east, ready to rise and to meet Christ when he appears on the Mount of Olives. Burial usually takes place singly, though in collective cemeteries near the settlements. more rarely in the settlement or even in the house, and occasionally in sites chosen for special reasons (crossroads, churches).

Similar to inhumation is cave burial. Natural or artificial caves (burial chambers and niches or shafts nith side vaults hewn into the rock) are knonn from prehistoric, present-day primitive and some ancient civilizations (*e.g.*, Knossos, Sicily. Fiji Islands, South American Pueblos). Mass graves are dug only in wartime or after major catastrophies. Memorials, varying from a simple stone or nooden board to sumptuous mausoleums. may be erected over the tombs. (See also CEMETERY; COFFIN; MONUMENTS AND MEMORIALS; SCULPTURE. SEPULCHRAL; TOMB.)

Cremation.—Destruction of the body by fire is world-wide in incidence Appearing in Europe with the late Neolithic banded-pottery culture, it began to displace inhumation toward the later Bronze Age. Since then the two alternative methods have coexisted. Ousted by Christianity in the late Roman empire, cremation experienced a revival in more recent times. In many societies cremation is associated with rank and status; it may be accorded to chiefs only or. conversely. to criminals It is the usual method of disposal among Hindus and frequent among Buddhists. In ancient Egypt, China and Israel, cremation was excluded by the respective beliefs; e.g, the view that immortality depended on the preservation of the body, veneration for the dead ancestors or belief in the resurrection of the body. Cremation may be partial only; the remains (bones, ashes) are then buried, scattered or preserved. Only rarely is it complete. in which case the bones are ground. mixed with combustible matter and burned again. The details of the procedure (place, time, kind of timber used) are generally regulated by tradition, in modern countries also by sanitary requirements. Explanations of the origins of cremation are speculative. to prevent magic being performed with the corpse. to prevent "walking," to liberate the spirit and speed it upward (India) etc

In the same way as tombs were originally conceived as "houses" for the dead (tomb chambers. house-shaped sarcophagi), urns too could be given the shape of a house (as among the Etruscans), thus indicating that the idea of a dwelling for the dead may have persisted even in cremation cultures (See also CREMATION)

Conservation. — The preservation of the whole body is generally regarded as the most extreme form of the denial of death. Known particularly from ancient Egypt (see MUMMY), it was also practised by many other groups, among them some of the most primitive (Australia, Torres strait), though usually reserved for high-ranking persons only (chiefs, priests, kings). The methods used vary from simple desiccation (*e.g* , smoke-drying) or treatment of the body with mineral or vegetable preservatives (usually after evisceration), to the most modern techniques of embalming (*q.v.*). The custom originated in countries with a suitably dry climate. Surprising similarities have been noted in the more highly developed techniques used in distant areas (*e.g.*, Egypt and Central and South America). Where only parts of the corpse are to be preserved (*e.g* , skulls for ancestor cults) or to be disposed of in some other way, decomposition may be artificially hastened.

Water Burial.--Next to exposure, the simplest way of disposing of a corpse is to fling it into the water. Hence this is often the method applied to slaves, foreigners and people considered to be of no account. In some islands, parts of the coast are reserved as "cemeteries"; corpses are wrapped up to protect them against fishes and weighted with stones. (In the Solomon Islands, however, they are laid on the reef to be eaten by sharks.) In the western world, nater burial is the usual practice for those who die on board ship.

The custom of placing the body in a canoe and pushing it into the sea cannot strictly be called water burial; it was practised by people who were probably the descendants of immigrant tribes and mas thus essentially a method of dispatching the deceased to the land of his ancestors. Disposal by launching on the water may be practised symbolically and combined with other methods: burial in boat-shaped tombs or coffins (*e.g.*, the boat-shaped Bronze Age stone arrangements in Bornholm, the Sutton Hoo boat or those found at Oseberg, Gokstad and Tune in Norway) or cremation on a blazing ship (as in the Germanic saga of Balder). The underlying idea seems to be that of a "voyage" to the land of the dead.

Exposure. — Exposing the corpse where it is left to decompose (on the ground, in trees, on rocks, on special platforms), to be devoured by animals or to await further treatment, is a method widely practised. In hot, dry climates exposure may result in desiccation and thus become a method of preservation The Vedda (Ceylon) and the ancient Chinese left the bodies in rock caves or in the jungle, protecting them slightly by a covering of leaves or brushwood. Some Buddhists prefer exposure as an act of charity toward the hungry animals and birds, and it is still the accepted manner of disposal among orthodox Parsees, who place their dead in their dakhmas ("towers of silence") to be devoured by vultures, lest they defile the earth or the fire. In the arctic region, where the ground is frozen. exposure is the nearest alternative to burial; some tribes (*e.g.*, the North American Naskapi) leave the body on a scaffold during winter until burial becomes possible. Actual platform burial (on artificial scaffolds or in trees) is frequent in Indonesia, Melanesia, Australia and America, but rare in Africa. According to one school of ethnology (W. Schmidt and W. Koppers). the method is related to totemistic ideas of immortality and is designed to facilitate the flight of the soul to the realm of the dead, but the explanation is doubtful.

Cannibalism. — Endocannibalism (*i.e.*, the devouring not of prisoners or strangers but of relatives) is a method ensuring that the deceased remains in the closest possible union with his tribe and does not fall prey to hostile demonic powers. Often the old and the sick are dispatched before death comes to snatch them The flesh is ceremonially eaten; in some tribes even the bones are pulverized and mixed with food or drink. (The same is done by some American Indian tribes with the ashes of cremation.) The method is held by some ethnologists to have originated among primitive matriarchal agriculturalists (*e.g.*, in Melanesia); it is found in Australia, South America and Africa.

Secondary **Disposal.**—With the exception of water burial, most methods of disposal leave room for subsequent secondary treatment of the remains; in the case of cremation it is a necessity. Even where interment is the rule, the bones may be exhumed for reasons of space economy (*cf.* the medieval charnel houses) or as part of a prescribed ritual (as in modern Greece). This secondary treatment may be accorded to parts (*e.g.*, the skull) or all of the remains. The interval between the two stages of the disposal varies from a few weeks (*e.g.*, the Trobriand Islands) to 10 or 12 years (e g , the North American Hurons). Secondary burial may be individual (as in eastern South America) or collective (as in the great Neolithic barrows). The ceremonies too may be related to the individual dead or to all the deceased of the tribe. In the former case they mark the close of the period of mourning and function as the passage rite whereby the soul is finally integrated in the community of the dead and the mourners are finally reintegrated into the community of the living.

HISTORICAL SURVEY

As mankind passed through the stages of culture marked by the discoveries of the crafts and techniques of stone polishing, copper- , bronze- and ironnorking, a variety of funerary customs developed. conditioned partly by natural and cultural resources and partly by beliefs about the kind of life after death and the relationship betneen the dead and the living. Whereas the death customs of historic cultures are known from their mortuary remains as well as from a nealth of literary testimonies. our knowledge of prehistoric culture as a whole is largely provided by funerary monuments. Prehistoric man made his arrangements for the dead nith permanency in view. The evidence yielded by the tombs (mode of disposal type of burial, objects deposited), in conjunction with related evidence (geological stratification, contemporary fauna), is our sole source of information concerning the nature and significance of the funerary remains. as well as the period and race to which they should be assigned.

Paleolithic. — Interment of the body together with ceremonial implements is attested at least from the Middle Paleolithic onward (in France. at Le Moustier, La Chapelle, La Ferrassie). The provision of food and implements suggests some kind of belief in continued life and a conception of the tomb (cave or rock shelter) as a dwelling Funerary equipment (personal ornaments of bone and shell, amulets. figurines) increases in the Upper Paleolithic period (Grimaldi, Barma Grande, Cro-Magnon, Brno. Solutré) and there is a striking and lavish use of red colour—possibly as a vitalizing agent. The body may be placed in ochreous earth.or smeared or sprinkled with red ochre (*e.g.*, the "Red Lady of Paviland," Wales) The "sleeping" position and the even more tightly flexed position ("contracted burial") mere most frequent in Upper Paleolithic Europe. as they still are with many primitive tribes Flexing and tying the body have been explained as a return to the fetal position (thus implying some kind of idea of rebirth). as a measure to prevent the dead from walking, and as economy of space. Upper Paleolithic tombs also yield remarkable indications of a cult of the skull Skulls would be severed from the body and prepared as "bowls," or buried separately. The Ofnet (Bavaria) deposits—two scooped-out "nests"—contained over 30 richly ornamented skulls. all facing west.

The Paleolithic practices continued into Mesolithic times as witnessed hy the Ofnet skull burials and the Téviec (Brittany) tombs a well as the Mas d'Azil and similar ossuaries Many of these show that the bones were deposited after the flesh had decayed or had been scraped off. In Denmark extended burial (as distinct from the contracted position) was practised, the tombs being surrounded sometimes by large stones (Erteholle). These again, could be covered with earth (mound burial) or with single capstones. The latter type known as dolrnens or (Danish) *dysser*, became a prominent feature of the megalithic culture that spread in Europe during the Neolithic period (see ARCHAEOLOGY: *Neolithic and* Bronze Ages in *Europe*).

Egypt. — The transition from food gathering to food production nhich is generally considered as one of the turning points in the history of human societies and their cultures, also had profound effects on mortuary ritual, which became increasingly elaborate. reaching a climax in the funerary cult of Egypt. Egyptian Neolithic cemeteries were situated nearly (only rarely in) the settlements. The bodies mere buried in flexed position, clothed, and provided with ornaments and various means of sustenance. Often they were turned toward the west—possibly the first sign of the subsequently very important notion of a western land of the dead. With the unification of Egypt soon after 3000 B.C., the early dynastic tombs underwent rapid elaboration: the pit was undercut on one side to allow for more tomb furniture; the sand mound over the tomb became a rectangular stone mastaba; doors, niches and steps were added; and finally the cult offerings were transferred from the tomb itself to a temple by it. The superimposition on each other of mastabas of decreasing size (stepped pyramid) finally produced the pyramid (*q.v.*) tomb.

Whereas burial in the dry sand of Egypt might result in the natural preservation of the body, this would not be the case in tombs. however elaborate. Permanence had to be assured by artificial mummification as well as by the use of effigies. The latter, placed in a temple, had the advantage of being more accessible for ritual purposes than the corpse which lay at the bottom of the funerary shaft. The effigy was "brought to life" by the ceremonial of the "Opening of the Mouth" (performed later on the actual mummy) and made the object of regular mortuary rituals. With the development of the worship of Osiris in the later dynastic period, the whole ritual became assimilated to the myth of the death, dismemberment and resurrection of Osiris: the dead man's body was reconstituted and his spiritual, *i.e.*, vital essences, the ba and the ka, restored to him. This rebirth to immortality or "Osirification" was, at first, the privilege of the king—himself divine. Later it became accessible to nobles and even to commoners.

To assist the deceased in his "resurrection," to protect him from demons and other dangers, and to ensure a favourable verdict at the judgment of the dead (presided over first by the sun god Ra, and since the 11th dynasty by Osiris), he was also provided with suitable texts and magical formulas. These texts, of different ages and varied contents, and known as the Book of the Dead, were inscribed on papyrus or on the walls or the coffins (Pyramid texts). In the New Kingdom the papyri were put into the coffin together with the mummy, so as to increase their efficacy. (See also EGYPT: History: Ancient Religion.)

Mesopotamia.—Unlike Egypt, Mesopotamia never had a highly developed mortuary cult. The outlook for the dead was gloomy: a kind of shadow existence in a House of Darkness, the "Land of No Return," similar to the underworld of the Hebrews (Sheol) and the Greeks (Hades). Grave goods, though meagre, nevertheless indicate some kind of belief in survival. The exception to the general rule are the sumptuous royal tombs at Ur (2900–2700 B.C. according to C. L. Woolley) with their wealth of funerary furniture. The Sumerian kings took to their graves not only priceless vessels and ornaments but also their retinue of wives, courtiers, attendants and guards. However, this royal funerary cult is not characteristic of subsequent development in Babylonia.

Eastern and Western Mediterranean.—Burial in stone structures of different shapes and kinds and various degrees of elaboration (vaults, passageways, etc.) spread throughout Europe during the Neolithic period. The earliest tholoi (circular stone structures) in Cyprus have been found similar to those discovered in Iraq near Nineveh (Tell Halaf period). Groups of tholoi came to be enclosed with dry-stone walls and roofed with corbeled vaults, thus producing the vaulted "beehive tombs." Some tholoi (Hagia Triada, tholos B at Koumasa) have yielded the remains of hundreds of interments; clearly, many generations were being "gathered to their fathers" in community tombs. The same applies to the stone-built or rock-cut tombs in Crete and the Aegean Islands (see AEGEAN CIVILIZATION). Megalithic and rock-cut tombs of similar layout and constructions have been found in Sardinia (the gallery tombs known locally as *tombe* di giganti), Malta, Spain, the Pyrenees and Atlantic Europe; *e.g.*, Brittany (the famous passage grave at Carnac [*q.v.*]) and the British Isles (barrows and cairns [*qq.v.*]). In northern Europe the megalithic tradition, deriving from the Mediterranean, met with other cultures coming in from other directions and practising different types of burial. However, the contents of all these tombs (ornaments, trinkets, animal bones—possibly remains of funerary sacrifices—female figurines perhaps representing some kind of mother goddess, designs) clearly suggest ceremonial treatment of the dead involving certain beliefs.

Bronze Age.—Although some Neolithic and Early Bronze Age tombs contain evidence of whole or partial cremation, this mode of disposal became general only from the Middle Bronze Age onward. Characteristic of the period is the appearance in Europe, from western Asia Minor to Ireland, of cremation cemeteries in the form of urn fields. Particularly well-known examples are the "terramara" and Villanova urn fields in Italy, and the great Hallstatt cemetery in the Austrian Alps. The precise reason for the correlation of cremation with Bronze Age culture is unknown. (See also VILLANOVANS; HALLSTATT.)

Greece.—From the earliest times in Greece, when inhumation still was the sole mode of disposal, different types of tombs are known: circular dome tombs, rectangular chamber tombs, shaft tombs and pit tombs. Burial often took place in the village or even under the house. There is evidence of human sacrifices having been offered as part of the funerary ritual, in addition to the regular tomb furnishings (treasures, vessels, etc.). Funeral games in honour of the dead were no longer held in later periods. Exposure of the corpse before burial, sometimes for ten days or more, was not unusual. Violent expressions of grief (wailing, self-laceration, beating the breast) were customary though disapproved by lawgivers and moralists (Solon, Plato).

Proper burial rites were essential for the soul's admission to the realm of the dead, and sacrifices were performed at the tomb at prescribed dates (the third and the ninth day after burial). Mourning included abstention from pleasures and wearing black. There were also annual commemorations of the dead and festivals at which the dead were supposed to return in order to be welcomed and entertained (*anthesteria* [*q.v.*]). These visits were occasions of considerable uneasiness: precautionary measures were taken, and there was great relief at the end of the festival.

By the time of Homer cremation had become fairly general, and his detailed account of the obsequies of Patroclus (Iliad xviii, xxiii) gives a good idea of the pomp and costliness of the elaborate ceremonial as performed for outstanding persons. For ordinary folk the rituals of cremation and (more generally) burial would, of course, be simpler.

Rome.—In ancient Rome, funerary ceremonial varied with the times as well as with the rank, wealth, occupation, place and religion of the dead person. Most of our evidence dates from the late republican and imperial periods. As a man breathed his last, his name mas called out (*conclamatio*)—a ceremony that is still performed at the death of a pope. When the deceased failed to respond and to return, conclamatum est and the corpse was bathed, washed, perhaps also embalmed, and arrayed in a toga. Formal announcement of the decease and the impending obsequies was made, and at the appointed time the funeral procession (which sometimes included actors and jesters) made its way to the Forum where the departed citizen was eulogized (laudatio), and thence, through the city gates. to the place of inhumation or cremation. This was not in a public cemetery but in family holdings which lined the roads. The best known of these is the line of tomb ruins along the Via Appia. Tombs were of various types: mausoleum, tumulus, columbarium (*q.v.*). The latter, which derives its name from the dovecot type of chambers with niches, is usually found in plots belonging not to families or gentes but to co-operative funeral associations '(collegia *funeraticia*). It was as such an association that the early Christians in Rome were organized (see CATACOMBS). The tomb would be marked by an epitaph giving biographical information about the deceased, and often also by a portrait bust. Incised in the stone there might also be a request for remembrance or a more general exhortation, couched in the form of an address to the passing stranger. Even when cremation had become fairly general, at least among the upper classes, the earlier form of disposal still survived symbolically in the burial of some minor part of the body (os *resectum*), usually the little finger. Lower-class funerals were, of course, much simpler, and slaves and the poor were buried in a general cemetery, the "potter's field" of Rome.

Mourning lasted for nine days, followed by offerings at the tomb (*sacrum* novendiale) and a banquet at the house. There was a further period of mourning—eight or ten months, according to the relation of kinship. The Roman rituals imply a general belief in some kind of survival and a wide solidarity between the quick and the dead. The latter exist and participate, albeit in a ghostly manner, in the affairs of the living. Hence scrupulous care had to be taken for the correct regulation of mutual contacts. Ancestors enjoyed a divine cult (di paternales, later the di *manes* generally). and the Parentalia were celebrated every year from Feb. 13–21, the last day of the festival having a public character (see MANES). During the feasts of the dead, no marriages could be concluded and all temples were closed. Spirits. if dissatisfied or unpropitiated, could become dangerous, bloodsucking, vampirelike ghosts (lemures); to propitiate them the Lemuria were held, during which the pater *familias* performed certain ceremonies and finally chased the ghosts away.

THE MAJOR *RELIGIONS*

Islam.—At the approach of death a Muslim (or those around him) pronounces the profession of faith. which may then be recited again, together with sura 36 of the Koran, over the dedd body. The body is laid on a stretcher in the direction of Mecca (kibla) and reverently and carefully washed (*ghusl*) according to very precise regulations. The nostrils and orifices are stuffed with cotton and the body sprinkled with camphor and rose nater. The eyes are closed and the feet tied. About the sort and number of shrouds (in any case an odd number), their colour, and other details there are rnany differences of opinion and custom. Next. the prayer for the dead (salat *al-djinaza*), the formula of which is minutely prescribed, is recited. Martyrs, however, are not washed and not prayed over. A watch by the corpse is customary, though not prescribed, and the Koran is recited by hired readers.

Details of the procession to the cemetery vary In Egypt the poor and the blind may precede the bier, chanting the *kalima,* followed by the relatives and someone who carries a reading desk with the Koran. The bier is borne by men only, even if the deceased is a woman. It is recommendable to follow a funeral procession (oil foot. because the angels of death go on foot). and it is considered a particular act of merit to help carry the bier. The grave is of ample size, to enable the deceased to sit up when interrogated about his orthodoxy by the angels Munkar and Nakir. The body is laid on its right side. propped by bricks, with the face toward Mecca There is no further service. A shawl is rent, three handfuls of earth are cast on the grave by the bystanders, and sura 112 of the Koran is recited (though not by the Wahhabis and some others) Before the tomb is closed, the correct answers for the angelic examination on the catechism ("Who is your God, Who is your prophet?" etc.) are prompted into the dead man's ear by two *fikis* (tutors); the Malikites, however, disapprove of this custom. The tomb is closed and the mourners depart reciting the *fatiha.*

A good many popular death customs are practised in spite of the disapproval of tradition; *e.g.,* wailing or declaring the praises of the dead man, burning a light near the bier, the ornamentation of graves and the placing of inscriptions on the tomb. On returning from the funeral to the house the *fikis* may hold a repast, recite *sura* 67 and perform the ritual of the *sabha* (the rosary of 1,000 heads), transferring the merit of the recitation to the deceased Visits of condolence to the mourners are prescribed by religious law Wailing is resumed by women every Thursday for three weeks; on the Fridays they visit the grave and perform various rituals. Visits to the graves take place also on other occasions

Judaism.—Many of the death customs mentioned in the Bible were ancient Semitic practices (rending of garments, self-mutilation walking barefoot. funeral meals; see Jer. xvi, 5–8; Ezek xxiv, 17), and some of them were prohibited because of their pagan associations (Lev. xix, 28; Deut. xiv, 1). Inhumation, if possible in one's country and "with one's fathers," was the generally practised mode of disposal. To be deprived of proper burial was considered a major disaster, and exposure was a disgrace which even convicted criminals must be spared (Deut. xxi, 22 ff.; Jer. vii, 33; Ezek. xxix, 5; Ps. lxxix, 3). To be properly lamented and mourned over was almost as important as burial, and the Old Testament contains many references to the ritual of wailing and keening.

Postbiblical Judaism has preserved many biblical funerary customs, modified by later developments. At the approach of death the confession of sins and the confession of faith are recited (the latter also by those present). The dead body is then laid on the ground, acd Psalms (particularly Ps. xci) are recited by the watchers. The corpse is washed with decency and reverence according to a prescribed ritual, arid wrapped in a simple white linen shroud. (Since the ordinance of Gamaliel II, 2nd century A.D., all Jewish burials have been of equal simplicity.) For climatic reasons the original custom required immediate burial. All ministrations connected with the washing and burying of the corpse are performed by voluntary or professional organizations known as "holy brotherhoods." These ministrations, as well as the attendance at a funeral and the comforting of the mourners are considered as meritorious acts of charity. The corpse is buried in extended position, either in a plain wooden coffin or immediately in the grave lined with stone slabs Usually a handful of dust or earth from the Holy Land is laid in the grave or coffin. The funeral service consists of Psalms, the "acknowledgment of the justice of God's decree," funeral speeches in praise of the deceased. prayers for the repose of his soul, and the Kaddish doxology Those present throw earth on the grave and then stand in two rows through which the next of kin walk out of the cemetery.

The ancient funeral banquet has fallen into desuetude, but on returning from the burial, mourners eat a simple meal served to them by friends and neighbours. The next of kin manifest mourning by rending their upper garment and staying indoors for seven days (cf Gen 1, 10 and I Sam. xxxi, 13), sitting on the floor or on low stools. Since the niourners cannot leave the house to attend synagogue, morning and evening services may be held at the house Mourning varies according to the degree of kinship (strictest for the death of parents) and is graded in stages: the first seven days after the funeral, the first month after the decease. the first year. These stages of the mourners' return to normal life correspond to the stages of the soul's progress in the hereafter (final separation from the body in the grave, purgatory, admission to celestial repose). During the latter part of the middle ages, the idea gained currency that prayers and merits accruing from good works might profit the departed souls. and some earlier customs (e g., the recital of the Kaddish) were reinterpreted in that sense. The development of more ideas and customs of this kind (e g, for protecting the soul from hostile demonic powers) was stimulated by the kabbalistic movement of the 16th century.

Christianity.—When discussing the funerary customs of Christian people, a distinction must be made between the essentially Christian elements, deriving from specifically Christian beliefs and liturgical traditions on the one hand, arid general, folkloristic elements on the other. The latter, which may combine in sundry ways with the Christian element, will not be considered in this section (but see Pre- and *Postburial* Rites, above).

The starting point of all Christian mortuary rites is the faith that by Christ's death on the cross and by his resurrection man has shed his old condition. spiritual death (ie., sin), as well as its outward expression, physical death (Rom. vi, 23). The individual incorporated in Christ, i e, in the church of which Christ is the head. has gained immortality by sharing in the resurrection-life of Christ. This immortality will become fully manifest at the general resurrection.

Mourning over death was not an original Christian custom, since the deceased had merely left this temporary abode in order to join his Lord in glory and to expect the final resurrection. In the 4th century, funerals were still occaiions of joy and those attending them wore white Also, the Christian form of the "cult of the dead." *i.e.*, the cult of the martyrs, was not a matter of mourning; there was in it an element of triumph. and altars, chapels and finally churches were constructed by preference above or near the tombs of martyrs By the 8th century, however, the realities and attitudes of the Christian world had changed. Funerals were now occasions of mourning (*i.e.*, the wearing of black), and prayers mere said for the purification and deliverance of the soul from hell.

By the end of the middle ages the following sequence of rites had developed: At the approach of death. a priest is called in to confess and absolve the dying person, to administer Holy Communion (viaticum: spiritual food for the last journey of the soul) and extreme unction (anointing with olive oil blessed by a bishop) and to pray (commendatio *animae* of the western rite). Burial is preceded by the office of the dead. consisting of the usual canonical hours (vespers, matins, lauds; the special antiphon *dirige* (has given rise to the "dirge") and, in the morning, the Requiem Mass (*q.v.*) with prayers for absolution of the dead, and the censing and aspersing of the body. Requiem Masses are also said on the 3rd. 9th. 30th and 366th day. The burial service of the Anglican Book of Common Prayer is a modified version (sentences. psalm, lesson) of the dirge. Some modern Protestant liturgies do not have prayers for the dead. though there is no doubt that from very early times the eucharistic liturgy was offered for the dead as well as the living. All the souls of the faithful are commemorated on Nov. 2, All Souls' day (*q.v.*).

The actual inhumation is accompanied by a short committal prayer, sometimes also by censing and sprinkling with holy water. Interment has always been the traditional Christian practice. The permissibility of cremation has given rise to discussion in recent times, and many churches have adapted their funeral service to cremation. But even the Roman Catholic prohibition of cremation is considered to be a matter of ecclesiastical discipline rather than of divine precept or natural law. Tombs are usually marked by a cross or by (at times very ornate) tombstones incised with a cross.

The Roman Catholic doctrine of purgatory (*q.v.*), rejected by both the Eastern and the Protestant churches, has given rise to practices intended to obtain remission of (temporal) punishment for poor souls. Of these. the practice of indulgences (*q.v.*) is the best known because of the abuses to which it gave rise and the misinterpretations to which it was subject. There are minor as well as major differences (*e.g.*, regarding liturgy, orientation of the corpse, vestments worn) in the burial rite. depending on whether the deceased is a priest, layman, infant, etc.

Hinduism.—The Hindu way of life. the Aryan *dharmá*, is permeated by ceremonials and sacramental rituals (*samskaras*)—most of them domestic rituals. Considering the particular Hindu doctrines regarding the soul and reincarnation (see HINDUISM). ceremonies connected with death and afterlife are clearly of outstanding importance. In fact, every Hindu desires a son mainly because only a son can properly perform the regular funeral rites (*antyeshti*) which ensure a happy rebirth in the hereafter. Hindu death ceremonial is long and complicated. There are many variations in points of detail, some local, others due to the caste of the deceased. the particular school or sect to which he belonged. and other factors.

At the approach of death. relatives and Brahmnns are summoned, *mantras* and sacred texts are recited and ceremonial gifts prepared. It is desirable that the dying person touch a cow (*vaitarani*) which is then given to a Brahman. The subsequent ceremonial is concerned partly with the deceased and partly with his relatives (particularly the chief mourner or *purohita*), who are all impure and consequently have to go through various purification rites. Since the time of the Rigveda, cremation has been the usual mode of disposal. It is performed, wherever possible, near a river, though some low castes usually bury their dead and the same is done occasionally with children and ascetics. The treatment of the corpse, the shrouding, the procession to the place of cremation with the attendant rituals (offerings. circumambulations, etc.), the location, size, orientation and arrangement of the pyre, the kind of timber used, the procedure of committing the body to the flames (sprinkling of the pyre, placing various utensils and offerings on the body), the postcommittal rites (lustrations, recitations. return to the home after sunset)—all these are strictly regulated. For ten days after the funeral the mourners are unclean and secluded from society. They are subject to certain tabus (*e.g.*, they must not study the Veda or cut their hair) and must perform daily ceremonies intended to provide the naked soul of the deceased with a new spiritual body with which it may pass on to the next life; otherwise the soul might become a ghost and haunt the living. Ceremonies include the setting out of milk and water, and the offering of rice balls (*pinda*). At a date fixed according to various rules, the secondary burial takes place. The bones are collected and placed in urns or barrels which may be either buried or thrown into the water; some schools enjoin a second cremation after pulverizing the bones and mixing them with combustible material. Further rites are performed to ward off evil and to mark the return of the mourners to ordinary life (*santikarma* and *smasana*), including the kindling of a new fire in the house and the construction of a ritual hut for the disposal of the urn; viz., the bones. Other regular memorial offerings (*shraddha*) continue to be made on fixed dates in order to nourish the souls of the ancestors in the afterlife.

Buddhism.—There is no fixed funerary ritual characteristic of all Buddhists. Customs vary according to geographical and ethnocultural factors (southeast Asia, Ceylon, Tibet, China. Japan). local pre-Buddhist traditions, and the particular school of Buddhism concerned. Even in a single relatively homogeneous Buddhist area, e g, Japan. there are considerable differences in the rituals of the different sects (Shingon, Tendai. Jodo, Shinsho, Nichiren. etc.). Buddhism has generally countenanced popular superstitions. Hence animistic and magical beliefs as well as other folkloristic elements are much in evidence in the death customs of many Buddhist countries. The most usual method of disposal among Buddhists is cremation, though burial. preservation and exposure also occur. Often the dead are kept—embalmed or buried—for a period of time before cremation (*e.g.*, in Thailand).

Death plays a central role in Buddhist theory and meditation. Death is painful and inevitable. and all men fear it. But its real sting is the fact that it is not an end but a new beginning: it is the birth of new existence. Hence meditation on death is necessary to enlightenment. For the truly enlightened man death is no longer the passing to another existence but the extinction of, and release from, existence: Nirvana. Buddhism rejects the notion of a substantial soul. Yet the notion of karmic rebirth presupposes that even after the dissolution of the combination of changing elements which constitute the empirical human organism. some kind of substratum or element remains which may become the point of crystallization for the emergence of a new set of mental states; i.e, a new existence. Hence one's last thoughts before death determine the nature of rebirth: at death the "fundamental thought" (*bhāvanga*) is transformed into "emigrating thought" (*chyntichitta*) which, in its turn. determines the "rebirth thought," the nucleus of the new existence. Proper preparation for death, by mēditation as well as by *puja* ceremonies. was therefore considered important and even provided for in the emperor Astoka's instruction regarding criminals awaiting execution. But whatever determines in theory the nature of the following rebirth. whether the last thought at death or whether the total quality of a whole life's endeavours, these considerations affect popular Buddhist practice only little The most conspicuous elements in popular funerary ritual are the fear of hell and the demons, efforts to reduce punishment by vicarious acts of merit and by magical formulas, and the assurance of bliss by invocation of the merciful beings. In some sects the corpse, after being washed. is shaved and "ordained" a monk: *i.e.*, a member of the *sangha.* Wakes and (at times very elaborate) temple rituals are held which may include burning of incense, chanting of the confession of faith, exhortation of the deceased, invocations of the Buddhas and the use of secret *mantras.* Great importance is attached to the recitation of sutras—before as well as after disposal—and to other works of merit. The idea underlying these vicarious acts of worship and charity is the accumulation of disposable merit which can be transferred to the deceased. As a matter of fact, many Mahayana rituals are simply "masses for the dead."

See also references under "Funerary Rites and Customs" in the Index volume.

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FUNG (DARFUNG), a mixed Negroid people occupying parts of Sennar (*q.v.*) and the hilly country to the south between the White and Blue Niles in the Republic of the Sudan. They traditionally come from west of the White Nile and are affiliated to the Negro Shilluks. The Fung became the dominant race in Sennar in the 15th century, assimilated the speech, religion and habits of the Arabs settled in that region, and until the 19th century were one of the most powerful of African peoples in the eastern Sudan. See AFRICA: Ethnography (Anthropology) : Northeast Africa.

FUNGI. This term, Latin for "mushrooms." is applied not only to mushrooms but to all of the large and diverse group of plantlike organisms, to which the mushroom family belongs. Fungi have no chlorophyll; they are not differentiated into roots, stems and leaves; and they reproduce by forming spores — reproductive cells that develop directly into new organisms. They range in size from microscopic single-celled forms to large and elaborate structures; in properties, from such useful organisms as yeasts and penicillin to destructive plant rusts. mildews and molds.

Because of their lack of chlorophyll and other physiological means of synthesizing carbohydrates from carbon dioxide and water. fungi are dependent on other organic matter, living or dead, for their food. Lack of chlorophyll is not, however, a characteristic that is unique with fungi. Certain algae (*q.v.*) are devoid of chlorophyll and are parasitic; and most bacteria (see BACTERIOLOGY) are unable to synthesize primary foods. Fungi cannot be defined with complete precision therefore; membership in the group is inferred from similarities to typical fungi.

The undifferentiated body of a fungus — lacking stem, leaf and root structures — is known as a thallus. In typical fungi the thallus consists of an extensive network of branching threads, the hyphae, collectively called the mycelium. However, many fungi are nonmycelial. In these the thallus may be an amoebalike structure, at first naked but later enclosed in a secreted membrane, or a simple cell with a permanent wall, or a more or less spherical structure with minute rootlike outgrowths.

From the earliest attempts at scientific classification all living things were held to belong to one of the two kingdoms, plant and animal. But at least since the early years of the 20th century it has been apparent that the plant kingdom consists of a number of independently evolving groups. The sorting of these groups into the two kingdoms is a matter of convenience rather than an indication of actual relationship. In this historical sense, and in everyday speech, fungi may be called plants,

DISTRIBUTION OF FUNGI

Fungi occur throughout the earth, wherever organic material occurs on which they can subsist. Like other forms of life, they are most abundant in temperate and tropical lands. But they form an important part of the small number of living things inhabiting Antarctica, they are found in considerable numbers in most fresh waters and in smaller numbers in the sea, and even at high altitudes and latitudes viable fungus spores occur in the air. It is estimated that about 100,000 species exist. More names have been published for fungi, but more than half of these are duplicates. In a small area of limited vegetation (such as the Marshall Islands) the species of fungi outnumber by several times the seed plants. while in a larger area (such as the state of Iowa) the numbers are about equal. Since fungi are nowhere thoroughly known, estimates of their numbers are quite tentative.

Because most fungal structures are unlikely to have been fossilized. their distribution in time is little known. The hyphae of fungi have been found within fossil plants of the Devonian period. Many fungus spores have been found mixed with fossil spores, pollen and other remains of higher plants. but although they have been given names suggesting their similarity to recent fungi, their correct classification, in the absence of the fruiting structures that produced them, is rarely possible.

STRUCTURE OF FUNGI

The visible mycelium of the simpler fungi forms a loose, cottony mass. Within the substratum (such as a parasitized leaf, decaying organic material, soil) it constitutes a similar loose, branching network of separate threads. In many of the more complex fungi there exist, in addition to assimilative mycelia of distinct fibres, massive structures in which the threads are felted together. In Sclerotium and Rhizoctonia lens-shaped or oval bodies the size of a small seed are formed by the branching, intertwining and compaction of the hyphae. When these are carried about they serve to disseminate the fungus. In various pore fungi (Poria *cocos*, Polyporus tuber-regium and others) hard oval bodies 20 cm. or more in diameter are formed in the soil, and serve as reservoirs of food from which fruiting bodies are developed. Whether small or large, these structures are sclerotia. Similar massive structures of sterile hyphae, often crustlike or nodular but frequently clublike or of various other shapes, may later produce conidia on their surface or inside spore-producing cavities within their substance. These are stromata. In other fungi many nearly parallel hyphae are united into long strands, resembling shoestrings (in the honey mushroom, *Armillaria* mellea) or flattened cottony cords (in the house fungus, Serpula [*Merulius*] lacrymans), two to ten millimetres in width. These strands. the rhizomorphs, have the central hyphae enlarged as conducting tubes. and serve to carry water and nutrients from the area in which they occur to a new area which the fungus may later penetrate. Thus they are organs for the spread of the fungus.

The fruiting body of the higher fungi is similarly composed of a felt of large numbers of branching hyphae. A mushroom, which is one type of fruiting structure, is composed of threads as truly as is a mold. Most of the threads in the stalk run lengthwise. Many of those in the cap run from the centre toward the margins, and the surfaces are composed of variously oriented hyphae. These may be of three sorts: structural hyphae, often thick walled, sparsely branched. with little protoplasm; generative hyphae, thin walled. with abundant protoplasm; and binding hyphae, short celled, much branched. irregular and contorted. which serve to tie the others into a mass. However compact the larger fungus structures may be, the structural unit is a branching thread and the whole is a felt rather than a true tissue.

Noncellular Fungi. — If spores of one of the common black molds (Mucor, *Rhizopus*) are placed on a suitable nutrient (cooked corn meal, blotting or filter paper soaked in fruit juice, or nutrient agar) they will soon germinate. The outer spore wall is ruptured and the inner, colourless wall protrudes, swelling and elongating to become the wall of a hypha (fig. 1[D]). The older, basal part of such a hypha soon becomes fixed and rigid, but the tip continues to push out, increasing the length of the hypha, and commonly branches. Soon there is formed a large and complex branched system (fig. 1[A]). Where growing tips come in contact with each other they often fuse and thereby produce a network. Each hypha consists of a tubular wall of secreted material, lined with a layer of fluid protoplasm in which are embedded numerous nuclei. and enclosing a central stream of sap, containing in solution various salts, food substances and other metabolic products. The protoplasm (including the nuclei) is mobile within its wall and continually migrates from the older parts of the mycelium toward the growing tips. In a mycelium several days old the protoplasm entirely evacuates the hyphae first formed, and the abandoned segments are separated from the living by secreted partitions formed successively behind the migrating protoplasm. In most black

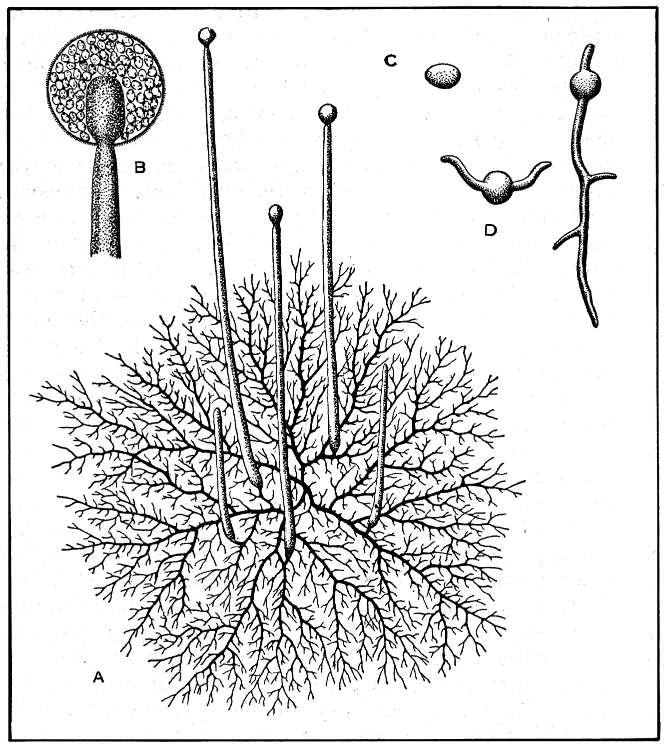


FIG. 1—MUCOR MUCEDO

(A) Diagram of mycelium with several upright sporangiophores; (B) sporangium; (C) spore; (D) germinating spores with germ tubes

molds true septa. which are partitions dividing one portion of the protoplasm from another, are not regularly formed except in the fruiting structures. Thus, except for injured areas or the oldest hyphae. the protoplasm and enclosed sap (the vacuole) are continuous throughout large masses of mycelium.

When a mycelium has attained sufficient size and sufficient reserve food it proceeds to reproduce. (See below for a fuller description of the reproductive process.) In the black molds the first step in this process is the formation of thicker and more rigid hyphae which grow not into the substratum but out into the air. Into these fruiting branches a large amount of protoplasm migrates, so that it is much denser there than in assimilative hyphae. After such a branch has reached its full length (from about 0.5 to 4 mm. in the genera under discussion, but up to 30 cm. in other black molds) the tip swells to form a more or less spherical vesicle (fig. 1[A]). into which most of the protoplasm flows, and which is then separated from the stalk by a septum. This septum does not lie straight across the summit of the stalk, hut arches into the vesicle so as to form a protrusion into it (fig 1[B]) The vesicle is the spore case or sporangium, the stalk is the sporangiophore, and the protrusion is the columella. Within the sporangium, the protoplasm is divided into many blocks each including one or more nuclei. These blocks then contract into a spherical or oval shape, secrete a dark-coloured external mall and become spores (fig. 1[C]) that are set free by the rupture of the sporangial wall On a suitable substratum they germinate to repeat the cycle. These black molds exemplify the structure of a coenocytic (noncellular or nonseptate) mycelial fungus.

Cellular Fungi.—One of the green molds *Aspergillus* or *Penicillium,* found on decaying fruits and vegetables illustrates a cellular or septate fungus. When its spores are sown on a suitable nutrient, such as one of those employed for the black molds, they germinate in similar fashion to form a short, branched hypha But before the hypha has attained any great length it becomes divided into segments—i e., cells—by septa. These are begun by the deposition of wall material in a ring on the inner surface of the hyphal wall The deposition continues toward the centre of the hypha until a circular partition is formed, complete except for a pore in the centre. Through these pores the protoplasm of each cell is continuous with that of the cells immediately above and below it in the hypha, so that even in a septate mycelium the cell contents form a continuous system. When the mycelium reaches the stage of fruiting it gives rise to stout aerial branches (fig. 11[A]) which are septate like the assimilative hyphae. In *Aspergillus* the apex of such a branch swells to form a vesicle which, rather than producing internal spores. pushes out from its surface a large number of fingerlike protrusions (fig. 11[A. c]). These may branch once or twice; ultimately the outer portions are constricted just back of the end, a septum is formed at the constriction and the cell so formed develops a thick wall and becomes a spore. By constriction and septation a second spore is cut off just below the first, and later a nhole series of spores is similarly formed, having to each other the relation of beads on a string. A single vesicle may bear scores or hundreds of these series. Such spores. formed from a specialized segment of a hypha, are conidia, and the stalk on which they are borne is a conidiophore. The other common green mold. *Penicillium,* is similar except that the branches of the conidiophore do not radiate from the surface of a conspicuous vesicle.

Composition of *the* Wall.—In a relatively small number of species of fungi the wall is composed of the carbohydrate cellulose, as in all young cells and most mature cells of green plants. In most fungi. however, the wall is chiefly chitin, a carbohydrate similar to that forming the integument (covering) of insects and many other animal structures. In some fungi (Tremella and other jelly fungi) the wall swells in the presence of water and becomes gelatinized. In others (Fomes) the wall is greatly thickened and hardened by the deposition of mineral compounds, resins and other metabolic by-products, becoming lignified as in the harder tissues of woody plants. Hyphal walls frequently are impregnated also by pigments. Nearly all the colours shonn by fungi—and these include the whole spectrum as well as black—result from pigmented hyphal walls.

NUTRITION AND FUNCTIONS

The nutrient requirements of fungi are similar to those of bacteria, of animals and, except that fungi cannot synthesize carbohydrates, of green plants. According as they are able to produce the appropriate digestive enzymes, various fungi are able to utilize sugars, starches. cellulose and lignin as carbohydrate foods. Fats are suitable as food for a number of fungi. It is not certain that any fungus can fix atmospheric nitrogen, as can some bacteria, to form proteins; therefore, some form of combined nitrogen is a necessary nutrient for fungi. Some species can use nitrates. others can use nitrogen in the form of ammonia, and many others require external supplies of organic nitrogenous substances such as proteins or amino acids. Apparently all fungi need phosphorus. potassium. sulfur, iron and magnesium, and at least some species must have zinc. manganese, copper, molybdenum and gallium, although in minute quantities. The required amounts of these trace elements are so small that it is difficult to prepare nutrient solutions sufficiently free from them for the fungus to show the effect of deprivation. It is probable that ultimately other mineral requirements will be demonstrated. Like other organisms, fungi also require in minute quantities certain vitamins. Thiamin (vitamin B_1) is probably needed by all fungi. but some are able to synthesize an adequate supply from simpler compounds. Many, however, can grow only if an external source of thiamin is provided. Other vitamins are similarly required by some fungi although none, apparently, need riboflavin (B_2). Like all living things, fungi need water, and all need at least a low concentration of atmospheric or dissolved oxygen,

The surface of the living mycelium absorbs water and water-soluble mineral and food substances. These diffuse through the hyphal wall into the protoplasm and may be passed on to the central vacuole. There they are moved to other portions of the mycelial network not only by the relatively slow process of diffusion. as in organisms divided into cells. but also by the flow of the sap through its enclosing protoplasmic tubes. The mycelium also secretes enzymes through the wall into the substance on which the fungus is growing. By their action a part of the nutrient substratum is digested outside the fungus, the soluble products of digestion then being absorbed.

With respect to their sources of food, fungi fall into three classes: (1) saprophytes feed on dead organic material; (2) parasites derive their food from living things, to the detriment of the host; and (3) symbionts live in association with other organisms with mutual benefit, each commonly contributing essential nutrients to the symbiotic partner and receiving nutrients from it.

Saprophytic Fungi. — Saprophytic fungi have an important place in nature. They reduce to a form usable by other organisms the dead bodies of plants and animals. freeing the carbon, nitrogen, hydrogen and minerals which otherwise would remain forever locked up in the corpses. This function they share with bacteria. Although there is no sharp dividing line, the fungi do most of the work of digesting complex carbohydrates and the bacteria digest mostly proteins. The black and green molds usually live as saprophytes. Another familiar saprophyte is the meadow mushroom, *Agaricus campestris,* which grows wild in meadows and pastures where the dung of grazing animals is added to the organic matter in the soil, and is also cultivated in prepared beds composed largely of partially decomposed manure. In either situation the mycelium, starting from spores or from commercially prepared masses of mycelium (spawn). spreads through considerable volumes of soil. breaking down, by enzymes which it secretes, the organic soil components to simple carbohydrate and nitrogenous compounds which can be absorbed by the mycelium and serve as its food. After a period of growth and food storage which may involve weeks (in mushroom beds) or years (in nature), the mycelium forms at the surface of the substrate (substance on which the enzyme sets) a crop of mushrooms, its fruiting structures, which immediately shed spores from which new mycelia may arise.

Other saprophytic fungi are those which produce bracket mushrooms or conks (*Fomes applanatus,* Polyporus sulphureus) on the surface of tree trunks. The tree may be standing or fallen, living or dead. Although any part of a dead tree may be attacked. the mycelium in living trees penetrates, digests and destroys only the dead heartwood. House fungi, especially *Serpula* (*Merulius*) lacrymans and Poria incrassata can reduce timbers to a weak, friable mass. The yeast fungi, minute single-celled forms, belong to the same biological class. They live in watery solutions, chiefly those containing sugar, such as fruit juices, ensilage, plant sap and the moist component of bread dough.

Parasitic Fungi. — These are numerous in species, partly because many of them are able to attack only a few kinds of host plants, or even only a single one. Many of them are facultative parasites; that is, they can live at the expense of a living host until it dies, and then continue to feed on the dead tissue. Often the mycelium on the living host reproduces by conidia, or asexual spores, and that on the dead host by other and more complex fruiting bodies. Corn smut grows parasitically within tissues of the ears, tassels and other organs of Indian corn (maize), stimulating the host to produce large, tumourlike swellings whose soft tissues finally are absorbed by the mycelium whose cells then round off and become spores. These spores germinate in soil and there produce large numbers of cells capable of reinfecting the host. Other fungi are obligate parasites, unable to live apart from living tissues of a suitable host. Such species have never been cultivated. An example of this class is stem rust of wheat, which produces two types of spores while growing on wheat and certain grasses, and two other types on the leaves of barberry. Many parasites form their mycelia between the cells of the host, absorbing nutrients through the cell walls of both host and fungus. Others, of which the downy mildews are examples, send out short specialized hyphae which penetrate the cell wall of the host and sometimes its outer protoplasm, coming to lie near the nucleus of the cell attacked. These hyphae may form coils or branches within the cell, thereby increasing their surface for absorption. Such intracellular absorptive hyphae are called haustoria.

A successful obligate parasite is necessarily one that does not kill, although it may cause dwarfing, enlargement, sterilization or distortion of the living plant or animal on which its own life depends.

Symbiotic Fungi. — Lichens provide the most conspicuous examples of symbiotic fungi. Lichens are often mistaken for mosses. as the common name, reindeer moss, of one of the most important lichens indicates. However. a lichen is an association of a fungus and an alga, with the fungus forming a leaflike, crustlike or branched matrix enveloping large numbers of algal cells (see LICHENS). A similar beneficial relationship exists between fungi and many seed plants and ferns, whose roots are symbiotic with the mycelium. The two organisms together form a compound structure known as a mycorhiza (*q.v.*). An especially complex symbiosis exists between various scale insects and fungi of the genus Septobasidium, which is widely distributed in the warm temperate and tropical regions of both hemispheres. These fungi grow only on living parts of higher plants, most commonly on the smooth bark of various trees. where they form feltlike or lichenlike crusts. They appear to be parasitic on the tree, but actually each fungus covers a colony of scale insects. The insects suck the juices of the plant and in turn are infected with haustorium-bearing hyphae that extend from their bodies into the fungus crust. Such insects are not killed by the *Septobasidium,* although they remain sterile. The fungus is an obligate parasite upon them, as they in turn are upon the plant. Other insects of the same colony, however. live within an elaborate system of tunnels or houses developed by the fungus, within which they feed upon the host plant protected from most of their normal enemies. At the season when the uninfected insects are producing young. the fungus is producing spores on its outer surface. The immature insects which crawl over this surface may carry off a spore and become infected by it. If they move to another area of bark they establish a new growth of the fungus, and if they remain close by they add to the size of the old. Those insects that do not crawl over the surface, or that otherwise escape infection. may settle down within the protection of the old Septobasidium. The fungus thus parasitizes a part of the insect colony and protects the rest.

REPRODUCTION

The spores of fungi serve the function of the seeds of higher plants but differ from them in their smaller size and simpler structure. Both sexual and asexual reproduction occur among fungi, and some species exhibit an alternation of generations. in which a sexual phase of the plant is followed by an asexual phase. In some fungi the mycelium can reproduce asexually of itself, but will reproduce sexually only when grown with certain other mycelia. This selective mechanism in sexual reproduction, known as heterothallism, functions to ensure the genetic heterogeneity of the offspring.

Asexual Reproduction. — Asexual reproductive spores, oïdia and conidia, are produced by the separation of cells from a mycelium. Oidia commonly occur among various species of mushrooms. Conidia, which are distinguished from oïdia by their shapes, may be spherical, cylindrical or of other distinctive form; they may be one or many celled; and they may be formed directly on assimilative hyphae or borne on conidiophores. The conidium-bearing hyphae may be isolated or, in the more highly developed species, aggregated into crusts, cushions or clusters resembling sheaves of wheat. In many species the conidiophores arise within more or less pear-shaped cavities of special spore-producing structures (pycnidia). Other fungi produce minute pellets (bulbils) formed of a knot of intertwined hyphae, which serve for reproduction. The black molds and the water molds and their relatives are dispersed by specialized cells formed within and from the protoplasm of larger cells (sporangia). In the black molds these sporangiospores are provided with a firm wall, are resistant to desiccation and are scattered abroad by the air. In many water molds (fig. 4[D, E]) the spores are naked particles of protoplasm provided with threadlike flagellums by which they swim through water (zoospores). All of these types of reproductive bodies are usually (but not always) endowed with the same hereditary potentialities as the mycelium from which they arise.

Sexual Reproduction. — Most fungi exhibit the process of fertilization. This consists in the fusion of two bodies of protoplasm to form one, the zygote. The interval between cell fusion and nuclear fusion may extend through most of the life cycle;

nuclear fusion is the final, critical event in fertilization. The gamete (fusing) nuclei have in any species a basic number of chromosomes, the haploid number; the zygote has the double (diploid) number; and nuclear fusion is the end of the haploid and beginning of the diploid phase. The reverse process is meiosis (see CYTOLOGY) by which the haploid condition is restored, marking the end of the diploid and beginning of the haploid phase. In many Ascomycetes and in Basidiomycetes there is a third phase, after the protoplasts have fused but before nuclear fusion has occurred, in which haploid nuclei from the two parents are associated in a common cytoplasm; if the nuclei are paired, this is called the dicaryotic phase. Few fungi have a diploid phase protracted beyond the zygote. In the black molds the fusing bodies are multinucleated branches (fig. 6); in the water molds (fig. 4[B]), they are an egg and one nucleus from a male hyphal branch (antheridium). In some Ascomycetes the gametangia are differentiated as males and females (fig. 8) but the fusing protoplasts are completely undifferentiated; in others the antheridium is missing and its function is assumed by an ordinary hyphal cell. In the Basidiomycetes, the most highly developed class of fungi, fertilization occurs between two hyphae, a hypha and a conidium, or even two conidia.

Heterothallism.—This phenomenon is best exemplified by the black mold *Rhizopus* nigricans. It had long been known that although any culture of this species produced sporangia, only rarely did one show gametangia and the zygospores (fig. 6[G]) resulting from their fusion. In 1904 the cause of this rarity became known when it was discovered that all mycelia of this species fall into two groups. such that any member of one fails to produce zygospores when grown together with any other member of the same group, but forms them when combined with any member of the other. The species is heterothallic. There are no constant differences between the members of the two groups other than their reciprocal behaviour when crossed, each stimulating the other to the formation of gametangia, and usually no differences are apparent in size of gametangia, rate of growth or biochemical properties. It is therefore impossible to designate one accurately as male and the other as female, and the complementary groups are called merely plus (+) and minus (−). A (+) mycelium produces only (+) sporangiospores, and a (−) only (−). The zygospore, upon germination, may produce either. Heterothallism has since been found in most other groups of fungi, as well as in algae. In many fungi, especially among Basidiomycetes, the mycelia fall into four rather than two groups in each of which the four will mate only with one other. Here the groups clearly are not sexually differentiated. Homothallic species, in which fusion of cells or nuclei from a single mycelium can occur, are frequent. Many of these are believed to have descended from heterothallic forms.

Types of Spores.—Fusion, whether of multicellular gametangia, of cells or of nuclei within a single cell, usually initiates the formation of distinctive spore types. In the Phycomycetes the typical spore is either the zygospore, usually thick walled. with a sculptured surface, and supported between the two similar gametangial branches, or the oospore, a fertilized egg with thickened wall.

The Ascomycetes are characterized by ascospores (fig.. 12), formed in limited numbers (usually eight) within a saclike cell in which fusion earlier occurred.

In the Basidiomycetes the typical basidiospore (fig. 14[C]) is formed on a slender stalk growing from the surface of the cell where fusion took place.

These four types of spores, formed directly after fusion, are known as perfect spores, and have been found to be the best indicators of relationships within the fungi. Classification accordingly is based on them. The fruiting structure which gives rise to perfect spores is called the perfect stage. Conidia, oïdia and the other types produced without change in the cytological or genetic state of the fungus are said to be imperfect, but the term must not be taken to indicate a failure in reproducing the parent. Fungi lacking perfect stages, or in which they are unknown, are called Fungi Imperfecti.

CLASSIFICATION

Most students of the fungi now regard them as derived from colourless flagellates. Along with the algae, they are placed within the phylum Thallophyta of the plant kingdom. Three classes of fungi are universally recognized: Phycomycetes, Ascomycetes and Basidiomycetes; and a fourth problematical class, Myxomycetes, once regarded as an offshoot of the amoeboid protozoa, usually is included. The bacteria or Schizomycetes, which are sometimes classified as a third subdivision of the Thallophyta and sometimes as an additional class within the fungi, are discussed elsewhere (see BACTERIOLOGY). The lichens, as associations of algae and fungi, are classified according to their components, the algal components among the algae and the fungal components among the Ascomycetes and Basidiomycetes.

The basis of classification of the fungi, as mentioned above, is the mode of spore formation. The Fungi Imperfecti include members of all four classes—but mostly Ascomycetes—that lack or rarely produce the perfect stage, that is, the fruiting body that forms spores by fusion.

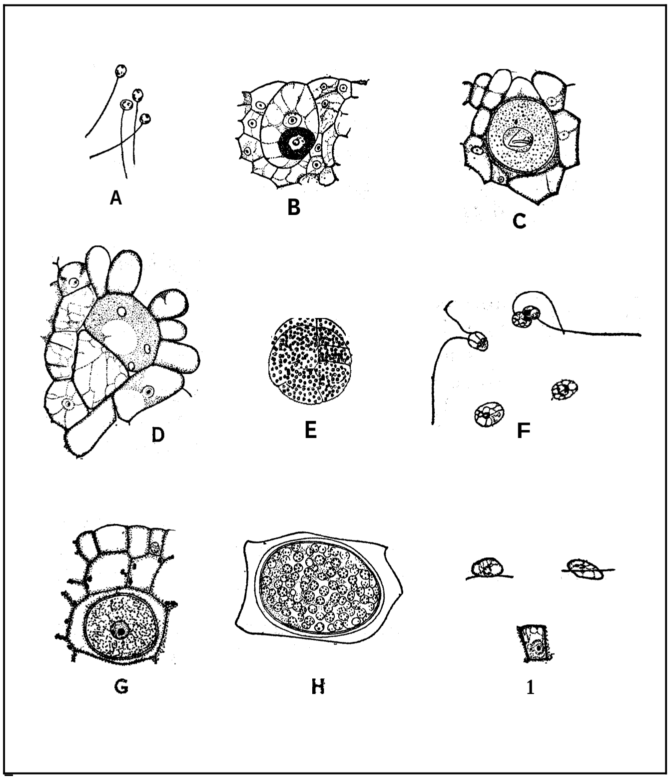
SCHEME OF CLASSIFICATION

Class I. Myxomycetes (slime molds)
- Subclass I. Exosporeae
- Subclass II. Myxogastres

Class II. Phycomycetes (algaelike fungi)
- Subclass I. Archimycetes
- Subclass II. Oömycetes
- Subclass III. Zygomycetes

Class III. Ascomycetes (sac fungi)
- Subclass I. Protoascomycetes
  - Orders: Dipodascales; Saccharomycetales ; Taphrinales
- Subclass II. Euascomycetes

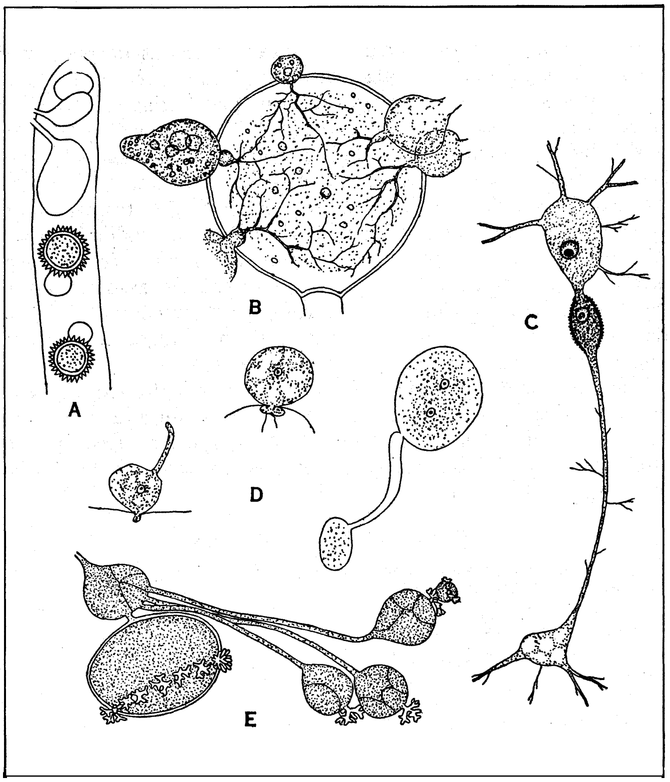
Class IV. Basidiomycetes (club fungi)
- Subclass I. Heterobasidiomycetes
  - Orders: A. Ustilaginales (smuts) ; Uredinales (rusts)
  - B. Auriculariales; Tremellales
- Subclass II. Homobasidiomycetes
  - Orders: Agaricales; Gasteromycetes



FROM "PROCEEDINGS OF THE ROYAL SOCIETY" BY COURTESY OF THE COUNCIL AND K. M. CURTIS

FIG. 2.—LIFEHISTORY OF SYNCHYTRIUM ENDOBIOTICUM

(A) Zoospores; (B) young protoplast within a hypertrophied epidermal cell; (C) mature summer spore; (D) germination of summer spore; (E) young sorus, future walls indicated by lines; (F) copulation of two planogametes; (G) young hypnospore; (H) hypnospore during maturation of zoospore primordium; (I) penetration of the zygote



FROM E. GAUMANN, "VERGLEICHENDE MORPHOLOGIE DER PILZE" (GUSTAV FISCHER)

FIG. 3

(A) Three emptied sporangia and two spiny resting spores of *Olpidiopsis saprolegniae* in the end of a hypha of Saprolegnia; (B) sporangia of *Rhizidiomyces* apophysatus, in various stages of development, attached to the oögonium of *Saprolegnia* and sending delicate rhizoidal threads into it; (C) conjugation of thalluses of Polyphagus euglenae, showing female nucleus about to enter the copulation tube; (D) *Zygorhizidium willei;* the male thallus (at left) with developing copulation tube; the female thallus (centre) and the two in process of conjugation; (E) branching thallus of *Urophlyctis* alfalfae, the lower turbinate cell of which bears a single mature resting spore and three branches, each terminated by a turbinate cell in the early stages of resting-spore formation

Myxomycetes (Slime Molds)

All but perhaps two species of Myxomycetes belong to the subclass Myxogastres. The spores are surrounded by a firm, ornamented wall. and are sufficiently resistant to desiccation that in some species they germinate after 40 years' storage. In water the wall opens by rupture or by a pore to set free a single amoeboid body later transformed into one or two naked swarm cells that swim by two unequal flagellums. one directed forward and one trailing. These swarm cells may fuse directly, or increase in size and each divide to form two similar cells. Such division may be repeated, and the cells may pass through amoeboid or encysted phases. Ultimately, flagellated cells fuse in pairs, retract their flagellums and assume an amoeboid form, the first stage of the plasmodium, which is diploid. The plasmodium increases in size and becomes multinucleate by division of the original fusion nucleus. It may also join other plasmodia so completely that no evidence persists of its often compound nature.

In fruiting, the protoplasm forms a thick, enclosing membrane. and frequently a stalk and a tangle of threads running through the sporangium. All of these structures are secreted; *i.e.,* noncellular. The protoplasm then breaks up into uninucleate units, each of which forms its own wall and becomes a spore. The haploid condition is restored by meiotic reduction divisions immediately preceding spore formation.

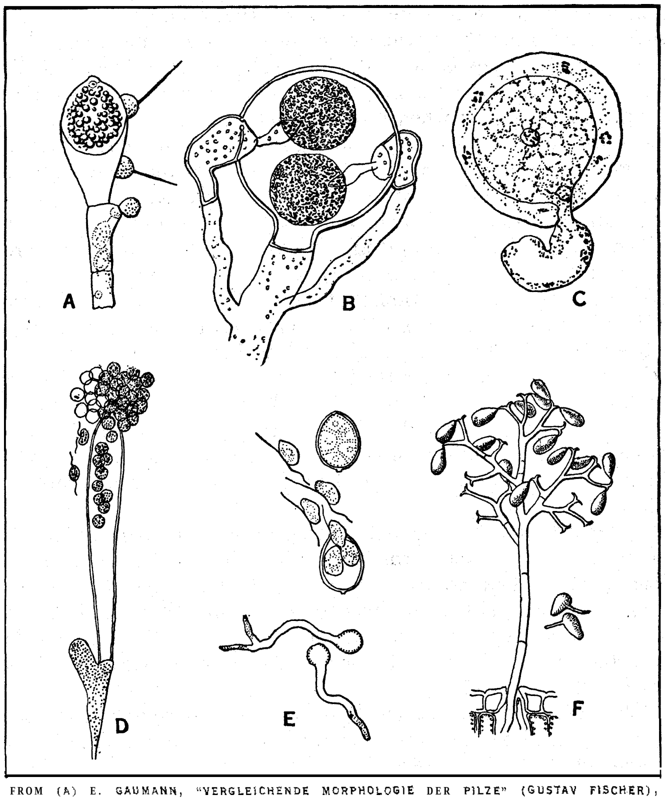
Groups of sporangia of the Myxogastres are frequently seated on a common membrane, the hypothallus. The branching fructification of the subclass Exosporeae is only a more complex hypothallus. The cysts of the latter group are not spores, but rather are homologous with the sporangia of the former. They do not form firm-walled spores, but germinate directly by forming eight swarm cells. Otherwise the two subclasses are essentially alike. (See MYCETOZOA.)

Phycomycetes (Algaelike Fungi)

This large primitive group includes the fuzzy molds found on bread, jelly and preserved fruit, water molds, insect and fish parasites, the downy mildews parasitic on hops and other plants and destructive blights such as the potato blight that caused the Irish famine in 1846–47. Typically the mycelium is composed of nonseptate, branching hyphae, although cellular hyphae occur in some higher forms and in some lower forms hyphae are poorly developed or absent.

In asexual reproduction, which is the more common form for the Phycomycetes, spores are formed in cells called sporangia. In sexual reproduction either zygospores, resulting from the conjugation of two like cells, or oospores, resulting from fertilization of an egg cell by a sperm cell, may be formed. In lower forms the spores may be motile, animallike zoospores; in higher forms they usually are air-borne. Alternation of generations occurs in some members of this class.

Archimycetes.—In the separation of the Phycomycetes into the three major subclasses—Archimycetes, Oomycetes and Zygomycetes—a standard classification is used. The primitive Archimycetes are regarded by some students as degenerate Oomycetes and Zygomycetes. By others they are considered to be primitive forms such as those from which the Oomycetes and Zygomycetes are postulated to have arisen. In some modern classifications the Archimycetes and Oomycetes are merged, the former name being abandoned, and a primary division into two groups, Uniflagellatae

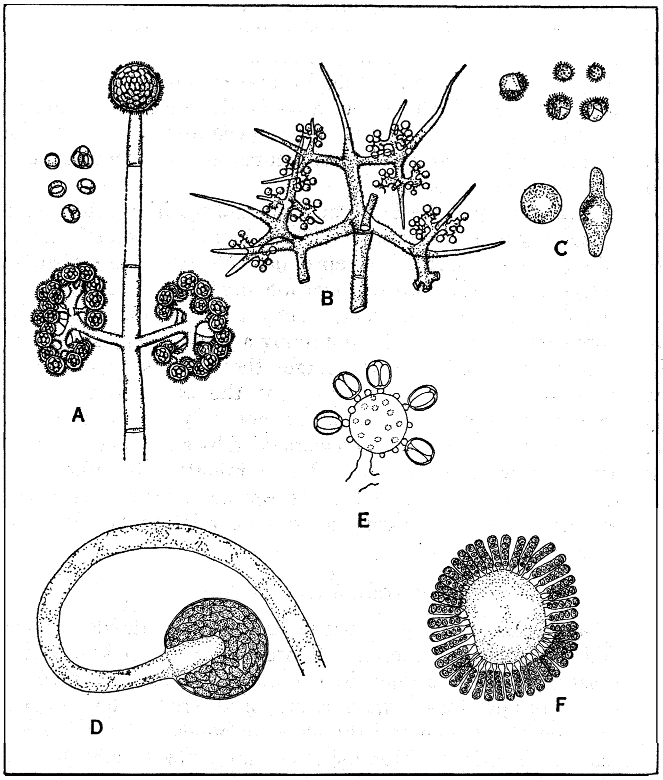


FROM (A) E. GAUMANN, "VERGLEICHENDE MORPHOLOGIE DER PILZE" (GUSTAV FISCHER), (B) G. MASSEE, "PLANT DISEASES, (GERALD DUCKWORTH), (C) GWYNNE-VAUGHAN & BARNES, "FUNGI" (CAMBRIDGE UNIVERSITY PRESS)

FIG. 4

(A) Uniciiiate spermatozoids of *Monoblepharis macrandra* emerging from the basal antheridium and moving up over the surface of the oogonium. The single oosphere is fertilized by the entrance of one of these at the apex of the oogonlum. (B) Globose oogonium of *Saprolegnia* containing two oospheres each of which is being approached by a fertilization tube sent in from a laterally applied, clavate antheridium; (C) fertilization of the oöplasm of *Pythium* debaryanum by the entrance of a male nucleus from the antheridium; (D) sporangium of Achlya freeing swarm spores which encyst at the mouth before breaking out to swim away; (E) sporangia of Phytophthora *infestans,* the lower freeing swarm spores. Below these, encysted spores germinating by tube. (F) Branched sporangiophore of Peronospora schleideni emergent from the stomate of an onion leaf; the sporangia, often termed conidia, germinating by tube without forming swarm spores and Biflagellatae, based on the number of cilia on the zoospore, is adopted.

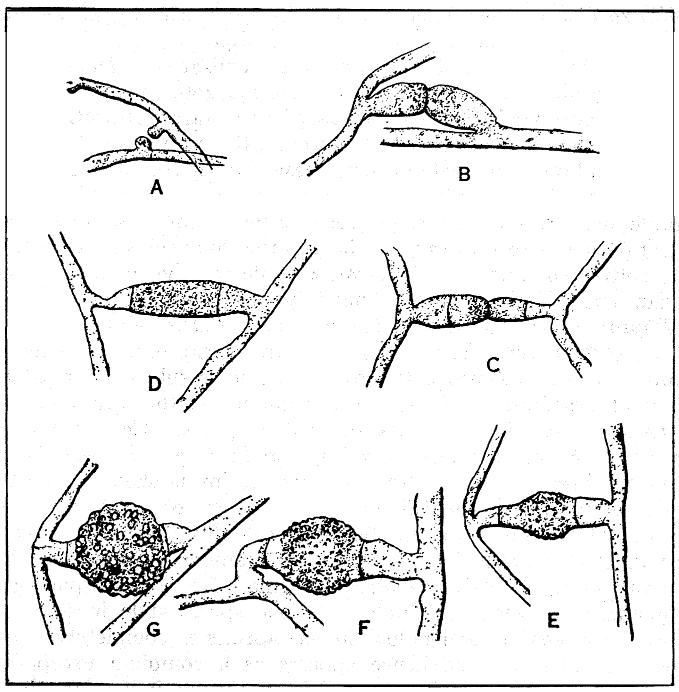
The mycelium is rudimentary or lacking; at maturity the thallus is transformed into a sporangium or differentiated to provide vegetative and sexual cells. In the simplest representatives of the Xrchimycetes, such as the genera of pond-scum parasites, *Olpidium* and *Synchytrium* (fig. 2), the thallus undergoes development in the cells of the host for a period as a naked protoplast. Later it assumes a wall and reproduces asexually as a sporangium or sorus of sporangia, freeing uniciliate zoospores. In sexual reproduction a pair of uniciliate, swarm-sporelike gametes fuse to form a motile zygote. The zygote after a period of vegetative growth encysts to form a resting spore. A similar morphology and mode of life are present in *Olpidiopsis* in which the zoospores are, however, biciliate. Here there are no motile gametes, a larger female and a smaller male thallus merely conjugating, with the passage of the content of one cell into the other. The receiving cell then forms a heavy wall and matures into a resting spore to which the emptied cell remains attached. In *Rhizophidium, Rhizidiontyces* (fig. 3[B]) and other related forms the parasite is enveloped in a visible membrane from an early stage and is attached to the outer surface of its host, into which it sends a short peglike haustorium or delicate branching mycelial threads. At maturity the whole thallus functions as a sporangium or acquires a thick wall and becomes a resting spore. A mode of sexual reproduction in which the conjugation of two individual thalluses creates a resting zygote is found in various genera; *e.g.*, in *Polyphagus* and *Zygorhizidium* (fig. 3[C,D]). In the former. which is parasitic on *Euglena*, the fungus possesses a highly developed system of haustorial threads, enabling it to attack a number of algal cells simultaneously. In certain other members of the group these threads are less delicate and resemble the hyphae of higher forms. In *Physodema* and *Urophlyctis* such hyphae develop large, swollen, intercalary, pluricellular vesicles, whose component cells not only serve as centres for fresh hyphal development. but also give rise to large, thick-walled resting spores (fig. 3[E]). In the case of species of these genera on alfalfa, beet and other plants, prominent warts or tumourlike swellings are formed on the host. The same is true of *Synchytrium* (*e.g.*, in black wart of potato).



FROM (A, B, C, E, F) E. GAUMANN, "VERGLEICHENDE MORPHOLOGIE DER PILZE" (GUSTAV FISCHER), (D) AFTER F. MOREAU IN "LE BOTANISTE"

FIG. 5

(A) Sporangiophore of *Thamnidium elegans* bearing a large terminal sporangium and numerous lateral sporangiola; (B) conidophore of Chaetocladium *brefeldii*; (C) stages in germination of the monosporic sporangiolum of Chaetocladium *jonesii*; (D) sporangium of *Blakeslea* trispora; (E) sporangiola of same; (F) sporangia of *Syncephalastrum* cinereurn, each containing a single row of spores



FROM GWYNNE-VAUGHAN AND BARNES, "FUNGI, (CAMBRIDGE UNIVERSITY PRESS)

FIG. 6—MUCOR HIEMALIS

(A, B) Progametangia formed as lateral branches of the hyphae; (C) each progametangium divided by a septum to form a gametangium and a suspensor; (D) fusion of the two gametangia; (E–G) successive stages in the maturation of the zygospore

Oömycetes.—These fungi have a well-developed mycelium of large coenocytic branching hyphae. The lower families (Monoblepharidaceae, Saprolegniaceae) are usually saprophytes, living in water on vegetable or animal remains, while the Peronosporaceae are chiefly highly specialized parasites on land plants. The group exhibits structural modifications of both its asexual and sexual organs which are related to the gradual change from an aquatic to a terrestrial existence.

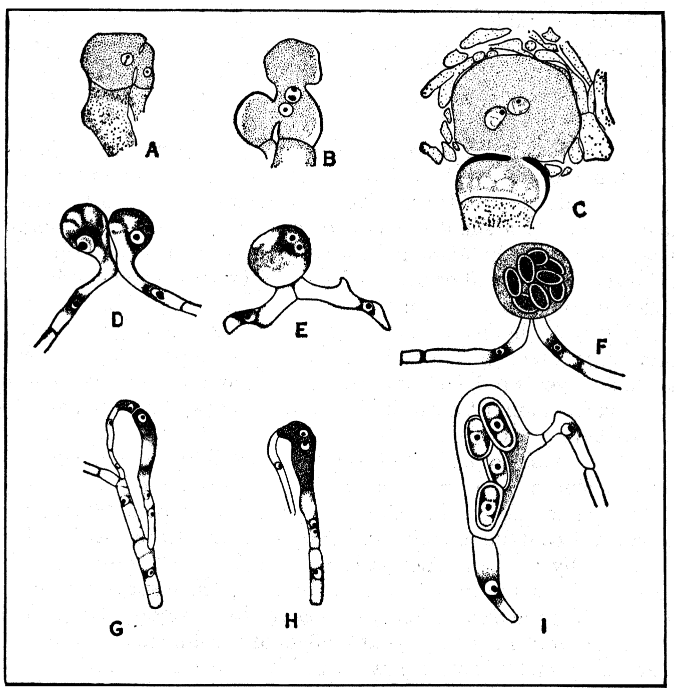
In the lower orders propagation is by zoospores. uniciliate in the Monoblepharidales. biciliate in the Saprolegniales and Peronosporales or downy mildews. The sporangium in the Saprolegniales may be merely a slightly enlarged terminal portion of the hypha (fig. 4[D]). In *Pythium* and *Phytophthora* of the Peronosporales it is usually spherical or oval in form and under certain conditions, following dissemination, may put out a germ tube which develops directly into a hypha. In other genera of the order (*e.g., Peronospora)* this direct mode of germination is alone possible, zoospores are no longer produced and the sporangium is now capable of germinating in moist air or in dew and thus adapted for a parasitic life on land plants (fig. 4[F]).

During sexual reproduction the group exhibits the tendency for replacement of the union of motile gametes by conjugation of walled gametangia. In *Monoblepharis* the female organ, the oogonium, contains a single, nonmotile. uninucleate egg which is fertilized by a motile spermatozoid, which closely resembles the zoospore in structure. The fertilized egg then surrounds itself with a thick membrane and forms a resting oospore (fig. 4[A]). In the Saprolegniales the young oogonium contains many nuclei, potential gametes, only a few of which persist to function as the egg nuclei. There are usually several eggs (oospheres) in the mature oogonium but there are no spermatozoids. Though parthenogenesis occurs in some species the antheridium normally puts forth a fertilization tube which conveys the male nuclei to the eggs. Thus, even in members of this aquatic group, water is no longer the means by which the male nuclei reach the eggs. In

Albugo bliti of the Peronosporales the egg has many nuclei and numerous male nuclei pass from the antheridium and fuse nith them in pairs. There is thus multiple fertilization The odspore which results may be regarded as a coenozygote since it contains many zygote nuclei, each the result of a separate fertilization In most of the higher Oomycetes, however, the mature egg is uninucleate and only one male nucleus passes into it from the fertilization tube. The assumption of the function of the gametes by the gametangia results in a single fertilization, made so as to ensure the production of the zygote. Many of the Oomycetes are parasites of cultivated plants and the cause of destructive diseases; *e.g.*, "damping off" disease of seedlings *(Pythium)*, late blight of potato *(Phytophthora)*, downy mildew of grape *(Plasmopara)*.

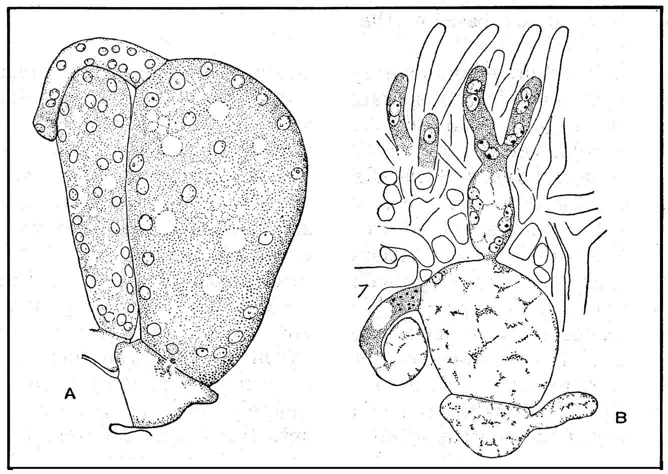
Zygomycetes.—These fungi are largely saprophytic in habit and terrestrial. Reproduction by conjugation results in the production of zygospores. Zoospores are unknown; the characteristic sporangia contain thousands of walled spores. Certain higher genera, however, are reproduced by conidia *(e g., Chaetocladium, Cunninghamella)*, and there is a series of forms showing that in this family, as in the Oomycetes, transition of sporangium to conidium has taken place. In one series this has been brought about by the gradual reduction in the number of spores in the sporangium; *e.g., Thamnidium* has small few-spored sporangia (sporangiola) with sometimes only one spore while in *Chaetocladium* a small sporangiolum in one species is completely filled by a single spore and hence appears as a conidium except at germination (fig. 5[A, B, C]), and in another no indication whatever of an endogenous spore is given. In *Blakeslea* multispored sporangia are normally accompanied by spherical heads bearing many sporangiola, each with only three spores. Between these types occasionally a complete series of intergrading forms exists. In the closely related genus, *Choanephora*, sporangiola are lacking and large multispored sporangia are accompanied by conidia borne over spherical heads as are the sporangiola of *Blakeslea*.

Members of the order Mucorales are saprophytes on organic substances or parasites on other molds. Among them is the genus *Mucor*, or bread and jelly molds. In the complete life cycle of the Mucorales, conjugation of coenocytic gametangia occurs. The resulting structure, the zygospore, contains many zygote nuclei.



FROM (A) GAUMANN, "VERGLEICHENDE MORPHOLOGIE DER PILZE" (GUSTAV FISCHER). (B) GWYNNE-VAUGHAN AND BARNES, "THE FUNGI" (CAMBRIDGE UNIVERSITY PRESS), (C, D, E) LA REVUE GÉNÉRALE DE BOTANIQUE (E. ORLHAC. PARIS)

FIG. 7.— (A) FORMATION OF COPULATION OPENING IN ENDOGONE LACTIFLUA; (B) NUCLEAR MIGRATION: (C) FORMATION OF HYPHAL SHEATH AROUND ZYGOTE: (D–F) DEVELOPMENT OF ASCI IN EREMASCUS FERTILIS: (G–I) DEVELOPMENT OF ASCI IN ENDOMYCES



FROM "ZEITSCHRIFT FUR BOTANIK (GUSTAV FISCHER)

FIG. 8.— (A) ANTHERIDIUM (LEFT) AND ASCOGONIUM (RIGHT) IN PYRONEMA, (B) ASCOGENOUS HYPHAE GROWING FROM ASCOGONIUM

The gametangia are usually morphologically indistinguishable. They may both arise on the same mycelium or on a specialized erect hypha or zygophore, as in *Sporodinia*. Such species are termed homothallic. In other cases the gametangia arise on two separate mycelia, differing in kind but not corresponding to distinct sexes. an example of heterothallism.

The germination of the zygospore usually results in the production of a germ tube bearing a germ sporangium. and in *Phycomyces nitens* it is in this structure that the zygote nuclei undergo the reduction divisions. The resulting spores are of two kinds, (+) and (—); but in any one germ sporangium only one kind is formed, except for a few spores, presumably binucleate, which are homothallic. It is of interest to note that H. Burgeff experimentally produced similar mycelia by the admixture of the contents of hyphae from (+) and (—) mycelia and thus reached the conclusion that homothallic mycelia contain both (+) and (—) nuclei.

Insect Parasites.—The Entomophthoraceae are chiefly a family of insect parasites of which one, *Entomophthora muscae*, attacks the common housefly. They are reproduced asexually by conidia which are shot off from the conidiophores in such numbers as to form a halo around the dead fly.

The small family of the Endogonaceae molds with its chief genus *Endogone* may be included here. The species form mostly underground stromata in which the reproductive organs are embedded. In *Endogone lactiflua* two conjugation branches of unequal size grow in contact with each other. They are multinucleate at first and from each a terminal cell containing a single nucleus is cut off. These cells unite and from the larger there arises an outgrowth which rapidly enlarges; into this pass the two gamete nuclei. This outgrowth is the zygote, which not only develops a thick wall but becomes surrounded and embedded by a number of vegetative hyphae (fig. 7[A, B, C]). Its germination is unknown.

Endogone has been included in the Ascomycetes and is of considerable interest as indicating a possible relation between that class and the Zygomycetes.

Ascomycetes (Sac Fungi)

This large class of higher fungi includes yeasts, molds, mildews and edible truffles and morels. Spores are produced in asci or spore sacs. The mycelium is composed of hyphae regularly segmented into portions containing one or several nuclei. Asexual reproduction is common and this class provides a rich variety of conidial fructifications. Many species may show several different types of conidia on the same mycelium. There are many species in which the ascus fruit is rarely produced and there may consequently be many generations reproduced entirely by conidia. It is not, therefore, surprising to find a large assemblage of fungi (Fungi Imperfecti) which are only known to reproduce asexually and many of which are believed to be incomplete forms of Ascomycetes.

The sexual reproduction of the lower Ascomycetes (Protascineae) may be compared with that of certain Phycomycetes such as *Endogone*. In *Eremascus fertilis* the sexual branches arise from two ceighbouring cells of a hypha and grow up side by side. They each receive a nucleus from their parent cells and then fuse together. The two nuclei unite and the zygote enlarges and forms a spherical ascus. The fusion nucleus divides and eight ascospores are formed (fig. 7[D, E, F]). The main point in which *Eremascus* differs from *Endogone* is that the direct product of fertilization is in the latter a zygospore and in the former an ascus. This then is one of the essential differences that mark off the lower Ascomycetes from the Zygomycetes. The higher forms are distinguished by a further advance, in that every ascus in an ascocarp is a separate zygote. The ascogenous hyphae usually grow out from ascogenous cells and by proliferation form a number of crooks or crosiers and thus provide for large numbers of asci. In heterothallic species the cells of the ascogenous hyphae may contain only a single pair of nuclei each and so form a dicaryotic system or dicaryon. It is in the ascus that nuclear fusion is finally accomplished, to be succeeded immediately by the meiotic phase and the formation of spores.

The ascogenous hyphae, however! do not form an independent self-supporting mycelium. They are dependent on the haploid mycelium for their nutrition, and this is accomplished by the enclosure of the ascogenous hyphae in a simultaneous growth of vegetative hyphae from the parent mycelium. Thus there is formed the fruit body or ascophore, one of the characteristic structures of the higher ascomycetes, showing in the different families great variety in structure and organization.

In *Eremascus* the two sexual organs are alike, but in the related *Endomyces* they are differentiated into a large female gametangium, the ascogonium and a smaller male, the antheridium (fig. 7[G, H. 1 In the Euascomycetes this differentiation in sex is maintained and the ascogonium is usually characterized by the development of a receptive portion, the trichogyne. Both structures may be divided by cross walls into several cells, the whole ascogonial branch (archicarp) thus consisting of a hypha of many cells, which is sometimes spirally coiled.

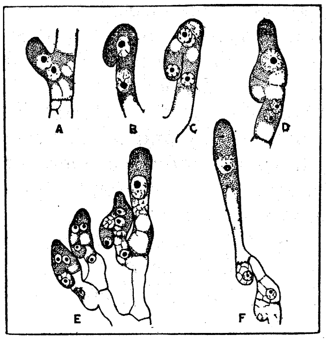
The antheridium shows no corresponding development, in fact it is possible to trace throughout the whole group the gradual dwindling in importance and final elimination of this organ.

It has been proved that macroconidia as well as microconidia (the so-called spermatia) may function in fertilization and that nuclei of opposite mating type may also be brought together as a result of nuclear migrations from one purely vegetative system to another. In *Neurospora* the microconidia also germinate readily to form perfectly normal mycelia. They are therefore asexual organs of dissemination. that may in addition function in place of gametes, rather than differentiated male cells.

In *Pyronema omphalodes* the large pear-shaped ascogonium bears at its upper end a tubular trichogyne, the tip of which fuses with the club-shaped antheridium. All these structures are multinucleate. The contents of the antheridium pass first into the trichogyne and then. by absorption of the intervening wall, into the ascogonium, where the male and female nuclei become associated (fig. 8[A, B]). In *Humaria granulata* the trichogyne has disappeared though the ascogonium still has the form of those described above and like them gives origin to the ascogenous hyphae. Finally in *Humaria rutilans* the ascogonium itself has disappeared and with it, all trace of autogamous fertilization.

A parallel series can be traced in a related genus, *Ascobolus*, in which the ascogonium is many celled. In *A. magnificus*, which is heterothallic, normal conjugation takes place between antheridium and trichogyne; in *A. furfuraceus* antheridia are absent. In one species, *Ascobolus carbonarius*, the long and often coiled trichogyne comes into contact with one of the oval, stalked conidia, borne on the mycelium, and fuses with it and thus, apparently. fertilization is effected.

This process finds an interesting parallel in one of the lichen fungi. *Collema pulposum*. Here the archicarp, as in many lichen fungi, is a coiled thread terminating in a long slender trichogyne; the latter comes into contact with a conidium and fusion results. In other species of *Collema* the trichogynes, projecting above the surface of the thallus, get attached to their surface one or more uninucleate bodies, the so-called spermatia, which are formed in flask-shaped bodies resembling pycnidia. As the name implies, these spermatia have been regarded sometimes as male gametes.

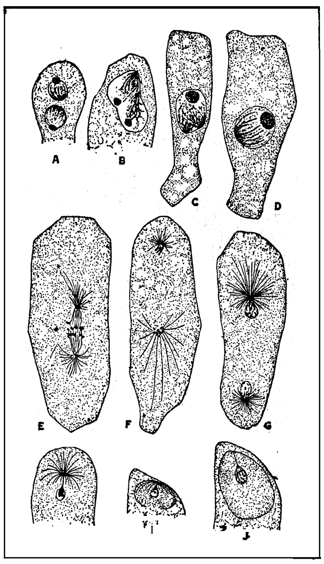


FROM "ZEITSCHRIFT FÜR BOTANIK" (GUSTAV FISCHER)

FIG. 9.—(A–F) CROSIERS IN ASCOGENOUS **HYPHAE** OF PYRONEMA

These processes of modification and disappearance of the sexual organs should not obscure the fact that the essential feature of fertilization is the fusion of two haploid nuclei, and it is immaterial whether these nuclei are derived from different sexual organs, antheridium and ascogonium, from the ascogonium alone, from an ascogonium and a vegetative cell or from two vegetative cells. In every case the process which brings them together, whether fusion immediately results or not, marks the starting point of a new development, viz., dicaryotic growth, represented by the ascogenous hyphae. These hyphae eventually give rise to the asci and in the majority of the Ascomycetes they are formed in a characteristic way. As already stated the ultimate segments of these hyphae are binucleate and any one of them may grow out to a short branch, into which the two nuclei pass. This cell now curves over at the tip to form a hook, and the nuclei moving up to the summit divide there conjugately. The spindles are so arranged that when the two cross walls are formed, the summit of the crook contains two nuclei, while one is in the tip and another in the stalk (fig. 9).

In most cases the tno nuclei at the summit fuse together and form the fusion nucleus of an ascus, which is the only truly diploid cell in the whole life cycle. The point of the crook and the stalk lie close together and either of them may now become binucleate by the migration into it of the nucleus from the other. The binucleate cell so formed may now originate a new crook and so the process may be repeated several times.



FROM E. GAUMANN VERGLEICHENDE MORPHOLOGIE DER PILZE (GUSTAV FISCHER)

FIG 10.—PHYLLACTINIA CORYLEA (A) Young ascus with dicaryon; (B–D) caryogamy; (E–G) steps in division of primary ascus nucleus (*Erysiphe cichoracearum*); (H–J) spore formation

The young ascus now enlarges, the nucleus also increasing in size, and finally the latter divides; this is followed by two further divisions and thus eight nuclei are formed uhich become the centres in forming eight ascospores (fig. 10). There is no doubt that the first division in the ascus is the heterotype or reducing division (*see* CYTOLOGY). The two following divisions have, for the most part, the characters of postmeiotic divisions.

There are a number of forms, however (*Sphaerotheca, Humaria, Lachnea, Ascobolus*), in which the nuclei in the ascogonium, however derived, have been described as fusing together. Obviously a double reduction would be necessary to produce haploid nuclei for inclusion in the ascospores, and the second reduction is said to take place during the second or third division Genetic uork on Ascomycetes disproves the whole theory of a double fertilization and a double reduction. Until one finds through hybridization experiments eight genetically different kinds of spores formed in certain asci of a cross, or that the spores alternate one and one for definite generic characters, the theory of double fertilization must be abandoned.

These genetic studies have shown also that heterothallic Ascomycetes can readily be hybridized, and it has been shown that genetic characters are inherited according to Mendelian principles. The Mendelian ratios. which are only approximated in experiments with higher animals and plants, occur precisely and regularly in breeding the mold *Neurospora,* which has the additional merit of permitting mating of cells of known genetic composition. Dominance, recessiveness, heterocaryotic vigour. lethal factors. which may be either dominant or recessive, as well as other genetic features nhich are so well knoun in connection with genetic work nith the common fruit fly, maize, datura and other diploid organisms. are not known in the fungi.

The mode of spore formation in the ascus is peculiar. The eight nuclei formed in the third division show delicate radiations, extending from a centrosome, nhich meet around the nucleus and thus delimit a portion of the protoplasm on which a wall is secreted to form a young spore (fig. 10[H, I. J]).

In the higher Ascomycetes, the developing ascogenous hyphae are enclosed by a development of the haploid mycelium, on nhich, in fact, they are parasitic. The whole structure which results is known as a fruit body or ascocarp. In the simpler orders (Plectascales and Perisporiales) the enclosure is complete, the sterile hyphae compacting together on the outside to form a completely closed investment. Such a fruit body is called a perithecium. In other orders (Hypocreales, Sphaeriales, Laboulbeniales) a perithecium is formed, often flask shaped and with a neck with a definite opening for the discharge of the spores (fig. 12).

The remaining orders have a fruit body known as an apothecium. Here the numerous asci are assembled, together with sterile hyphae or paraphyses, in a continuous layer known as the hymenium. This is freely exposed on the surface of the ripe fruit body which may be a flat disk or a cup (Pezizaceae) or a convex, often stalked, structure (Helvellaceae).

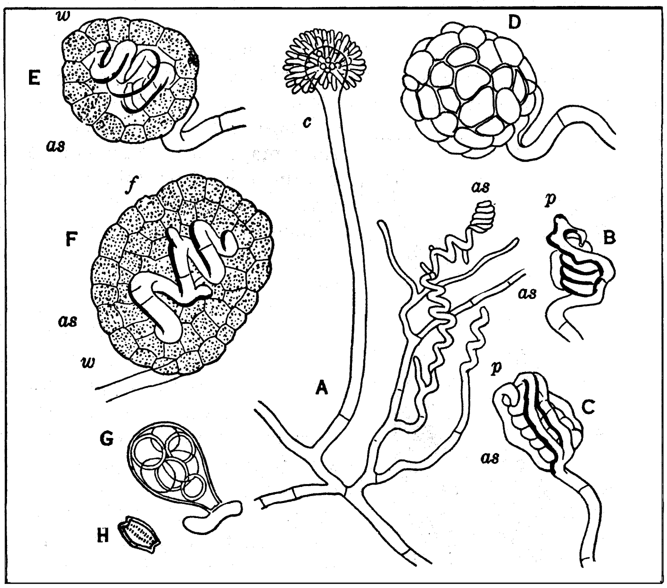
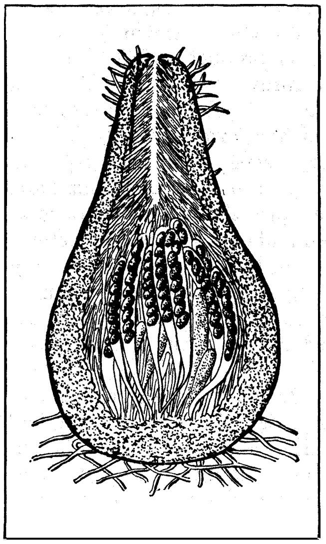


FIG. 11.—DEVELOPMENT OF EUROTIUM REPENS

(A) Hypha with conidiophore (*c*) of the *Aspergillus* stage and young archicarp (as); (B) spiral archicarp (as) with the antheridium (*p*); (C) the same, beginning to be surrounded by hyphae forming perithecium wall; (D) perithecium; (E, F) sections of young perithecia: (*w*) parietal cells, (*f*) pseudoparenchyma, (as) ascogonium; (G) an ascus; (H) an ascospore

Yeasts.—The Endomycetales are a small family in which (Endomyces, *Eremascus*) the asci result directly from the conjugation of the gametangia and are thus borne directly on the mycelium (fig. 7). The important family of the yeasts, Saccharomycetaceae, is included in this order. These are fungi which, living normally in liquid media, have the form of oval or spherical cells which reproduce by budding. Some forms, when grown under certain conditions. can develop true hyphae and thus show their derivation from fungi of normal structure. Many genera have a sexual process represented by the conjugation of ordinary cells. The result is the formation of an ascus in which ascospores are formed (*Schizosaccharomyces, Zygosaccharomyces*). *Saccharomycodes* ludwigii forms the ascospores in the ordinary yeast cells and conjugation takes place between the germinating spores. The ordinary yeast cells so produced are thus diploid cells. Work on the yeasts has shown that the industrial yeasts may be, in fact, diploid in their nature. It has been proved that hybrids between various strains of the industrial yeasts may be obtained rather easily so that new and better races of yeasts can be developed.



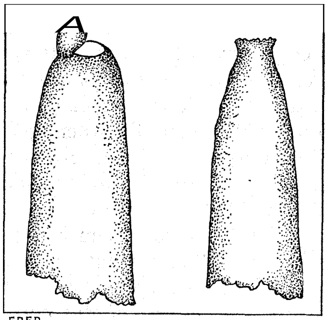
FROM STRASBURGER LEHRBUCH DER BOTANIK (GUSTAV FISCHER)

FIG 12 —PERITHECIUM OF PODOSPORA FIMISEDA IN LONGITUDINAL SECTION

The Exoascaceae is a family of parasitic fungi which grow on the higher plants, often producing malformation of the leaves, fruits, etc. The mycelium may develop in the deeper tissues, but eventually makes its way to the surface and the asci are produced between the epidermal cells, or more frequently they arise from hyphae which lie between the epidermis and the cuticle The cells of the mycelium are binucleate, and in the young ascus the two nuclei fuse and then undergo division, eight spores resulting in the usual manner. In some species (*Taphrina*) the original spores may bud in the ascus and give rise to hundreds of small conidia.

When spores are sown in suitable culture fluids they bud after the manner of yeast cells and produce conidia. In two species of *Taphrina* it has been shonn that these secondary conidia can conjugate in pairs by means of a short tubular process The nucleus from one-cell passes into the other and the binucleate cell so formed nos puts out a germ tube. Moreover. when the eight spores from one ascus are carefully isolated and germinated apart, it is found that they fall into two groups, the conidia of one group will not conjugate together but do so readily with any member of the other group. They are thus, like many of the Mucorini. heterothallic, and the separation into the two mating types must take place during the divisions in the ascus.

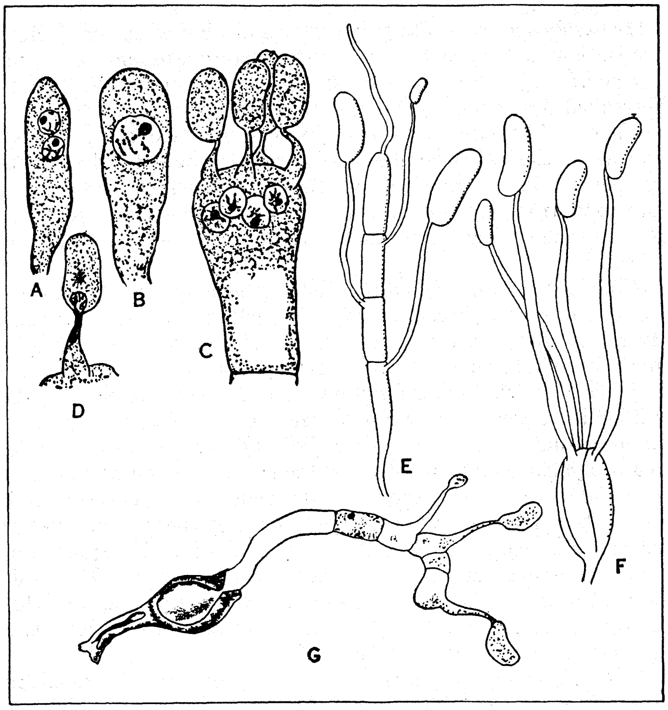
Blue and Green Molds.—The Plectascales include the genera *Eurotium* (fig 11) and *Carpenteles,* whose imperfect stages are the common saprobic molds *Aspergillus* and *Penicillium,* among the most ubiquitous and omnivorous of fungi. The ascocarps are closed and comparatively rare. Dissemination is chiefly by conidia, and for many of these molds perfect stages are unknown; these must be considered Fungi Imperfecti.



FRED J. SEAVER

FIG. 13.—LEFT, TIP OF OPERCULATE ASCUS; RIGHT, INOPERCULATE ASCUS

Powdery Mildews.—The Perisporiales include the Erysiphaceae or powdery mildews and the Perisporiaceae or sooty molds. The Erysiphaceae occur as parasites on leaves and tender parts of living plants, forming a white mycelium dotted over with black fruiting bodies (the cleistothecia). They give rise to diseases on numerous plants in temperate regions, among them the mildew of hop, gooseberry and rose and many other cultivated plants. The Erysiphaceae rarely fruit in the tropics; the one and only species reported in fruit from Puerto Rico (*Erysiphe malachrae*) was later found to be the cause of the commonest cotton disease in Peru. There it is known as



FROM (A, B, C, D) W. RUHLAND, "KENNTNISS DER INTERCELLULAREN KARYOGAMIE BEI DEN BASIDIOMYCETEN" (ARTHUR FELIX), (E, F) W. G. SMITH, "BRITISH BASIDIOMYCETES," (G) GWYNNE-VAUGHAN AND BARNES, "FUNGI" (CAMBRIDGE PRESS)

FIG. 14

(A) *Armillaria mellea:* young basidium with the two primary nuclei; (B) after fusion of the two nuclei (*Hypholoma appendiculatum*); (C) basidium before the four nuclei, derived from the secondary nucleus of the basidium, have passed into the four basidiospores; (D) passage of a nucleus through the sterigma into the basidiospore; (E) basidium and spores (*Auricularia auricula*); (F) basidium and spores (*Exidia glandulosa*); (G) *Uromyces*

manta blanca or "white blanket" because of the frosted appearance imparted to the leaves of cotton in autumn. The Perisporiaceae in contrast are predominantly tropical, produce a black mycelium on leaves and other parts of living plants but occur as epiphytes, feed on honeydew and other materials excreted by sucking insects, disfiguring the hosts on which they grow. The Microthyriaceae also included here differ from the Perisporiaceae in having shield-shaped perithecia with an ostiole instead of closed cleistocarp or cleistothecium.

The orders Hypocreales and Sphaeriales (sphere fungi) include most of the families which frequently have been grouped together under the name of Pyrenomycetes. They have perithecia which, when mature, have a well-defined mouth (fig. 12). In some genera the fruit bodies are borne directly on the mycelium *(Sordaria, Chaetomium)* or isolated in the host tissues (*Venturia*), but more often they are borne on a stroma *(Nectria, Cucurbitaria)* or embedded in it *(Epichloe, Claviceps, Valsa)*. The stroma may be flat or cushion shaped or immersed in the tissues of the host. In the more specialized forms the stroma may show a sterile basal stalk, the perithecia being limited to the upper part, where they may more efficiently distribute their spores *(Xylaria)*. The Pyrenomycetes is by far the largest group of the Ascomycetes, a conservative estimate of the number of species being 10,000. Though the majority are saprophytes some well-known diseases of plants are caused by members of this group; *e.g.,* canker in fruit trees (*Nectria*), ergot of cereals and other grasses *(Claviceps)*, apple and pear scab *(Venturia)*. Most species of *Cordyceps* are parasites on insects.

The Pezizales are divided into two sections, the operculates in which the asci open with a definite circular lid (the operculum), and the inoperculates in which the ascus opens with an irregular rupture (fig. 13). At maturity the spores are discharged from the asci like shot from a gun and in such numbers that they appear as a cloud of smoke. This phenomenon occurs in the operculates and inoperculates alike. The fungi of this order are called cup fungi because many of the species are disk or cup shaded.

The operculates include the larger and more conspicuous forms, the cups often reaching a diameter of several inches, although many are also minute. Two families are recognized—the Pezizaceae, in which the fruiting bodies are predominantly cup shaped, and the Helvellaceae, which comprise those with a stem and head of variable form. To this group belongs the May mushroom, *Morchella esculenta.* With few exceptions the operculates are saprophytic; and the conidial stage, while present in some forms, is inconspicuous and in most forms unknown. A few of these, such as *Pyronema* and *Ascobolus,* have definite sex organs, while in a large majority definite sex organs are obscure or absent, although heterothallism has been demonstrated in several.

The inoperculate cup fungi include some medium-sized forms, but a large majority are minute in size. While perhaps a large majority are saprophytic, a much larger percentage of this group is strictly parasitic and in these the asexual or conidial stage is much more highly developed and is doubtless an adaptation to their parasitic habits. This is especially true of *Sclerotinia* and its segregates. The conidial stages take a variety of forms, such as *Monilia* and *Botrytis*. The genus *Monilinia* was established for those species which have a *Monilia* as their conidial stages. *Monilinia fructicola* is the brown rot of peach and very destructive.

L. Tulasne in 186j observed minute bodies in certain Discomycetes which he called spermatia or conidiola, which he believed to be male sperms. In *1832* it was definitely proven by F. L. Drayton that microconidia which were found in many species of *Sclerotinia,* and which were probably morphologically identical with the spermatia of Tulasne, stimulated the production of apothecia when placed on certain structures which develop on another thallus of the same fungus. To this process is applied the term "spermatization," thus definitely proving heterothallism or the existence of (+) and (—) strains.

Truffles.—The Tuberales is a small group of fungi that includes the well-known delicacy truffles (*Tuber* sp.). They live underground in the neighbourhood of trees and may be concerned in the formation of mycorhizae. The hymenium lines internal chambers in the fruit bodies.

The Laboulbeniales is an order of peculiar fungi, whose manifold structure has been made known by the investigations of

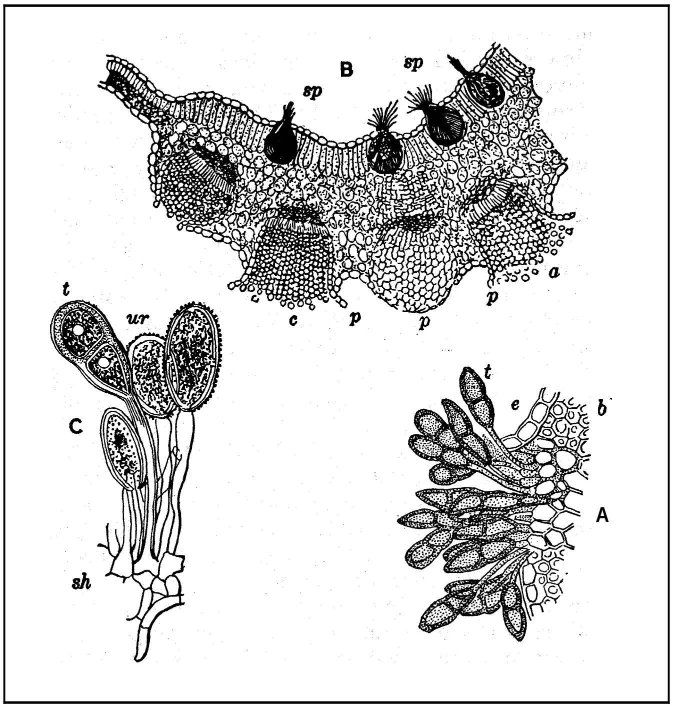
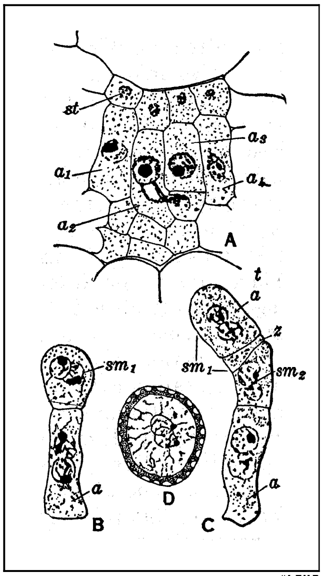


FIG. 15.—PUCCINIA GRAMINIS

(A) Mass of teliospores: (*t*) on a leaf of couch grass, (*e*) epidermis ruptured, (*b*) subepidermal fibres (after De Bary); (B) part of vertical section through leaf of *Berberis* vulgaris, with (a, c) aecial sori, (*p*) peridium and (*sp*) pycnia (after Sachs); (C) mass of uredospores (*ur*), with one teliospore (*t*), (*sh*) subhymenial hyphae (after De Bary)

R. Thaxter in the United States. They are minute fungi from one to ten millimetres in height which grow attached to the bodies of insects, especially beetles. They are dark brown in colour and consist of a basal receptacle which bears appendages, on which are the sexual organs. The female organ is fertilized by male cells or spermatia. The fertilized ascogenic cell (ascogonium) gives rise to asci which are enclosed in a perithecial wall that develops around the female organ. Some species are probably heterothallic (*Amorphomyces*). They have been aptly described as ornamental parasites, and seem not to harm their hosts.



AFTER BLACKMAN IN STRASBURGER, "LEHRBUCH DER BOTANIK" (GUSTAV FISCHER)

FIG. 16.—PHRAGMIDIUM VIOLACEUM

(A) Portion of young aecium: (*st*) sterile cell, (a) fertile cells; at a, the passage of a nucleus from the adjoining cell is seen; (B) formation of the first spore mother cell (*sm*), from the basal cell (a) of one of the rows of spores; (C) further stage in which from srn, the first aeciospores (a) and the intercalary cell (*z*) have arisen, sm_2, second spore mother cell; (D) ripe aeciospore

Basidiomycetes (Club Fungi)

The mycelium, like that of the Ascomycetes, is fully segmented, but in the haploid mycelium the segments are uninucleate. They differ from the Ascomycetes in the absence of sexual organs, whose functions are performed by hyphal or conidial fusions. The dicaryotic (binucleate) mycelium which results is extensively developed, has an independent existence and in the higher forms, is, in fact, the only mycelium which can normally be distinguished.

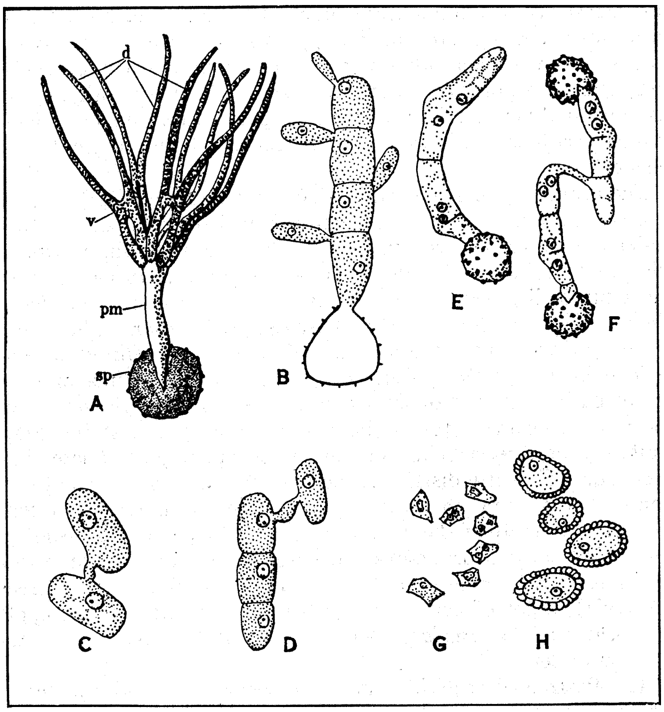
Though gametangia are absent, the haploid mycelium is often differentiated for mating type. Heterothallism occurs in the Uredinales and Ustilaginales, and is widespread in the higher forms. In the latter, pseudogamous fusions presumably occur between hyphae of the mycelia of different kinds, though in only a few cases have these actually been observed. Asexual reproduction by conidia and oïdia occurs in both types of mycelia.

In the lower families the basidia are borne directly on the dicaryotic mycelium, but in the vast majority of forms they are borne on fruit bodies or sporophores. These are not formed, as in most Ascomycetes, as the immediate result of a sexual process (see above) but arise from dicaryotic mycelium at a time and stage in its development which are determined by physiological factors, such as .nutritive conditions, humidity, light, etc. The basidium, like the ascus, is the gonotocont. In it the reduction of the chromosomes is effected but the daughter cells (usually four) resulting are exogenous; *i.e.*, borne on short stalks (sterigmata) outside the mother cell (fig. 14[D]). Two kinds of basidia occur. Those characteristic of the subclass Homobasidiomycetes are, like asci. undivided (holobasidia). Most of those of the subclass Heterobasidiomycetes have the basidia divided by septa into four cells (phragmobasidia) (fig. 14[E]). The dividing walls may run transversely, *e.g.*, Auricularia, or longitudinally as in Tremella (fig. 14[F]). The fertilization which takes place in the young basidium is followed immediately by the reducing divisions and the development of spores. but in the Uredinales and Ustilaginales, after the nuclear fusion, a resting stage, often prolonged. may intervene. This may be accompanied by a thickening of the wall of the mother cell! which may even become set free from the mycelium as a spore (teleutospore, chlamydospore). These probasidia, as they are called, germinate by a short hyphal outgrowth (promycelium) which bears the four basidiospores (sometimes termed sporidia). The prohasidium and promycelium together constitute two successive developmental stages and two morphological divisions of the complete basidium. In these forms the probasidium is concerned with the distribution and perennation of the fungus as well as with the production of the basidiospores (fig. 14[G]).

The basidiospores may be thin walled and adapted for immediate germination, and this is the case in the Heterobasidiomycetes and in some of the lower families of the Homobasidiomycetes. These thin-walled spores when germinated in water or nutrient solutions may sprout like yeast cells and produce gemmae or secondary conidia. In the higher families many are thick walled and are resting spores. In the majority of Basidiomycetes the spores are discharged from the sterigmata, but only for a short distance (0.1–0.2 mm.). They are, for the most part, distributed by air currents.

Within the subclass Heterobasidiornycetes is the family Auriculariaceae of mostly parasitic forms of which the simpler representatives, *e.g., Helicobasidium,* bear the basidia scattered on a loosely woven mycelium, but in the more typical forms, *e.g.*, Auricularia, the hyphae, which have gelatinous walls, are compacted to form fruit bodies, often of considerable size. The basidia are borne on the lower surface of these fruit bodies and are the terminal portions of hyphae which do not reach the surface, become somewhat wider and divide transversely into four cells. From each of these arises a long filament which projects beyond'the surface of the thallus and develops a spore at its tip (fig. 14[E]). The spores can germinate at once and bud off small curved conidia. The fruit body is formed throughout of binucleate cells; the origin of this condition is unknown. The Jew's-ear (Auricularia *auricula*) is a well-known representative of this order.

Rusts.—The Uredinales is a large order of parasitic fungi, in the subclass Heterobasidiomycetes: known as the rusts, which are responsible for the diseases of many of the higher plants—ferns, conifers and flowering plants. There are two kinds of mycelium, haploid and dicaryotic. Both are parasitic and may be found on the same host (autoecious) or on different hosts (heteroecious), sometimes belonging to widely different families. They are intercellular, highly specialized parasites, producing haustoria which penetrate the living cells of the host, and often stimulate the tissues to increased growth and the formation of galls. They are often short-lived—attacking the leaves of the host and falling with



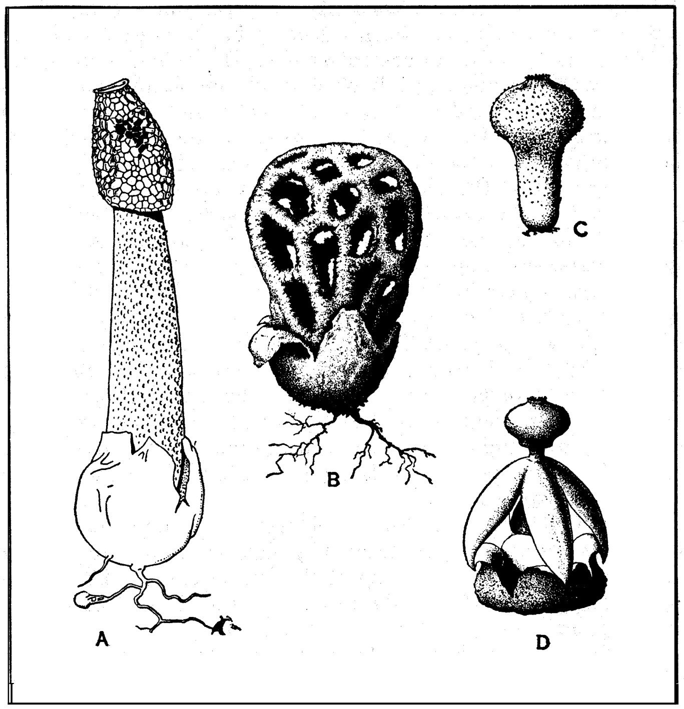
FROM (B-H) E. GAUMANN, "VERGLEICHENDE MORPHOLOGIE DER PILZE" (GUSTAV FISCHER) (A) VINE, "STUDENT'S TEXT BOOK OF BOTANY, (ALLEN & UNWIN)

FIG. 17

(A) Germinating resting conidia of Tilletia caries; (B) germination of smut spores (*Ustilago scabiosae*); (C, D) copulation of sprout cells (*Ustilago* violacea): (E, F) germinating and copulating promyceiia (*Cintractia montagnei*); (G) young binucleate spore fundaments; (H) mature uninucleate spores (*Ustilago holostei*)

them; but when they extend to the stems of perennial plants. they are also perennial. Four kinds of spores may be produced in the life cycle of one species. viz., pycniospores (called also spermatia) on the haploid mycelium and aeciospores (aecidiospores), uredospores and teliospores (teleutospores) on the dicaryotic mycelium. The aeciospores are borne in fructifications (sori) known as aecia. which are frequently cup-shaped receptacles surrounded and enclosed by an investment (peridium), and containing chains of spores, which arise from a primordial layer of cells at the base of the aecidium. The spores are binucleate, and it has been shown that in the development of the aecium the basal cells are formed from uninucleate cells which either become binucleate by the migration of a nucleus from a neighbouring cell or, by uniting in pairs. give rise to a fusion cell with two nuclei (fig. 16). In either case there is a process. regarded by some workers as sexual in nature, by which the dicaryotic generation is initiated, whose first products are the aeciospores. The pycniospores are thin-walled cells of small size borne in sori known as pycnia (spermogonia). In many species these are flask-shaped structures with the base sunken in the host tissue and with protruding ostiolar filaments. Attempts to bring about infection of the host by means of pycniospores were unsuccessful and they long were regarded as functionless. It has been discovered that the pycniospores are functional. They are exuded from the pycnia in drops of sweet fluid (nectar) which is sought by flies and other insects. When drops of this nectar are transferred from the pycnia on one mycelium to those on another mycelium, pycniospores are thereby transferred and the formation of aecia follows. When such transfer of pycniospores is prevented by the exclusion of insects, which serve to transfer the nectar in nature, aecia do not form. It seems clear that the dicaryotization which is effected in the aecial primordium is initiated by the transfer of pycniospores by insects. The details of the mechanism by which the invading pycnial nuclei finally reach the deep-seated aecial primordium are less clear. Evidence indicates the ostiolar hyphae as the place of entry and that nuclear migration follows. These facts explain how new races of rust may arise through hybridization in the development of the aecial stage.

The aecidiospores germinate readily on the surface of the appropriate host, and the germ tubes enter the tissues by way of the stomata. They give rise to a binucleate mycelium and on this in due course appear the uredospores. These are so-called "summer" spores, *i.e.*, conidia of the diploid mycelium, and can infect fresh hosts and so spread the disease. Later in the year and on the same mycelium teliospores are formed. These are typically thick-walled and resting spores. The uredospores are binucleate and so are the young teliospores, but in the latter the two nuclei fuse before their development is completed. The teliospores are thus the probasidia. They germinate in due course and give rise to the promycelium; on the sterigmata of this organ after its division into four cells the four basidiospores. known as sporidia, are produced. These are uninucleate and can at once infect the proper host and develop the haploid mycelium. This is the life history of one of the most complicated forms, the so-called euforms. of which the black rust of wheat (*Puccinia graminis*) is an example. In this species the host of the haploid mycelium is the common barberry (fig. 15). In other species one or more of the spore types may be absent. The -opsis forms have no uredospores (*Gymnosporangium* sp.). In the brachy- forms the aecia are absent but the pycnia are accompanied by sori of uredospores, nhich in some cases arise as the result of a fertilization like that already described as taking place at the base of the aecium. These primary uredospores thus appear to be homologous with aeciospores. Other species have neither aecia (or primary uredospores) nor pycnia and are known as hemi- forms; there are micro- forms in which teliospores alone occur. In the latter the binucleate condition is established at an early stage— probably by the migration of a nucleus from one cell to another of the haploid mycelium. The most reasonable interpretation of these forms with a shortened life history is that they have been derived from the more complete forms. The teliospore is the spore form almost invariably present and the classification of the family is based largely on its structural peculiarities.



FROM (A) W G. SMITH. "BRITISH BASIDIOMYCETES" (B, C, D) E. GAUMANN, "VERGLEICHENDE MORPHOLOGIE DER PILZE" (GUSTAV FISCHER)

FIG 19 —(A) MATURE STINKHORN (PHALLUS IMPUDICUS), SHOWING REMNANT OF ENCLOSING MEMBRANE, (B) FRUCTIFICATION OF CLATHRUS CANCELLATUS (C) A PUFFBALL (LYCOPERDON PERLATUM), (D) FRUCTIFICATION OF AN EARTHSTAR (GEASTRUM CORONATUM)

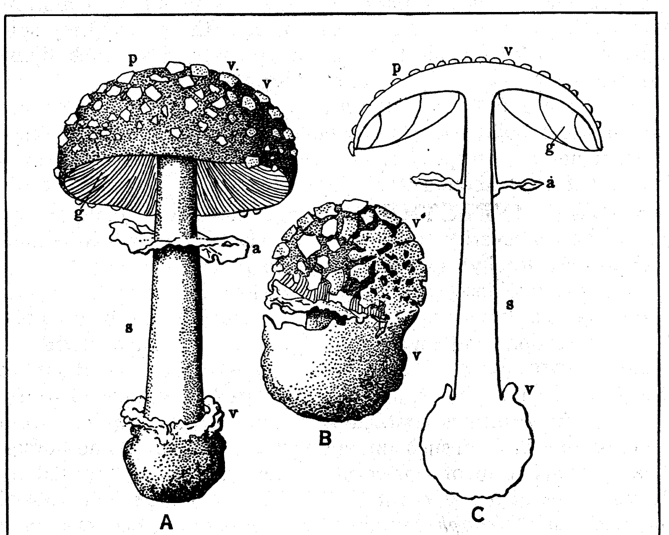


FIG. 18 —AMANITA MUSCARIA

(A) Mature fruiting body (mushroom); (B) young (button) stage; (C) longitudinal section: (*p*) the *pileus*, (*g*) the gills, (*a*) the annulus or remnant of partial veil, (*v*) volva or remnant of universal veil, (*s*) stalk

Smut and Bunt Parasites.—The Ustilaginales were regarded by O. Brefeld as shoving a halfway stage in the evolution of the class Basidiomycetes from the lower fungi and he placed them in a separate group, the Hemibasidiomycetes. The cytology of the group, however, leaves little doubt that they are true Basidiomycetes and form a parallel order to the Uredinales or rusts.

They are parasites on grain and fodder plants causing the well-known diseases smut and bunt The mycelium, nhich is usually binucleate, often develops slowly at first and then grows rapidly at a particular stage of development of the host and produces its spores; *e.g.*, the smut of wheat (*Ustilago tritici*) attacks the wheat in the flower. The grains already infected are sown, the plant develops without external sign of disease and not until the ears are formed does the fungus develop in the flowers and give rise to a black powdery mass of spores. These chlamydospores are formed from binucleate hyphae which divide into short cells which separate, round themselves off and form the thick-walled chlamydospores. The two nuclei fuse in the spore which is, like the teleutospore of the rust, uninucleate (fig. 17), but diploid.

On germination the spores give rise to a promycelium. In the Ustilaginaceae the nucleus undergoes two successive divisions as in the Uredinales, and the promycelium (basidium) is divided by transverse walls into four cells. These may not form sporidia but may pair by conjugation tubes between genetically unlike (+) and (−) cells (*Cintractia montagnei;* fig. 17), or they may bud off sporidia, which sprout like yeast cells and eventually conjugate in pairs (fig. 17). The binucleate cells, however formed, can sprout secondary cells or give rise to hyphae, either of which can infect a new host. In one species (*Ustilago zeae*), the mycelium in the host is at first uninucleate and conjugation takes place at the appropriate time between cells of the hyphae, which then round off and form spores.

In the Tilletiaceae, the promycelium remains undivided! eight or more daughter nuclei are formed by division and a whorl of long curved sporidia arise at the tip of the promycelium. These fuse together in pairs, and from the fusion cell secondary sporidia may arise (fig. 17[A]).

The Tremellaceae is a family of mostly saprophytic fungi with gelatinous fruit bodies. Their mycelium is binucleate and gives rise to nearly spherical basidia. In these the fusion nucleus undergoes the usual divisions and the cell becomes divided by four vertical walls into four daughters, from each of which a long filament grows up to the surface of the fruit body and develops a spore (fig. 14[F]).

The general characters of the subclass Homobasidiomycetes have already been outlined. Their basidia are undivided and they are typically collected together in a continuous layer, the hymenium, in which are associated with them sterile hyphae or paraphyses. In the lower families the hymenium is borne on the surface of the fruit body. This may be a flat crust of indeterminate form and extent or, in species growing on vertical trunks of trees, may be bracket shaped. In this case the hymenium is on the lower surface. A whole series of forms show that the bracket may narrow at its point of attachment and form a stalk and the fruit body is then differentiated into the stalk or stipe and the broad cap or pileus. More advanced forms show the central stalk and caplike pileus characteristic of the common mushroom and its relations, the toadstools. A further modification of the hymenium-bearing surface is the development of spines and wrinkles, folds, thin plates (gills) and of pits and tubes, all of which have the effect of increasing manyfold the surface of the hymenium, without correspondingly increasing the size of the sporophore (fig. *18).*

In the higher families the fruit body when young is a rounded spherical structure and the hymenial layers are differentiated from the inner tissues. In the Agaricales the fruit body ruptures before the basidia are matured and so exposes the hymenium, but in the Gasteromycetes the opening of the fruit body is delayed until the spores have been formed. In this last-named group the fungus fruit body is often elaborately constructed and may be formed of fibrous tissue, gelatinous tissue, plectenchyma, etc. At maturity a rapid expansion of pseudoparenchymatous tissue forming the so-called receptaculum may rupture the outer covering and expose the mass of spores, embedded in the mucilaginous remains of the fertile tissue clinging to its surface (Phallus impudicus, Clathrus cancellatus; fig. *19).*

For further discussion of the symbiotic relations of fungi with algae see the article LICHENS; for the symbiotic relations of fungi with the higher plants, especially orchids, heaths and forest trees, see MYCORRHIZA. For the role of the parasitic fungi in plant diseases see PLANT DISEASES.

For human diseases caused by fungi, see FUNGUS INFECTIONS. *See* also DRY ROT; MUSHROOM; PUFFBALL; SMUT AND BUNT; TRUFFLE; YEAST.

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FUNGUS GNAT, or mushroom fly, any member of the families Mycetophilidae and Sciaridae of the order Diptera (*q.v.*), small, mosquito-like flies almost all of which as maggots (larvae) feed on fungi. In the Sciaridae, or dark-winged fungus gnats, the eyes almost touch and the wings are usually dusky. The larvae are creamy white or grayish and sometimes occur in such large numbers that they migrate over the ground in snakelike lines which may be one-half inch deep, the migrations evidently occurring when the food in the leaf mould or humus is exhausted and a new Source must be found. *Sciara tritici* damages the roots of wheat. Species of *Sciara,* and certain mycetophylids, attack mushroom beds and sometimes completely destroy them. In the Mycetophilidae there are a few injurious forms, including *Pnyxia* scabiei which bores into potato tubers and causes unsightly scabs; severe infestations occur; the female is wingless. Larvae of several species are luminous. *Arachnocampa luminosa,* occurring in countless numbers in the caves of New Zealand, light the caves; they spin webs, and sticky strands hang down apparently to catch flying insects. Large numbers of tourists visit the caves.

In Europe and North America the larvae of *Ceroplatus* are luminous and build sticky webs on which they crawl with ease; some, if not all, are predaceous. Adults, mostly less than one-fourth inch long, abound in swampy areas. (C. H. CN.)

FUNGUS INFECTIONS. Fungus diseases of man, or mycoses, vary in severity from the relatively benign skin infections such as dermatophytosis (ringworm) to fatal systemic infections such as coccidioidomycosis. In the United States in the 1950s, 350 to 400 deaths per year were reported as caused by fungi (*q.v.*). Benign infections and superficial mycoses occur much oftener.

Local Infections.—Dermatophytosis is caused by about 20 species of dermatophytes, a group of related fungi able to utilize keratin. Ringworm is contagious and usually is acquired from other persons or from such animals as dogs, cats, cattle and horses. The epidemic form of ringworm of the scalp (*q.v.*), caused by Microsporum *audouini,* occurs in children. Athlete's foot, caused by species of Trichophyton and Epidermophyton, occurs over a wide age range. (See also SKIN DISEASES; TINEA VERSICOLOUR.)

Thrush (*q.v.*), caused by Candida albicans, is an infection of the mucous membranes which sometimes spreads to the skin and occasionally becomes systemic. Vaginal thrush during pregnancy and oral thrush in the newborn are common. The fungus is commonly present in the intestinal tract of normal persons and is often present in the sputum of persons suffering from any type of pulmonary disease.

Actinomycosis, which occurs in both cattle and man and is caused by *Actznomyces bovis,* may involve the skin, subcutaneous tissues of the jaw, including bone (the condition called "lumpy jaw") and many of the visceral organs; *e.g.,* the lung, appendix or liver. The disease is characterized by firm swelling with formation of sinus tracts that discharge pus containing small colonies of the fungus. The fungus is present in normal persons in the tonsils and on tooth surfaces, and infection sometimes follows dental neglect or injury. *(See* also RESPIRATORY SYSTEM. DISEASES OF.)

Systemic **Mycoses.**—The three preceding groups of infections are caused by fungi which are frequently present on body surfaces of man, in many instances without producing apparent disease. The fungi causing most of the more severe systemic mycoses, on the contrary. are not normal residents in or on man but grow and survive independently as saprophytes in soil and decaying organic debris. Some of these fungi can be recovered easily from such sources and, therefore. man must frequently be exposed to pathogenic fungi. The conditions under which such exposures are followed by infections are not fully known, but they include inhalation of air-borne spores. ingestion and implantation of the fungus under the skin as the result of an injury. In respiratory mycoses. severity of the disease appears to increase with the intensity of exposure. The factors of individual immunity and susceptibility are of prime importance. In coccidioidomycosis, for example, a person who recovers from an initial mild infection appears to be immune to reinfection. Most of the systemic mycoses respond poorly to treatment.

Coccidioidomycosis, caused by *Coccidioides immitis*, occurs either as an acute but benign respiratory infection known as valley fever or as a progressive, generalized granulomatous disease called coccidioidal granuloma. Granulomata are growths consisting primarily of granular tissue surrounding a centre of irritation. The respiratory infection is primary and is usually self-limited (*i.e.,* ceasing after a time as a result of its own processes). However, in some cases (and more often in dark-skinned peoples) it may involve almost all organs with the usual exception of the gastrointestinal tract. Coccidioidomycosis is endemic only in the southwestern section of the United States. in Argentina and in intervening arid areas. The fungus has been isolated from soil and found to produce disease in dogs, rodents and cattle as well as in man. *(See* RESPIRATORY SYSTEM, DISEASES OF.)

Histoplasmosis, caused by *Histoplasma capsulatum,* also has an acute respiratory form, usually self-limited, but occasionally it is a rapid fatal infection involving the spleen, liver, lymph nodes and other organs. Healed pulmonary lesions may calcify and then may be confused with those of tuberculosis. Histoplasmosis is endemic in many parts of the world. Cats, dogs and other animals are often infected. The fungus is present in soil and in organic debris, especially in the enriched soil around chicken houses.

North American blastomycosis, caused by *Blastomyces dermatitidis,* is a granulomatous disease involving the skin, the lungs and many other organs. The fungus is similar to *Histoplasma* in some respects, including its ability to incite the formation of similar antibodies in the blood of the infected person.

South American blastomycosis, caused by *Pavacoccidioides brasiliensis (Blastomyces brasiliensis),* is a granulomatous disease involving the skin. the mucous membranes, the lymph nodes and the gastrointestinal tract. It is an important fatal disease in South America. Infection is thought to follow ingestion of fungus spores.

Cryptococcosis (torulosis), caused by *Cryptococczis neoformans,* usually produces meningitis (*q.v.*), although the skin, bones and visceral organs are often involved. It is world-wide in distribution. Unlike most pathogenic fungi, *Cryptococcus* usually produces little cellular reaction in the host. It has been isolated from soil and pigeon droppings.

Sporotrichosis, caused by *Sporotrichum schenckii,* is seen as a persistent ulcer at the site of a penetrating thorn wound with secondary lesions in the regional lymph nodes. It is rarely systemic. Unlike most of the deep mycoses it responds promptly to treatment with iodides.

Chromoblastomycosis, caused by species of *Phialophora,* is a chronic, slowly progressive, granulomatous disease of the skin and subcutaneous tissues, usually of the lower legs. Its more frequent occurrence in the tropics is believed to be due to exposure of barefoot workers to thorn injuries, which permit implantation of fungus spores.

The mycetomas are a group of mycoses having multiple causes. They are characterized by swelling, usually on the feet, and the eventual death of the affected tissues, with a formation of sinus tracts containing pus in which the fungus causing the infection may be found in the form of dense colonies (granules), varying in consistency and colour according to the species of fungus. The mycetomas also are more commonly seen in the tropics, probably because of more frequent exposure.

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(C. W. Es.)

FUNKIA, a genus of the lily family; the plants are tufted with broad several-ribbed radical leaves and scapes of ahite or blue ascending horizontal or drooping flowers, planted both for the ornamental clumps of foliage and the bloom. Other names for this group are *Hosta* and plantain lily. *See* HOSTA.

FUNSTON, FREDERICK (1865–1917), U.S. soldier, was born at New Carlisle, O., on Nov. 9. 1865. After three years' study at the University of Kansas, Lawrence. he worked as a railway conductor and as a newspaper reporter in Kansas City. In 1891 he was appointed botanist for the department of agriculture in the Death valley expedition and two years later was commissioned to report on the flora of Alaska, where he made extensive explorations. including a journey down the Yukon alone in an open boat. In 1896 he joined the Cuban insurgent army in which he became a lieutenant colonel. On the outbreak of the Spanish-American War in 1898, he returned to the U.S., was appointed colonel of the 20th Kansas volunteers and sent to the Philippine Islands. For his conduct at the battle of Calumpit in 1899, during the Filipino insurrection, he received the congressional medal of honour and was promoted to brigadier general of volunteers. For his capture in 1901 of Emilio Aguinaldo (*q.v.*), the leader of the revolt, he was made brigadier general in the regular army. In April 1914, when the naval forces turned the captured city of Veracruz, Mex., over to the army, Funston became military governor of the city. He was rewarded with the commission of major general. In 1916 he directed the army's pursuit of Francisco ("Pancho") Villa and died Feb. 19, 1917, at San Antonio, Tex.

FUR. Fur is the soft, downy, dense growth of fibres covering certain animals. The word is derived from the Old French *fuerre* and *forre,* meaning either "sheath" or "covering." Fur-bearing animals also have a covering of longer hairs above the fur undergrowth. This is called guard hair or overhair, protects the underlying fur from injury and prevents it from matting or felting. Both guard hair and fur protect the animal from cold and storm.

The use of fur as apparel probably dates from the early stages of human history. Primitive man's chief needs in the colder regions of the earth were food and warmth, and it is reasonable to suppose that the use of animal fur for warmth was not long separated from that of animal flesh for food. To the barbarian in his northern forests fur was a necessity and as such had its value; but it is important to note that in almost every civilization of which history is cognizant fur had its value from early times as an ornament or decoration. The Chinese are said to have esteemed it highly 3,500 years ago; the Greek legend of Jason and the Golden Fleece may well have had its origin in some more than usually perilous and fortunate fur trading voyage to the Euxine; and the use of furs was one of the luxuries Rome adopted from Greece. In the narrowing of this distinction between fur as a necessity and fur as the luxury of the few, desirable because of its rareness and beauty, may be found the clue to the subsequent development of the fur trade. In the civilization of mediaeval Europe fur was emphatically a luxury. As such its use was forbidden by the church to monks and to all but the highest ecclesiastics, while among the laity it was carefully regulated by frequent and severe sumptuary laws. None but those of royal blood were allowed to wear certain furs, and in general a man's social importance could be gauged by the amount and nature of the fur he wore. Fur, be it observed, was mainly connected uith male attire at that time; in certain instances, indeed, it became almost a badge of office, as witness the judge's ermine. The only form in which fur seems to have been permitted to all who could afford it in the middle ages was as headgear, and in the English language the words "beaver" and "hat" seem to have been used almost interchangeably from the time of Chaucer. The chief sources of European fur supply in the middle ages were northern and central Europe. and the Hanseatic league. with its chain of towns dotted round the Baltic was a great power in the trade.

The modern age may be said to have begun for the fur trade with the discovery of America. That event opened up vast fur resources to European enterprise. and this seems to have been an aspect of the neu continent uhich appealed to the early explorers most strongly In patents of discovery and charters to early settlements "trade in furs" is frequently mentioned, and much of the interior exploration of North America was the direct consequence of this trade. The French settlers in Canada uere especially ardent fur traders; the more adventurous among them had penetrated to the Mississippi, and probably to Lake Winnipeg, long before the English had crossed the Alleghenies The Hudson's Bay company entered the field in the latter half of the 17th century and from the time of its existence has spread its trading posts and interests from Vancouver to Prince Edward Island, and northward to the Arctic ocean. The fur trade of the 18th and early 19th centuries, nhen an Indian trapper would barter his winter's catch for a blanket and a bottle of cheap spirits, uas a highly profitable business; John Jacob Astor, among others, founded his fortune upon it. The supply of furs appeared inexhaustible and the demand steadily grew; for the industrial revolution in Britain and western Europe, creating vast new wealth, created also new desires and furs, from being a luxury, became by the middle of the 19th century a fashion. In the 20th century, the United States emerged as the uorld's major user of furs. After World War II, however, changes in the American way of living acted to the detriment of fur sales. The virtual universality of the automobile diminished the importance of fur coats as items of utility and uarmth. The shift to suburban and informal living by the upper middle class—the best fur customers—reduced the desire for formal fur apparel. Such small furs as capes, stoles and jackets became popular. The rapid economic growth of Canada made it an increasingly important consumer of furs Also, the economic recovery of post-World War II Europe brought indications that Britain and the continent in the 1950s were bigger users of furs than in the previous decade.

THE MODERN FUR TRADE

Sources of Wild **Furs.**—Wild furs come not only from cold climates, as is commonly believed, but from temperate and tropical zones as well. More than 80 countries on all six continents contribute to the world supply of pelts for commercial use. The fur trade reaches from the arctic areas of Siberia and Canada to the southernmost tip of Africa for almost 80 varieties of furs which can be made into apparel. Still, the most important sources of supply are the cold regions where the temperature ensures the growth of thick, luxuriant fur.

North America is the home of the greatest variety of fur bearers. The frozen wastelands, forests and marshes of this continent are inhabited by mink, beaver, muskrat, skunk, American opossum, marten, fisher, ermine, silver fox, blue fox, red fox, white fox, cross fox, raccoon, bear, wolf, weasel, wildcat, fitch, otter, sable, lynx and wolverine. The United States has 40 different types of indigenous furs. The most important are mink, muskrat, beaver, raccoon. skunk and opossum.

Northern and central Europe and Siberia supply badger, beaver, ermine, fitch, fox, hare, lynx, marmot, marten, mink, muskrat, nutria, otter, Persian lamb and karakul, sable, squirrel, wolf, fox, goat and moleskin. The latter fur is found in the British Isles and in the Netherlands, France and parts of Africa.

China delivers marmot, kolinsky, marten, kid. goat and lamb. Korea supplies kolinsky; central Asia Persian lamb and other lamb skins. India contributes leopard, ocelot, tiger and some stone marten. Ceylon provides leopard. From Japan come mink or weasel and flying squirrel. South America is the home of chinchilla, nutria, fox, skunk and chinchilla rats.

Tremendous quantities of rabbit skins are pelted in Australia, France, Belgium and Great Britain, and big quantities came from New Zealand until 1953 when exports were halted. In the 1950s, myxomatosis, a virus disease, reduced the supply from Australia, Tasmania, New Zealand and Great Britain.

The seal is the principal marine animal used commercially. The best type, known as Alaska fur seal, comes from the Pribilof Islands. 300 mi. west of the Alaska mainland. When the United States purchased Alaska in 1867, the seal herd was an estimated 3,000,000 animals. Uncontrolled slaughter of the seals cut the herd to 100,000 animals in 23 years. This indiscriminate slaughter or pelagic sealing came to an end in 1911 under an international conservation agreement, restoring the herd to 1,500,000 animals by 1954. The Pribilofs account for 80% of the world's seal population, and about 60,000 are killed annually. Other seals are to be found in the Komandorski Islands of the U.S.S.R. in the Bering sea, in Robben Island off the coast of the Union of South Africa, in the Kurile Islands of Japan and in the antarctic islands belonging to Uruguay and South Africa.

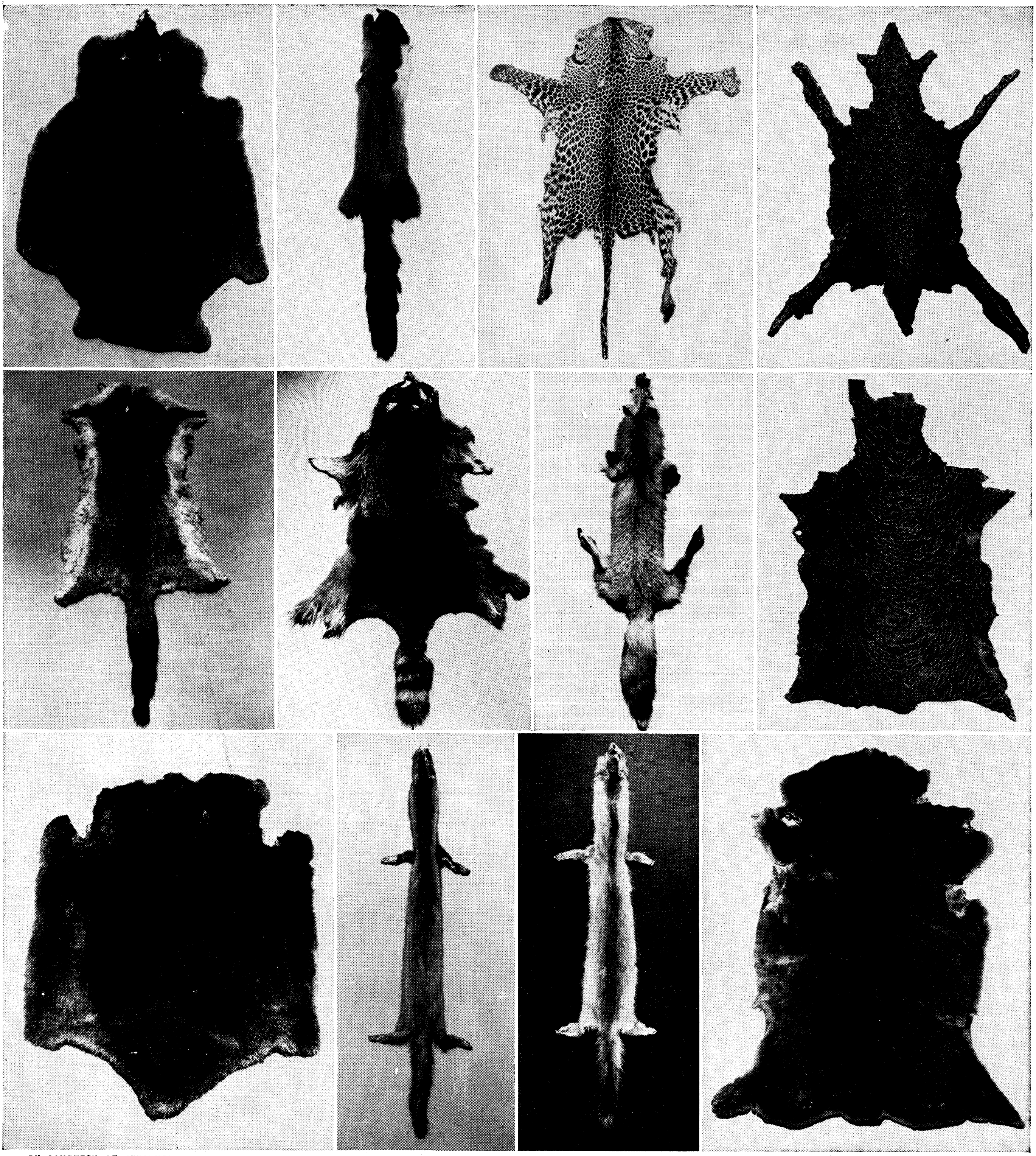
Ranched Furs.—The outstanding development in the world's fur supply in the 20th century has been the breeding of mink and fox on farms or ranches. Mink ranching began commercially in the United States in the 1930s. The scientific development of mutation mink, natural pelts bred in a variety of colours ranging from pale brown and platinum gray to pale blue and pure white was notable. (See below, under Fur Farming.)

Collection and Distribution.— Fur skins find their way into the world's markets through two main channels. A large number are delivered or sold to collecting agents, who sell them to skin merchants in various fur centres. Skin merchants maintain stocks of furs, selling them to manufacturers or retail furriers. Most raw fur skins, however, are shipped to auction houses and offered at public auction to skin merchants, manufacturers and commission brokers who buy for merchants and manufacturers. Fur auction houses act as marketing agents for shippers of fur skins and receive fees based on the value received for the furs at auction.

The major fur auction centres are London, New York city, Leningrad and Montreal. Regular auctions of secondary importance are held in St. Louis, where fur seal skins are sold semiannually, Seattle, Minneapolis, Winnipeg, Edmonton, Vancouver, Regina, Copenhagen, Oslo, Helsinki, Stockholm. Melbourne and Sydney are the main centres for rabbit-skin auctions, which are also held in London. The practice in fur auctions all over the world is to set aside several days prior to the sale as an inspection period, enabling buyers to examine the skins in the warehouse and to make judgments as to the quality and value of the pelts. The buyers work from catalogues in which are listed lot numbers, corresponding to the lots or bundles of skins in the warehouse.

Bidding at fur auctions is not free, strictly speaking, in that shippers often set minimum limits on the price they want for certain pelts. The auctioneers reserve the right to withdraw or "buy back" a bundle of pelts if the buyers' bids fall below the shipper's limit. In some auctions, however, bidding is not restricted in this manner. Furs from all over the globe are auctioned off in London, which is considered the capital of the international industry. In a typical month, for example, London auction firms offered more than 700,000 Persian lamb, and 25 other types of furs amounting to an additional 850,000 skins.

The Hudson's Bay company is the dominant fur collecting organization and marketing agent in the world, with auction houses in London, Montreal and New York city. The London Public Sales, comprised of Hudson's Bay company and two other firms,



BY COURTESY OF (EXCLUDING TOP, THIRD LEFT) ASSOCIATED FUR INDUSTRIES OF CHICAGO, INC., PHOTOS BY CHICAGO PHOTOGRAPHERS; (TOP, THIRD LEFT) THE WELLS TREISTER COMPANY, INC.

VARIETIES OF FUR

Top left: Beaver (U.S.)
Top, second left: Gray squirrel (U.S.)
Top, third left: Leopard
Top right: Black dyed Persian lamb (South-West Africa)
Centre left: Opossum (Australia)
Centre, second left: Racoon, the lower half sheared (U.S.)
Centre, third left: Red fox (U.S.)
Centre right: Broadtail processed lamb, dyed (Argentina)
Bottom left: Muskrat, sheared and dyed black (U.S.)
Bottom, second left: Natural royal pastel mink (U.S.)
Bottom, third left: Natural silverblue or platinum mink (U.S.)
Bottom right: Mouton processed lamb (U.S.)

BY COURTESY OF HUDSON'S BAY COMPANY

FUR TRAPPING IN CANADA

Top *left:* A Chipewyan trapper, dressed in parka of moose hide and hood trimmed with fox fur, starting out from his camp with a supply of traps over his shoulder. His gun is resting on the back of his carriole toboggan. The caribou horn (bottom foreground) is used as a brake when the toboggan is going down hill

Top *right:* Setting a trap for a fox near a small tree

Bottom: Digging a hole in the ice to set a trap for otter

BY COURTESY OF HUDSON'S BAY COMPANY; PHOTOGRAPHS (TOP LEFT) BULMAN BROS LTD. (TOP RIGHT, CENTRE RIGHT) ASSOCIATED SCREEN NEWS LTD

THE TRAPPER AT WORK

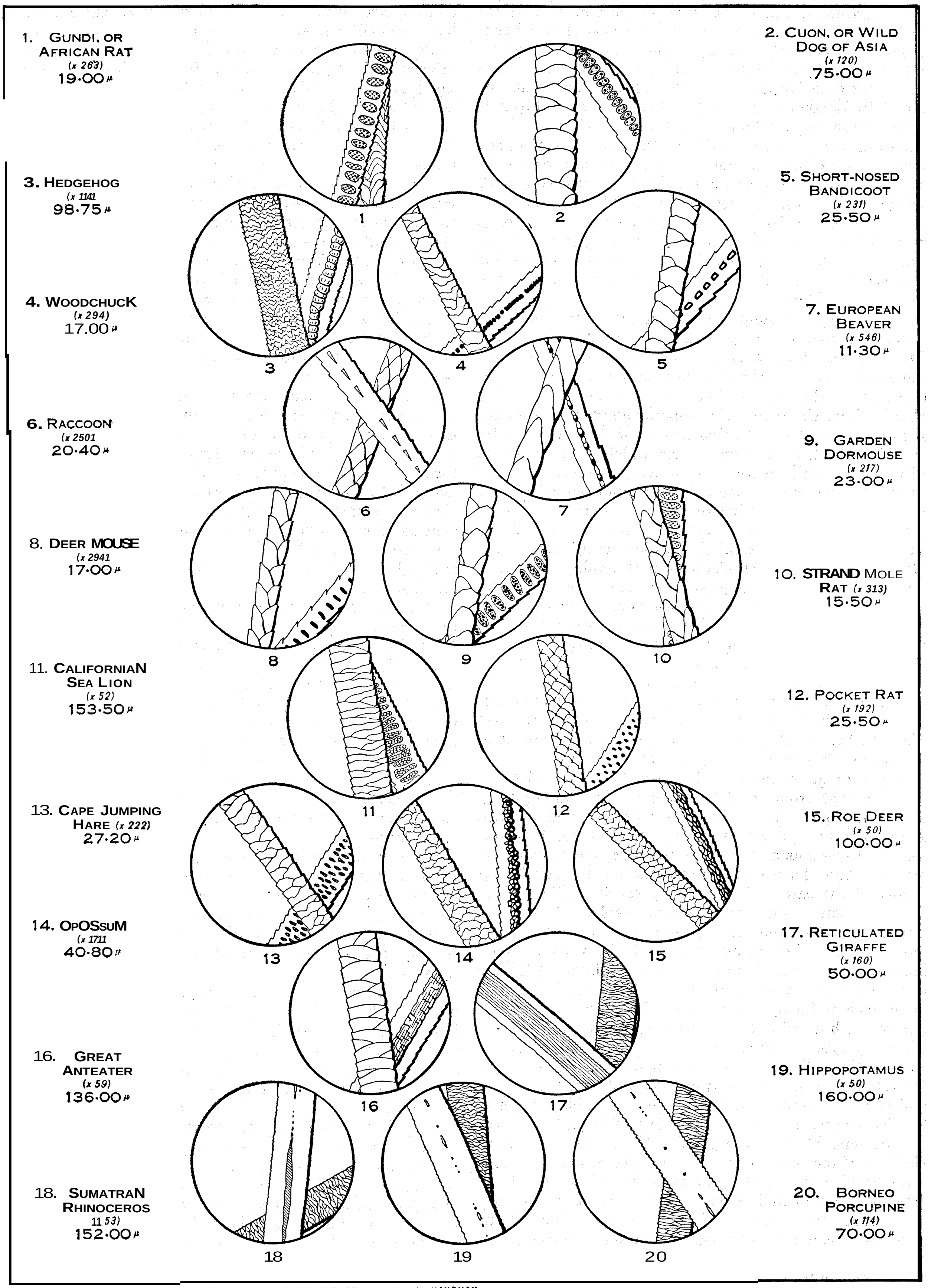
Top left: Setting a trap for mink on the shore of a lake. The trap is baited with a fish head

Top right: Having built a "cubby" of spruce poles and branches, an Indian places a trap for mink inside it. This trapper is a Cree and his snow shoes are far better made than those of the Chipewyan trapper

Centre right: Constructing the old-fashioned deadfall trap of logs, the type in use before the coming of the white man with his steel traps

Bottom left: Chipewyan hunters bringing in fox and wolf skins to the Hudson's Bay Company post at Churchill, Man.

Bottom right: A Chipewyan woman stretching a beaver skin on a home-made frame



BY COURTESY OF AMERICAN MUSEUM OF NATURAL HISTORY AND OF DR. LEON A. HAUSMAN

FUR AND HAIR UNDER THE MICROSCOPE. SHOWING OUTSIDE VIEW AND LONGITUDINAL SECTION

The magnification is shown by the figure preceded by an x. The average diameter of the hairs in μ is shown under the name of the animal. (μ = 1/1000 mm) holds major auctions in the spring, summer, autumn and winter.

In New York city during the height of the season (December to March), few days pass without an auction sale at one of four firms, and occasional sales are held throughout the year. New York is the centre for American ranch and mutation mink and ranks second to London as a seller of Persian lamb. Monthly auctions are held in Montreal and other Canadian cities.

The important auctions in London, New York and Montreal draw an international audience and often last a week or longer. The annual Leningrad sale is usually held in July. It is conducted by Soyushpushnina, official Soviet agency, which buys the skins from state and collective farms and controls domestic and foreign marketing. The auction runs a full week. In 1954, for example, 30 types of furs totalling 3,000,000 skins were offered to 80 to 100 buyers representing 15 countries. Soyushpushnina also sells furs by contract to individual purchasers.

World Wars I and II eliminated Leipzig as a fur centre, its business being diverted to Leningrad, London and New York city.

Fur Dressing and Fur Dyeing.—Briefly, the function of the fur skin dresser is to make the skin suitable for use in the later stages of the trade, the objects aimed at being the creation of a soft, pliable leather; the removal of superfluous matter from the pelt; and the preservation and enhancement of the natural lustre of the fur. The details of the process vary widely with the nature and condition of the skin treated, but in every instance there are at least four distinct stages, some being comprised of several processes, in the operation. First of all there is the preliminary cleaning and softening of the pelt; then fleshing (removal of fleshy matter from the skin) and stretching; then leathering (the formation of a leather on the skin, actually a form of tanning); and then a final cleaning. After each stage and between many of the intermediate processes the fur is cleaned, a revolving wooden drum containing sawdust or other suitable material being generally used for this. Separate departments of the fur dresser's art are unhairing (the removal of guard hairs where necessary), shaving and seal-skin dressing which is a complicated business presenting features not found in the majority of furs. Though it doubtless originated in a primitive and haphazard manner, modern fur skin dressing is a highly developed scientific process requiring, incidentally, considerable mechanical equipment.

Fur dyeing is of great antiquity but may be said to date its modern development from the latter part of the 19th century. Before that period the dyeing of furs was mainly carried out with vegetable or mineral colouring matters. Since then, however, various chemical compounds known as fur bases have come into general use and have largely superseded the older materials by reason mainly of the ease with which they can be applied. The use of these synthetic compounds has also enabled fur dyers to produce many new colours on furs, and fresh ones are added every year. This again has led to the adoption by the fur trade of many skins which in their natural colours would be disdained by the public, but when well dressed and dyed make attractive furs.

The importance of fur dyeing increased in the 1950s as the fur trade began to catch up with the international trend toward colour in virtually every type of product from cloth coats and dresses to automobiles. New colours became an important selling point among fur retailers, marking the transition from the traditional browns and blacks of natural furs to such shades as blonde, beige, charcoal and platinum gray, blue, white and even pink and red. Typical of the innovations made possible by the fur processor's art was the case of raccoon. The long-haired, brown raccoon coat of the 1920s had become, three decades later, a sheared, lighter-weight fur available in blonde, beige or white as well as the natural colour. Great secrecy is maintained on the technical side of fur dyeing, each dyer jealously guarding his methods from competitors. France, Belgium and London are the chief dyeing centres of Europe. Leipzig was once supreme in this field but after World War II its experts relocated in Frankfurt, London and New York. The largest fur processing industry is in New York.

Fur Manufacturing.—Furriery, or the making up of furs into garments, has progressed from the primitive sewing together of skins to the position of a highly skilled and intricate occupation, and the modern manufacturing furrier often has a good claim to be recognized as an artist in the same sense in which a designer and creator of gowns is so recognized. Paris exerts great influence in originating fur fashions, and the ideas of Italian designers are also significant. New York city, the largest manufacturing centre, developed a highly respected corps of fur designers among its custom furriers, stylists who create for individual manufacturers and commercial designers who sell patterns to manufacturers and retailers.

Fur manufacturing remains, essentially, a handicraft industry. Highly skilled and well-paid labour in the United States accounts for 20% to 25% of the cost of manufacturing a garment. Cost of skins and other materials runs about 62%. Typical of the manual operations in furriery is that of fur cutting. The cutter, best-paid artisan in the trade, is charged with matching pelts according to colour and quality in order to make for uniformity of colour and texture in the finished garment. He also cuts the skins to conform to the designer's pattern with a minimum of wastage. Sewing is performed on power-driven machines and is a task requiring much painstaking and skill.

There are two main types of fur manufacture. One is the letting-out technique; the other, the skin-on-skin method. The first, usually applied to mink, involves slicing every skin into diagonal strips $\frac{1}{8}$ to $\frac{1}{4}$ in. in width and then sewing these strips together to make a longer and narrower skin that will run the full length of the garment without seams showing on the fur side. The skin-on-skin method is less costly. It consists of sewing one full skin adjacent to another in a uniform alignment. Some firms specialize in sewing the leftovers of full skins, such as paws, flanks and gills, into blanketlike "plates" which are then fashioned into garments.

Manufacturers distribute their products either by selling directly to retailers, or to wholesalers or jobbers who sell to retailers. New York city's manufacturing industry in the 1950s had about 2,000 firms. There were about 600 firms in Montreal and Toronto.

The Fur Retailer.—Retailers of fur garments are the direct contact of the industry with the consuming public. There are three main types: (1) custom furriers who design and manufacture their own garments and also carry stocks of ready-to-wear furs; (2) women's apparel specialty stores which carry furs as part of a general stock of apparel; and (3) department stores. All these stores usually maintain fur servicing departments, which remodel and repair garments for customers and also store furs in refrigerated vaults.

Retailers obtain merchandise directly from the manufacturer or from the wholesaler or jobbing house. In the United States, department stores first became important factors in fur retailing in the 1920s. Previously, custom and specialty retail furriers had been practically the only sellers of furs; the thousands of smaller fur retailers, however, continued to do more than 50% of U.S. fur sales dollar volume.

When aggressive (and often exaggerated) advertising practices were introduced in the retail fur trade, certain restrictions were imposed by the U.S. federal trade commission. These were made more stringent in 1952, when congress passed the Fur Products Labeling act, designed to protect the consumer from misleading advertising and selling practices. The law forbade a store to describe a fur in terms of another. For example. marmot dyed to resemble mink could no longer be described as mink-dyed marmot but only as dyed marmot. A fur products name guide was issued by the federal trade commission, listing the true and permissible fur names. In addition, retailers were required to note the country of origin of fur skins. Thus, a garment made of Canadian muskrat, which has been sheared and dyed black to resemble fur seal, could no longer be called Hudson seal but had to be labelled, "black-dyed sheared muskrat; country of origin, Canada." Government regulations in other countries vary but are generally less stringent than those of the United States.

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(E. C. L.; S. J. GD.)

FUR FARMING

The keeping and breeding of animals for their fur is one of the oldest occupations. The Chinese have farmed goats and dogs for an unknown number of centuries, using the flesh of the animals as food and their skins, fur or hair, according to species, for the purpose of trade; while, if one considers the sheep as a fur-bearing animal, the inception of fur farming is lost in the mists of antiquity. Though many of the animal-husbandry practices of livestock raising were adapted to the raising of fur animals, some of the fur-farm problems were peculiar to these wild species under confinement. This necessitated specific research. The Canadian government in co-operation with the Canadian National Silver Fox Breeders association established a research station at Summerside. P.E.I., in 1920, and the United States government started the United States Fur Animal experiment station at Saratoga Springs, N.Y., in 1923. These stations have published many scientific and popular articles. By 1940 the U.S. government was conducting research on fur animals co-operatively with colleges and universities in the states of Wisconsin, New York, Pennsylvania, Washington and Alaska. Several of the provinces in Canada were also doing fur-animal research in addition to that on Prince Edward Island, and Sweden, Norway and Denmark began similar research because of the increasing importance of fur farming in their economies.

Silver Fox Farming.—A silver fox is a mutation of a red fox in which the red colour is replaced by black. The white band on the guard hairs gives the silvery effect. The early captured foxes were nearly black, but by selective mating over a 20-year period the bright silver fox was produced in which the white bands were extremely wide and the black was free from the rusty brown so common in the early foxes. Since the black colour is dependent upon a single genetic recessive factor, black or silver foxes when mated together always produce silver-black foxes. Because of the rare chance-mating of two black foxes in the wild, however, only a very small percentage were of this colour.

On fur farms odd-coloured fox pups occasionally appeared in a litter. At first such animals were quickly discarded for fear that the purity of the herd would be questioned. Some enterprising fox farmers, however, mated them and eventually several profitable mutant colours were developed, such as white face, platinum, pearl and glacier blue. The breeding of silver foxes in captivity was accomplished on Prince Edward Island in 1894. At first it was carried on with much secrecy until an especially beautiful silver-fox skin brought £580 at auction in London. Charles Dalton, later knighted by the English crown for his contributions to fox farming, and R. T. Oulton (both Canadians) are considered to be the pioneers in fox farming. Such prices for skins made prices for breeding stock fabulous. The cost of a pair of foxes rose from $3,000 in 1910 to $35,000 in 1913, and extensive speculation took place even on options on newborn pups. World War I and better business judgment had reduced operations to a more practical basis by 1927.

Peak production in the United States of 350,000 silver-fox skins was reached in 1939. In that year Canada produced 230,000 and the Scandinavian countries somewhat fewer. By the mid-1950s fewer than 10,000 silver fox pelts were being produced annually in the Gnited States, and production in other countries was also drastically reduced.

Long furs were not wanted in the late 1940s, and the average price of $12 to $16 for fox pelts that cost more than $30 to produce then put many fox farmers out of business and caused others to reduce their operations. The highly desirable U.S. market affected fox farmers in other countries, especially Canada.

Though pair mating was at first deemed necessary, polygamous mating finally became the common practice. The one litter per year is whelped after a gestation period of 52 days. An average of four young per litter is considered satisfactory, and these are weaned when about eight weeks old.

Silver foxes after about seven months old weigh from 10 to 15 lb. The pups are pelted in November and December of the first year. Those pups selected for the herd are bred during late winter and early spring of the following year.

The early large ground-floored pens were replaced with smaller ones with raised wire floors to avoid parasite infestation and for better sanitation. A guard fence with an overhang to prevent foxes that break out of their pens from escaping is essential. This also provides seclusion and prevents stray dogs and other animals from giving the foxes distemper. Distemper ravages caused enormous losses until a satisfactory vaccine was developed.

A desirable fox ration is composed of 25% to 50% of horse meat or various packing-house by-products. The rest of the ration is composed of dry concentrates, vegetables and water. Continuous feeding of certain fish may cause losses in foxes. A fox ordinarily eats about one pound of food per day. The feed companies finally developed a satisfactory cubed feed for summer and fall feeding of foxes. This reduced materially the necessary refrigeration.

Blue Fox Farming.—Though some blue foxes are raised in pens—principally in Norway—the most interesting early development was in Alaska, where entire islands were leased and the foxes ran wild. The natural foods were supplemented during certain parts of the year. Parasitism and lack of controlled breeding, together with lower prices for pelts, finally put these operations out of business by the late 1940s. Litters of blue foxes often had ten young.

Mink Ranching.—Though minks were raised in captivity for their fur as early as 1866, it was not until about 1930 that they were produced in quantity. Undoubtedly, the impetus was due in great part to the development and fostering of new and striking mutant colours. After mid-20th century there were three times as many mutation mink skins produced as the dark natural-coloured mink, and the Mutation Mink Breeders association rigidly controlled the market. Most skins were sold dressed.

In minks the underfur should be about $\frac{5}{8}$ in. long and the guard hair about one-half again as long. Mink skins lend themselves admirably to a manufacturing process known as letting-out in which the skins are cut into narrow strips diagonally from the centre and then resewn in such a manner as to make the skin two or three times its original length. The darker centre strip is retained, and the flow of the garment is enhanced.

A mature female mink weighs about $1\frac{1}{2}$ to 2 lb. and the males about 4 lb. The sexes are kept separately, and polygamous mating is the common practice—usually in March. There is a varying time of delayed implantation of the embryos, and consequently the gestation period varies from 40 to 76 days. A litter average of four is satisfactory. Weaning takes place at eight weeks and the pelting about the last of November of the same year. Mink will breed when about 11 months old.

Minks are kept in individual pens having 10 to 20 sq.ft. of raised wire floor space. Small detachable nest boxes facilitate care of the animals. The mink ration requires a higher percentage of raw meat than that for foxes, and fish may replace most of this without harm to the animals. The daily feed allowance is about $\frac{1}{4}$ lb. per day though animals to be pelted should be fed all they will eat.

Chinchilla Raising.—The chinchilla is a native of South America, and during the early 1900s many chinchilla furs from animals trapped in the wild were marketed. Overtrapping produced such a scarcity that an American, M. F. Chapman, was induced to start raising them in captivity. By the mid-1950s more than 500,000 chinchillas were being kept in captivity in the U.S., one-fourth as many in Canada and only a small number in the rest of the world. Until 1954 operations were largely in selling breeding stock for several hundred dollars per pair, but in June of that year the first auction ever held of a large quantity of chinchilla pelts from ranch-raised animals resulted in an average price for selected skins of $37. This put chinchilla raising on the more stable basis of producing skins for use in the fur trade.

Chinchillas are small, squirrel-like land rodents weighing about $1\frac{1}{2}$ lb. at maturity. Their fur is extremely fine and silky, blue-gray in colour, with characteristic white bands on the guard hair.

Martens.—This attractive and interesting forest fur animal is closely related to the sable and weighs from 1½ to 3 lb. at maturity. Many attempts to raise martens in captivity have failed because only about 15% to 20% of the females produce young.

Martens breed in July and August and, after several months delayed implantation, whelp in April. Experimentally, this implantation period was shortened by artificial lighting, simulating early spring conditions, so that the martens were caused to whelp in December instead of April. Twenty litters obtained over several years at the United States Fur experiment station averaged 2.6 young per litter. Martens thrive on about the same kind of feed as the foxes and minks. They consume from six to eight ounces daily and particularly relish small fruit and berries.

Other Fur Animals. — Karakul sheep and somewhat similar breeds of sheep have been raised in Russia and the near eastern countries for hundreds of years. These produce the very desirable black Persian lamb skins and other similar types. By the 1950s South-West Africa was producing several million Persian lamb skins after many years of selective mating of karakul rams to progeny of white sheep. Selected skins from white lambs are sheared, plasticized and usually dyed to be sold as mouton.

The raising in captivity of several other fur animals was initiated and developed to a promotional basis for selling, but by the mid-1950s had not materialized commercially because of availability of the furs from the wild supply. Among these can be listed beavers, nutrias (a South American rodent), fishers, muskrats, fitches, raccoons and skunks.

Possibilities of raising these animals in captivity for their fur depended upon fashion and the finding of new striking colours. It is true that even with the natural-coloured animals improvement can be made by selective mating for clearer colour, greater density and the other characteristics that give them greater fashion appeal. The scarcity of the wild types will be a contributing factor toward successful farming of these animals.

Rabbit skins from animals raised in hutches primarily for their meat have been used extensively in the fur trade from time to time. Selected skins from the older animals of Europe have proved very satisfactory in the natural state or sheared and dyed, but only a small percentage of the skins from the eight-week-old "fryer" rabbits in the United States are suitable for fur garments. Very few rabbits are raised primarily for their fur.

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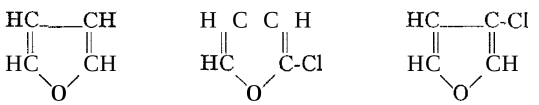
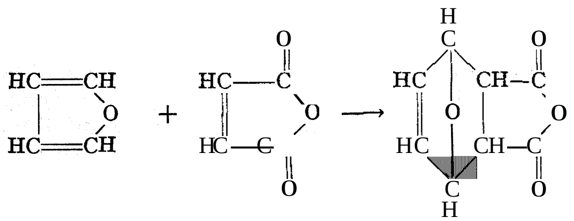
FURAN CHEMISTRY is that branch of organic chemistry that deals with the family of organic compounds known as the furans (see also FURFURAL). Furan itself (boiling point 31.3° C.; specific gravity 0.937) is a colourless liquid of strong ethereal odour which is relatively insoluble in water, but completely soluble in alcohol, ether and acetone. It has been found to occur in various wood oils, and it may be prepared conveniently in the laboratory by the decomposition by heat of furoic acid. Large-scale production is carried out by passing the vapours of furfural and steam over a suitable catalyst.

The constitution of furan (C_4H_4O) is generally represented as indicated below, and while the other members of the family retain the characteristic five-membered ring or nucleus, one or more of the hydrogen atoms is replaced or substituted by other atoms or groups of atoms—*e.g.*, C_4H_3O-Br, bromofuran; C_4H_2O-$(COOH)_2$, furandicarboxylic acid. Because of the asymmetry of the ring, however, these substitution products can exist in more than one form, and to distinguish these forms, or isomers, it is convenient to denote the location of the substituent(s) by numbering the five-ring atoms counterclockwise beginning with the oxygen atom as number one. Since it has been experimentally established that positions 2 and 5 and positions 3 and 4 are equivalent, two and only two monosubstitution isomers (C_4H_3O-X) of furan are possible, depending upon whether the new substituent (X) replaces a hydrogen atom on a carbon adjacent to, or once removed from, the oxygen atom. This is illustrated below by the case of chlorofuran (C_4H_3O-Cl). There are four possible isomeric disubstitution derivatives if the substituents are alike; if unlike, the number of isomerides is greater. For polysubstituted furans the number of isomers can be deduced readily from the structure.



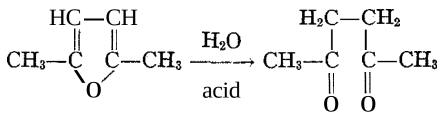
furan 2-chlorofuran 3-chlorofuran

The chemical behaviour of the furans is quite complex as a consequence of the combination, in one-ring system, of characteristics associated with dienes, with vinyl ethers and with benzene types. A great many addition reactions attest to the dienic behaviour of this class, including Diels-Alder syntheses involving the simple furans (*e.g.*, reaction of furan with maleic anhydride).



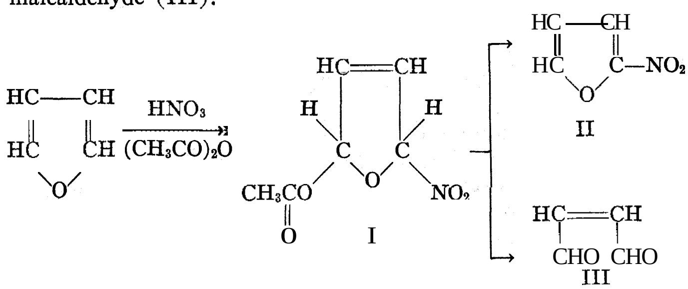
This dienic activity is suppressed in derivatives possessing electron-withdrawing substituents (CO, NO_2, etc.), so that furans such as furfural and nitrofuran fail to react in like manner.

Acid hydrolysis reveals the kinship of the furan ring to a vinyl ether. Furan and its alkyl-substituted derivatives are readily cleaved by aqueous acids to open-chain dicarbonyl compounds, as illustrated by the formation of acetonylacetone from 2,5-dimethylfuran.



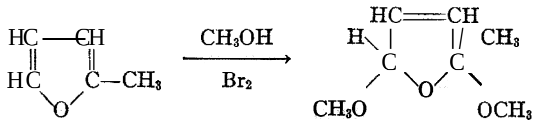
Again, however, the nature of substituent groups can affect the ease of reaction, and furfural, furoic acid and particularly the nitrofurans are resistant to acid hydrolysis.

In general, furan types are more reactive and less in the sense of nuclear integrity than their benzene counterparts, and the usual substitution reactions have been applied with varying success. The reagents employed are acidic in nature and it is important, in most instances, to avoid moisture, and to control experimental conditions carefully in order to minimize resinification and cleavage of the ring. By appropriate modification the Friedel-Crafts reaction (*q.v.*) can be applied for the synthesis of alkylated and acylated derivatives. The related Gattermann aldehyde synthesis has also been carried out in a number of instances. Sulfonation, while not usually feasible with fuming sulfuric and chlorosulfonic acids, has been accomplished by use of the milder pyridiniumsulfonic acid. Halogenation may be carried out to obtain either addition or substitution products. Nitration is usually effected with nitric acid in acetic anhydride as the reagent. With furan itself, this gives rise to an intermediate nitro-acetoxy-dihydrofuran (I) which, by the action of pyridine, loses the elements of acetic acid to form 2-nitrofuran (II). If water is present, however, I may decompose with formation of malealdehyde (III).

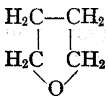


That the furan ring is less stable as a unit than the benzene ring is further reflected by the fact that the extensive chemistry of the phenols and aromatic amines has no complement in the furan series. The furanols and furylamines exhibit much more kinship to the aliphatic keto-enol and ketimine-enamine systems, respectively, than to the analogous benzene derivatives.

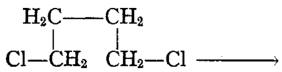
Furan compounds are very susceptible to nuclear oxidation, particularly in acidic medium. Under such conditions, it is difficult to find reagents that permit selective oxidation of a substituent group. In admixture with air, over a suitable catalyst (vanadium pentoxide) at elevated temperature, furan or furfural give rise to maleic anhydride in excellent yield. Carefully controlled alkoxylation, electrolytically or with chlorine or bromine, permits the isolation of unsaturated acetals which are useful intermediates in organic syntheses. This is illustrated by the alkoxylation of 2-methylfuran to a cyclic acetal of acetylacrolein.



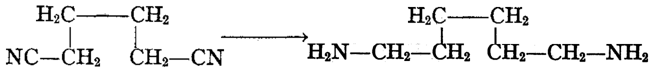
When furan compounds are subjected to the action of hydrogen in the presence of a nickel catalyst, the ring is reduced, and saturated cyclic ethers, the tetrahydrofurans, are obtained. In this way, furan gives rise to tetrahydrofuran itself (IV), and this represents another step in the industrially important synthesis of nylon from furfural. The further steps involve cleavage of IV to 1,4-dichlorobutane (V), treatment with sodium cyanide to obtain adiponitrile (VI), and reduction to hexamethylenediamine (VII). Nylon is made by reaction of VII with adipic acid.



IV



V



VI VII

See A. P. Dunlop and F. N. Peters, The Furans (1953); "The Chemistry of the Furans," The Quaker Oats Company, *Bulletin 202A* (1947). (A. P. D.)

FURETIÈRE, ANTOINE (1619–1688), French scholar and miscellaneous writer, was born in Paris and became abbé of Chalivoy in the diocese of Bourges. His satires—Nouvelle *Allégorique, ou histoire* des derniers troubles arrive's au royaume *d'éloquence* (1658); Voyage de Mercure (1653)—won him admission to the French Academy in 1662. When the academicians heard that Furetikre was on the point of issuing a dictionary of the French language, they interfered, alleging that he had used their information, and that they possessed the exclusive privilege of publishing such a book. After much bitter recrimination on both sides the offender was expelled in 1685; but he took his revenge in his satire, *Couches de l'académie* (Amsterdam, 1687). Furetière is best known as the author of Le Roman bourgeois (1666; ed. by Fournier and Asselineau, 1854), which ridiculed the fashionable romances of Madeleine de Scudéry and of La Calprenkde. His *Dictionnaire universel* was posthumously published in 1690. Le Roman bourgeois was newly edited in 1921 with notes by François Tulou. *Poésies* diverses was partially reprinted, after its 1664 edition, in 1908 in Baltimore, Md.

FURFOOZ, a village 10 mi. from Dinant in the Ardennes, Belg. Pop. (1955 est.) 139. Three caves with prehistoric remains were excavated there in 1872. Of these the Trou du Frontal is the most famous. In it were found human skeletons with brachycephalic skulls, associated with animal bones, those of the reindeer being particularly plentiful. People with anthropological characters, similar to the skulls found at Furfooz, seem to have arrived in central Europe soon after the Ice Age. They spread along the Alpine region and adopted the culture of Azilian-Tardenasian folk.

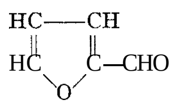
FURFURAL (2-furaldehyde, fural, furfurol) is the best-known member of the furan family and the source of the other technically important furans (*see* FURAN CHEMISTRY). It is a colourless liquid (boiling point 161.7° C.; specific gravity 1.1598) subject to darkening on exposure to air. It dissolves in water to the extent of 8.3% at 20° C., and is completely miscible with alcohol and ether. The chemical formula is C_4H_3O-CHO.

A span of about 100 years marked the period from discovery of furfural in the laboratory to the first commercial production in 1922. The subsequent industrial development provides an excellent example of the industrial utilization of agricultural residues. Corncobs, oat hulls, cottonseed hulls, rice hulls and bagasse are the major raw material sources, the annual replenishment of which ensures a continuing supply. In the manufacturing process, ten-ton lots of the raw material and dilute sulfuric acid are steamed under pressure in large rotary digesters. The furfural formed is removed continuously with steam, and concentrated by distillation: the distillate, on condensation, separates into two layers. The bottom layer, comprising wet furfural, is dried by vacuum distillation to obtain furfural of minimum 99% purity.

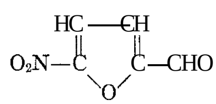
Furfural is used as a selective solvent for refining lubricating oils and rosin, and to improve the characteristics of diesel fuel and catalytic cracker recycle stocks. It is employed extensively in the manufacture of resin-bonded abrasive wheels, and for the purification of butadiene needed for the production of synthetic rubber. The manufacture of nylon requires hexamethylenediamine, of which furfural is an important source. Condensation with phenol provides furfural-phenolic resins for a variety of uses. Nitration gives 5-nitrofurfural, which, in the form of its semicarbazone, is the pharmaceutical Furacin, a bactericide with numerous applications in human and veterinary medicine.

When vapours of furfural and hydrogen are passed over a copper catalyst at elevated temperature, furfuryl alcohol is formed. This important derivative is used in the plastics industry for the production of corrosion-resistant cements and cast-molded items. The similar hydrogenation of furfuryl alcohol over a nickel catalyst gives tetrahydrofurfuryl alcohol, from which are derived various esters and dihydropyran.

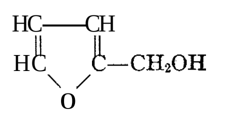
In its reactions as an aldehyde, furfural bears a strong resemblance to benzaldehyde (*q.v.*). Thus, it undergoes the Cannizzaro reaction in strong aqueous alkali; it dimerizes to furoin, C_4H_3O-CO-CHOH-C_4H_3O, under the influence of potassium cyanide; it is converted to hydrofuramide, $(C_4H_3O\text{-}CH)_3N_2$, by the action of ammonia. It participates in the Perkin and Claisen condensations and related syntheses; with acetone, furfural gives rise to furfurylideneacetone, C_4H_3O-CH=CH-CO-CH_3; with acetaldehyde, it reacts to form furylacrolein, C_4H_3O-CH=CH-CHO. However, furfural differs markedly from benzaldehyde in a number of ways, of which autoxidation will serve as an example. On exposure to air at room temperature, furfural is degraded and cleaved to formic acid and formylacrylic acid. Behaviour similar to that of benzaldehyde would have given rise to furoic acid as the major product under these conditions. To obtain the latter in good yield, it is the practice to oxidize furfural in alkaline medium, the acid being subsequently liberated from the resulting salt. Furoic acid (formerly called pyromucic acid as a consequence of its formation by heating mucic acid) is a white, crystalline solid which is useful as a bactericide and preservative. Its esters are fragrant liquids which are used as ingredients in perfumes and flavourings.



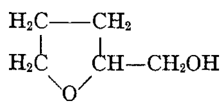
furfural



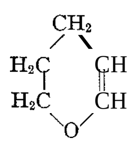
5-nitrofurfural



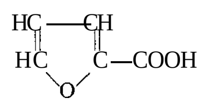
furfuryl alcohol



tetrahydrofurfuryl alcohol



dihydropyran



furoic acid

See A. P. Dunlop and F. N. Peters, *The Furans* (1953); "Furfural" and "Q.O. Chemicals," The Quaker Oats Company, Bulletins, 201A (1953) and 203A (1955). (A. P. D.)

FURIES, from the Latin *furiae,* by which name the Greek Erinyes (q *v.*) were known in Roman literature. The resemblance of name caused occasional confusion with the very ancient, but obscure, Roman goddess Furrina, whose functions and the derivation of whose name are unknown.

FURLONG, a measure of length, originally the length of a furrow in the "common field" system (from the O.E. *furlang, i.e.,* "furrow-long") (*see* LAND TENURE: ECONOMIC AND AGRARIAN ASPECTS). As the field in this system was generally taken to be a square, ten acres in extent. and as the acre varied in different districts and at different times, the furlong also varied. The side of a square containing ten statute acres is 220 yd. or 40 poles, which was the usually accepted length of the furlong. This is also the length of one-eighth of the statute mile. Furlong was as early as the 9th century used to translate the Latin *stadium,* one-eighth of the Roman mile.

FURNACE, ELECTRIC, a device used for heating material to change its state (*e.g.,* to melt it) or its physical, chemical and mechanical properties. In such furnaces electrical energy is converted into heat energy; the heat thus generated is proportional to the resistance encountered by the electric current and to the square of the current passed.

Electric furnaces are commonly classified as resistance, arc and induction types. The resistance medium for the resistance furnace is usually a solid wire. ribbon or rod or sometimes a liquid electrolyte; the resistance medium for the arc furnace is a gas, and for the induction furnace the medium is generally a solid or liquid.

Electric current usually 'does not flow through the material to be heated (*i.e.,* the charge) in resistance furnaces, although in certain electrolytic processes. such as those used in the production of aluminum. the current does flow through the electrolyte. Electric current may flow through the charge in certain arc furnaces, or the current flow may be confined to the gas phase above the charge. Finally, in induction heating electric current generally passes through the charge, except in the case of some melting furnaces in which current flows through the crucible and the charge is heated indirectly.

It is important to note in the study of furnaces that heating usually takes place by a subtle interplay of the three modes of heat transfer — convection, conduction and radiation.

Resistance Furnaces. — Most resistance furnaces are the indirect type—the current does not flow through the charge. Instead, separate resistors, which serve as heating elements, are provided. In furnaces for laboratory use, nichrome, graphite or molybdenum are the most commonly used resistors. Graphite and molybdenum oxidize readily in air and therefore can be used only in a protective nonoxidizing atmosphere, such as helium or oxygen-free nitrogen. Platinum resistors can be used in air but are. of course, expensive. For temperatures up to 1,200' C. (2,200° F.) iron-chromium-aluminum resistors are used; for temperatures up to 1.000° C. (1,832" F.) nickel-chromium is satisfactory. In industrial furnaces, and to a limited extent also in laboratory furnaces. rods and tubes of silicon carbide form satisfactory heating elements for temperatures up to 1,300° C. (2,650° F.), yielding resistor life of several hundred to several thousand hours, according to temperature and kind of service.

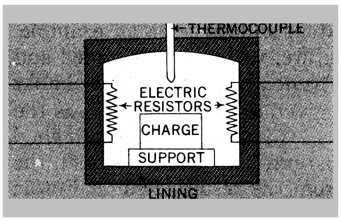


FIG. 1. — RESISTOR FURNACE

Laboratory furnaces usually consist of a refractory tube (*e.g.,* alumina), around which the resistor is wound. Tube and resistor are then embedded in appropriate insulating material, which in turn is held in an outside casing.

Resistor furnaces for industrial use are built in a large variety of shapes and forms. However, all consist essentially of resistors (heating elements) which usually, although not always, are located in the working chamber, electric insulators to support the heating elements, an inside wall, heat insulation and an outside shell. In some instances the electric insulators form part of the inside wall; on the other hand, frequently the inside wall and heat insulation coincide. Fig. 1 is fairly representative of a batch-type unit. However, many indirect heat resistor-type furnaces are provided with conveying means to carry the charge through the furnace; the variety of designs does not permit detailed description here. The majority of furnaces of this type are equipped with automatic temperature control, maintaining the furnace temperature constant within narrow limits.

In the listing of resistor materials one group of materials, fused salts, was not mentioned because it involves a totally different furnace design. In this type of furnace the electric current passes through a molten salt resistance, and heating of the salt bath occurs. In some cases technically pure salts such as barium chloride and potassium chloride are placed in metallic or nonmetallic containers; electrodes are placed in the salt, and the current passing from one electrode to the other provides enough energy to melt the salt. The charge can be placed in the liquid salt bath and heated to the desired temperature. Because of the intimate contact between the molten salt and the charge, heating of the latter is very rapid; moreover, the salt may prevent oxidation of the charge.

A type of direct-heating salt bath is characterized by the electrolytic furnaces used in the production of lithium, sodium, potassium, calcium. magnesium, aluminum, etc. In these furnaces the electrolyte is a fused salt heated directly by the passage of current through it. For example, in the production of aluminum, the fused salt is a mixture of aluminum oxide and sodium aluminum fluoride. During electrolysis of the fused salt aluminum metal collects at the bottom of the furnace on a graphite cathode and oxygen is set free at graphite anodes. Heating of the furnace is accomplished entirely by the passage of current through the resistance of the electrolyte.

Another direct-heating resistance furnace is employed in the production of silicon carbide. The raw materials are placed on a refractory base within a furnace and at each end the charge is connected to one or several electrodes which, in turn, are connected to the power supply. Current flows lengthwise through the charge, which may be several yards in length.

Resistance heating has been in use since the early 1900s and has undergone various developments. Infrared heating, for example, is carried out by exposing the surfaces to be heated to high-temperature sources. Banks of incandescent lamps, preferably with carbon filaments, are frequently used as heat sources; or common resistors (nickel-chromium type) may be designed to reach high temperatures. Infrared heating is useful mainly for rapid heating of surfaces. For example, in order to dry paint (a major field of application) at a temperature of 400° F., heat sources at 2,000° F, or even higher are used, but exposure times are short (from a few seconds to a few minutes).

Arc **Furnaces.**—Arc furnaces are used for melting or refining ferrous (and, occasionally, nonferrous) metals and for the production of refractories and ferroalloys. One important type of arc furnace is the direct arc or open arc, characterized by the Heroult

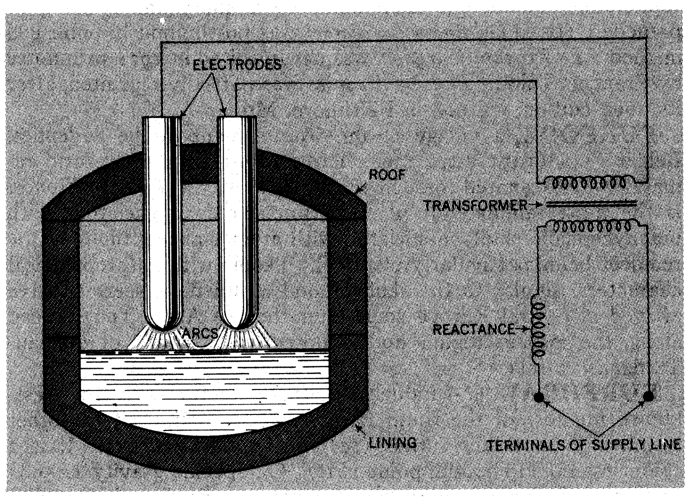


FIG. 2. — ARC FURNACE

furnace in fig. 2. A direct arc furnace consists of a transformer, often a reactance, buses and the furnace proper. In the transformer, voltage is reduced from the supply system to that required by the furnace. The buses, consisting of heavy copper or aluminum bars, connect the transformer to the electrodes. The latter bring the current into the furnace chamber. Electric arcs extend from the tips of the electrodes into the bath.

In the United States electrodes are made exclusively of carbon or graphite rods or bars; in other countries such electrodes find competition with Soderberg, or self-burning, electrodes, consisting of steel sleeves filled with a carbonaceous mass, that are fed continuously into the furnace. The furnace proper consists of a steel shell, lined with a refractory (generally basic magnesite) and covered by a roof. Tapholes permit withdrawal of the molten product as well as the slag and the furnaces can usually be tilted. Charging of the furnace is done either through doors or from the top, after removing the roof.

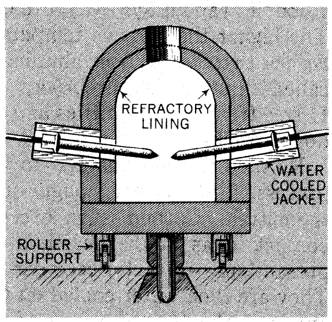


FIG. 3.—STASSANO ROTATING FURNACE

Over the years the size of furnaces as well as the power rating increased, both contributing to a decrease of energy consumption per ton of output. The maximum voltage used in open-arc furnaces for steel production increased gradually to about 300. High voltages make possible high production rates but present a safety problem for the operator and (since high voltage results in long arcs) reduce the life of the furnace roof.

Another type of arc furnace is the Stassano rotating furnace, essentially a cylindrical enclosure with two or three electrodes placed on a horizontal axis and facing each other. The arc is maintained between the electrodes and burns in the centre of the furnace, radiating toward the lining above and the charge below. This type of furnace is illustrated in fig. 3, which shows a vertical section through two of the electrodes. The electrodes are surrounded by water-cooled jackets. Gases from the reactions pass out through a vent in the top and the furnace is provided with a charging hopper and tapping spout (not shown). Slow oscillation of the furnace provides mixing of the charge. This type of furnace originally was used for the smelting of magnetite and hematite but is now built in small units for nonferrous alloys and gray iron foundry work.

Submerged arc furnaces are used for the production of ferroalloys. This type of furnace is illustrated in fig. 4. Transformer and buses are essentially the same as those in open arc furnaces. but the electrodes extend well into the charge, with short arcs playing from the electrode to the nearest parts of the charge and between various particles of the charge. In addition to the types of electrodes mentioned for open arc furnaces. European industry also uses composite electrodes, built of a number of discrete carbon or graphite blocks arranged in rows or cylindrically. The intense concentration of heat creates an odd-shaped reaction zone (see fig. 4). Some furnaces have no lining, the cold, nonmolten material protecting the side walls of the shell. Furnaces frequently do not have covers: and, since gases develop in the reactions involved, flames often may be seen burning around the upper end of the electrodes.

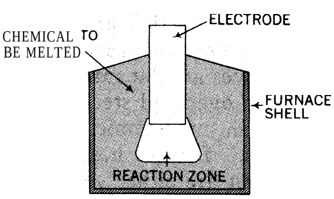


FIG. 4.—SUBMERGED ARC FURNACE

Induction Furnaces.— Furnaces of the induction type depend for their operation upon resistance heating. Although in induction furnaces there is no electrical connection between the electrical supply and the metal in the bath: there is an indirect connection by electrical induction similar to that prevailing in transformers between primary and secondary windings; in fact, induction furnaces may be understood as transformers with the coil as primary and the bath or crucible as a one-turn secondary winding. On the other hand, since heat generation occurs in the charge or in the crucible, induction furnaces are of the direct-heat type. The charge is generally the hottest point in the furnace.

Induction furnaces may be classed broadly into two groups, the core type and the coreless induction furnace. Induction furnaces are used for melting and induction heating appliances for heat-treating. brazing and soldering. Use of induction heating (or melting) is limited to good conduction materials, essentially metals.

Core-type melting furnaces are used almost exclusively in the nonferrous field. Fig. 5 shows a typical cross section. A V-shaped channel penetrates a coil. which is connected to the power supply; both legs of the V issue into a receptacle containing the batch of metal. This type of furnace must operate continuously; when pouring. the furnace is never emptied completely, enough metal being left to form a closed loop. The electromagnetic forces in the melt result in an energetic stirring; the forces are so strong that the same principle—of a liquid conductor surrounded by a coil—has been used successfully to pump hot liquid metals.

Core-type induction furnaces are rarely used for melting steel. For this purpose they have been replaced by coreless furnaces. Mechanically, coreless furnaces are very simple. They consist of a crucible surrounded by a water-cooled coil. the space between crucible and coil being filled with heat insulation. The coil is connected to a high-frequency power source. Up to 10.000-cycles-per-second rotating machinery can be used; beyond that value vacuum-tube generators or spark generators are used. The former make use of vacuum tubes of the same principle as, though larger than, those used in radio. Spark generators use the high-frequency oscillations occurring when a spark discharge across an air gap occurs. In view of the magnetic stray fields, any metal used in the construction of the furnacemould heat up. Hence the outside shells are made of wood, plastic or similar materials. Coreless induction furnaces for melting have been built in sizes up to several tons. When melting a nonconducting material. a conducting crucible (*e.g.,* graphite) which transfers heat to the charge may be used. Theoretically there is no limit to the temperature which can be reached in a coreless induction furnace. Practically, temperatures beyond 1,500° C. are hard to achieve.

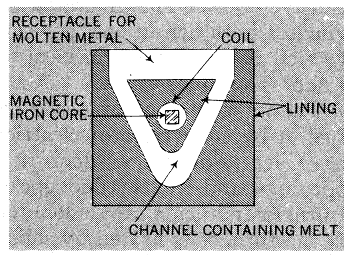


FIG. 5.—CORE INDUCTION FURNACE

As noted above, induction heating is used not only for melting purposes but also for heat-treating and brazing. The very rapid temperature rise, taking only seconds and occasionally only fractions of a second, and the possibility of localizing the points of heat generation are two of the main reasons for the rapid development of this technique. The arrangement is simple: a high-frequency power generator? of the same general type but normally of smaller rating than the generators used in melting furnaces. is connected to a water-cooled copper coil. The shape of the coil matches that of the piece to be heated. In view of the rapid temperature increase, control is frequently by time: power is disconnected after a preset length of time.

Because of the nature of energy transfer by induction (from the coil to the heated object). only a thin layer next to the surface is heated, the thickness of the layer decreasing with increasing frequency. From this shallow layer of heat generation heat is conducted to the inside of the piece. Basically in the same manner, but in technical execution quite different, induction heating at supply line frequency (50 to 60 cycles per second) can be used for raising the temperature of chemicals in pipes, bottles or other containers.

As stated, induction heating is applicable only to good conductors of electricity. Frequently confused with this method is one applicable only to very poor conductors, called dielectric heating. Fig. 6 shows schematically the arrangement for such heating. The piece to be heated is placed between two metal pieces, the electrodes. The latter must not touch the material. The electrodes are connected to a high-frequency (*e.g.,* 500.000 cycles per second) power supply. operating usually at more than 1,000 v. Under the influence of the high-frequency field, ,small (technically called "displacement") currents flow in the material, heating the latter, the heat being proportional to the electric resistivity of the material. This method of heating is used widely in the manufacture of plastic objects and finds increasing use in the curing of rubber and the drying and glueing of wood. See also HIGH-FREQUENCY HEATING.

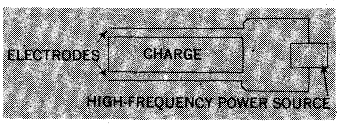


FIG. 6.—SCHEMATIC ARRANGEMENT FOR DIELECTRIC HEATING

BIBLIOGRAPHY.—V. A. Paschkis, *Industrial Electric Furnaces and Appliances,* 2 vol. (1945–48); American Society for Metals, *Induction Heating* (1946); N. R. Stansel, *Induction Heating* (1949); G. H. Brown *et al., Theory and Application of Radio-Frequency Heating* (1947); W. Trinks, *Industrial Furnaces,* 2 vol. (1951); J. L. Bray, *Ferrous Process Metallurgy* (1954). (V. Ps.; R. E. GE.; X.)

FURNACE, METALLURGICAL. A metallurgical furnace is a structure in which a temperature in excess of 1,000° F. (about 540° C.) can be maintained without serious damage to the walls and in which one of the following operations can be performed: (1) the heating of solid pieces of metal to various temperatures in different atmospheres; (2) the melting of metals for making castings; (3) the extraction or reduction of metals from their ores; (4) the refining of metals; (5) the distillation of metals; (6) the roasting of metallic ores; (7) the carburization of steel; and (8) the brazing of metals.

In metallurgical practice, a structure that is designed for a temperature between 600° F. (about 300° C.) and 1,000° F. is called an oven. A furnace or an oven is called a kiln if a gas or vapour is driven off the solid material being heated. The term coke oven violates both definitions, however, because in the making of coke (which is not a metallurgical process) the temperature rises to 1,800° F. (almost 1,000° C.) and gases and vapours are released.

The interior of a furnace is heated either by the combustion of fuel or by conversion of electrical energy into heat. All furnaces have access-openings (doors). A fuel-fired furnace has burner openings and vents (flue openings), usually in the side walls. Burners and vents are seldom located in the hearth or in the roof. If the furnace is heated by solid fuel that burns on a grate, a firebox is provided, which is separated from the hearth by a bridge wall.

If the charge remains in the same spot during the metallurgical operation, the furnace is called a batch furnace. If the charge moves progressively, the furnace is continuous. If solid pieces of metal are heated, the hearth is plane, horizontal or slightly inclined. If metals are smelted or refined on a hearth, the hearth is concave and is equipped with a taphole and a spout. The taphole is poked open at regular intervals or at the end of the operation. Furnaces with concave hearths are usually flame heated and are called open-hearth furnaces, reverberatory furnaces and (rather inaccurately) air furnaces. The term reverberatory arose from the fact that products of combustion transmit a large portion of their heat to the vaulted roof of the furnace, whence the heat is reflected (reverberated) to the hearth. Metals also are refined in externally heated pots, or crucibles, and in shaft furnaces that are charged at the top, the processed material being withdrawn at the bottom.

A furnace in which air or oxygen is blown into and through molten metal is called a converter. Underground furnaces in which long pieces are heated in a vertical position are called pit furnaces.

If the charge is in contact with the products of combustion, the furnace is said to be direct fired. In a muffle furnace, a separating nall lies between charge and products of combustion. Either the charge or the flame can be inside the muffle. If the flame is inside, the muffle is called a radiating tube.

Materials and Elements of **Construction.**—Furnaces are built of refractory material. of heat resisting metals and of metals cooled by air or water. The great majority of the refractories are oxides, such as silica, alumina, magnesite, dolomite, chromite and zirconia. Fire clay is a mixture of silica and alumina, with impurities that soften the bricks at high temperatures. Silicon carbide (which is not an oxide) has a high strength at elevated temperatures, but both silicon and carbon burn in oxidizing atmospheres if the protective skin of silica flakes off. The ideal refractory material has a high compressive strength at furnace temperature, a low thermal conductivity and a low coefficient of expansion. Refractory insulating bricks approach this ideal. These bricks, which are often called lightweight firebricks, are used up to 2,400° F. (about 1,300° C.). They resist temperature, but are destroyed by slags. Lightweight bricks have a lower compressive strength than dense bricks. Difficulties with refractories increase with temperature, with superimposed load and with chemical attack by liquids and gases. For heating solid metal up to 1,600° F. (about 870° C.), fire clay of medium quality is adequate. The higher the furnace temperature, the purer the clay must be. Bricks that are rich in alumina and low in impurities, formerly called "first quality firebrick," are known as "high-duty" bricks. If free from any impurities and very dense, they are called "superduty" bricks.

Refractories are adapted to the chemistry of the metallurgical process. Silica is acid; magnesite and dolomite are basic; chromite is neutral. Carbon is an excellent refractory if no oxygen can contact it, as in the hearth of a blast furnace. In spite of all precautions, refractories wear away under extreme conditions. They are then water-cooled on the outside of the furnace. An example is the blast furnace of the steel industry. Its hearth is built of bricks that are water-cooled. When the furnace is shut down for relining, no trace of the bricks remains; they have been worn away and replaced by frozen slag. In the upper part of the blast furnace (for making pig iron), the walls are subjected to abrasion by ore and coke and to infiltration of carbon monoxide, which breaks up ($2\,CO = CO_2 + C$) at decreasing temperatures. Pressure by solid carbon disintegrates the brick. For both reasons. a hard and dense special brick is used.

Refractory bricks are available in many standard sizes and shapes. Special shapes, especially large tiles, are expensive and liable to crack during the burning process. (See also FIREBRICK.)

Depending upon furnace temperature, muffles are made of alloy steel, fireclay or silicon carbide. Whenever conditions permit, furnaces are insulated by insulating bricks, powder or cement.

In furnace walls, expansion and contraction are not reversible. Unless bound together, a furnace will become leaky and finally collapse. For that reason, furnaces are bound by structural material. The vertical members are called buckstays; the horizontal members are called tie rods. If a furnace is to be gastight, it is enclosed in heavy steel sheets.

Most furnace roofs are arches that are built up from arch bricks and straight (constant thickness) bricks. Roofs that are arched in two directions (turtleback arches) are rare except over electric-arc furnaces. Roofs on large heating furnaces are flat rather than arched. The roof tiles are suspended from overhead steel beams. The suspension members are either metallic or ceramic.

Because concrete is disintegrated by heat, furnace hearths are not set directly on concrete foundations, but are either ventilated by air passages (between hearth and foundation) or set on thick slag fills.

Furnace Stacks.—Metallurgical furnaces for roasting or smelting develop dust and gases. In densely populated sections, nonpoisonous dust is removed by filters or electric precipitation. Poisonous gases, such as sulphur dioxide, can be converted at high cost into commercial products. As a rule, these gases are discharged at the tops of stacks several hundred feet tall, where wind velocity is many times greater than it is near the ground. When the gases reach the ground, miles away from the stack, they have diffused and are so diluted that they are not injurious.

Fuels.—Coal and coke are the usual solid fuels. In shaft furnaces for reduction of metal and in cupolas, solid fuel is a necessity. For metallurgical operations performed on hearths, solid fuels burning on a grate have been replaced by powdered coal and by gaseous or liquid fuels, where available. Flame control with solid fuels burning on a grate is poor and the labour cost is high, even if mechanical stoking is employed. Finely powdered coal

(95% through a sieve of 200 meshes per inch) is burned in large furnaces if the ash causes little trouble. Ash does no harm if it drops on a slag bath or an ash-cover in the furnace, but fly ash clogs ducts and wears nearby machines.

Early in the 20th century. coal was extensively gasified in gas producers; it is still so gasified to producer gas where more convenient fuels are not generally available. Producer gas has a low heating value; it contains soot. tar and dust. Its composition varies, and the gas ducts between producer and furnace must be burned out each week end. (See GAS INDUSTRY.)

In integrated steel works, blast furnace gas, coke-oven gas, tar and pitch are the principal fuels. In most other furnaces, powdered coal, natural gas, fuel oils and city (manufactured) gas are burned.

Fuel consumption per unit weight of processed metal varies within wide limits. If a component of the charge is burned in the process, the so-called fuel consumption may be zero. In some other processes, it is very great. In the blast furnace (for making pig iron) from 0.8 to 1.0 lb. of coke is required to make a pound of iron.

Electrical energy is utilized for metallurgical furnaces in three ways. In one method, electric heating elements (resistors) are fastened to the walls and the roof of the furnace. Metallic resistors are useful up to 1,900° F. (about 1,040° C.) furnace temperature. Resistors of silicon carbide are useful up to 2,500° F. (about 1,370° C.). In a second method, electric current passes through the charge, which then becomes a resistor and is heated by the current. This method is applied to both solid and liquid metals. In a third method. alternating current flowing in a coil induces eddy currents in the metal that is encircled by the coil or closely surrounds the coil. The eddy currents heat the metal. Metallic objects of less than 1¼-in. thickness are induction heated without being enclosed in a furnace.

See also FUELS; FURNACE, ELECTRIC.

Furnaces for Heating Solids on Hearths. — If metallic solids are heated on a hearth or on a support immediately above the hearth, the furnaces are used for annealing or heating for carburizing, quenching, drawing (tempering), rolling or forging. Most of these are tube furnaces and are continuous (see ANNEALING). The charge is pushed through the furnace, either directly or while resting on trays, or is carried through the furnace on a rotating hearth. In other furnaces, the charge rests on live (driven) rollers, or on traveling chains, or on belts of woven wire. Shaking hearths and vibrating hearths also transport the charge through the furnaces. Metallic objects are also heated while suspended in furnaces. At temperatures approaching 2,300° F. (1,260° C.), strength of the means of suspension is of concern. If the furnace is continuous, tightness of the strips that cover the slot in the roof is very important.

Bright sheet strip and machined parts are heated in protective atmospheres to prevent discolouration and oxidation. Most protective atmospheres are prepared by partial combustion of a hydrocarbon. such as natural gas, in separate furnaces, and by removing water vapour and carbon dioxide from the products of combustion. Furnaces with protective atmospheres are heated either by electric resistors or by radiant tubes. Infiltration of air is prevented by furnace pressure and by vestibules at entrance and exit doors. "Atmosphere" furnaces, including vacuum furnaces, are enclosed in airtight steel shells.

Metal heating furnaces are precision heating machines with automatic transportation of the charge and automatic control of furnace pressure, temperature and atmosphere.

Shaft Furnaces. — In these furnaces air rises in the shaft and burns the fuel, which is either coke or sulphur, or both. As a rule. air is blown into the shaft near its bottom. The required air pressure depends upon the height of the shaft, fineness of charge and rate of air flow desired per unit of cross-sectional area of shaft. Most shaft furnaces, such as the cupola which remelts iron in foundries, are cylindrical; but if the charge tends to hang to the walls and to vault, the shaft is conical, wide end down. Despite this precaution, "hanging" occurs occasionally in a blast furnace for smelting iron. The blast pressure then rises up to 30 lb. per square inch gauge. The air that is blown into cupolas or roasting furnaces is usually cold, but fuel economy requires that the air for iron blast furnaces be preheated. Beginning about 1945, the blast pressure was increased in some furnaces by throttling (restricting) the outflow of gases at the top. The throughput of blast furnaces is increased by this measure. Blast furnaces for smelting iron are about 100 ft. tall and have hearth diameters up to 28 ft. They produce up to 1,200 tons of pig iron in 24 hours. Furnace height, blast pressure and blast temperature can be reduced if the blast is enriched with oxygen.

hlultideck (or multihearth) furnaces also are shaft furnaces. They consist of from 8 to 12 circular hearths (up to 25 ft. in diameter) on top of one another. Alternately, the hearths have drop holes at the rim and near the center. A vertical shaft moves rabble arms which are so shaped that they move the ore alternately in and out. The size of the drop holes is critical: if too small, dust fuses on the underside of the hearth above; if too large, the roaster runs cold.

Some hood furnaces resemble shaft furnaces. Coils of strip sheets that are to be bright annealed are stacked on top of one another and are covered by a metallic hood, through which a protective gas is circulated. The hood is surrounded by a cylindrical furnace.

Flame Furnaces. — This term includes all those furnaces in which a flame passes horizontally over the charge that is melted on a dished hearth. Flame furnaces are called open-hearth furnaces when used for the production of steel, reverberatory furnaces when used for the production of copper and nickel, and air furnaces nhen used to melt scrap cast iron. The dished hearth is made so dense and impervious by fusion that the heavy molten metal cannot penetrate into and through it. At the slag line, the walls are built of a material that resists chemical attack by the slag (silica for acid slags or chrome-magnesite and dolomite for basic slags).

Silica bricks are strong at high temperatures. For that reason, silica roofs are common even in furnaces with basic slags, although the silica is gradually worn away by vapours and spittings from the bath. Chrome-magnesite bricks last longer in basic processes, but (in most industrial districts) are more expensive.

Open-hearth furnaces are of the batch type. Reverberatory furnaces are continuous. The ore concentrate is fettled (charged) through lateral openings in the roof. Slag overflows continuously at one end, and metal is tapped at intervals at the deepest part of the bath.

With a few exceptions, the reaction heat released by the process does not suffice to maintain reaction temperature. In furnaces of this type, fuel is burned above the charge. Depending upon the required furnace temperature, the fuel is burned either in cold air or in preheated air. Air temperatures up to 1,300° F. (about 6j0° C.) are obtained in metallic recuperators, which are heat exchangers with a metallic wall between outgoing products of combustion and incoming air. Higher air temperatures up to 1,800° F. (about 980° C.) preferably are attained in regenerators, which are brick-filled chambers through which air and hot gases flow alternately in opposite directions. The result is that flame also flows through the furnace alternately in opposite directions. Direction of flow is controlled by reversing valves.

Since 1942, oxygen has been blown, through lances, into the bath of open-hearth furnaces. This is done in the latter part of the refining period. when the slag reactions are slow.

The first open-hearth furnace for steel (c. 1870) held five tons of metal. In the second half of the 20th century the standard size in steelworks was a50 tons, and furnaces of up to 600 tons capacity were in operation.

In flame furnaces for the reduction and refining of metals, wear by chemical action at high temperatures is so rapid that the furnaces must be rebuilt at regular intervals.

Crucible Furnaces. — For many years, steel of high quality was produced in crucibles, mhich are pots of refractory material. Crucibles of graphite or of high grade fire clay were heated by the products of combustion of preheated producer gas and preheated air. Since about 1932, steel of highest quality and other metals have been refined in evacuated crucibles heated by induction. Crucible and ingot mold are then integral. The alloy is both melted and poured (by tilting) in vacuo. Metals such as titanium, which must be free from bases, are melted and annealed in hermetically sealed pots or crucibles.

Crucible furnaces for remelting nonferrous metals are of simple design. The crucible rests upon a support in a cylindrical furnace into which a flame is projected tangentially. (See also CRUCIBLE STEEL.)

Converters. — Converters are refractory-lined vessels into which a molten metal is poured for the purpose of changing the composition of the metal by burning undesirable elements and removing them in gaseous form. This aim is reached by blowing either air or oxygen into and through the metal. Converters are bottom-blown, side-blown or top-blown. In steel works practice, the air enters from the windbox (under the hearth or bottom), and flows upward through many small openings (tuyères), the total area of which is less than 1% of the hearth area. In the blouing of steel, the air pressure ranges between 20 and 26 lb. per square inch gauge. If the pressure is too low, the air rises in bubbles, containing improperly utilized oxygen. If the air pressure is too high, too much of the metal is thrown out, in the shape of pellets, through the mouth of the converter. The reactions are most intense immediately above the bottom, which wears away quickly. Converters rest in two trunions; they are tilted for receiving and for discharging metal. Bottom-blown converters must have, on one side, a pouch that holds the charge in the inclined vessel, without the metal's spilling out of the mouth or flowing into the tuyères. Blowing begins before the vessel is righted. In converters constructed since 1950, oxygen is blown into the bath from above, through a central pipe. Converters in steel works range from 1j to 50 tons holding capacity. Small steel converters are usually side-blown.

Converters in the metallurgy of copper and nickel are side-blown cylindrical vessels, with an average size of 13 ft. in diameter and 30 ft. in length, having from 46 to 52 tuyères of $1\frac{1}{2}$ inch diameter. The air pressure is 14 lb. per square inch (gauge).

Depending upon the nature of the charge, converters are lined with acid (silicious) material, or with basic (dolomite) material. (See also CONVERTER STEEL.)

Electric Arc Furnaces. — Electric furnaces for making alloy steels are round or elliptical boxes, through the roofs of which carbon electrodes reach down to the charge. Electric arcs, combustion of the electrodes and heat generated by the current in the charge bring the charge up to reaction temperature and supply reaction heat. When the process has been finished, the furnace, including electrodes, is tilted. The electrodes are moved in and out automatically to maintain the current near a predetermined value. A transformer located close to the furnace is connected to the electrodes by heavy flexible cables. In steel making, electric furnaces have taken the place of crucible furnaces and of small open-hearth furnaces. Because heat is generated directly in the charge under the slag cover, the roof is protected so that higher temperatures can be obtained in the bath than in crucible or open-hearth furnaces.

Electric furnaces using direct current serve in the production of aluminum. Carbon electrodes reach down into a bath of molten salts (cryolite), which lies in a carbon-lined tank. Liquid aluminum collects on the carbon lining and is withdrawn at regular intervals through a taphole. Such furnaces are electrolytic cells operated at high temperature.

Salt Bath Furnaces. — Salt bath furnaces are containers filled with molten salts, the composition of which is such that the salt is liquid at the desired temperature. These furnaces heat fine tools uniformly and, in many cases, saturate the surface of the charged pieces with carbon and nitrogen, for imparting hardness after quenching. Low-temperature salt baths lie in suspended iron pots that are externally heated. High-temperature salt baths are contained in refractory pits, which are usually heated electrically through electrodes that dip into the bath. Some salt baths are flame heated from above.

Retort Furnaces. — Easily volatilized metals such as mercury, magnesium and zinc are produced in slightly inclined retorts that project outside the furnace at one end. The vapourized metals condense in the cold zone. Burners must be so arranged that all retorts reach the same required reaction temperature. Too low a temperature reduces the yield of metal; too high a temperature shortens the life of the retorts.

Recirculating Furnaces. — If metallic objects are to be heated to a uniform specific temperature below 1,500° F. (about 800° C.), fuel is burned in a separate combustion chamber. When leaving this chamber, the products of combustion mingle with other products that have already passed through the heating chamber. Circulation is obtained by mechanical means. The charge is safe from local overheating. For temperatures below 1,000° F. (about 540° C.), these furnaces are really ovens. They are often called air furnaces.

Tower Furnaces. — Strips of steel sheet and tin plate are delivered from the cold mill at speeds that exceed one mile per minute. Continuous bright annealing at a corresponding rate of speed requires a long time in the furnace, for heating, holding at temperature, and cooling, all in a protective atmosphere. The long time period is obtained in special furnaces by passing the strip up and down several times over graphite rollers, between heaters and, finally, between coolers. These furnaces are as tall as 40 ft.— hence the name "tower furnace."

Other Furnace Types.--Furnaces that do not fit into any classification appear from time to time. An example is the electric-arc crucible furnace with inert atmosphere (including vacuum). The walls are water-cooled copper; an induction coil is provided for stirring the molten metal and the bottom of the crucible is removable for dropping the ingot after solidification.

Laboratory and Portable Furnaces. — Most laboratory furnaces use gas, oil or electricity as the heating medium. The furnaces are small copies of the muffle, tube and crucible types. Small portable assay furnaces, using coke or coal and arranged so that they can be used either as muffle or crucible furnaces, are frequently used in situations where other methods of heating are not available, as in prospecting.

For related information, see BLAST FURNACE; COPPER; CUPOLA FURNACE; FUELS; IRON AND STEEL INDUSTRY; LEAD; OPEN-HEARTH STEEL PROCESS.

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FURNABIIDAE: see OVENBIRD.

FURNEAUX, TOBIAS (1735–1781), English navigator who introduced domestic animals and potatoes into the South sea islands, and who made the earliest British chart of the south and east coasts of Tasmania. He was born at Swilly, near Plymouth, on Aug. 21, 1735.

Furneaux entered the Royal Navy, and was employed on the French and African coasts and in the West Icdies during the latter part of the Seven Years' War (1760–63). He served as second lieutenant of the "Dolphin" on her voyage around the globe (Aug. 1766–May 1768), and commanded the "Adventure" which accompanied Captain James Cook on his second voyage. On this expedition Furneaux was twice separated from his leader; the first time he explored a great part of the south and east coasts of Tasmania. Most of the names which he gave to the features observed survive, and Cook, on his third voyage, named after Furneaux the islands in Banks strait, the opening into Bass strait, and some islands of the group now known as the Low islets. After the "Adventure's" final separation from the "Resolution" off New Zealand in Oct. 1773, Furneaux returned home alone, bringing with him the first South sea islander seen in the British Isles, Omai of Ulaietea, who returned to his home with Cook in 1776–77. Furneaux was made a captain in 1775, and commanded the "Syren" in the British attack of June 28, 1776, upon Charleston, S.C. He died at Swilly on Sept. 19, 1781.

See J. Hawkesworth, *An Account of the Voyages undertaken . . . by Captain Wallis,* etc., 3 vol. (1773).

FURNES (Flem. VEURNE), an old-fashioned little town amid the dunes near the coast in West Flanders, Belgium, about 26 mi. S.W. of Bruges. Pop. (1955 est.) 7,297. It is the centre of a considerable area extending to the French frontier, and its market is an important one for the disposal of corn, stock, hops and dairy produce. During the Norman raids Furnes was destroyed, and the present town was built by Baldwin Bras de Fer, first count of Flanders, about the year 870. In the 14th century the barony of Furnes owned 52 rich villages; but these have all disappeared, partly because of French invasions down to the end of the 18th century, but chiefly through encroachment of the sea followed by accumulation of sand. Furnes contains a market place with many curious old houses and the church of St. Walburga, which is a fine survival of the 13th century with some older portions.

Near Furnes on the seashore is the fashionable bathing place called De Panne. On the last Sunday in July the *fête* of Calvary and the Crucifixion is celebrated. Of all popular festivities in Belgium this is the nearest approach to the old Passion play.

FURNESS, HORACE HOWARD (1833–1912), U.S. Shakespearean scholar, was born in Philadelphia, Pa., Nov. 2, 1833, the son of William Henry Furness (1802–96), minister of the First Unitarian church in that city. He graduated from Harvard in 1854 and was admitted to the bar in 1859 but soon devoted himself to the study of Shakespeare. He accumulated a collection of illustrative material of great richness and extent and brought out in 1871 the first volume of a new variorum edition, designed to represent and summarize the conclusions of the best authorities in all languages — textual, critical and annotative. The volumes appeared as follows: *Romeo and Juliet* (1871); *Macbeth* (1873; revised by his son, 1903); *Hamlet* (2 vol., 1877); *King Lear* (1880); *Othello* (1886); *The Merchant of Venice* (1888): *As You Like It* (1890); *The Tempest* (1892) ; *A Midsummer Night's Dream* (1895); *The Winter's Tale* (1898); *Much Ado About Nothing* (1899); *Twelfth Night* (1901); *Love's Labour's Lost* (1904); *Antony and Cleopatra* (1907); and *Cymbeline* (1913). For his first volumes he made an independent text, but beginning with *Othello* he used the first folio.

Few U.S. scholars have shown such single-hearted devotion to a formidable task, and few have so brightened erudition with gentleness, sanity and humour. Furness was conservative in his methods but sound in his judgments. He died at Wallingford, Pa., on Aug. 13, 1912. His wife, Helen Kate Furness (1837–83), compiled *A Concordance to the Poems of Shakespeare* (1874); and his son and namesake (1865–1930) was a partner in and successor to his father's work.

Furness' *Letters* were edited by his son in 1922.

FURNESS, a district of Lancashire, Eng., separated from the major portion of the county by Morecambe bay, though once easily accessible over the sands at low tide. It is bounded by Morecambe bay, the Irish sea, the Duddon estuary, Cumberland and Westmorland. Its area is about 230 sq.mi. It forms part of the Morecambe and Lonsdale parliamentary division of Lancashire and contains the county borough of Barrow-in-Furness (*q.v.*). Except for a coastal strip the surface is almost entirely hilly and contains such eminences as the Old Man of Coniston and Wetherlam.

Apart from the Duddon, the principal rivers are the Leven (which drains Windermere) and the Crake (which drains Lake Coniston). They flow into a common estuary in Morecambe bay. Furness is nearly all included in the Lake District National park. Roudsea Wood Nature reserve was the first one to be declared within an English national park. It covers 287 ac. about 10 mi. W. of Grange over Sands. Several of the place names are suffixed with that of the district, as Barrow-in-Furness, Dalton-in-Furness, Broughton-in-Furness. Between the Duddon estuary and Morecambe bay lies Walney Island, 8 mi. long and 1 mi. wide, connected by a bridge to the mainland. The southwestern part of Furness is rich in iron ore, which has been worked from early times. Production reached its peak in the 1880s after which it declined. It was because of the existence of this ore that Barrow grew in the 19th century, at first as a port from which the ore was exported to south Wales, while later furnaces were established on the spot, but now they depend upon ore imported from abroad.

Furness has an especial interest because of its famous abbey, the ruins of which, beautifully situated in a wooded valley to the north of Barrow, are extensive and mainly of fine transitional Norman and Early English date. The abbey of Furness, dedicated to St. Mary, was founded and built of fine red sandstone in 1127 by monks of the Benedictine order of Savigny in France. In 1124 they had settled at Tulketh, near Preston, but migrated in 1127 to Furness.

In 1148 the brotherhood joined the Cistercian order. Stephen granted to the monks the lordship of Furness, and his charter was confirmed by Henry II and subsequent kings. The abbot's power throughout the lordship was almost absolute. He had a market and fair at Dalton. The abbey became one of the richest in England and was the largest Cistercian foundation in the kingdom. At the dissolution of the monasteries its revenues alone amounted to between £750 and £800 a year. The abbot was one of the 20 Cistercian abbots summoned to the parliament of 1264 but was not cited after 1330. The abbey founded offshoot houses, the most important being Rushen abbey on the Isle of Man. In 1535 the royal commissioners reported four of its inmates, including the abbot, for incontinence; in 1536 the abbot was charged with complicity in the Pilgrimage of Grace and on April 7, 1537, surrendered the abbey to the king.

In 1540 the estates and revenues were annexed to the duchy of Lancaster. About James I's reign the site and territories were alienated to the Prestons, from whom they descended to the dukes of Devonshire.

Conishead priory, near Ulverston, an Augustinian foundation of the reign of Henry II, has left no remains, but of the priory of Cartmel (1188), 6 mi. E., the fine church is still in use. It is a cruciform structure of transitional Norman and later dates, the design of the tower being unique in England. The chancel contains some superb Jacobean carved oak screens.

FURNISS, HARRY (1854–1925), British caricaturist and illustrator, best known for his political and social lampoons, was born at Wexford, Ire., March 26. 1854. Mainly self-taught, he settled in London in 1873 and, before turning wholly to free-lance work in 1894, became very popular as a staff artist on the *Illustrated London News* (1876–84) and *Punch*. In his parliamentary cartoons he never used the distortions of the Rowlandson-Gillray tradition, but drew in the less savage tone of a Richard Doyle or a "Phiz," rather emphasizing idiosyncrasies of face and dress: an amusing example is the strip cartoon "Getting Gladstone's Collar Up." He also designed a famous commercial "tramp" poster for a brand of soap ("I used your soap two years ago since when I have used *no other!"*). Strongly critical of the Royal Academy, he held in 1887 an exhibition of parodies of the work of leading Burlington House exhibitors. and in 1890 published *Royal Academy Antics*. He illustrated many books. including Lewis Carroll's *Sylvie and Bruno* (1889) and complete editions of Dickens (1910) and Thackeray (1911). In 1912–13 he worked as a film writer, actor and producer for Thomas Edison in New York and London; *Our Lady Cinema* (1914) outlined his hopes for that art. He also appeared as a novelist, essayist and writer of art instructional manuals. He died at Hastings, Sussex, on Jan. 14, 1925.

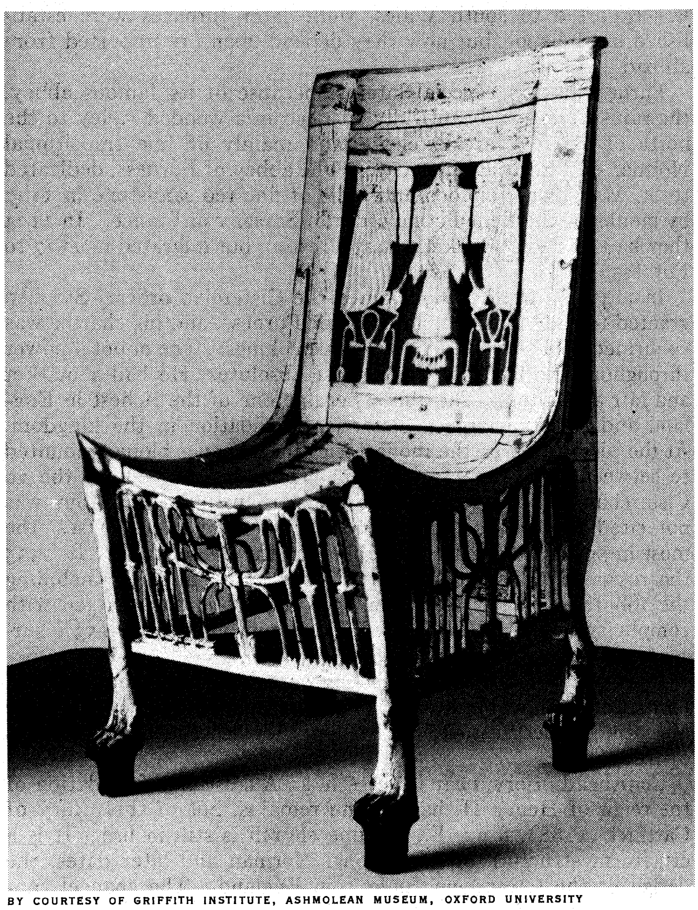
See H. Furniss, *Confessions of a Caricaturist,* 2 vol. (1901).

FURNITURE. In this article the furniture of Egypt, Greece and Rome, China, India, Europe and America is described in its development through the ages.

The article INTERIOR DECORATION is similarly treated to complete the picture of the interiors of houses in different parts of the world from the earliest times.

ANCIENT CIVILIZATIONS

Egypt. — The bed was perhaps the earliest piece of furniture. It consisted of a wooden framework raised on four legs which were often carved; soft flax cord, plaited, was lashed to the four sides of the framework and formed a springy surface for the sleeper to



BY COURTESY OF GRIFFITH INSTITUTE, ASHMOLEAN MUSEUM, OXFORD UNIVERSITY

EGYPTIAN CARVED WOODEN CHAIR FROM THE TOMB OF TUTENKHAMON (14TH CENTURY B.C.), THEBES

lie on. In the 18th dynasty (c. 1587–1375 B.C.) beds sloped up toward the head, a painted or carved wooden footboard preventing the sleeper from slipping down. The great beds found in the tomb of Tutenkhamon were put together with bronze hooks and staples so that they could be taken to pieces for convenience of carriage. In the same tomb was a folding wooden bed with bronze hinges which was probably for the use of the Pharaoh on his tours of inspection. Pillows were not used; in their stead were wooden or ivory headrests. These were so essentially individual, being made to the measure of the owner, that they are often found in tombs to be used by the dead man on his arrival at the land of eternity. A folding headrest was evidently for the use of a traveller.

Early stools were merely squared blocks of stone, probably required only for ceremonial purposes by a people accustomed to squatting on the ground. When made in wood the stool had a flat seat covered with a soft cushion. In time the stool developed into the chair by the addition of a back and arms; the legs were held in position by crossbars, but in the 18th dynasty angle pieces of acacia wood also fastened the seat to the legs; such angle pieces had been artificially forced to grow at right angles and were therefore exceptionally strong. Footstools were of wood. The royal footstool was painted with the figures of the two traditional enemies of Egypt so that the Pharaoh might symbolically tread down his enemies under his feet.

For keeping clothes or other objects, boxes or baskets were used, the boxes being often elaborately painted. Tables were almost unknown, a pottery or wooden stand supporting a flat basketwork tray held the dishes for a meal, and the stands which held the great pottery jars which contained the drinks—water, wine or beer—were also of wood. Wooden furniture was usually put together by dovetailing or with dowels of acacia wood.

Ewers and basins of pottery or metal were probably in use in every household. for where meals are eaten with the fingers hand-washing is essential before and after a meal. Of the 22nd dynasty (*c.* 952–749 B.C.) is a silver "antisplash" basin, evidently part of the travelling equipment of a Pharaoh. (M. A. M.)

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Greece and Rome.—Knowledge of the furniture of the Greeks and Romans is obtained from various sources including literary descriptions. representations of chairs, tables, etc.. on sculptured reliefs, vase paintings and other works of art, and from the few actual pieces of furniture which still survive.

In ancient homes the couch, used for reclining on by day and as a bed at night. held an important place, and the earliest couches probably consisted of a mattress on a simple framework on four legs nith a solid seat or with the latticework of cords or leather thongs which persisted into Roman times. The legs occasionally imitate those of animals with claw feet or hooves, but usually they are either turned on the lathe and ornamented with mouldings, or they are rectangular and decorated in various ways, either with incised designs or with volutes, rosettes and other patterns in high relief. From about the 6th century B.C. onward the legs project above the couch frame and these projections become the head-boards and footboards, the latter being lower than the headboards and developing at a later date. In Hellenistic times headrests and footrests are curved and decorated with bronze medallions carrying busts of children or satyrs or heads of birds and animals in high relief. Turned legs now largely replace rectangular ones. While a bronze bed of 2nd-century B.C. date has been found at Priene (Samsun) and marble couches sometimes occur in tombs, wood was the usual material, the legs being sometimes encased in bronze mouldings and having metal feet and the rails covered with bronze sheathing. Couches of the same type were used in the early Roman empire, and remains of several examples with these bronze fittings have been found at Pompeii. Gold. silver, tortoise shell. bone and ivory were also used for decoration, with veneers of rare woods. Late couches found in Italy and in many parts of the empire are characterized by the high back and sides which replaced the earlier headrests and footrests.

From the Greek archaic period onward many varieties of individual seat are known, the most imposing, perhaps, being the high-backed thrones of wood or marble. elaborately adorned. Like the couches, they are supported on rectangular or turned legs or legs with animal feet, and they frequently have arm rails. Another type of throne, with or without back and with a boxlike seat and no feet, is also found. and in the Roman period this develops into a small armchair with solid rounded back made in one piece with the sides. set on a rectangular or semicircular base. This armchair was often of wickerwork, as well as of wood or stone. There was also the popular Greek *klismos*, a lighter chair with slightly curved back and plain curved legs, which turned into the more substantial Roman *cathedra.* The *diphros,* a stool standing on four turned legs, was another long-lived favourite, and from works of art it is known that the Romans developed a yet more decorative type of stool, probably made of bronze, with curved legs ornamented with scrolls. The convenience of the folding stool was also realized at an early date and the crossed legs are sometimes connected by stretcher bars, while in another form of this stool they terminate in hooves or claw feet. The variety with straight legs became the *sella curulis* of the Roman magistrate, but it also continued in domestic use and remains of actual folding stools are known from such sites as Ostia. It., and the British barrow burials at Bartlow, on the Essex-Cambridgeshire border, and Holborough, Kent. The stool with animal feet developed more solid legs with a double curve. and examples of it have come to light at Pompeii. An iron stool of this type with bronze decorations found at Nijmegen, Neth., belongs to a still more substantial form of this cross-legged stool which may not have always folded up

Greek tables were usually small and easily portable and included an interesting type with an oblong top supported by three legs, two at one end and one at the other. These legs usually tapered from the top and ended in claw feet, and the bronze and stone examples, which are occasionally found. show carved flutings on the front of the legs and scroll ornament at the side below the table top. Rectangular tables with four legs were also used and in the Roman period largely replaced the three-legged variety.

Round-topped tables with three legs of animal form became increasingly popular from the 4th century B.C. onward. A nearly complete wooden table, found in Egypt and now in the Musée du Cinquantenaire. Brussels, is decorated with swans' heads with graceful necks rising out of a band of acanthus foliage, below which are very realistic antelope legs with hooves instead of claw feet. This type of table seems to have been popular all over the Roman empire, as it often appears on tombstones depicting funerary banquet scenes. Actual fragments of table legs and tops are sometimes discovered; and Britain produced a remarkable series of them made of Kimmeridge shale. From references in Pliny and other authors it is known that citrus wood was another favourite material. Several complete tables found at Pompeii and Herculaneum are made of marble and decorated with beautifully carved heads of lions and panthers. Another type of smaller table is round or rectangular with only one central leg. and there are pairs of table supports consisting of solid slabs, ornamented in high relief, which carried tops of mood or marble.

Pompeian wall paintings show that plain undecorated wooden tables and benches were used in kitchens and workshops, and some household possessions were kept in cupboards with panelled doors. Rectangular footstools, sometimes with claw feet, were used with the high chairs and couches. Small bronze tripods and stands are further items of Roman furniture. Clothes and money were stored in large wooden chests with panelled sides standing on square or claw feet. Chests used as coffins in the Crimea in the 4th century B.C. are still in existence and give a good idea of the skill of the Greek carpenters. They have arched or gabled lids and are decorated with marquetry work and with applied stucco or terra-cotta ornament, gaily painted. Roman treasure chests were covered with bronze plates or bound with iron and provided with strong locks. Jewellery and personal belongings were kept in caskets, in small round or square boxes or even in baskets.

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THE ORIENT

China.—Although examples of Chinese furniture are familiar to most westerners, remarkably little systematic study has been made of it. Its origins remain comparatively obscure, its workshops mostly unrecorded, its designers unknown and accordingly its dating extremely difficult. The Chinese almost entirely ignore it as an art form. G. Ecke in his *Chinese Domestic Furniture* (Peking, 1944) says, "Chinese furniture has retained its architectural character and the imprint of pristine dignity throughout changes of taste, into the days of a dying tradition." Certainly most of the forms of Chinese furniture such as the low table and the covered bed are found on the oldest Chinese paintings in existence and can even be recognized in the early forms of the Chinese characters dating back to before 1000 B.C. The designs have been remarkably conservative throughout the ages—a factor which greatly hinders the historian in his attempts to date pieces.

Chinese furniture can be divided into two main types: (1) lacquered wood pieces either inlaid with mother-of-pearl or elaborately carved; and (2) plain hardwood pieces.

Of the first almost nothing is known and dating of such pieces as tables or stools is possible only from the designs of such decorative motifs as dragons, peonies, etc., and by their background motifs. The most important historically in this class are the black lacquer pieces inlaid with mother-of-pearl which have been preserved in the imperial repository (Shōsō-in), Japan, from the 8th century. In the red lacquers, such as seats and tables, the earliest pieces date back to the Ming dynasty (1368–1644), their workmanship being characterized by softer contours and freer, more spirited designs than the later (Ch'ing, 1644–1911) pieces. These lacquered objects influenced the European cabinetmakers.

The plain hardwood furniture is frequently encountered. Its deserved popularity both in China and the west has been gained by its classical simplicity, reserved ornament and lack of pretence. In these products of the finest workmanship, purity of line, plastic strength and a flawless polish combine to produce a harmonious, solid effect.

A Chinese house requires less furniture than a western house. Correspondingly, the types of furniture are fewer—nardrobes, chests, tables both high and low of all types and shapes, altar tables, stools, beds sometimes testered with curtains, screens and stools for use by the bed, chairs and couch-tables.

Although the fundamentals of Chinese joinery must have been formed a millennium before the modern era. the great development in Chinese furniture took place with the introduction of Buddhism from India into China during the first centuries A.D. Hitherto the Chinese had sat cross-legged, or knelt on the floor or on stools. Buddhism made popular the western style of sitting on higher chairs with back rests and with or without side arms. The fusing of the Indo-Asian back-and-arm chair to the Chinese architectural style involved the fusing of the existing stool forms into a chair formed of frame and panel, post and rail or bamboo construction. None can be called comfortable. Unlike the chair, which is not a successful piece of furniture, the chests and armoires are superb examples of careful joinery and often have finely worked metal mounts which greatly enhance the beauty of their solid design. These mounts, which often adorn wardrobes, cabinets and chests, can sometimes provide a clue to their dating.

A number of hardwoods were used for the plain furniture. Their names and equivalents are difficult to render in English and no agreement has been found for them—purple sandalwood (the most distinguished), rosewood of many varieties, mostly imported from Indochina and called "old," "new" and "yellow," rednood, burl (especially for inlay) and a kind called "chicken-wing" wood. Rosewood in its many varieties is perhaps the most frequently encountered and the most popular for its seeming translucence and satin-soft finish. It is above all the faultless workmanship, so typically Chinese, and the fine polish of Chinese furniture which attracts the westerner. It was the Chinese respect for the spirit of wood, their command of line, curve and cubic proportions which became the ideal of the 18th-century *ébéniste*.

According to the Chinese, the best period for furniture was the early Ming period, but examples from the 15th century are extremely rare though modern reproductions of excellent workmanship continue to be made in China. (P. C. S.)

India.—India's place in the history of furniture is that of an adapter or transformer of imported western styles rather than a creator of independent styles of its own. Domestic furniture in the sense in which it is known in Europe was not traditional in India before the 16th century, and even such familiar objects as tables and chairs were rarely used until the spread of Portuguese, Dutch and English furniture.

It was precisely the difficulty of obtaining suitable furniture locally for their settlements which encouraged the European traders to export western prototypes for copying. It was soon found, however, that the Indian craftsman, although a poor copyist, was a skilled and imaginative adapter of foreign styles. This led to the emergence of an independent Indo-European style of furniture which was much admired for its own sake and subsequently exerted fresh influences in the west.

The Indian craftsman's poor copying is reflected not only in distortions of shape but also in his misunderstanding of European joinery techniques. For instance, in most 17th-century Indian furniture, dovetailing is imitated without recognition of its true structural function, with the result that such joints often had to be reinforced with glue or pegs. In decorative treatment, on the other hand, the Indian was more at home, and much of his inlay and veneering is equal to the best contemporary western work.

Early Indo-European furniture can be divided into two distinct groups, according to whether the influence was primarily Portuguese or Dutch (the English, although participants in the furniture trade, did not exert a national influence on styles until the late 18th century).

The Indo-Portuguese group includes a northern Indian or provincial Mogul style and a southern or so-called Goanese style. The former is artistically the more interesting and includes a variety of furniture decorated with inlaid bone or ivory on ebony and other dark woods. The most important historical piece in this group is a credence table made for the Jesuit chapel at Lahore in 1610, now preserved at the Victoria and Albert museum. London. This table provides a firm dating point. With it can be identified a large number of portable writing cabinets (Portuguese *escritorio*), Italian in form but purely Mogul in decoration. Italian influence is explained by the fact that in the late 16th century Renaissance styles were dominant in Portugal itself. When the English reached India in the early 17th century, examples of this northern. Indo-Portuguese furniture were shipped to London, there to be coveted as something entirely exotic.

The second Indo-Portuguese style) sometimes called Goanese (though in fact more probably made on the Malabar coast, south of Goa), is more stereotyped in form and in decoration. It is distinguished by large and rather cumbersome cabinets of a type known in Portugal as *contador*, the inlay ornament being either geometrical or semi-abstract. The Indian contribution to this style is more inhibited and lacks altogether the charm and fancifulness of northern Indo-Portuguese furniture.

Indo-Dutch furniture is easily distinguishable from Indo-Portuguese, since the former reflects contemporary Dutch taste as clearly as the latter reflects Portuguese. There were two types of Indo-Dutch furniture. The first, which was made on the Coromandel coast, was mainly in light-coloured woods, the decoration being in inlaid bone. incised and lacquered. The second is a style of carved ebony furniture which, although commonly found in India and often thought to be Indian in origin. was in fact made at Batavia (modern Djakarta) in Java, the Dutch administrative headquarters in the east. The carved relief decoration of the ebony furniture is floral in character and closely related to the flowering-tree style of contemporary Indo-Dutch embroidered bedspreads and hangings, in which the tulip is prominent.

With the growth of British power in India in the 18th century, all Indo-European furniture styles came increasingly under English influence. Whole suites were made in ivory in the manner of Chippendale and Sheraton, not only for European buyers but also for Indian native rulers who increasingly favoured European styles of furniture. Some of the best surviving pieces of ivory furniture of this kind were seized from the palace of Tipu Sahib at the fall of Seringapatam in 1799 and are now preserved at the Victoria and Albert museum.

In the 19th century Indian artistic standards degenerated and furniture of the period reflects this clearly. The emphasis was on decorative elaboration for its own sake and although much 19th-century Indian wood carving shows great technical skill: this rarely compensates for formlessness and stereotyped ornament. It would be unfair to associate the tastelessness of this style with Indian furniture as a whole.

See R. Edwards and K. de B. Codrington, "The Indian Period of European Furniture," *Apollo Magazine,* vol. xxi–xxii (London, 1934–35) ; V. I. van de Wall, Het *Hollandsche Kolonial* **Barokmeubel** (Antwerp, 1939). (J. C. I.)

EUROPE

Early Middle Ages.—Comparatively little furniture of the mediaeval period in Europe has survived, and only a handful of these pieces date from before the end of the 13th century. One reason for this is the perishable nature of wood, but more important is the fact that furniture was made in such small quantities up to the time of the Renaissance. Therefore much of the earlier history of furniture has to be drawn from other sources, from contemporary literature. illuminated manuscripts, from Romanesque and Gothic sculpture and later from inventory descriptions.

During the early mediaeval period little furniture was used, and what there was was limited to the most basic types of a single design. After the collapse of the Roman empire during the 4th century and its withdrawal to Byzantium. western Europe lost the many sophistications of Roman domestic life and among them furniture. It was to take the Teutonic peoples several centuries before they evolved furniture that approached the standard of domestic equipment familiar to the Roman empire. But there is evidence that certain ancient traditions of furniture making, and particularly that of turnery, were known to and influenced the early Teutonic craftsmen. Turnery was used in making chairs, stools and couches in Byzantium. and it seems that this technique was known across Europe as far north as Scandinavia. Few types of furniture were made during these early centuries, but there were chairs, stools, benches and the most primitive forms of chest. *Beowulf,* which gives some glimpses of the domestic economy of western Europe in about the 7th century, mentions no other furniture than benches and some kind of seat or throne for the overlord.

Later Middle Ages.—The 14th and 15th centuries produced many developments both in construction and design of furniture throughout Europe, and a range of new types, among them cupboards, ambries and various sorts of desks, were slowly evolved. One of the main reasons why so little furniture was made during mediaeval times was the constant insecurity of life. No man could possess more than he could defend, and therefore he was forced to keep his possessions limited to the barest necessities that he could carry away with him in times of emergency. Both the French word for furniture, *meuble*, and the German, *Mobel*, have the sense of movables, and during the whole of the middle ages this was exactly what they were. Any nobleman who owned more than one dwelling place did not have furniture for each of his establishments but instead had one set of furnishings that he carried with him from house to house. Anything that could be moved, and this frequently included the locks on the doors and the window fittings, was carried away and used to furnish the next house en route. Furniture was so scarce that it was quite usual for a visitor to bring his own bed and other necessities with him. These conditions had a double effect on mediaeval furniture, for not only did it make it difficult for men to possess more than the basic types of furniture, but it also affected the design of the furniture itself. Folding chairs and stools, trestle tables with removable tops and beds with collapsible frameworks were usual.

The religious houses were an exception to this. They enjoyed a certain security denied to the outside world. Much of the best furniture of this period was therefore made for use in churches and monasteries, and many of the ideas and developments that were later to add to the domestic comfort of Europe originated in the cloister. An example of this can be seen in the early development for ecclesiastical use of the various types of reading and writing furniture, such as lecterns and desks, which show an ingenuity in construction lacking in that of more domestic pieces such as chairs and tables. It must be remembered that throughout the middle ages and well on into the 16th and 17th centuries all types of furniture remained scarce, and what furniture there was belonged to the nobility and the wealthy merchants. The household equipment of the peasantry throughout Europe, even as late as the 18th century. was frequently so crude in design and roughly constructed that it was hardly worthy of the name of furniture.

The introduction of framed panelling in the Burgundian Netherlands at the beginning of the 15th century, an innovation that soon spread throughout western Europe, was one of the most important constructional developments in the whole history of furniture. Panelled construction solved the problem of building large surface areas, as on the front of a chest or cupboard, which before this time had been limited by the size of individual planks. These, usually hewn by an adze, were heavy and liable to warp and split. Panels could be cut thinner. the main strain being taken by the framework, thus making furniture lighter; and, by not fitting the panels too tightly in their stiles, if the wood warped it was less likely to split. Now that it was possible to construct larger surface areas a new range of case furniture. in particular cupboards and improved chests, was developed. while panelled construction was also used for chairs. Other constructional improvements of the 15th century included the introduction of drawers into cupboards and similar case furniture, and neater and more efficient joints such as the mitre and the mortise and tenon. Panelling was frequently decorated with a flat form of ornament called linen fold or parchment, since it resembled folded sheets of these materials laid on the surface of the wood. Linen fold was widely used in the north of France. Flanders, Low Germany north to the Baltic. Scandinavia and England. It is noticeable that the linen fold of France, the Low Countries and Germany is carved with a sharper definition and greater delicacy than was usual in England and elsewhere. Both panelled furniture and room panelling were decorated with linen fold. Other forms of ,carved decoration on furniture became commoner during the 15th century and surfaces were carved with tracery and other Gothic motifs. During the middle ages a great many pieces of furniture, including those with carved decoration, were painted and sometimes gilded: a practice that continued well on into the Renaissance. The present state of existing pieces, with their plain wooden surfaces, is misleading. Pieces such as chairs, tables and various types of cupboards were also frequently draped with bright fabrics while chairs. settles and other seat furniture were provided with cushions.

The chest was the basic type of mediaeval furniture; acting as cupboard, trunk, seat and, if necessary. as a simple form of table and desk. Apart from its versatility, it was from the chest that several other types of furniture, such as the cupboard and the box chair; were evolved. The most primitive form of chest was made from a hollowed-out log, a single plank! roughly hinged to it, forming the lid. Later, chests were made of six planks. crudely pegged or nailed together and frequently strengthened with iron banding. Chests of this sort, dating from the 13th century, in many cases found in churches. are among the earliest pieces of European furniture that exist. The chest remained one of the most important pieces of furniture until the end of the 1jth century when on the continent the cupboard began to compete with it in usefulness.

Chairs remained scarce throughout the middle ages. Occupation of a chair long symbolized authority or a mark of honour, and even a large house might possess only chairs for the lord and his wife and perhaps another for a distinguished visitor. The use of the word "chairman" is a reflection in modern times of this mediaeval custom. All chairs were made with arms and sets of chairs mere unknown. Early chairs constructed of turned spindles, seen in Romanesque sculpture, have already been mentioned. Later, there were two main types. One was a variety of folding chair, with X-shaped frame: made both of wood and metal, the seat and back consisting of rectangular strips of some strong fabric or leather. As the need for moving furniture about lessened, a heavier type of chair was made. This was basically a development of the chest and in many cases the seat was hinged, allowing the base to be used for storage, with panelled back, arms and base. The panelling was often carved with linen fold, and sometimes with other Gothic motifs. Many of these chairs had exaggeratedly high backs terminating in elaborately carved canopies; some were freestanding while others had their backs fixed to the wall in the manner of a church stall. Settles were also used for seating during the 1jth century. An innovation on the continent nas the settle mith a pivoted bar forming the back rest. which could be snung over to allow a person to sit on either side—evidence of the weight and immovability of the furniture of this period.

Tables were mainly of trestle construction with long rectangular tops that could be dismantled. During the 1jth century smaller tables nere made on the continent which could be more conveniently moved and. especially. drawn up to the fire. Various forms of cupboard, ambry and *dressoir* were developed at this time, panelled and decorated with linen fold or Gothic carved ornament. Basically all these types were a chest nith doors, raised on legs of simple rectangular form; elaborations of construction and decoration soon followed as did the specialization of their functions. Cupboards. *dressoirs* and credence tables were used for the storing of plate and for serving at banquets. the plate being displayed on the top and on shelves above and below the cupboard. Other cupboards were made to hold food and day-to-day provisions; in the case of food or dole cupboards, as they were called, the front and sides were pierced for ventilation.

Little English furniture survives from mediaeval times and, as on the continent, information must be sought in contemporary references and from the pictures of domestic interiors in illustrated manuscripts. Most of these manuscripts are of foreign, particularly French or Flemish, origin but they are reliable evidence because the governing classes, who were practically the sole possessors of proper furniture, copied the domestic habits of the continent. English oak was the chief material, but softer woods were also used. A certain amount of furniture was imported from abroad, providing new ideas for the English carpenter and joiner. The furniture usually found in important houses consisted of beds, chests, cupboards, tables, benches and stools. Wills and inventories prove that draped bedsteads were treasured possessions of mediaeval householders, both in England and on the continent, prized not for the rough framework but for the magnificent woven and embroidered hangings. These hangings consisted of a celure (back), tester (canopy), curtains and valances. Humbler beds of the truckle type were also used.

RENAISSANCE

Italy. — The Renaissance, which originated in Italy in the early years of the 1jth century, gradually brought about a complete change in the domestic furniture of that country and of Europe. The classical tradition had never been entirely lost in Italy and when a deliberate return to old models was made, furniture gained an importance that it had not known hitherto. Social and economic changes also affected the history of furniture at this time. The growth of a wealthy and powerful middle class throughout Europe caused the building of more substantial houses and the demand for good furniture. Italian Renaissance furniture shows a strong architectural bias and the purpose of the piece, as in Roman furniture. was subordinated to its form. The furniture of the early Italian Renaissance is often restrained, with beautiful, simple designs carved in walnut. For more elaborate work, sculpture in low relief and stucco modelled in intricate patterns were much used. The stucco was usually gilded all over and picked out in bright colours.

There was no class of furniture on which rhe wood carver's and stucco modeller's skill was more exercised than on the *cassone* (see **Cabinet Furniture**) or marriage coffer, frequently made in pairs and provided and filled for the bride. In addition to elaborate relief work and gilding, these coffers were often painted on the front and sides, and occasionally inside the lid as well, with appropriate biblical or mythological scenes. Motifs popular with the Italian carver included cupids, amorini, grotesque masks, scrolled foliage and strapwork. The fixed writing desk is the forerunner of the writing bureau, which became an indispensable article of furniture as writing became more general.

A type of chair or back stool, called a *sgabello*, was much favoured at this time in Italy. Often richly carved and gilded, it was evolved out of a simple joiner's contrivance of the middle ages. The seat mas a small wooden slab, generally octagonal, supported at front and back by two solid boards cut into an ornamental shape. A piece of wood in the shape of a half-opened fan formed the back. Another chair of the period also drew upon mediaeval inspiration, the folding X-shaped chair, sometimes called a Dante chair. Tables were generally oblong, supported by columns, consoles or terminal figures, with a long central stretcher running from end to end. The influence of Italian furniture of the Renaissance was paramount and soon spread abroad, revolutionizing the furniture of Europe. Some countries borroned freely, others, particularly in the north, selected ideas and motifs and adapted them to a more individual style.

France. — The furniture of France was among the first to be influenced by the Italian Renaissance. Louis XII and many of his court visited Italy. and soon imported Italian artists and craftsmen and works of art into France. The French Renaissance of furniture can roughly be divided into two stages. First there was a period of transition and adaptation, during the reign of Louis XII and the first part of Francis I's reign. when the pieces were basically Gothic in form and Gothic ornament was mixed with the *putti*, medallion heads and grotesque decoration of the incoming Renaissance style. During the second phase. from the end of the reign of Francis I, the new style displaced the Gothic. But the more exuberant arabesque shapes of Renaissance decoration gave way to increasingly architectural design and oak was almost entirely superseded by walnut. Centres of furniture making were established at Fontainebleau, where Francis I employed several Italian artists and craftsmen; in the Île-de-France, headed by the work of J. du Cerceau; and in Burgundy, where, led by the craftsman and designer Hugues Sambin. design was influenced by the Renaissance style evolved in the Netherlands.

Much of the carved walnut furniture of France in the 16th century is remarkable for gracefulness and delicacy. Sometimes it is enriched with inlay of small plaques of figured marble and semi-precious stones, sometimes with inlay or marquetry of ivory, mother-of-pearl and different coloured woods. Many of the pieces of carved walnut, especially the buffets produced at this time under the influence of Du Cerceau and Sambin. are heavy and the whole surface is covered in elaborate carving. a particular feature being the wide variety of muscular and satyr-faced caryatids which adorn the front or are set at the corners.

Chairs began to be lighter in design. the back became narrower and the panelled sides and base were replaced by carved and turned arms and supports. and legs were joined by stretchers at their base. A particular chair of this pattern was known as a *caquetoire* or conversation chair, supposedly designed for ladies to sit and gossip in. A further feminine influence on chair design of this period. not limited to France, was the introduction of the chair without arms, or the single chair. which is said to have been designed to accommodate the wide skirts of the period.

Elaborately carved oblong tables were supported by consoles or fluted columns connected by a stretcher surmounted by an arched colonnade. Again they were lighter than their mediaeval equivalents and by now the tops were permanently joined to their bases. Chests. decorated in the new style, were still widely used. though they were frequently replaced by the armoire (see CABINET FURNITURE), which was now sometimes made in two stages, the upper compartment containing numerous small drawers.

Austria and Germany. — Italian models were followed in the northern Austrian provinces. The cabinetmakers of Augsburg and southern Germany evolved an elaborate type of work based on the example of Italy. Cabinets had doors in front, which revealed an arrangement of drawers and compartments inside. Inlay and marquetry decoration mere popular, particularly for architectural scenes. The inlaid writing desk of Christoff Müller of Augsburg, made in 1555 and later placed in the Berlin museum, is shaped at the end like the façade of a Renaissance mansion.

Spain. — In Spain foreign influence came at a far earlier time and from remoter parts. namely the Islamic world. With the invasion and occupation of the south by Arabs and Moors in the 8th century. the greater part of the peninsula became virtually an oriental country, After the expulsion of the last Arab ruler, at the end of the 15th century. many Moriscos still remained in the country. and the intelligent and industrious craftsmen among them still worked for the Christian rulers of the land in their own traditional styles. Thus a style. half eastern and half western, called Mudejar, was created in Spain.

A type of cabinet known as a *vargueño* is typically Spanish—a medley of European and oriental elements. The upper part is a chest with a fall front. often elaborately mounted in wrought iron and backed with velvet, and with a massive iron lock. Inside is an intricate arrangement of drawers and recesses. The cabinets were richly carved, painted and gilded and inlaid with ivory. A *vargueño* in the Victoria and Albert museum. London, is decorated on the front with a representation in inlaid woods and ivory of the animals entering the ark. There is a tendency for Italian models to be followed in the furniture of the 16th and 17th centuries. In a country so renowned for its ironworkers it is not surprising to see that bracing irons of fanciful workmanship were often attached for strengthening to tables and benches.

Low Countries. — In the 16th century Italian Renaissance ornament was adopted and transformed by the artists and designers of northern Europe, particularly in northern Germany and the Low Countries. who created an independent style of decoration. Strapwork, cartouches and grotesque masks are characteristic features of this northern Renaissance style, and are found repeatedly in the pattern books of such German and Flemish artists as W. Dietterlein and V. de Vries — books of ornament which circulated among and influenced metalworkers, carvers, plasterers and furniture makers throughout the north.

Mediaeval furniture of the Low Countries was strong and solid, and these characteristics remained in the time of the Renaissance, combining with the new style of ornament. Heavy oak tables, sometimes draw tables. had massive legs and solid stretchers. The beds in the corners of the living room were heavily draped. Folding wooden chairs and low stools. with more or less elaborate turnery, were still used, besides a new type with baluster-formed or twisted legs and arms, and straight backs heightening as the 17th century went forward.

Scandinavia. — In Scandinavian countries furniture for the most part remained simple and primitive. Houses of the well-to-do contained furniture from northern Germany or from the Low Countries, and these provided models which the native craftsmen copied.

England. — The Italian Renaissance did not affect the design or ornament of furniture in England until about 1520. As in France, evolution from the Gothic style was a gradual process, influence coming first from Italy and in the second half of the 16th century from the Low Countries. In the early stages furniture remained Gothic in form, though slowly Italian motifs replaced the older Gothic ornament. Many pieces of early Renaissance English furniture combine linen fold panelling with medallion heads and Italianate cupids, but by the middle of the century both new ornament and new forms had replaced the mediaeval style. About the middle of the century the direct influence of Italy weakened and its place was taken by that of the Low Countries. The northern style of Renaissance ornament already mentioned was propagated in England by the pattern books, immigrant workmen and the example of imported Flemish and German furniture, and before long it was adapted by English craftsmen into an individual and peculiarly English style. Characteristic of this style is the enrichment of every surface with flamboyant carved, turned, inlaid and painted decoration. an exuberance which strongly reflects the spirit of the English Renaissance. During Elizabeth I's reign there was a considerable and fairly widespread increase in domestic comfort, to be seen in improved construction! a multiplication of types and the tentative beginnings of upholstered furniture. The celebrated inventory of Lord Lumley, made in 1590, indicates that large houses of the late 16th century were equipped with considerably more and better made furniture than previously, though many of the most highly regarded pieces in the greater Elizabethan households were imported from abroad. These pieces, however. were quickly copied by the English craftsmen, and new decorative techniques were applied to other suitable pieces. A series of inlaid chests with perspective architectural scenes, often called nonsuch chests, were either imported from Germany or made by German workmen in England. They were strongly influential in propagating the technique of inlaid decoration, which by the end of the century was being applied to every type of furniture. The majority of the population was still using furniture as rough and makeshift as it had been a century before.

At this time there were important changes in the constitution of the furniture-making trade in England. Individual woodworking crafts became more specialized and the differences between the carpenter's, the joiner's. the turner's, the coffer maker's and other craftsmen's work became more clearly defined. The carpenters possessed a charter as early as 1477. The Joiners' company of London was granted one in 1570 and the turners theirs in 1604. In the provinces two crafts were frequently united under the protection of one company; for example, the Carpenters' and Joiners' company of Worcester and the Turners' and Joiners' company of Chester. In country districts. where skilled labour was scarce arid the discipline of the companies could not be enforced, the local carpenter practised all the crafts as best he could. The companies performed two main offices, first the protection of their members' rights under their charter and second the maintenance of a high standard of craftsmanship in the products of their members. In both they did much to imprbve the design and construction of English furniture in the 16th and 17th centuries.

Apart from the gradual change from Gothic to Renaissance ornament, the 16th century produced several changes in the design and construction of individual types. Chairs became slightly more common, though even in Elizabeth's own palaces stools were the usual form of seating. Evolving from the box chair came a type where the arms and legs were no longer filled in with panelling, but had plain or turned legs. with shaped arms resting on carved or turned supports. The backs of chairs were still panelled and decorated with carving and inlay or surmounted with a wide and richly carved cresting. X-shaped folding chairs of varying construction were also used. In the early 17th century chairs without arms were introduced, called farthingale chairs, made to accommodate the wide skirts of the ladies. They had upholstered seats and a low rectangular upholstered back raised on short supports a little above the seat. Armchairs of similar design were made. Turkey work and velvet were usually employed for upholstery.

Early in the 16th century the mediaeval practice of concealing all the wooden frame of a bed beneath its hangings gave way to the new style of leaving the greater part of the frame exposed and enriching it with carving and other decoration, making the frame itself an important part of the general design. Later examples, notably the celebrated Great Bed of Ware. are lavished with elaborate turnery. carving, inlay and painted decoration. Favourite carvers' motifs, for beds and other types, included strapwork, grotesque masks and caryatids. bulbous turned pillars and supports, arcading and patterns of scrolled foliage. The heavily turned cup and cover motif is frequently found on bedposts in the later 16th century. The cumbersome Gothic trestle tables were replaced by "joyned tables" with their tops fixed to their frames. Draw tables which could be conveniently lengthened by pulling out the two leaves concealed under the top were also introduced. A few smaller tables were made in the second half of the 16th century. sometimes for cards or gaming. Table legs and the friezes of the frames were decorated with carving and inlay. and the cup and cover motif is often found on the legs. Various types of cupboard were made, usually in two stages. With court cupboards both stages were left open, but with other types either the top or both stages were enclosed. A simple form of chest of draners was introduced about 1620.

The progress of English furniture was greatly retarded in the first half of the 17th century by the Great Rebellion. A certain amount of austere furniture produced in the middle of the century can be called Cromwellian. though the influence of the puritan regime was largely negative. and it was not until 1660 and the return of Charles II that the baroque style came to England and with it a revolutionary progress in English cabinetmaking.

BAROQUE

During the 17th century the baroque style (*see* BAROQUE) had a drastic effect upon furniture design throughout western Europe. Large wardrobes. cupboards and cabinets had twisted columns. broken pediments and heavy mouldings But the main characteristic of baroque furniture is not the application of more and richer surface ornament; few pieces of furniture can have had more lavish surface decoration than those made in the late Renaissance. In baroque furniture the details are related to the whole, and instead of making the piece into a framework of unrelated surfaces, each detail contributes to the harmonious movement of the over-all design. A change to the baroque style of furnishing was not made in all countries at the same time, but the evolution was spread over a period starting with its adoption in the Low Countries in about the 1620s and going on late into the 17th century when Germany and England began to develop it.

The baroque style owed much to the oriental influence that snept over Europe in the 17th century. when several of the European maritime countries, particularly Portugal. Holland and England, established regular trading relations with India and the far east. Lacquered furniture and domestic goods were imported from the east and, also, the oriental craftsmen worked in a pseudo-European style from designs supplied by the traders. Before the end of the 17th century oriental decorative techniques were being widely imitated in Europe and the roots of the "Chinese taste" were firmly entrenched. Heavy tropical woods were also brought to Europe, and from these furniture was made which borrowed much from the prevailing taste for oriental elaboration. Ebony cabinets with eaved mouldings, intricate carvings in low relief and marquetry in tinted ivory and coloured woods were made in Italy, Germany, the Low Countries and elsewhere. It was at this time that the *ébéniste* acquired his name.

Flanders and Holland.—The early Flemish baroque furniture, dating from the second quarter of the 17th century. was but a slight adaptation of the late Renaissance style. Typical are the oak cupboards with four doors and the chairs with seats and backs of velvet or leather held in place by nails.

In Holland the baroque style did not encroach on late Renaissance furniture until nearly 1640. Dutch furniture of this period can be distinguished by its simpler design and a preference for moulded panels over carved ornament. Later, marquetry decoration and walnut veneer surfaces became the commonest decorative treatments. At the end of the century lacquered furniture, particularly cabinets with small drawers, became popular.

Italy.—Though it was in Italian architecture. painting and sculpture that the baroque style was evolved, Italy was not the first to apply this style to furniture. But by the mid-17th century it was producing flamboyantly carved, painted and gilded furniture, decorated with such typical motifs as *amorini*, acanthus, shells and boldly drawn scrolls, and was further enriching chairs and stools with fine-cut velvets and table tops with marble, *pietra dura* and scagliola. Chairs and stools with exaggerated scrolled arms and legs, exemplified by the work of A. Brustolone in Venice, and handsome walnut and ebony cabinets and cupboards with carved decoration on the pediments, friezes and corners and sometimes inlaid with marble or *pietra dura* set in moulded panels typify the Italian furniture of the later baroque phase.

France.—In France the Italian influence of the 16th century was gradually assimilated and a national style of furniture was evolved which soon spread its influence into neighbouring countries. The reign of Louis XIII, covering most of the first half of the 17th century. was a time of transition. The Gobelins factory. which still remains a national establishment, was founded by Louis XIV for the production of *meubles de luxe* and furnishings for the royal palaces and the national buildings. Charles le Brun was appointed the first director. Furniture was veneered with tortoise shell or foreign woods, inlaid with brass and ivory or heavily gilded all over. At times it was even completely overlaid with silver. The name of André Charles Boulle (*q.v.*) is particularly associated with this style of decoration. His cabinets and tables were completely covered by sheets of tortoise shell and brass cut into intricate patterns so as to fit into one another, the tortoise shell alternately forming the pattern and the ground; hence the two types, *boulle* and *contreboulle*. The light fanciful grotesques of J. Berain were much used for this work. Heavy gilt brcnze mounts protected the corners and other parts from friction and rough handling and provided further. ornament. Many other craftsmen, both in France and other countries, copied Boulle's method and its influence lingered on until the 19th century.

England.—After the Restoration, from 1660 onward. there was almost revolutionary progress in English cabinetmaking, as it came to be called at about this time. The exiled court on its return introduced French and Dutch fashions and the English craftsmen were considerably helped in supplying the tastes of the nobility by a large influx of foreign workmen. Furniture became lighter, more highly finished and better adapted to varying needs. The general increase in technical skill of the cabinetmaker between 1660 and about 1690 is astonishing. Walnut was the favourite wood, though the use of oak continued in country districts for many generations. New processes appeared. notably veneering wide surfaces with thin sheets of wood, into which, in many cases, floral patterns in marquetry were inserted. In the earlier period of the Restoration these patterns were large, but toward the end of the century they grew smaller and more intricate. leading eventually to the type of marquetry made up of numerous small scrolls and called seaweed marquetry.

The passion for colour found an even better outlet in lacquer decoration. The importation of works of art from the east had begun in Tudor times, but was of little account until after the Restoration. Then the taste became widespread. John Evelyn and others reported their friends' houses to be furnished with Indian screens or panelled in the finest japan — descriptions implying oriental lacquer. Such things came from China and mere soon imitated in England, the native version of lacquering being called japanning. Toward the end of the century two men called John Stalker and George Parker published an elaborate treatise outlining in detail the various techniques of this craft.

New forms of decoration coincided with a multiplication of types. Day beds. a form of couch with an adjustable end. and winged armchairs served for repose. The upholstered armchair had its origin at this time, and a pair of chairs at Ham house, Surrey, called in the 17th century "sleeping chairs," are among the earliest of this type. A little later, toward the end of the century: sofas with backs and arms carried comfort a stage further. Velvet. silks and needlework were usual materials for upholstery. Various kinds of writing furniture were rapidly developed, including the bureau with enclosed desk and interior fittings of small drawers and pigeonholes which was made toward the end of the century. Chests-of-drawers came into more general use. Mirrors were no longer rarities! though glass remained expensive for some time after the duke of Buckinghain established his famous glass-works at Vauxhall. The frames n-ere carved, lacquered or decorated with marquetry. Fashions succeeded each other with great rapidity. Chairs show these changes most clearly, developing in a brief period from mere seats into movable decorations. Scrolled legs were common under Charles II, while later straight tapering baluster iorms mere used. In the grander beds of this period the tester, back and posts are covered with material and match the hangings. These state beds were strongly influenced by the designs of the Frenchman Daniel Marot, who came over to England to work for William and Mary. They were of enormous height with elaborately moulded cornices, and had ostrich plumes or vase-shaped finials at the corners of the tester.

During the late 17th century and on into the first half of the 18th century, besides the plain walnut furniture and the marquetry and lacquered pieces, a certain amount of elaborately carved and gilded iurniture, much influenced by the style of Louis XIV, was produced in England. Foremost among the makers of this de luxe furniture were three cabinetmakers, J. Pelletier, G. Jensen, and James Moore. Toward the end of the 17th century, during the reign of William and Mary, baroque furniture tended to become simpler and the use of ornament mas somewhat restrained. At the beginning of the 18th century, during the reign of Queen Anne, a new and entirely simple style arose, much influenced by the contemporary furniture of Holland. Carving and applied ornament were reduced to a minimum, the beauty of a piece relying on carefully designed curved lines and the colour of fine walnut veneers. The cabriole leg, originally devised in classical times and based on the curve of an animal's leg, mas introduced into England from the continent about 1700. Terminating in a clan-and-ball or paw foot and soon discarding the stretcher, it was widely used on chairs and tables and for every kind of support. Chairs had hooped uprights and fiddle-shaped splats curved to support the back. Tallboys, or double chests-of-drawers, cabinets fitted mith shelves and bureaus in two stages met the demand for greater convenience, as did a new range oi dining, card and other sorts of table.

By the second quarter oi the 18th century the English cabinetmaker had become well established and the progress of design and construction was no longer hampered by lack of skill. The system oi specialization practised under the companies had broken down and the different crafts were now practised under one roof, the cabinetmaker's shop. There, by the middle of the 18th century, it appears from cabinetmakers' bills that no side of interior decoration was too large or too small for attention.

ROCOCO AND NEOCLASSIC

The influence of French furniture was predominant in Europe during the 18th century, an influence that stretched from Russia to Sweden In the second half of the century England played a leading role in establishing the neoclassic style, and ior supreme craftsmanship provided an inspiration to workshops in several countries, but in the diffusion of the two styles of that century, the rococo and the neoclassic, French designs were imitated, with varying degrees of success, in every sophisticated household in Europe.

France. — The transitional phase in French furniture from baroque to rococo (*q.v.*) is called *régence,* though in fact this phase started just before the regency of Philip oi Orléans (1715): Strongly under the influence of oriental art, the heavy, monumental style of the earlier part of Louis's reign was gradually replaced by a lighter and more fluent curvilinear style. The leading exponent of the *régence* style was Charles Cressent (1685–1768), *ébéniste* to the regent. In his work the ormolu mounts, so important a part of the design of French furniture in the 18th century-, become equally if not more important than the marquetry decoration of the carcass. The curvilinear form was introduced. not only to externals such as legs and supports but, in the *bombé* commodes which first appeared during this period, to the case itself. High-qualitj- marquetry in coloured woods replaced ebony.

The rococo style, a development oi the *régence,* affected French furniture design from about 1735 to 1765, when it pave way to the incoming neoclassic style. The word rococo is derived from *rocaille;* the shell mas one of the basic forms of rococo ornament. Rococo is based on asymmetrical design, light and iull of movement. The iurniture oi this period is designed on sinuous and complicated lines. If any style can be attributed to one man. it was the designs of J. Meissonier, a goldsmith, sculptor and architect, that originated rococo. The repertory of ornament was large, hut it centred around subtle arrangement of the C-scroll with ragged edges, combining mith scrolled foliage, floral motifs, ribbon and, on occasion, trophies iormed oi musical instruments or gardening implements. The rococo Chinese taste had a convention of its own, pagodas, exotic birds, Chinese figures. icicles and dripping water. Chairs with flowing lines, delicately carved and gilded, were upholstered with silk, needlework or tapestry. The graceful *bombé* commode, often with marble top and with two or three drawers. the surface enriched with finely modelled ormolu mounts, was popular. Under Cressent's influence the importance of the mounts predominated, though later in the century the marquetry decoration gained first importance. Commodes and other pieces were decorated mith marquetry of floral or geometrical patterns, or sometimes with lacquer decoration, again combined with ormolu mounts. The most celebrated makers of mounts during Louis XV's reign were Jacques Caffieri and his son Philippe. J. Oehen was made *ébéniste du roi* in 1754. *A* pupil of Boulle, he mas the most celebrated *ébéniste* of the period, famed for the writing table made for Louis XV and now in the Louvre, Paris. which was finished by his brilliant pupil, J. Riesener.

The neoclassic style, sometimes called Louis Seize, began in the 1750s. Tiring of the rococo style! the restless spirit of the 18th century turned for inspiration to classical art. The movement was stimulated by recent archaeological discoveries, travel in Italy. Greece and the near east and the publication, all over Europe, of works on the classical monuments. The neoclassic style, based on straight lines and rectilinear iorms and using a selection of classical ornaments, mas first applied to French furniture during the 1760s. To begin with, the classical motifs were sparingly applied to furniture of unchanged form. but slowly the curved line of rococo was replaced by a simpler and more severe rectilinear design; chair legs were straight, tapered and fluted, and the commodes and other case furniture were no longer of *bombé* form. Marquetry was still widely used ior decoration, while some cabinets mere made of ebony inset with panels of Japanese lacquer. *Boulle,* which had not been employed in Louis XV's reign, returned to fashion. A greater number of pieces were signed during this period (signing had been made compulsory in Paris) and Riesener. M. Carlin and J. Saunier were a few of the leading *ébénistes.* Several German craftsmen also worked in France, among them Abraham and David Rontgen. A. Weisweiller and G. Beneman. Of the workers in bronze mounts Pierre Gouthière was supreme.

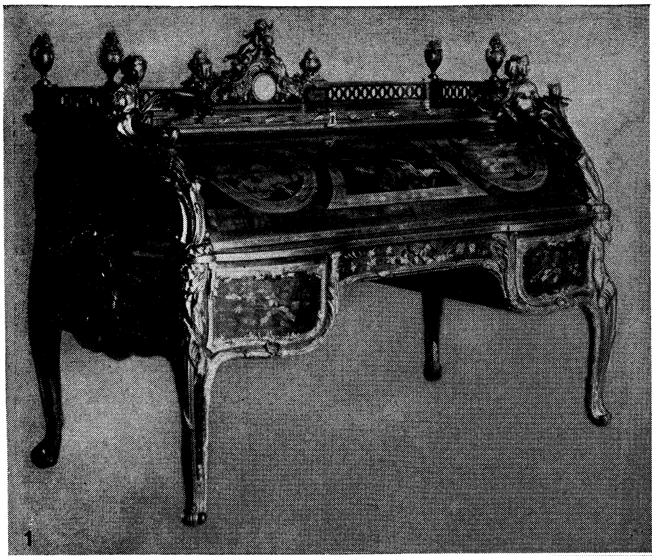
England. — .%bout 1720 mahogany mas imported into England and slowly it superseded walnut as the fashionable wood for making furniture; its consumption increased mith the repeal of the heavy import duties and its use was widespread by about 1735. The Palladian interiors demanded furniture more striking and larger in scale than the restrained walnut-veneered pieces of the early 18th century. Inspired by the contents oi French and Italian palaces. iurniture began to be designed by architects. William Kent, the most celebrated, having lived in Italy before starting practice. The design was classical, in keeping with the traditions of Andrea Palladio and Inigo Jones, the ornament baroque. At Holkham in Norfolk, Rousham in Oxfordshire and elsewhere Kent's iurniture may be seen in its proper environment, gilt mirrors and side tables mith sets of chairs and settees covered with patterned velvets matching the grandeur of elaborate architectural Palladian interior decoration.

During the 1740s, despite the resistance of the Palladian classicists who deplored its asymmetrical principles, the rococo style crept into English decoration and furniture design. During this decade pattern books of ornament in the full rococo style by M. Lock and H. Copeland were published in London, and in 1754 Thomas Chippendale published his *Gentleman and Cabinet-Maker's Director* which provided patterns ior a wide range of English iurniture in the rococo style and its two ofishoots, the Chinese and Gothic tastes. During the following years several similar works were published by such craftsmen and designers as W. Ince and J. Mayhew, T. Johnson and R. Manwaring. The

BY COURTESY OF (1–4) VICTORIA AND ALBERT MUSEUM, (5–9) THE SPANISH ART GALLERY, LONDON

EUROPEAN FURNITURE OF THE RENAISSANCE

1. German oak cupboard with Gothic tracery; 15th century. 2. Italian folding armchair; 16th century. 3. Flemish carved oak cabinet; late 16th century. 4. Italian marriage coffer (*cassone*) of carved walnut; 16th century. 5. Spanish iron-mounted wooden coffer; 15th century. 6. Spanish sideboard carved with Gothic tracery; 15th century. 7. Hispano-Moresque wood doors, gilt; 14th or 15th century. 8. Spanish carved wood table; late 16th century. 9. Spanish walnut bench braced with iron; 16th century



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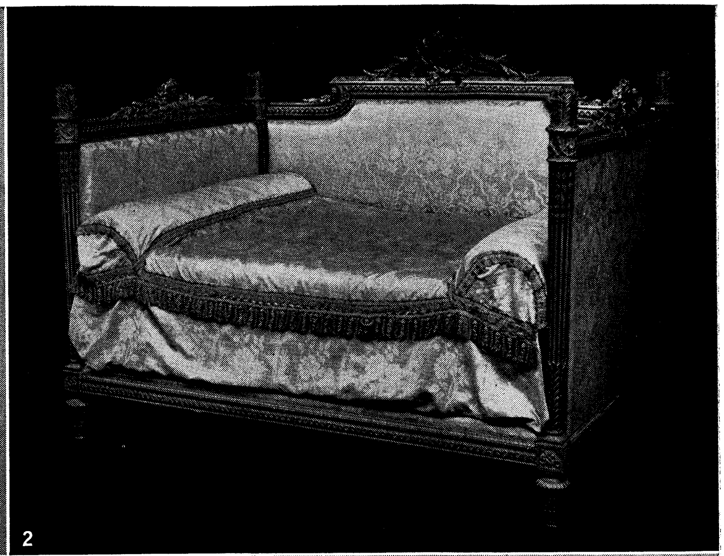

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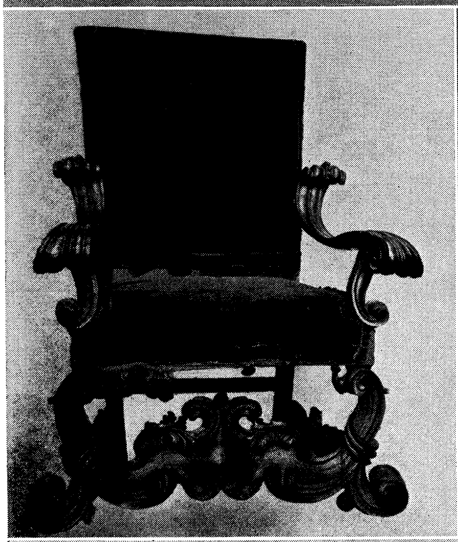

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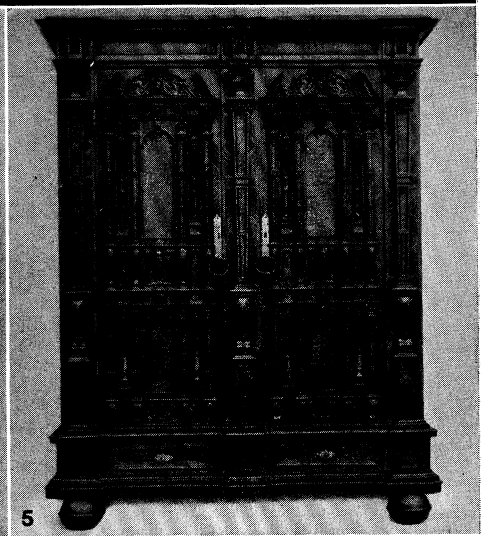

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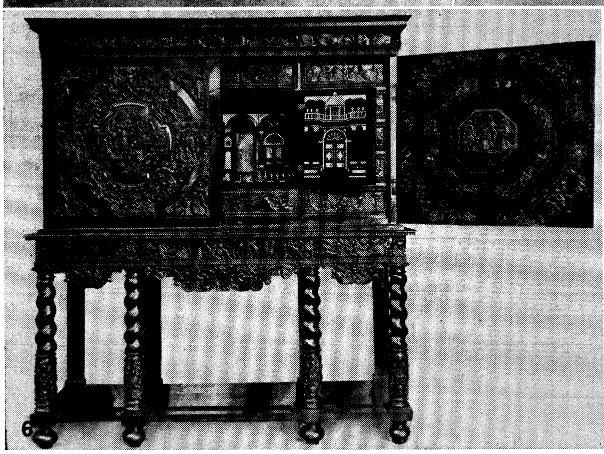

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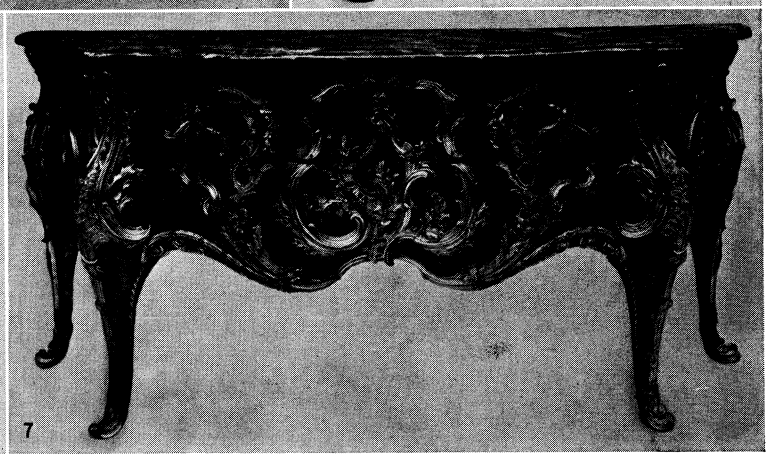

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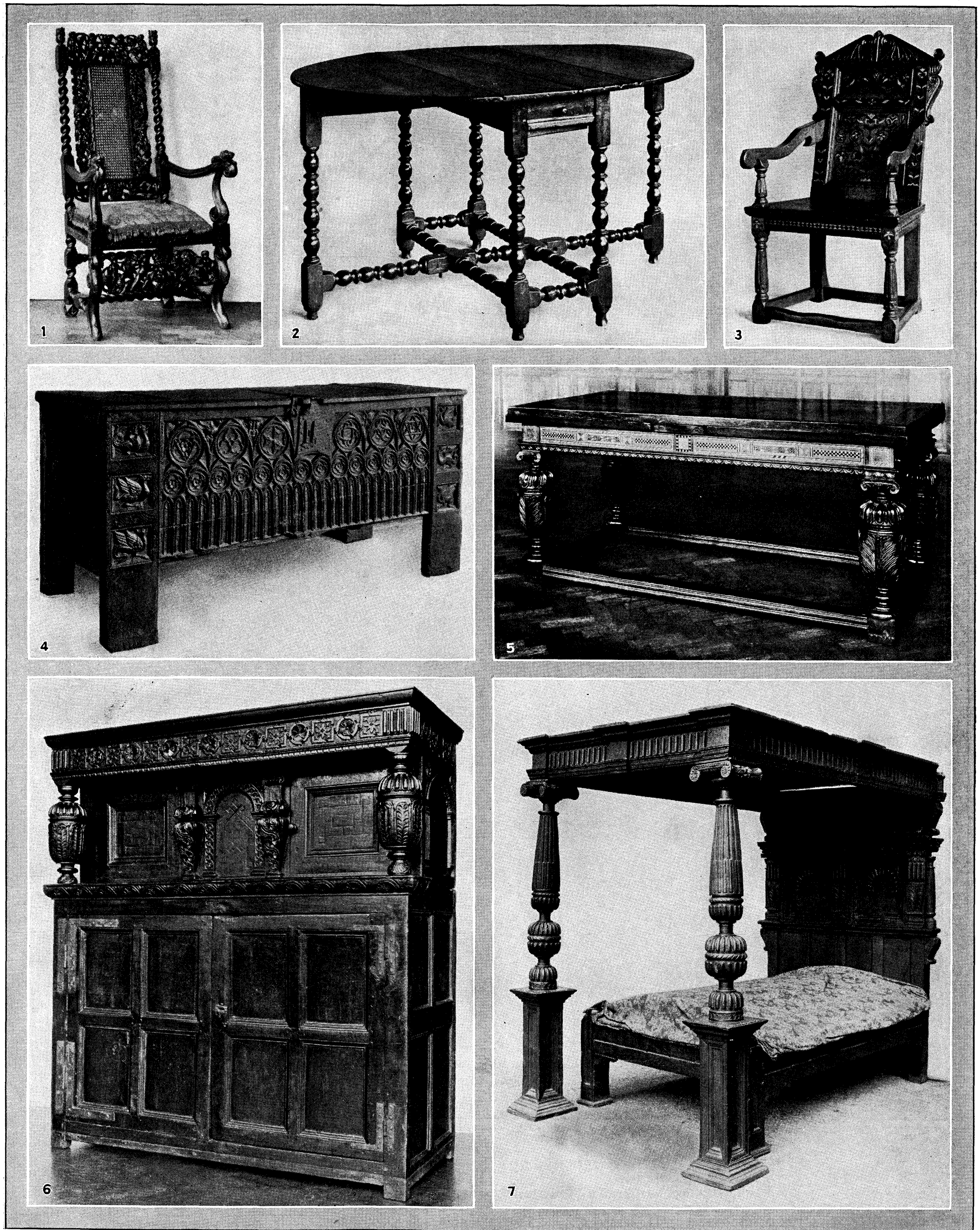
BY COURTESY OF (2–6) VICTORIA AND ALBERT MUSEUM, (7) THE KEEPER OF THE WALLACE COLLECTION, PHOTOGRAPH, (1) COLLECTION ARCHIVES PHOTOGRAPHIQUES, PARIS

EUROPEAN FURNITURE OF THE 17TH AND 18TH CENTURIES

1. "Bureau du Roi" made for Louis XV of France by J. F. Oeben and J. H. Riesener between 1760 and 1769
2. Bedstead of carved and gilt wood with coverings of blue silk damask; French, period of Louis XVI
3. Venetian chair of carved walnut upholstered in velvet; 17th century
4. French writing table of sycamore with gilt bronze mounts, marble top and inlaid plaques of Sevres porcelain; period of Louis XV
5. Oak cabinet; south German, 17th century
6. Dutch ebony cabinet and stand. Carved and edged with mouldings; interior ornament is composed of inlaid ivory and coloured woods; middle of 17th century
7. Commode with marquetry of coloured woods, marble top and gilt bronze mounts by J. Caffieri; from the room of Louis XV, Versailles



BY COURTESY OF (1, 3, 5, 6, 7) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM, (2, 4) COUNTRY LIFE, LONDON FROM "DICTIONARY OF ENGLISH FURNITURE"

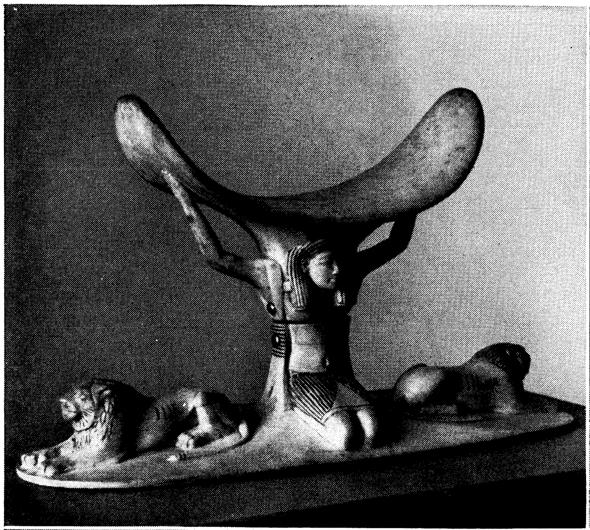
ENGLISH FURNITURE OF THE 14TH, 16TH, AND 17TH CENTURIES

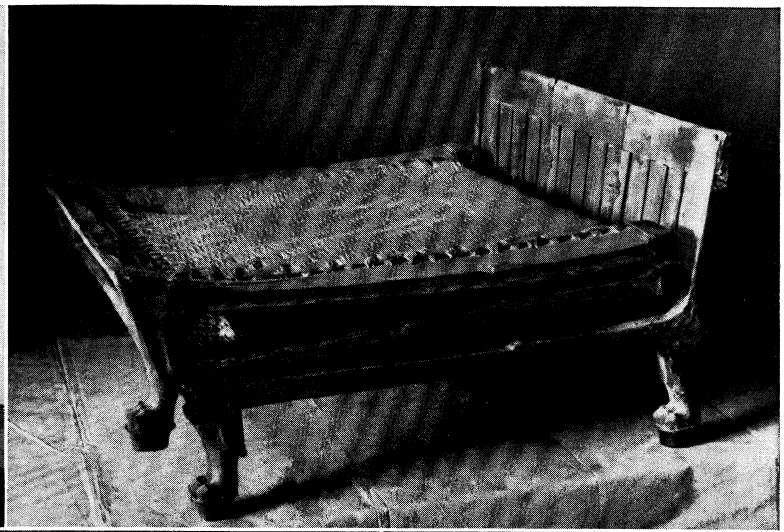
1. Armchair of carved walnut; about **1680.** 2. **Gate-leg table** of turned oak, the legs having wooden hinges, 2 **ft.** 4¾ in. **in height;** about **1660.** From **Capt.** N. R. **Colville. 3.** Armchair of oak inlaid **with** various woods; about **1600.** 4. Carved oak chest of the late 14th century; (from Sir Edward Barry). 5. Draw-table of oak, with inlaid frieze and carved legs; about **1600. 6.** Court cupboard of carved and inlaid oak; dated **1610.** 7. Bedstead of oarved walnut with inlaid frieze; **1593**

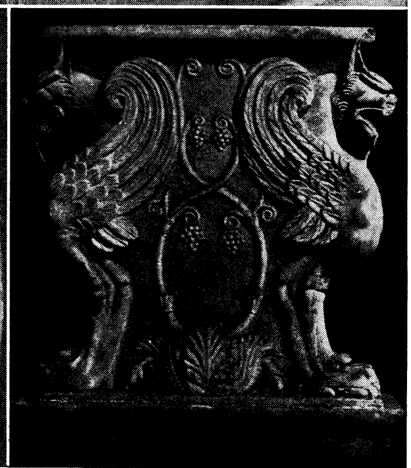
FURNITURE

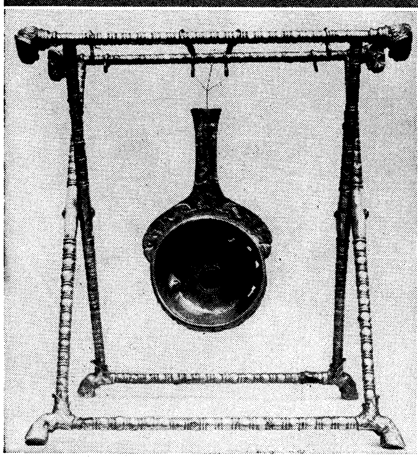
ENGLISH FURNITURE OF THE 18TH CENTURY

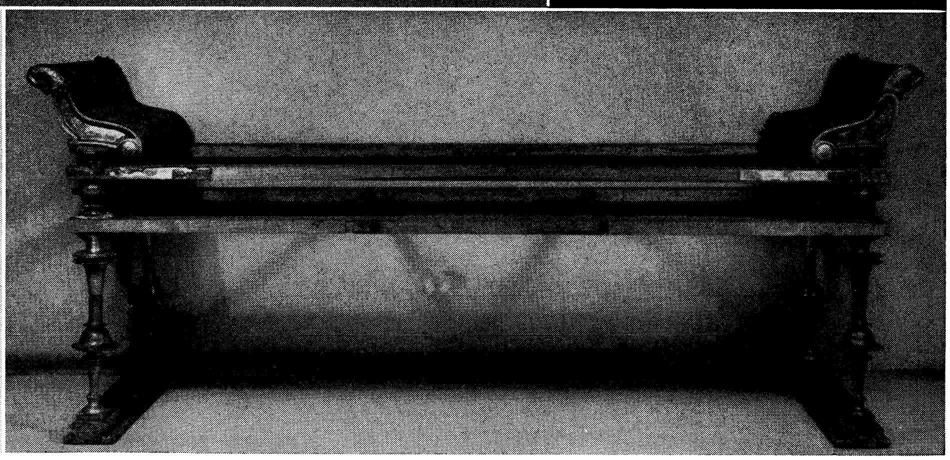
1. Commode veneered with satin wood and decorated with marquetry. About **1770**
2. Bookcase of carved mahogany. About **1745.** From Mr. J. Thursby Pelham
3. Commode chest of drawers. Carved mahogany. About **1760**
4. **Bureau bookcase veneered with burr walnut, gilt carved. About 1730**
5. Mirror in frame of wood, carved and gilt in the rococo style. Probably by Chippendale. About **1755**
6. Cabinet on stand; walnut decorated with floral marquetry. About **1685**
7. Side table with marble top, carved and gilt. In centre is figure of a child seated on a shell. Designed by William Kent. About **1730.** Houghton Hall
8. **Armchair of carved walnut, upholstered in red velvet.** About **1720**
9. Side table with classic decoration; carved and gilt. Designed by Robert Adam about **1770.** From **20.** St. James's Square. London











BY COURTESY OF (TO° LEFT, TOP RIGHT) GRIFFITH INSTITUTE. ASHMOLEAN MUSEUM, OXFORD UNIVERSITY. (BOTTOM RIGHT) THE WALTERS ART GALLERY, BALTIMORE; PHOTOGRAPHS, (CENTRE LEFT) GIRAUDON, PARIS, (CENTRE RIGHT1 ALINARI (BOTTOM LEFT) ARCHIVES PHOTOGRAPHIQUES, PARIS

EGYPTIAN, GREEK AND ROMAN FURNITURE

Top left: Carved ivory headrest, Egyptian, from the tomb of Tutenkhamon (14th century **B.C.**), Thebes

Top right: Folding camp bedstead, Egyptian, from the tomb of Tutenkh-amon

Centre *left:* Greek marble funeral couch from Macedonia

Centre right: Roman table support from Pompeii

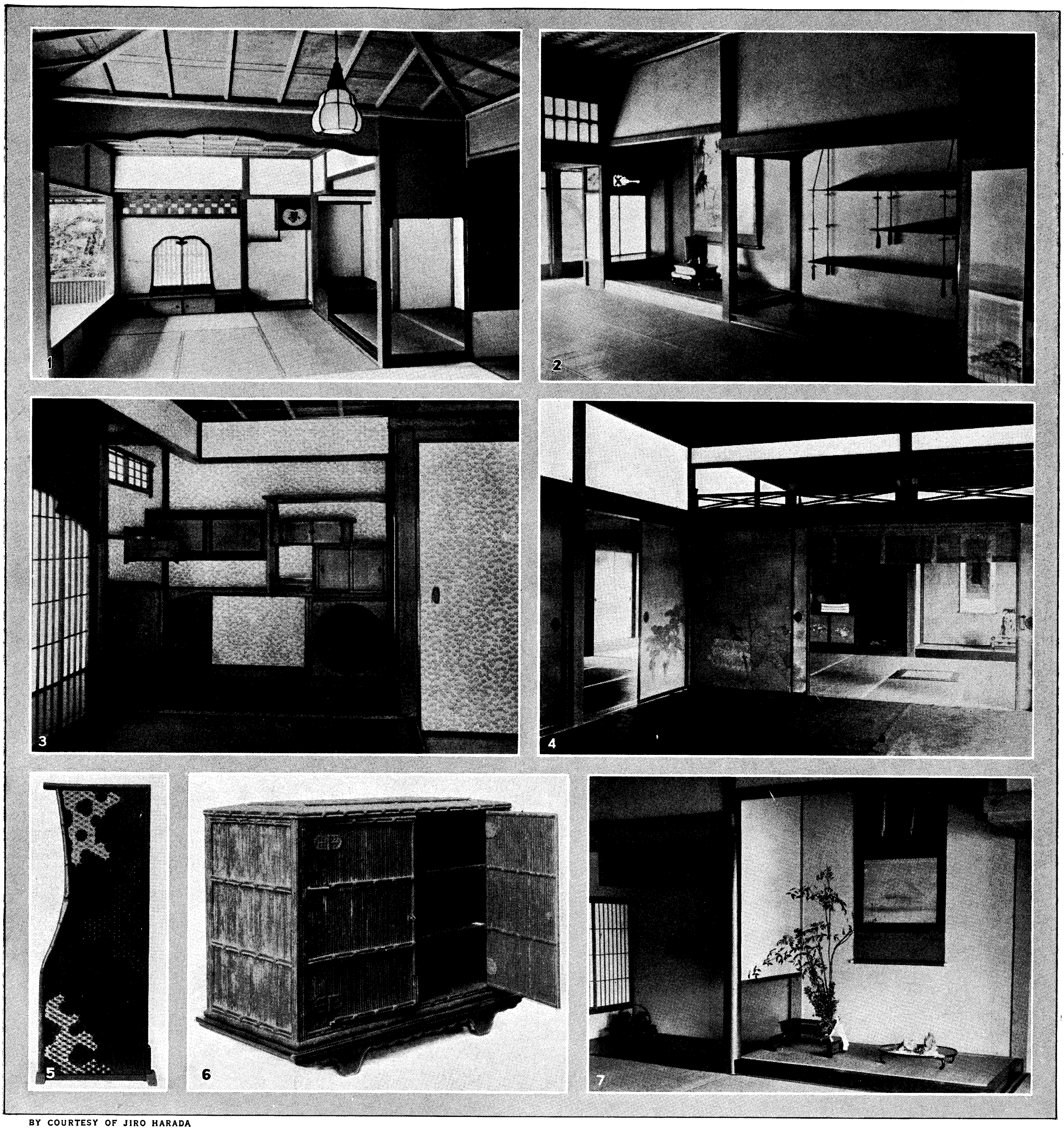
Bottom left: Roman silver folding stool from Ostia

Bottom right: Roman bronze couch, 1st century **B.C.**

FURNITURE

FURNITURE OF INDIA AND CHINA

Top left: Indian ivory table, carved in relief; late 18th century
Top right: Credence table made for the Jesuit chapel at Lahore; Indo-Portuguese, about 1610
Centre left: Cabinet veneered and inlaid with bone and light and dark woods; Indo-Portuguese, 17th century
Centre: Mirror cabinet, wood inlaid with bone; Indo-Dutch, early 18th century
Centre right: Chinese wooden bed; Ming dynasty
Bottom left: Ming tabletop cabinet
Bottom centre: Barrel stool; Ming dynasty
Bottom right: Ming chair



BY COURTESY OF JIRO HARADA

JAPANESE INTERIORS AND FURNISHINGS

1. Interior of the Keiun-tei in the garden of Mr. Tomita at Nagoya
2. A room in the house of Mr. Nishimura, Kyoto, showing tokonoma (raised alcove) and adjoining recess with shelves
3. Shelves and cupboards in a room in the Katsura detached palace
4. Guest rooms in the Temple Hokyoji
5. Pierced screen of paulownia wood, carved by Kobayashi Jodei. In the Imperial Household Museum
6. Small bamboo cabinet of the 8th century. In the Imperial Household Museum
7. Tokonoma in the home of Mr. Hatton, Nagoya. The kakemono (scroll-painting) of Fujiyama is complemented by a few sprays of red-berried *nandin* in a bronze basin, and by bon *seki* (a miniature land-scape made with stones and sand)

FURNITURE

BY COURTESY OF (1–7) ART INSTITUTE OF CHICAGO, (8, 9) MUSEUM OF FINE ARTS, BOSTON

U.S. COLONIAL FURNITURE

1. Oak and pine Bible box and table; 1660–80
2. Turned armchair, Carver type; late 17th century
3. Dutch style oak cupboard (*kas*), probably from Hudson river valley; about 1700
4. Oak and pine chest with drawers, Connecticut type; dated 1704
5. Gate-leg table, cherry and maple: 1680–1700
6. Side chair, transitional Queen Anne type, probably by John Gaines of New Hampshire; about 1720
7. Walnut armchair attributed to the workshop of William Savery, Philadelphia; about 1725–50
8. Side chair by Benjamin Randolph, Philadelphia; about 1760–75
9. Side chair attributed to Thomas Affleck, Philadelphia; about 1760–75

BY COURTESY OF (TOP LEFT) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (TOP CENTRE) THE PENNSYLVANIA MUSEUM, (TOP RIGHT, BOTTOM RIGHT) MUSEUM OF FINE ARTS, BOSTON, (BOTTOM LEFT) ART INSTITUTE OF CHICAGO

U.S. *FURNITURE 1760–1810*

Top left: Mahogany block front secretary desk with carved shell ornament and bracket feet, an example of the style developed by John Goddard, Newport, R.I.; about 1763

Top *centre:* Carved mahogany highboy with cabriole legs and scrolled pediment, Philadelphia: about 1770

Top right: Mahogany looking glass with gilt frame, Philadelphia; 1760–75

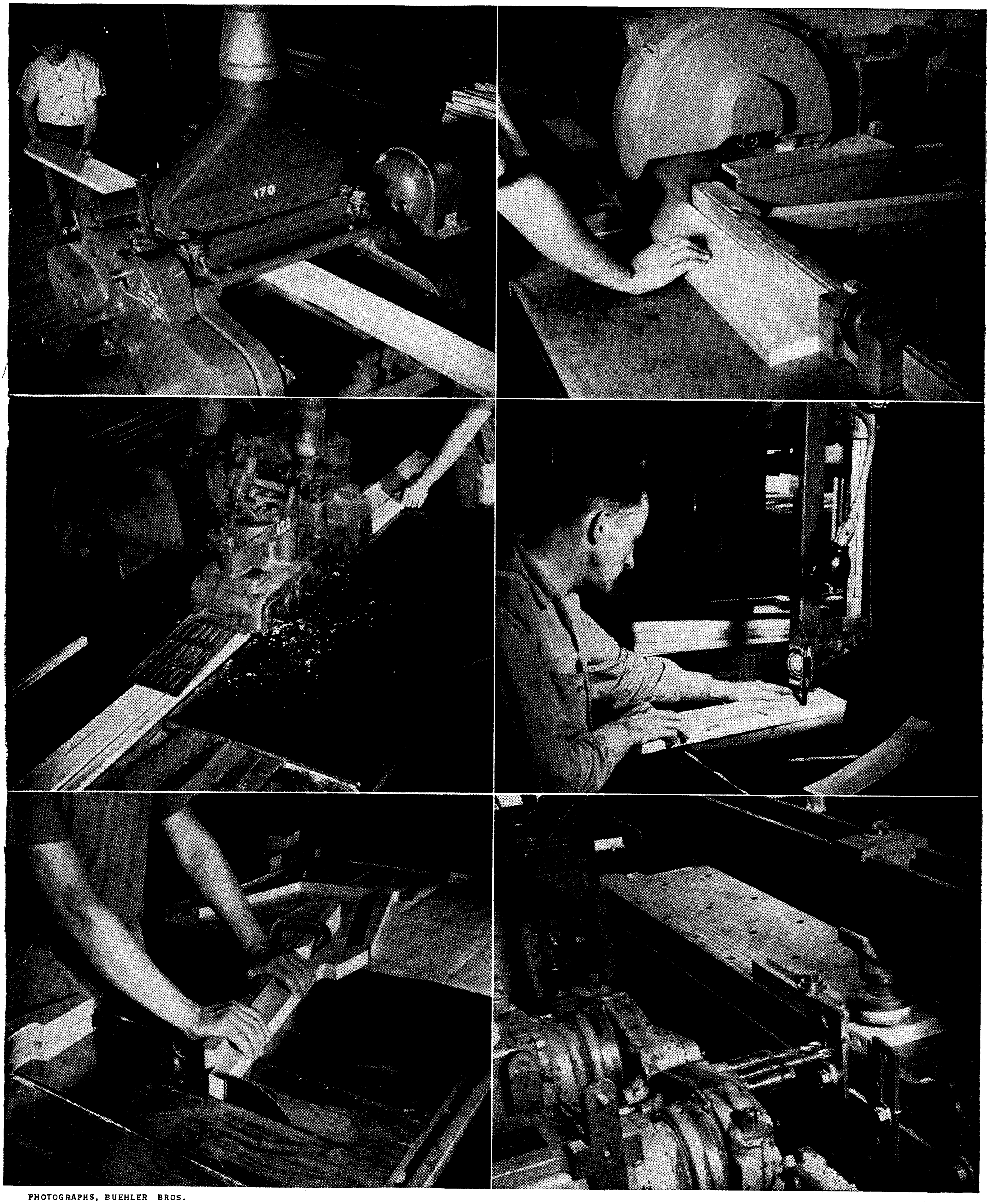
Bottom left: Mahogany sideboard with satinwood inlays, attributed to Matthew Edgerton, New Jersey; about 1790

Bottom right: Looking glass of 1800–10, probably Salem, Mass.

BY COURTESY OF (TOP LEFT, TOP CENTRE, TOP RIGHT) MUSEUM OF FINE ARTS, BOSTON, (CENTRE) METROPOLITAN MUSEUM OF ART, NEW YORK, (BOTTOM LEFT) MUSEUM OF THE CITY OF NEW YORK, (BOTTOM RIGHT) ART INSTITUTE OF CHICAGO

U.S. FURNITURE FROM 1795 THROUGH THE 19TH CENTURY

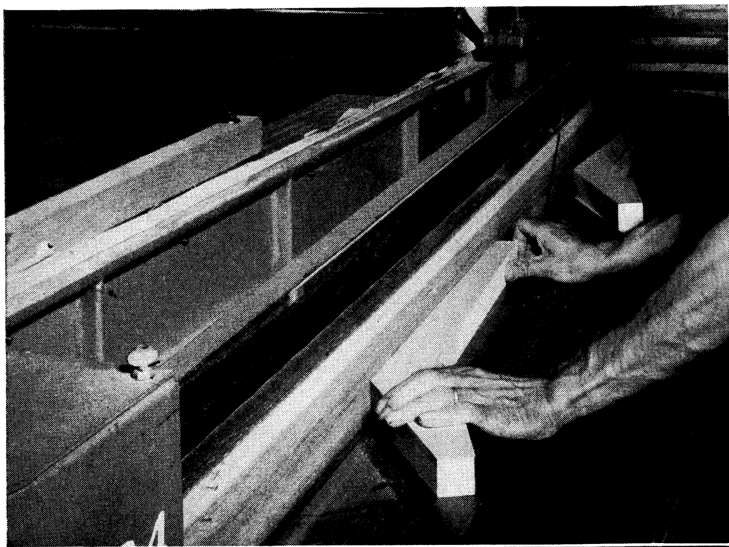
Top left: Hepplewhite side chair attributed to Samuel McIntire, Salem, Mass.: about 1795
Top centre: Tambour desk by John Seymour & Son of Boston; about 1800
Top right: Armchair attributed to Duncan Phyfe, New York city; 1800–10
Centre: Mahogany sofa with lyre ends by Duncan Phyfe, New York city; about 1800
Bottom left: Marble-top rosewood "parlour" table by John Belter. New York city. The piece is representative of the rococo revival of the mid-19th century
Bottom right: Walnut desk, a simplified factory-made piece typical of the post-Civil War period in the midwest; about 1870

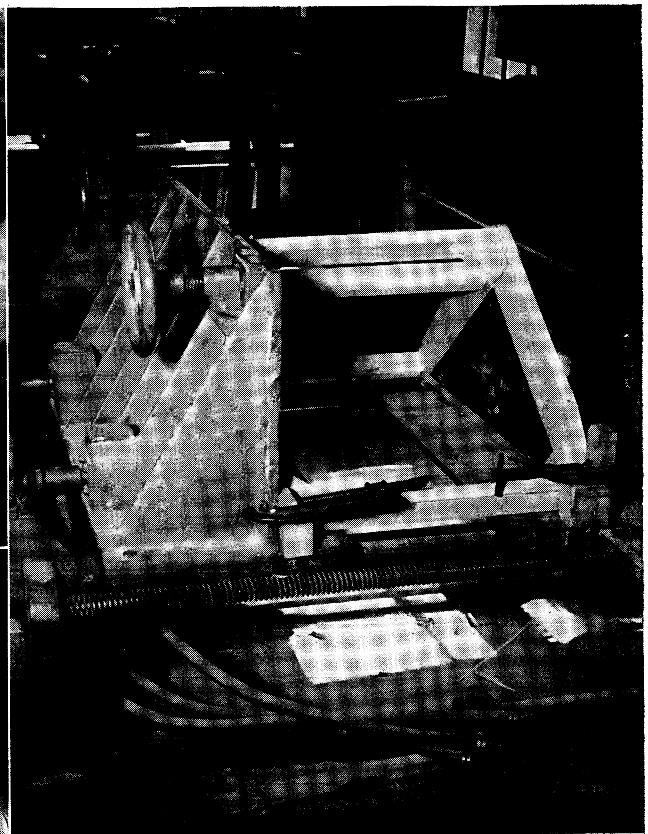


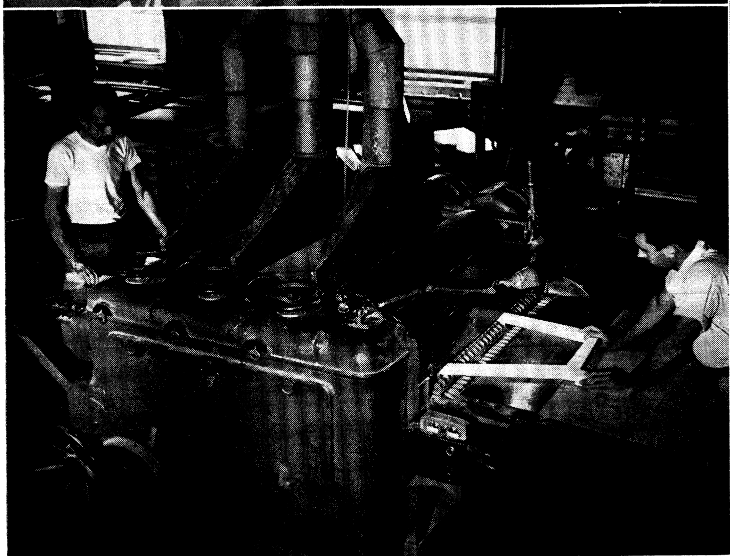
PHOTOGRAPHS, BUEHLER BROS.

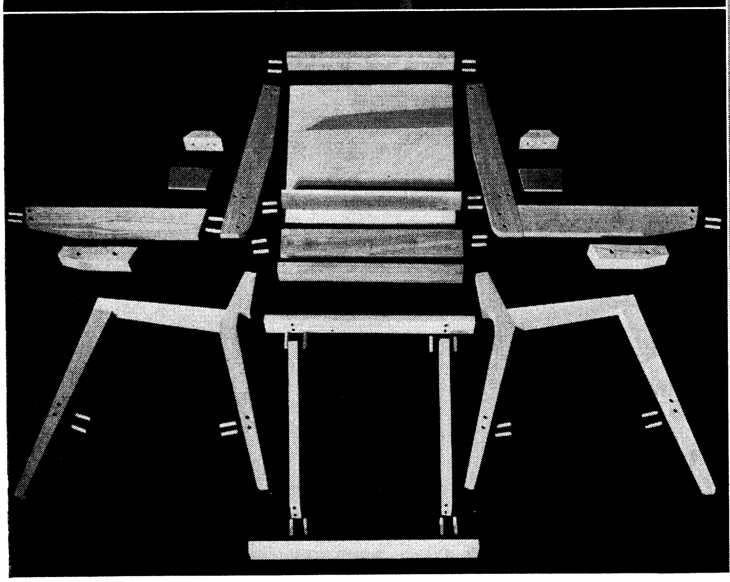
EQUIPMENT USED IN MANUFACTURE OF FURNITURE

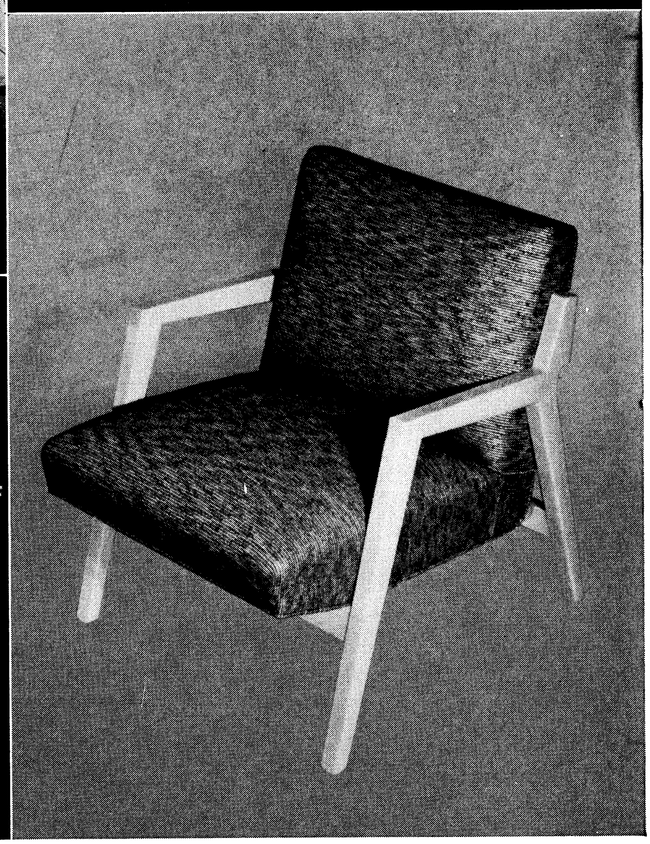
Top left: Planer with four cutting edges inserted in a high-speed rotating cylindrical head
Top right: Circular cutoff saw used to cut rough lengths and eliminate defects in the lumber
Centre left: Straight line ripsaw for rutting widths
Centre right: Band saw for cutting contoured shapes
Bottom left: Variety *saw* used to cut pieces to finished sizes
Bottom right: Boring machine, a hydraulically operated moving platform with three or more spindles holding drill bits for boring dowel holes











PHOTOGRAPHS, BUEHLER BROS.

LATER STAGES IN FURNITURE MANUFACTURE

Top left: Edge sanding with a cloth or paper belt coated with an abrasive
Top right: Air-driven clamp joins all the rails of the chair seat unit in one operation
Centre left: Surface sanding. Two of the abrasive drums of the machine rough-cut the pieces; the third polishes them to a smooth surface
Bottom left: Exploded view of all the machined wood parts of a chair designed by Mario dal Fabbro
Bottom right: The finished chair, assembled and upholstered

rococo style was firmly established in England throughout the 1750s and into the 1760s. Chippendale and other cabinetmakers borrowed not only ornament from the French *rocaille* but designs ior individual types as well. The fame of Chippendale as the chiei exponent of the rococo in English iurniture rests largely on his publication, though in fact it has now been more or less conclusively proved that he was not himself responsible for the designs, but employed two "ghost" designers, the pioneers of the rococo style in England, Lock and Copeland. Two important things should be rrmembered. First, there were several other cabinetmakers, for example William Vile and John Cobb, whose work irequently excelled that irom Chippendale's workshop, but whose only memorial is a small quantity of attributed furniture. Second, though it has become the practice to talk of a Chippendale chair or a Vile commode, this does not imply that the pieces were actually made by these craftsmen, but that they were made in their workshops.

Pattern books such as the *Director* admirably illustrate the wide range and diverse types of furniture in use in the mid-18th century. By this time every act of the day that necessitated the use of iurniture was catered for by some specialized piece, while the basic furniture such as chairs, cupboards, beds and tables mere designed and decorated in innumerable different iorms. The number of variants on the rococo chair splat must run into several hundreds. The ingenuity of the cabinetmaker and carver knew few limitations. During the rococo period marquetry decoration mas not used, though it was revived again and practised by Chippendale on some oi his finest pieces early in the neoclassic period. For bedroom iurniture japanning was popular.

The Gothic taste was an offshoot of the rococo style peculiar to England. Starting early in the century as a literary device, in the 1740s it began to take more solid shape in architecture, interior decoration and iurniture. As with furniture in the Chinese taste, Gothic furniture bore no relation to its mediaeval equivalents, but borrowed Gothic ornament, such as tracery and cusped arches, and applied them to furniture. The Gothic taste mas much publicized by Horace Walpole's celebrated villa, strawberry Hill, Twickenham, Surrey. Chippendale included designs for iurniture in the Gothic taste in all three editions of his *Director*.

The classical reaction, which set in shortly after 1760, swept away tortuous iorms and reimposed a classical discipline on design, though of lighter and more delicate touch than that of the previous classicists, the Palladians. Robert Adam, whose name is inseparably associated with this movement, had, like earlier architects, studied in Italy. There he sought inspiration both in the monuments oi classical times and the Renaissance, particularly the styles of decoration that the Romans had used ior their own domestic interiors. When he was given a free hand he included interior decoration and furniture in his architectural schemes, one of the best examples being his alterations and redecorations at Osterley, Middlesex, where he even provided harmonious designs for the lock plates and chimney furniture. His iurniture makes a restrained use of classical ornament, but paterae, husks, ram's heads and urns are less eloquent of the change than the symmetrical structural lines. At this time commodes and other objects were of satinwood, with delicate marquetry and ormolu mounts. Soon painted decoration was also used on furniture. Adam's furniture was copied and modified by contemporary cabinetmakers and may be seen translated into popular terms in George Hepplewhite's *Cabinet-Maker and Upholsterer's Guide* (1788).

In the last 20 years of the 18th century there mas a tendency toward greater and greater refinement. lightness and delicacy in furniture design. Furniture design retained, for the most part, symmetry of iorm and excellence of proportion. Heart- and shield-shaped backs on chairs and settees! tables and other pieces with tapered and fluted supports are characteristic, while feathers, wheat ears and shells are prominent in the painted or inlaid decoration. This refinement, strongly ieminine in character, is found represented in Thomas Sheraton's *Cabinet-Maker and Upholsterer's Drawing Book* (1791).

EMPIRE STYLE

The empire style, which quickly spread throughout Europe, each country adapting it to its own national taste, began in Paris after the Revolution. In England it is commonly called the regency style. The two French architects, C. Percier and P. Fontaine, who designed the furnishings for the state rooms of the first consul, contributed in great measure to the creation of the style and their work was assiduously copied at all the courts of Europe. Their ideas were incorporated and propagated in their *Recueil de décorations intérieures* (1801 and 1812).

Basically the new style was a continuation of the neoclassic style, with a much stronger archaeological bias. leading to direct copying of classical types of furniture, added to which mas the new repertory oi Egyptian ornament, stimulated by Napoleon's campaigns in Egypt. Mahogany-veneered furniture with ormolu mounts assumed the shapes of Roman, Greek and Egyptian chairs and tables. with winged-lion supports, pilasters headed with sphinxes' busts or palm leaves, while where no classical prototypes existed contemporary designs were enlivened with classical ornament.

In England the regency style is seen in the books of furniture designs by Thomas Hope (1807) and George Smith. Thomas Hope was the chief exponent, an amateur designer with some antiquarian knowledge who entirely decorated his own house, Deepdene, Surrey, in the style. When the fashion mas tàken up by cabinetmakers the results were often woefully incongruous. Mahogany and rosewood were used with bronzed or gilt ornament, and metal inlay, a cheaper technique, replaced inlay and marquetry. Along with this style there came a renewed enthusiasm ior the Chinese taste, as best exemplified in the iurniture and decoration of the Brighton pavilion. Between the 1820s and 1830s, in the final stages oi the regency style, both the design and construction of iurniture in England and on the continent showed signs of heaviness and overelaboration which heralded the general decline throughout Europe in the 19th century.

19th AND 20th CENTURIES

The Biedermeier style, strongly associated with Germany and Austria where its most salient features were developed, flourished in the prosperous middle-class homes of Europe irom about 1815 to 1848. This style is characterized by chairs with curved legs and sofas with rolled arms and generous upholstery. Mahogany veneers and light birch. grained ash, pear and cherry were used. The design and much of the ornament were influenced by the empire style, in particular the Grecian element.

In the 1820s there mas a revival of the Gothic style in England, which n-as partly stimulated by such romantic literature as the novels of Sir Walter Scott. Losing all the lightness and humour of the mid-18th-century Gothic revival, heavy mediaeval motifs were profusely and indiscriminately applied to every type of iurniture irom xi-ashstands to pianos. From the 1840s onward the furniture manufacturers, who had by this time replaced the cabinetmakers, began to borrow irom the styles of the past, Renaissance, baroque and rococo, lavishing misinterpreted decoration of these styles on pieces oi exaggerated and distorted iorm. The late Biedermeier was claborated mith a neorococo style, and in the middle of the century this iurniture was further encumbered with the sombre plush and velvet upholstery and bobbin-fringed covers so characteristic of the mid-Victorian period. e

While the widespread use of machinery lowered the standard of individual workmanship, and meaningless imitations of past styles suppressed originality in iurniture design, throughout Europe during the 19th century creative and experimental designers and cabinetmakers, working with such new materials as bentwood and metal, produced new types of iurniture which, though they mere exhibited at the Great exhibition in 1851 and at similar displays on the continent, mere largely ignored by the manufacturers. It was these neglected experimental pieces that were eventually to prove the prototypes of contemporary furniture.

William Morris has irequently been called the "father oi the modern movement." Sickened bv the shoddiness of the machine-produced goods of his own day, h turned for inspiration to the hand-craitsmanship of the middle ages and, basing his own work on their designs and methods, attempted to revive a respect for fine craftsmanship and to stir the aesthetic sense oi his contemporaries. His influence, though important, would have been greater if, instead of turning away irom the machine, he had applied his high ideals to discovering a way in which machines might be used to the best advantage. Morris' followers in the field of cabinetmaking included such designer-craftsmen as Ernest Gimson and the Barnsley family, who, working with a few assistants, produced small quantities of high-quality handmade furniture, the craitsmanship oi which has never been rivalled at any time. In Europe the example of Morris and his followers was so widely copied that many people believe modern iurniture design originated exclusively on the continent.

The *art nouveau* style mith its elongated forms flourished irom 1895 to about 1910, being well represented at the Paris exhibition in 1900. In England *art nouveau* mas not so popular as on the continent, and was entirely ignored by the Gimson school, though it is found in the work of the Scottish architect and designer, C. Mackintosh. Early in the 20th century, under the influence of Morris and Gimson, modern furniture design received a powerful stimulus in Germany with the creation of the *Werkbund* in 1907. Here at last the teachings oi Morris were used in conjunction with machinery. In 1914 the *Werkbund* held an exhibition at Cologne which inspired the creation in England of the Design and Industries association mhich aimed to bring about the collaboration of the artist and the manufacturer and to produce machine-made goods compatible mith the highest standards of design and workmanship. The results of this synthesis can be seen in the work of Ambrose Heal, who, at the beginning of the 20th century, began to produce large quantities of reasonably priced contemporary iurniture of simple line, decorated solely by the natural beauty oi the colour and graining of the timber. With commercial production of this kind a new public was slowly created and educated to appreciate not only English contemporary furniture but also that of Scandinavia. France and Italy.

Modern furniture continued to remain in an experimental period, and makers worked in a wide range of new materials. metal, plywood and laminated board, plastic and glass. Some designs were partly traditional, others completely original, the simplicity of modern furniture being relieved by beautiful moods from all over the world and by the use of bright contemporary textiles ior upholstery. Influenced by contemporary conditions, where a great percentage of city dwellers live in flats, ingeniously constructed built-in furniture began to replace the ireestanding furniture of the past, and the design of furniture was once again passing into the hands of the architect. *(See* also INLAYING; JAPANNING; MARQUETRY; ORMOLU; and BED; CABINET FURNITURE; CHAIR AND SOFA; TABLE; etc.)

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UNITED STATES

The story of North American furniture gains true significance when seen against its European background, mainly English Its successive variations irom this background reflect those geographic, economic and spiritual iorces which were shaping a total national individuality.

Early Settlers' Furniture.— From ancient wills and inventories and irom surviving pieces it is known that the first settlers in Massachusetts Bay and Virginia brought few comforts across the Atlantic. But by the second generation, about 1650, they had triumphed over enormous difficulties to create for themselves a fair facsimile of domestic equipment in the homeland. The simple furniture oi the early one-, two- or three-room irame cabin consisted of chests, cupboards, tables, benches, stools, an occasional chair and simple bedframes made by the community carpenter from memory rather than models. The heavy squared members and plane surfaces of oak were relieved by simple turning and scratch or two-plane carving, recalling the late mediaeval tradition of Elizabethan times. Toward the end of the century pine, maple and other woods came into use, sometimes in combinations. Surfaces formerly left in the wood were enlivened with coats or touches of black and earth reds and yellows, corresponding to the soitly dyed homespun wools and linens used in curtains and cushions and needed to relieve the starkness of wood and plaster.

From 1650 to 1700 there was probably little differentiation in the domestic furnishings of the English settlements. Dutch and Scandinavian forms came with Dutch and Swedish settlement on the Hudson and the Delaware, but these remained local in their influence.

Examples that have survived irom this early period show differences from the European prototypes that came not merely from lack of means or skill. The need to adapt and combine shows up in the different size, character and emphasis of parts, reflecting a changed environment and outlook.

Colonial Styles.— By 1700 the effect of French and Dutch fashions on late Stuart furniture in England had become evident in the American colonies. Fashion consciousness appeared, though for decades to come the furniture of the average colonial home kept to the earlier tradition evolved from mediaeval joining. The box chest was succeeded by the chest of drawers, often placed on a stand with turned legs. Chairs began to replace stools and the early heavy turned and wainscot type gave may to simplified versions of the high-backed scrolled forms of the English Restoration fashion. The day bed or chaise longue appeared with its upholstered pad. Small folding tables, cabinets and the tiered dresser to store and display tableware can testify to the rapidly increasing standard of comfort among the more prosperous. Carved suriace decoration was largely replaced by colour, through the use of paint or veneers or inlays of contrasting wood.

These innovations accompanied the use of the cabriole or reverse curve, which by about 1725 became the favoured form for legs oi chairs, tables, cabinets and stands of all sorts. At first. when it had little or no carving and a simple pad foot, this cabriole leg became the principal feature of the so-called Queen Anne style which dominated colonial iurniture designs until the Revolution.

Early in the 18th century the craft of the cabinetmaker became distinct from that of the joiner. The increasing complexity and lightness of construction and the use of veneers demanded special skills. The decorative effect of drawer and case pieces was enhanced with brass drawer pulls and escutcheons. Walnut became the principal cabinet wood and mas used over a structural carcass of pine.

Development of U.S. Styles.— Shortly after 1750 the earlier cabriole style was transformed by two factors. One was the rapidly increasing popularity of mahogany. The other was the influence of the English version of free rococo ornament, as reflected in the publication of Thomas Chippendale (*Gentleman and Cabinet Maker's Director,* 1754). Increased prosperity made it possible for a new generation of highly skilled artisans to take full advantage of the qualities of the new wood and the rich new ornamental vocabulary.

While the southern planter still depended largely upon London for his fine iurnishings, the merchants of Philadelphia, New York, Newport and Boston were well rewarded by their patronage of local craitsmen. In Philadelphia a local version of the so-called Chippendale style was brought to the highest mastery by such craftsmen as Thomas Affleck, Jonathan Gostelowe, Benjamin Randolph and William Savery. In Newport, R.I., the genius of the Goddard and Townsend iamilies evolved an equally distinctive style by developing the block front, decorated by the patterns of the wood grains instead of the carving of their contemporaries in Philadelphia. In spite of the Philadelphians' evident desire to match the works of the best London shops, they actually created their own style as distinct from that of England as the innovations of their Newport colleagues. Though less strikingly characterized, the cabinetmakers oi Boston, New York and the Connecticut valley also produced work of high quality and a definitely local flavour. Maintaining its hold on popular taste until well after the Revolution, this colonial "Chippendale" retained more of the sturdy elegance oi the earlier cabriole style than did its English equivalent.

The tendency of English design to massiveness and surface decoration contrasts with an apparent preference for the vertical and linear tension in colonial design.

Classic Influences.— The new classicism introduced into England by Robert and James Adam in the 1760s and later popularized in the furniture designs of George Hepplewhite (1788) and Thomas Sheraton (1791) came into vogue in the United States during the last years of the century. The shipowners and merchants of Salem, Boston and New York equipped their mansions with the work of Samuel McIntire, James Seymour and Duncan Phyfe, each of whom produced individual interpretations of the Hepplewhite-Sheraton mode. This early iederal style, which also shows some influence of the French *Directoire,* is characterized by small-scale rectangular design relieved by curved forms in plan only, and by a preference for light-toned wood finishes. Surfaces are generally unbroken, but decorated with bandings and inlays of contrasting woods, or in Phyfe's case with low relief carvings in the Adam manner. The most typical pieces are the sideboard and the small secretary desk, both of which developed a peculiarly American form.

Victorian Styles.— The early phase of the classic revival was followed about 1820 by the heavy iorms and archaeological detail preferred by devotees oi the Napoleonic empire style and the Greek revival. Refinement of proportion was sacrificed to effects of richness and mass. Carved accents became coarser in size and were often heightened by gilding or gilt bronze mounts. Veneers of crotch mahogany stained to a dark ruddy finish became the principal surface decoration.

A rapid degeneration of quality followed the introduction of machine processes after 1830. Factory production and popular demand encouraged the welter of ornament and a restless search for eclectic novelty which characterized all design irom 1850 until the contemporary functional movement. In terms of decorative design in general, the Victorian era is well described as "the battle of the styles," though most of the theory behind the modern movement was evolved during the last hali of the 19th century.

Later Styles.— While the revolt against the past began with the *art nouveau* of the 1890s, it was brought to a head in the 1920s by the Bauhaus movement in Germany which was based upon modern technology and was inspired largely by fresh insight into the traditional Japanese attitude toward design. In spite of widespread reluctance irom producers and consumers to follow this lead it largely prevailed, undergoing considerable modification in the process.

In furniture the movement was marked by a drive toward lightness and mobility. A tendency to carry simplicity to the point of desiccation, however, generated its own reaction. There was an accompanying development of modular design, involving the economy of interchangeable parts, and also of the storage wall as a space-saving substitute for case pieces and cupboards. Technological developments gave scope to a new range of wood finishes. principally in light tones, and to attenuated forms made possible by extruded metal parts and new methods of upholstery. Improved processes of mood lamination made it possible for plywood to play a vastly greater part in furniture construction and even to inspire new iorms such as the Eames chair. While advanced mechanical techniques made construction improvements possible, output was largely influenced by the prevailing industrial philosophy of obsolescence. After 1945 the contemporary mode became international in scope.

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(M. R. Rs.)

MATERIALS

Wood.—Species generally used for the exposed parts of furniture are: walnut, birch, maple, cherry, mahogany and gum (which is coloured to mahogany or walnut finish). For the covered parts of upholstered furniture such woods as ash, oak, maple and beech are used as irames because of their stability, straightness and ability to hold nails or tacks. The most widely used imported wood is mahogany and for solid furniture Honduras is preferred. Other kinds of red-coloured woods that are called mahogany come from the upper Amazon, Africa and the Philippines. Both the light and dark mahogany from the Philippines are widely used for plywood and case goods. Other foreign moods such as teak are used in smaller quantities for special custom-made pieces. Solid woods are used for soia and chair construction while veneer panels or plywood are favoured in cases and chests.

At the sawmill, where the trees are cut into boards of various thicknesses, the lumber is piled with strips between layers. This permits free circulation of air to dry the lumber. It takes two or three years to air-dry one-inch lumber outdoors. depending on the species and atmospheric conditions. To dry lumber more rapidly these stripped piles are placed in kilns. A kiln is a heated room where the temperature and humidity are very closely controlled and the air is forced through stripped piles of lumber by large fans which periodically change the direction of air flow. By kiln-drying, the moisture content of some species of one-inch lumber can be reduced to 6% or 10% in a matter of days.

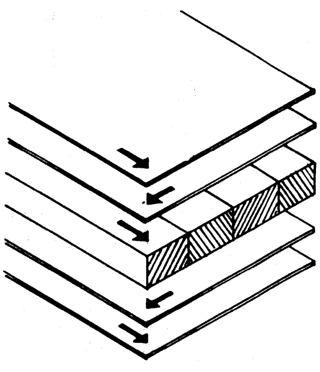

FIG. 1.— TYPICAL VENEERED LUMBER CORE PLYWOOD PANEL CONSTRUCTION

Plywood.— Panels with solid lumber cores in ¾-in. or 13/16-in. thicknesses are used for case goods construction because of the greater stability and interesting, uniform grain pattern of the face veneer. These panels consist of a ⅝-in. solid mood core sandwiched between two sheets of thin veneer, each 1/28-in. thick. These are set at right angles and glued and bonded under pressure. Beautifully grained veneers are cut irom select logs which are too costly to be used as solid wood. Cherry, white maple, birch, mahogany, oak, walnut. primavera. rosewood and other rare woods and plastics are used as veneers. Following World War II a resin-impregnated chip core is gradually replacing the solid poplar or other softwood core. The wood chips used in making this core were once a waste product of lumber mills.

In the thinner sizes plywood is made up of more uniform thicknesses oi glue-bonded pieces of wood set at right angles to each other. This type of plywood is used ior case backs, dust bottoms, drawer bottoms. It is also moulded to shape ior parts such as chair seats, chair backs, table and chair legs.

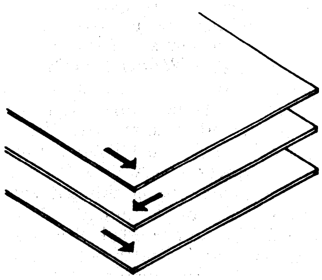

FIG. 2.— TYPICAL THIN PLYWOOD CONSTRUCTION

Hard Board.— Masonite is an example of hard board used instead of the thinner plywood in some inexpensive furniture

Glue.— Glue derived from animal hides has been used for centuries in the manufacture of furniture During. World War II there was a shortage of hide glue and synthetic glues were introduced. Of these the polyvinyl resin-base glues proved most satisfactory because they are easy to use and set quickly. Electrically heated resin glues will produce strong bonds in a matter of seconds.

Metal.— Steel in the form of sheets, rods and tubes is widely used for iurniture in institutions, hospitals, offices, homes and the transportation industry. In contemporary furniture steel is often combined with wood as a decorative feature. Following World War II aluminum almost completely replaced steel in outdoor furniture and invaded the institutional-furniture field because it neighs little and resists rust.

Brass, aluminum, silver, chromium and magnesium also became popular for decorating upholstered furniture and case goods.

Plastics.— Plastics appear in furniture in many forms. There are substitutes for metal hardware such as knobs and handles. Plastic veneers are laminated to wooden surfaces of table tops. They are used as ingredients in adhesives which bond together the parts of a piece of furniture. Some finishing materials are plastics, and plastics are moulded into chair seats.

Upholstery.—Upholstery is still mainly a handcraft. Modern machines cut multiple layers of fabrics, and staples replace tacking on inexpensive pieces, but well-made furniture is still produced by the skilled upholsterer, armed with needle, thread, hammer and a mouthful of tacks.

Upholstered furniture consists oi three main parts: the supporting unit, padding and cover. Spring-supported upholstery, which came into use during the 18th century, consists either of coil springs resting on burlap webbing and tied to the irame or the more modern non-sagging springs clipped to the frame. Other supporting units are plywood panels, webbed seat frames or steel bands held to the frame by helical springs. Padding is applied to the unit to provide comfort as well as styling. Padding is usually a layer of cotton placed over foam rubber, rubberized hair, Spanish moss or palm fibre held in place with burlap. The cover, of muslin and fabric or iabric alone, conceals this and is held in place by tacks or staples. Loose cushions are filled with special spring units, foam rubber or down, covered with layers oi cotton and encased in fabric.

Foam rubber, first introduced in furniture production in 1930, replaced many of the older padding materials. This spongelike rubber is made in sheets of various thicknesses which are easily cut to fit the furniture irame.

In upholstery work very few tools are necessary and only secondary experience is required on production-line operations. But highly skilled craftsmen are needed to make fine furniture.

Other Materials.— Glass is used to make doors and table tops or to protect table and chest tops. Ceramics, marble and tile are used to some degree in iurniture construction.

FURNITURE PRODUCTION

The Cabinet Shop.—A cabinet shop is usually a very small organization where the skilled headman develops or lays out the design and, with a few assistants, produces a finished piece of furniture. This type of shop specializes in custom and repair work so many hand tools are used, and the power-driven machines are oi the kind which can be easily adjusted to a wide variety of operations. In the C.S. only a small percentage of furniture is still made in cabinet shops.

A Typical Furniture Factory.— The average furniture plant usually has fewer than 100 employees. They operate many semi-automatic machines but such a factory is not conveyorized so completely as the mass-production plant. It is in these iactories that most of the fine iurniture is manufactured. This type of furniture requires considerable handwork to add refinements not found in inexpensive mass-produced iurniture.

The design for a piece of furniture is sketched and aiter the sketch is approved by the manufacturer a full-size drawing is made. Then a sample is made to check the design and production problems. After revising, the dran-ings are corrected and patterns and detailed cutting orders are sent to the production department. There the proper species of well-seasoned lumber is brought in. The lumber is usually planed on two sides so defects such as knots, cracks, and colour variations can be detected.

Straight rails are cut irom the boards by straight-line ripsaws and cutoff saws. The stock ior parts, which must be flat and straight, is usually faced or jointed aiter being cut to rough size. Curved parts are traced on boards, following patterns, and are cut out by a band saw. When curved parts are too large to be cut from boards received irom the lumber mill, the board defects are ripped out and the resulting narrow pieces are glued together into large panels from which the parts will be cut. Covered back legs are often made this way to save lumber. If the piece is a table or chest the panels which iorm the top or sides may also be glued in a similar manner, when solid wood is used for their construction.

In most rase goods such as chests and tables veneered lumber core plywood is used ior the large panels. If 100 or more pieces of the same kind are to he made. panels are purchased cut to exact size from plywood manufacturing companies. Then all that is necessary is to edge-band and cut the joints.

When parts must all be cut exactly alike, they are clamped in iorms having the proper contour and are then brought in contact with high-speed rotating knives which shape the part to proper size as the form rides against a guide on hand or automatic shapers and routers. Intricately carved pieces such as legs are roughly carved on multiple-spindle carving machines. These duplicate a master leg. by means of a follower point which is guided along the model surface and imparts the same motions to as many as 32 high-speed rotating

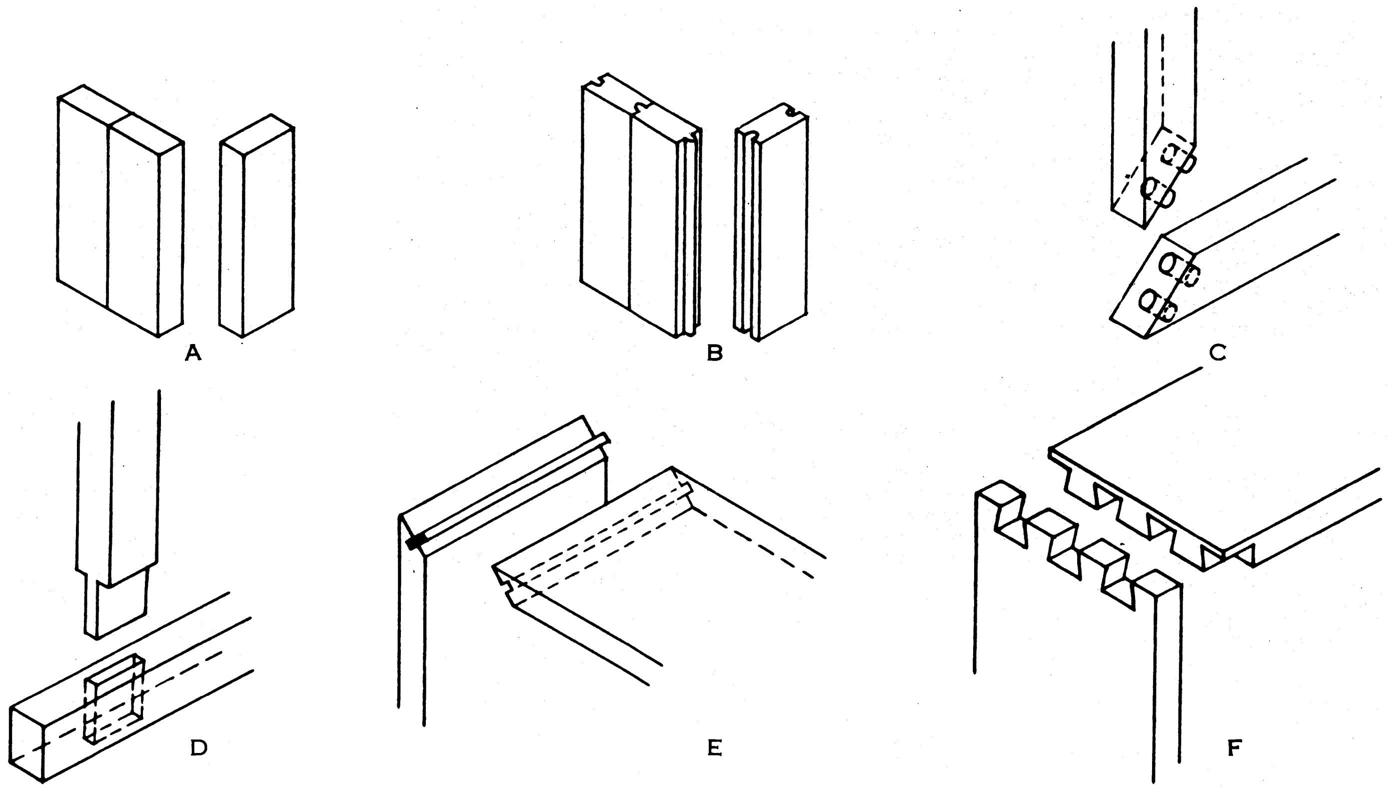

FIG. 3.— TYPICAL JOINTS USED IN FURNITURE MANUFACTURE: (A) PLAIN BUTT. AND (B) TONGUE AND GROOVE ARE USED CHIEFLY IN GLUED UP PANELS: (C) DOUBLE DOWEL IS THE MOST WIDELY USED JOINT IN UPHOLSTERED FURNITURE; (D) MORTISE AND TENON; (E) MITRE AND SPLINE. AND (F) DOVETAIL ARE USED PRIMARILY IN CASE GOODS CONSTRUCTION

knives as they whittle the leg blanks. After rough carving the legs are machine-sanded, and fine detail is added by the hand-carver. The next operation is periormed in the fitting department where the ends are cut to the desired angle, bored ior dowels or tenoned. Automatic modern machines often combine these operations. Exposed parts are sanded on edge belt sanders, three-drum travelling-bed sanders or belt sanders. Rounded parts are sanded on soft pneumatic drums and carved parts are sanded on a buffer, a machine ,which has shredded sandpaper supported by brushes on a revolving wheel. The parts are then glued and assembled. Often the side or back of a piece is assembled in air-driven clamps.

After the glue has set the parts may be returned to the machine department for additional machining that could not be performed before assembling, such as sanding joints even and shaping the edges. Then it goes back to the assembly department for final assembly. Air-driven clamps are used where the design permits. In other cases the piece can only be pressed together by hand clamps. Unless electronically cured glues are used, clamps must be applied long enough to ensure a good glue bond. The completed article is then cleaned to remove excess glue, inspected and hand-sanded to provide a smooth surface lor the finish. Application of the finish as well as upholstering is sometimes done in another iactory.

The **Mass-Production** Factory.— Mass-production factories are found in Grand Rapids, Mich., Jamestown, N.Y., and High Point, N.C. In the mass-production plants built after World War II it is possible to produce a small dinette chair in 35 minutes. The lumber is brought from the kiln to the rough mill department by motorized lumber carriers. There it is often lightly surfaced on both sides. Then power-fed cutoff saws remove deiects and cut the boards to length. Conveyors carry the hoards to hiah-speed ripsaws which remove remaining defects and trim the board to widths ready for gluing. These narrow boards are glued up into large panels, using resin glue in high-frequency quick-drying machines. The panels then go to a double surface planer. Such parts as chair back posts are rough-cut on a band saw in multiples and then shaped to exact size on an automatic shaper. The ends are trimmed and all holes bored in one operation by a front and back post-boring machine. Such parts as seat rails have both ends cut off, on plain or compound angles, and chucked or bored in one cycle of a double-end sawing, boring and chucking machine. Glue is shot into the dowel holes and the dowel driven in on a gluer and dowel driver. The exposed parts such as legs are then sanded on various types of automatic sanding machines before the chair is assembled and clamped in air-driven presses. The chair is now cleaned and sanded with 6/0 or 7/0 sandpaper to provide a smooth base for the finish.

FURNITURE CONSTRUCTION'

Wood Case Goods.— In most high-quality case goods the sides and tops usually are made of panels ⅝ in. or more in thickness. Panels may be made of solid woods or veneered lumber core. Back panels, dust panels and drawer bottoms usually are ¼-in. plywood. Drawers are separated by dust panels and slide on guide rails. The corner joints oi the drawers are oi a locking type such as the dovetail. If the design permits, there are numerous glue blocks reinforcing the corners of the case. On well-constructed furniture the joints are neatly made, well glued and tightly fitted.

Wood Chairs.— Good chair construction requires that the main rails be made oi well-seasoned hardwoods having sufficient width and thickness to provide rigid members. Joints should be well machined to provide complete wood contact for the glue whether they are double-dowelled or mortised and tenoned. Corners should be reinforced by fitted corner blocks glued and grooved or screwed in place. Cross members are added so that the tension of the springs and upholstery will not bend the long rails. Long legs of chairs are glued and dowelled between the rails or notched out, glued and double-dowelled to the rails, reinforced by screws, bolts or glue blocks. Short legs are usually double-dowelled to the bottom of the rails. On some modern iurniture the legs are pegged and glued into fitted corner blocks which are glued and screwed in place. A well-constructed piece of furniture is a rigid structure; arms should not be loose nor should the frame creak when someone sits on it. Cabinetmakers used to test the frame of an upholstered sofa by lifting the right front leg and watching the leit iront leg, which should lift when the right leg is about two-inches off the floor.

Finishing Wood **Furniture.**—The purpose of finish is to stabilize and preserve wood as well as to enhance-the beauty of the wood texture. A typical operation necessary to produce a quality finish of walnut wood is this: after the final machine sanding with 4/0 sandpaper just prior to finishing, the piece is hand-sanded with j/o paper. Light sapwood is stained to match the darker heartwood. Next a wash coat of lacquer thinned with three parts,of thinner is sprayed on and after drying is sanded with 8/0 paper. A filler is then sprayed or brushed on and padded into the pores of the wood. A coat of sealer is applied and sanded with 8/0 paper and followed by one or two coats of lacquer which are allowed to dry overnight or are quickly dried in heated chambers. It is then rubbed using ,360-grit wet-or-dry sandpaper and naphtha as a lubricant. Fine steel wool or special rubbing compounds are also used.

On tight-grained wood such as maple, a good quality finish can be obtained by using nongrain-raising stain and lacquer sealer. This is well sanded and followed by two coats of lacquer, each one rubbed down after application. On much inexpensive furniture the finish consists of a coat of coloured sealer followed by only one coat of lacquer which produces a less durable finish.

Some fine modern iurniture is finished by applying several coats of boiled linseed oil. This gives a mellow satin appearance.

After World War II a scratch-resistant group of synthetic lacquers was introduced to the furniture industry.

In the United States lacquers have almost completely replaced the so-called French finish and varnishes and shellacs in furniture production, which are used only in repairs or restorations of antiques.

Metal Furniture.—A great step was taken in metal furniture design when a chair of tubular steel was designed by Marcel Breuer in 1925 at the Bauhaus school in Germany. From his basic idea came large-scale production of low-priced steel and aluminum furniture designed for use in factories, hospitals, outdoors and in offices. Rod, wire and tubular metal shapes came to be used also in making complete furniture pieces or as supporting members of wood and upholstered furniture. Tubular steel is well adapted to furniture manufacture because it is lightweight, strong, flexible and more easily shaped than solid metal.

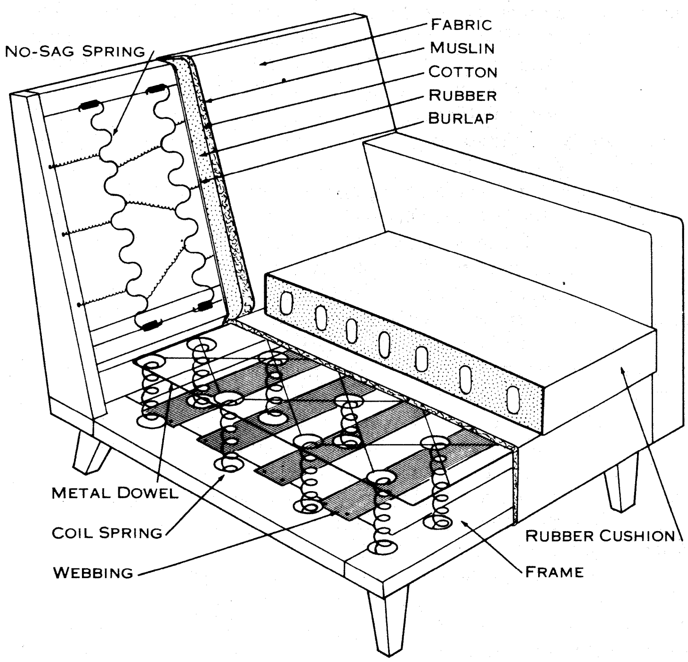

FIG. 4.—CONSTRUCTION FEATURES OF A MODERN UPHOLSTERED CHAIR

Metal furniture can be finished in several different manners. It can be painted with various coloured enamels applied over specially adapted primers. Steel can be chemically treated to produce a black or green rust-resistant finish or it can be chrome-plated.

Plastic Furniture.—Moulded plastics opened a great field for new design in sculptured forms.

The largest use of plastic is in the form of laminated sheets such as Formica and Micarta, which are easily bonded to plywood panels by special adhesives. These sheets are made with durable finishes in various colours and wood imitations. They are used extensively for table tops, kitchen-counter tops and bathroom furniture. Other plastics such as Koroseal, Naugahyde, Fabrilite and Duran, woven or in sheet form, are used in place of cloth fabric and replaced conventional upholstery webbing.

"Do-It-Yourself."—The "do-it-yourself" movement grew rapidly after World War II. This hobby, for which more than $6,000,000,000 a year are spent in the U.S., is a source of relaxation for millions of people who enjoy making things with their own hands. And what they make saves them money—they have only the cost of materials and tools.

The expansion of the "do-it-yourself" movement boosted the market for new tools, simple machinery, easily applied varnishes and paints, wood and plywood and simplified drawings which enabled amateur craftsmen to manufacture their own furniture.

The easiest "do-it-yourself" projects are outdoor furniture, magazine racks, tables, bookcases, cabinets, wardrobes, beds, chests and built-in units. The hard ones are chairs, armchairs and sofas.

(*See* also INTERIOR DECORATION.)

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FURNITURE POLISH. The two varieties in commonest use are furniture creams and furniture wax polishes, the quality of the polish differing with the ingredients used in its preparation.

Furniture creams are thick, milky white liquids, and are made by dissolving beeswax in turpentine by means of steam heat in a double-jacketed pan. Steam heat is used because of the dangerous inflammability of turpentine vapour in the presence of a naked light. After the beeswax has thoroughly melted, the steam is shut off and a solution of soft soap in hot water is added. The whole mass is then well beaten up to a thick, milky emulsion and packed in bottles ready for use. The beeswax may also be replaced, or partially replaced, by other waxes such as carnauba wax, Japan wax, ceresine wax, etc. The proportions of 9 oz. of pure beeswax (finely shredded) to $1\frac{1}{2}$ pt. of American spirits of turpentine, with the after addition of $1\frac{3}{4}$ pt. of hot water containing 2 oz. of soft soap dissolved in it, is considered to make a good mixture.

Furniture wax polishes are made by similarly dissolving beeswax and other waxes in turpentine with the aid of heat, about 1 lb. of wax to 1 qt. of turpentine being used. The clear melted liquid is then poured into tins, and on cooling sets hard and is ready for use. The addition of a little wax-soluble aniline dyestuff to the polish when in the liquid state is made in order to give it a more pleasing appearance.

An easily made polish, particularly suitable for cleaning old and dirty furniture, is obtained by shaking together 1 part of raw linseed oil, 1 part of turpentine and 1 part of vinegar.

FURNITURE WOODS: *see* HARDWOODS; TIMBER.

FURNIVALL, FREDERICK JAMES (1825–1910), English philologist and editor, was born at Egham, Surrey, Feb. 4, 1825. He assisted Frederick Denison Maurice in the Christian Socialist movement and was one of the founders of the Working Men's college, London. He promoted the study of early English literature, partly by his own work as editor and partly by the foundation of learned societies, especially the Early English Text society (1864), the Chaucer, Ballad, New Shakespeare and Wyclif societies and, at a later period, societies for the special study of Browning and Shelley.

His most important work was his "Six-Text" edition of the *Canterbury Tales.* He was honorary secretary of the Philological society and one of the original promoters of the *Oxford New English Dictionary.* He cooperated with its first editor, Herbert Coleridge, and after his death was for some time principal editor during the preliminary period of the collection of material.

Furnivall was always an enthusiastic oarsman, and throughout his life kept up his interest in rowing; with John Beesley in 1845 he introduced a new type of narrow sculling boat, and in 1886 started races on the Thames for sculling fours and sculling eights. He died July 2, 1910.

FURPHY, JOSEPH (pseudonym, TOM COLLINS) (1843–1912), Australian novelist, whose works proclaim nationalist social equality and were written with typical Australian raciness and broad humour. He was born at Yering, near Yarra Glen, Victoria, on Sept. 26, 1843, the son of an Irish immigrant. Educated by his mother, he worked at Kyneton, the Riverina and Shepparton, Victoria, where in 1884 he accepted a position in a foundry. There he began to write *Such Is Life,* which he finished in 1897 and published in three parts: *Such Is Life* (1903); *Rigby's Romance* (1921), which was serialized in *The Barrier Truth* in 1905; and *The Buln Buln and the Brolga* (1948). His *Poems* were published in 1916. A lean, shrewd, kindly man, Furphy was interested in schemes of social regeneration. He died at Claremont, Western Australia, on Sept. 13, 1912.

See K. Baker and M. Franklin, *Joseph Furphy* (1944).

(C. M. H. C.)

FURSE, CHARLES WELLINGTON (1868–1904), English romantic painter, was born at Staines, Middlesex, on Jan. 13, 1868. He entered the Slade school in 1884, winning the Slade scholarship the following year, and completed his education at Julian's academy in Paris. "Cain" was the first painting he exhibited at the Royal Academy (1888). He regularly showed work at the New English Art club. Among his pictures are: "Diana of the Uplands," "Lord Roberts" and "The Return from the Ride" (London). Elected an associate of the Royal Academy in 1904, Furse died in London on Oct. 16, 1904. (D. L. FR.)

FUR SEALS, a little group of marine carnivorous mammals forming the genera *Arctocephalus* and *Callorhinus.* The fur seals resort, or once resorted, in vast numbers to crowded "rookeries."

All the islands of the Southern ocean were densely peopled by fur seals when first discovered; so were Juan Fernandez, the neighbouring Mas-a-Fuero, the Kuriles and the islands in Bering sea. On the other side of America, in the Plate estuary, the Lobos Islands also have their seal herd. The history of nearly all these rookeries is one of wanton waste and rapid extermination. The South Shetlands were discovered in 1819; within two years the rookeries were already exterminated. The only herds to escape destruction are those of the Lobos Islands (Uruguay), of the Pribilof Islands (United States), and of the Russian Commander Islands.

The fur seal is polygamous as well as gregarious. The bulls or sikatchi, live to a great age and grow to a great size, far beyond that of the females. They arrive on their breeding-places in spring, choose their quarters on the rocky beach, and are joined a few weeks later by the cows (or matkas), who come in heavy with young. The pups (or kotik) are born soon after, and the comparative quiet of the rookery becomes a babel of angry noise. The bulls fight for possession of the cows, each striving to gather and keep a "harem" round him. The cows go out to sea to feed, but the bulls never leave their posts and fast throughout the season; they come in fat and vigorous in May, and leave in autumn gaunt, lean and battle-scarred. The young males or bachelors (holloschickie) keep to themselves, "hauling out" behind the breeding herd. Males and females are born in equal numbers; and the economic management of a rookery consists in protecting all females, in leaving the harems undisturbed, and in taking such toll of the young bachelors as to leave enough to take the places of the breeding bulls.

The Pribilof Islands, discovered in 1786, passed into the hands of the United States with the Territory of Alaska in 1867; their great rookeries had been wastefully used and ruinously depleted to begin with, but the Russian government had nursed them back into prosperity for 30 years, till at the time of the purchase they yielded 100,000 skins a year. But about 1880, pelagic sealing grew up, wherein young and old, males and females were killed without discrimination. This soon showed its effects upon the herd. After the U.S. government in 1911 took the fishery into their own hands, pelagic sealing was finally abolished, on terms of equitable compensation. The Commander Islands on the Russian side have a different tale to tell. The war and then the revolution led to neglect ashore and to piratical raids from the sea; and an expert who had visited these islands in 1897 and came again in 1922 was "dismayed" at the shrunken rookeries. See SEAL FISHERIES, CARNIVORA. (D. W. T.)

FURSEY (FURSEUS), **SAINT** (d. before 652), Irish monk and visionary. Of his early years nothing certain is known. After 630 he left Ireland for England and founded the monastery of Cnoberesburgh in the dominions of King Sigebert of East Anglia. After the king's death he crossed to France (before 644) and founded a monastery at Lagny on the Marne. When Fursey died (perhaps in 649) Erchinoald, mayor of the palace in Neustria, took possession of his body and 30 days later had him buried in his newly founded church at Péronne in Picardy. The earliest life of Fursey, written shortly after his death, has considerable historical value. His feast day is Jan. 16.

Fursey was said to have had visions of the other world, which became widely known through the account in Bede's Ecclesiastical History; they had considerable influence on the vision literature of the later middle ages. The shrine of Fursey at Péronne attracted many pilgrims, especially from Ireland, and the monastery of Péronne retained its Irish character until (and possibly beyond) the end of the 8th century. Fursey's brothers, St. Foillan (who had succeeded him at Cnoberesburgh) and St. Ultán, stayed at Péronne for some time, then went to Brabant and established themselves at Fosses. Later Ultán seems to have been abbot of Péronne.

See J. F. Kenney, *Sources for the Early History of Ireland,* pp. 500–505 (1929); L. Gougaud, *Christianity in Celtic Lands,* pp. 146–148 (1932). (L. BR.)

FÜRSTENBERG, the name of two noble houses of Germany. 1. The more important ruled in a mediatized principality in the district of the Black Forest and the Upper Danube, which comprises the countship of Heiligenberg, about 7 m. N. of the Lake of Constance, the landgraviates of Stuhlinger and Baar, and the lordships of Jungnau, Trochtelfingen, Hauser and Moskirch or Messkirch. The territory is discontinuous; and lies partly in Baden, partly in Wurttemberg, and partly in the Prussian province of Sigmaringen. The relations of the principality with Baden are defined by the treaty of May 1825, and its relations with Wurttemberg by the royal declaration of 1839. The *Stammort* or ancestral seat of the family is Furstenberg in the Black Forest, but the principal residence of the Furstenbergs is at Donaueschingen.

The family of Furstenberg claims descent from a certain Count Unruoch, a contemporary of Charlemagne, but their authentic pedigree is only traceable to Egino II., count of Urach, who died before 1136. In 1218 his successors built the town and castle of Furstenberg. Of the two sons of Egino V. of Urach, Conrad, the elder, inherited the Breisgau and founded the line of the counts of Freiburg, while the younger, Heinrich (1215–1284), received the territories lying in the Kinzigthal and Baar, and from 1250 onward styled himself first lord, then count, of Furstenberg. His territories were subsequently divided, though temporarily reunited under Count Friedrich III., whose wife, Anna, heiress of the last count of Wardenberg, brought him the countship of Heiligenberg and lordships of Jungnau and Trochtelfingen in 1534. On Friedrich's death (1559) his territories were divided between his two sons, Joachim and Christof I. Of these the former founded the line of Heiligenberg, the latter that of Kinzigthal.

In 1909 there were two branches of the princely house of Fiirstenberg: (1) the main branch, that of Fürstenberg-Donaueschingen, the head of which was Prince Maximilian Egon (b. 1863), who succeeded his cousin Karl Egon III. in 1896; (2) that of Fiirstenberg-Konigshof, in Bohemia, the head of which was Prince Emil Egon (b. 1876), chamberlain and secretary of legation to the Austro-Hungarian embassy in London (1907). The cadet line of the landgraves of Furstenberg is now extinct, its last representative having been the landgrave Joseph Friedrich Ernst of Fürstenberg-Weitra (1860–1896), son of the landgrave Ernst (1816–1889) by a morganatic marriage. He was not recognized as *ebenbürtig* by the family. The landgraves of Furstenberg were in 1909 represented only by the landgravines Theresa (b. 1839) and Gabrielle (b. 1844), daughters of the landgrave Johann Egon (1802–1879).

From the days of Heinrich of Urach, a relative and notable supporter of Rudolph of Habsburg, the Furstenbergs have played a stirring part in Germany history as statesmen, ecclesiastics and notably soldiers. There was a popular saying that "the emperor fights no great battle but a Furstenberg falls." In the Heiligenberg line the following may be more particularly noticed.

FRANZ EGON (1625–1682), bishop of Strasbourg, was the elder son of Egon VII., count of Furstenberg (1588–1635), who served with distinction as a Bavarian general in the Thirty Years' War. He began life as a soldier in the imperial service, but on the elevation of his friend Maximilian Henry of Bavaria to the electorate of Cologne in 1650, he went to his court and embraced the ecclesiastical career. He soon gained a complete ascendancy over the weak-minded elector, whose Francophile policy he instigated. Ecclesiastical preferments were heaped upon' him, and in 1663 he became bishop of Strasbourg. On the conclusion of a treaty between the emperor and the elector of Cologne, on May 11, 1674, Franz was deprived of all his preferments in Germany, and was compelled to take refuge in France. He was, however, amnestied with his brother William by a special article of the Treaty of Nijmwegen (1679), whereupon he returned to Cologne. He died on April 1, 1682 at Strasbourg.

His brother WILLIAM EGON (1629–1704), bishop of Strasbourg, began his career as a soldier in the French service. He went to the court of the elector of Cologne at the same time as Franz Egon, whose policy he shared. In 1672 William was seized by imperial soldiers in the monastery of St. Pantaleon at Cologne, hurried off to Vienna and there tried for his life. He was saved by the intervention of the papal nuncio, but was kept in prison till the signature of the Treaty of Nijmwegen (1679). As a reward for his services Louis XIV. appointed him bishop of Strasbourg in succession to his brother in 1682, in 1686 obtained for him from Pope Innocent XI. the cardinal's hat, and in 1688 succeeded in obtaining his election as coadjutor-archbishop of Cologne and successor to the elector Maximilian Henry. At the instance of the emperor, however, the pope interposed his veto; the canons followed the papal lead, and, the progress of the Allies against Louis XIV. depriving him of all prospect of success, William Egon retired to France. He died on April 10, 1704 near Paris.

In the Stühlingen line the most notable was KARL EGON (1796–1854), prince of Fürstenberg, the son of Prince Karl Alois of Furstenberg, a general in the Austrian service, who was killed at the battle of Loptingen on March 25, 1799. In 1804 he inherited the Swabian principality of Furstenberg and all the possessions of the family except the Moravian estates. By the mediatization of his principality in 1806 the greater part of his vast estates fell under the sovereignty of the grand-duke of Baden. In politics he distinguished himself by a liberalism rare in a great German noble, carrying through by his personal influence with his peers the abolition of tithes and feudal dues and stanchly advocating the freedom of the press. His palace of Donaueschingen, with its collections of paintings, engravings and coins, was a centre of culture, where poets, painters and musicians met with princely entertainment. He died on Sept. 14, 1854, and was succeeded by his son Karl Egon II. (1820–1892), with the death of whose son, Karl Egon III., in 1896, the title and estates passed to Prince Maximilian Egon, head of the cadet line of Fürstenberg-Pürglitz.

See Münich, *Gesch. des Hauses und des Landes Fürstenberg*, 4 vols. (Aix-la-Chapelle, 1829–47); S. Riezler, *Gesch. des fürstlichen Hauses Fürstenberg bis 1507* (Tübingen, 1883); *Fürstenbergisches Urkundenbuch*, ed. S. Riezler and F. L. Baumann, vols. i.–vii. (Tübingen, 1877–91), continued *s. tit. Mitteilungen aus dem fürstlich. Fürstenbergischem Archiv* by Baumann and G. Tumbült, 2 vols. (*ib.* 1899–1902); Stokvis, *Manuel d'histoire* (Leiden, 1890–1893); *Almanach de Gotha; Allgemeine deutsche Biographie.*

2. The second Fiirstenberg family has its possessions in Westphalia and the country of the Rhine, and takes its name from the castle of Furstenberg on the Ruhr. The two most remarkable men whom it has produced are Franz Friedrich Wilhelm, freiherr von Fiirstenberg, and Franz Egon, count von Fürstenberg-Stammheim. The former (1728–1810) became ultimately vicar-general of the prince-bishop of Munster, and effected a great number of important reforms in the administration of the country, besides doing much for its educational and industrial development. The latter (1797–1859) was an enthusiastic patron of art, who assisted the completion of the Cologne cathedral, and erected the beautiful church of St. Apollinaris near Remagen on the Rhine. He was a member of the Prussian Upper House in 1849, collaborated in founding the *Preussisches Wochenblatt,* and was an ardent defender of Catholic interests.

FURSTENWALDE, a town of eastern Germany, on the Spree river and the Oder-Spree canal. 28 mi. E. of Berlin on the railway to Frankfurt an der Oder. Pop. (1950) 30,388. Fürstenwalde is one of the oldest towns in the district of Frankfurt. From 1385 it was the seat of the bishop of Lebus. whose bishopric was incorporated with the electorate of Brunswick in 1595. The industries include. besides brewing and malting. manufactures of chemicals. boots, organs. stoves, etc.. iron founding and wool weaving. It was bombed in World War II.

FURTH, a manufacturing town of Germany, in the *Land* of Bavaria. at the confluence of the Pegnitz with the Regnitz. 5 mi. N.W. of Nurnberg by rail, at the junction of lines to Hof and Würzburg. Pop. (1950) 99,943. Fürth was founded, according to tradition, by Charlemagne, and was for a time under the burgraves of Nürnberg, but about 1314 it was bequeathed to the see of Bamberg. In 1806 it came into the possession of Bavaria. The old St. Michaeliskirche is a handsome structure; but the town's chief edifice is the new town hall, with a tower 175 ft. high. Furth owed its prosperity to the tolerance it meted out to the Jews, who found here an asylum from the oppression under which they suffered in Nurnberg, and who had a synagogue and a high school and were prosperous until Hitler's rise to power. Industries include production of chromolithographs and picture-books, manufacture of mirrors and mirror-frames, bronze and gold-leaf wares, pencils, toys, haberdashery, optical instruments, silver work, turnery, machinery and fancy boxes, and a trade in hops, metals, wool and coal. An annual fair is held at Michaelmas. The earliest railway in Germany was that between Nurnberg and Furth (opened Dec. 7, 1835).

FURTWÄNGLER, ADOLF (1853–1907), German archaeologist, was born on June 30, 1853, at Freiburg-im-Breisgau, and died at Athens on Oct. 10, 1907. From 1878 to 1879 he was engaged in work on the excavations at Olympia, and in 1884 became professor of archaeology in Berlin, exchanging his chair in 1894 for one at Munich. He conducted the excavations at Aegina and Orchornenos in 1901–03, and was the author of many important works on archaeology, notably *Die antiken Gemmen* (1900), and *Griechische Vasenmalerei,* begun in 1900 with Reichold, and continued by other scholars.

FURTWÄNGLER, WILHELM (1886–1954), German conductor, was born in Berlin Jan. 25, 1886, the son of the archaeologist Adolf Furtwängler (1853–1907). He received his musical education in Munich from Beer-Walbrunn, Rheinberger and Schillings, and then acted as conductor at Zürich. Later he occupied similar positions at Strasbourg, Lübeck, Mannheim, Vienna and Frankfurt-on-Main. In 1922, on the death of Arthur Nikisch, he became director of the Berlin Philharmonic and of the *Gewandhaus* concerts at Leipzig; he also gave annual concerts in New York. He conducted the Wiener Philharmonische Konzerte from 1927 to 1944 and again after 1948, became first conductor of the Berlin State Opera in 1933 and led the Bayreuth festivals. 1931, 1936 and 1937. He died near Baden-Baden, Ger., Nov. 30, 1954.

FURZE, GORSE or WHIN, botanical name *Ulex,* a genus of thorny papilionaceous shrubs of the family Leguminosae (*q.v.*), comprising 20 species, confined to west and central Europe and northwest Africa. Common furze, *U. europaeus,* is found on heaths and commons in western Europe from Denmark to Italy and Greece and in the Canaries and Azores, and is abundant in the British Isles. It grows to a height of two to six feet; it has hairy stems, and the smaller branches end each in a spine; the leaves, sometimes lanceolate on the lowermost branches. are mostly represented by spines from two to six lines long, and branching at their base; and the flowers, about three-quarters of an inch in length, have a shaggy, yellowish-olive calyx with two small ovate bracts at its base, and appear in early spring and late autumn. They are yellow and sweet scented and visited by bees. The pods are few seeded; their crackling as they burst may often be heard in hot weather. This species comprises *U. europaeus* proper, which has spreading branches and strong, many-ridged spines. and U. *strictus* (Irish furze), with erect branches and slender four-edged spines. Another British species of furze is *U. nanus,* dwarf furze, also a native of Belgium. Spain and the west of France; it is a procumbent plant. less hairy than *U. europaeus,* with smaller and more orange-coloured flowers, which spring from the primary spines and have a nearly smooth calyx with minute basal bracts. Furze or gorse is sometimes employed for fences.

Notwithstanding its formidable spines, the young shoots yield a palatable and nutritious winter forage for horses and cattle. To fit it for this purpose it must be chopped and bruised to destroy the spines. There are a variety of machines by which this is done rapidly and efficiently, and which are in use where this kind of forage is used to any extent. The agricultural value of this plant has often been overrated by writers. In the case of poor, dry soils it does, however, yield much valuable food at a season when green forage is not otherwise to be had. It is given to horses and cows in combination with chopped hay or straw.

This plant is invaluable in mountain sheepwalks. The rounded form of the furze bushes in such situations shows how diligently the annual growth, as far as it is accessible, is nibbled by the sheep. The food and shelter afforded to them in snowstorms by clusters of such bushes is also of much importance. Young plants of whin are so kept down by the sheep that they can seldom attain to a profitable size unless protected by a fence for a few years. In various parts of England whin is cut for fuel. The ashes contain a large proportion of alkali and are a good manure, especially for peaty land.

FUSARO, a lake of Campania, Italy, ½ mi. W. of Baiae and 1 mi. S. of the acropolis of Cumae. It is the ancient Acherusia *palus,* separated from the sea on the west by a line of sand hills It may have been the harbour of Cumae in early antiquity. In the 1st century AD. an artificial outlet was dug for it at its south end, with a tunnel, under the hill of Torregaveta. This hill is covered with the remains of a large villa, which is almost certainly that of Servilius Vatia, described by Seneca. There are remains of other villas on the shores of the lake. Oyster cultivation is carried on there and there is a hydrobiological station in the former royal casino on an island in the lake.

FUSE. Japanese city in Osaka prefecture, east of Osaka city of which it is essentially an industrial and residential satellite. Pop. (1955) 176,052. Cotton textiles and metal casting were locally important during the feudal period and provided the foundation for modern industrialization after rail lines were built to Osaka in 1914 and 1924. In addition to metals and machinery manufacturing, Fuse specializes in such consumer goods as textiles, celluloid toys, leather and rubber goods, medicinals and chemicals. (J. D. EE.)

FUSE (FUZE), an appliance for firing explosives in military shells, missiles, mines and bombs, in blasting operations, in fireworks and, in an entirely different form, to protect electrical circuits from the effects of overloads. *(See* BLASTING; AMMUNITION, ARTILLERY; FIREWORKS.)

The word is one of the forms in which the Latin *fusus* ("spindle") has been adapted into English, early forms of the military shell fuze having taken the form, ordinarily, of a spindlelike tube. Spelling of the word for detonation of explosives was originally with an "s." United States military forces found it desirable to adopt the "z" spelling to avoid confusion with the verb fuse, to melt by heat, or with the electrical fuse derived from the verb, or the fuse of blasting operations and fireworks.

In ammunition and other ordnance-type munitions, fuze denotes a device that causes the munitions to function under desired conditions. It regulates the final functioning of the munition, and should not be confused with either the primer or the firing pin which initiate launching of a rocket or artillery shell, nor with such items as a detonator or striker which are initiating components of a fuze.

Normally, a fuze has elements to set off the munition, to prevent its premature functioning and to cause it to perform only under predetermined conditions. These conditions determine the general type to which a fuze belongs, there being, broadly, five types: (1) impact fuze, which functions as it hits the target; (2) time fuze, which delays functioning for a certain period from a starting time; (3) command fuze, which acts upon some form of signal from a remote-control point; (4) proximity fuze, which functions when the munition carrying it approaches to within a given distance of the target; and (5) inferential fuze, which recognizes conditions leading to the inference that a target is nearby.

In blasting operations and in fireworks, the term fuse denotes a device employed to fire explosives from a distance or after a delay. Safety fuse is a hollow cord filled with a cpmposition resembling black powder and designed to propagate burning at a slow and steady rate. The far end of the fuse is usually crimped into a detonator *(q.v.)* embedded in the explosive charge. Instantaneous fuse, also called Cordeau and Primacord, is a hollow cord filled with powdered PETN (pentaerythritoltetranitrate). Fired by a detonator, it propagates detonation at a speed in excess of 6,000 m. per second and is capable of initiating the detonation of certain explosives.

In electrical engineering a fuse (always so spelled) is a safety device, commonly consisting of a strip or wire of easily fusible metal, which melts and thus interrupts the circuit of which it forms a part, whenever that circuit, through some accident or derangement, is caused to carry a current larger than that for which it is intended. In this sense the word derives from *fusus,* the past participle of Lat. *fundere* ("to pour") from which comes the verb fuse, to melt by heat. (F. D. McH.)

FUSELAGE, the central structure of an airplane (*q.v.*), connecting the wings with the tail surfaces, and containing the crew, passengers and sometimes the power plant and fuel. "Body" is in general use in a similar sense but includes also both the shorter nacelle of the airplane with "pusher" air screw, and the engine nacelle of the multiengine airplane.

There are two chief forms of fuselage construction. In one an underlying braced framework is used (formerly of wood and steel, now generally of metal throughout) with a covering of fabric, the latter kept in a "fair" shape by light supporting ribs. The other is on the lines of a boat, comprising a thin continuous skin with strengthening ribs, of wood or of metal throughout.

Such a scheme has the advantage that cross bulkheads are not essential, and is therefore convenient when large cabin space is required. In practice, however, the construction of the former can be made sufficiently free from obstructions, and is generally preferred on account of lightness. (W. S. F.)

FUSELI, HENRY (JOHANN HEINRICH FÜSSLI or FUESSLI) (1741–1825), Anglo-Swiss historical painter and author, one of the most exotic, original and sensual of painters, though not one of the greatest, was born at Zurich, Switz., on Feb. 7, 1741, the son of Johann Caspar Fussli, a court painter and town clerk. Educated at the Collegium Carolinum in Zurich he was influenced by J. J. Bodmer, but later as a theological student he fled together with his friend Johann Caspar Lavater as the result of a political publication. He traveled to Berlin and, on the recommendation of the British ambassador, to London in 1764. In 1765 he translated J. J. Winckelmann's *Reflections on the Painting and Sculpture of the Greeks* into English. He was encouraged by Sir Joshua Reynolds to become a painter and went to Italy, arriving in Rome in 1770. In Venice in 1772 fever affected his right hand. He sent his first work, "The Death of Cardinal Beaufort" (Liverpool), to the Royal Academy in 1774. During his stay in Rome he studied Michelangelo and the antique, and visited Naples in 1775. He left for Zurich in 1778, where he painted "The Oath on the Rutli," returned to London in 1779 and painted "The Nightmare" in 1781. In 1788 he was elected associate of the Royal Academy. becoming a member two years later. He contributed nine pictures for John Boydell's Shakespeare gallery. His own Milton gallery of 40 large paintings, opened in 1799, was only moderately successful. During 1799–1805 he was professor of painting at the Royal Academy. In 1801 the first of his *Lectures on Painting* were published, showing his continued admiration for the heroic and for Michelangelo. He was elected keeper of the Royal Academy in 1804 and edited Matthew Pilkington's *A Dictionary of Painters* in 1805, and wrote the introduction for William Blake's edition of R. Blair's *The Crave*. Although he said, "Blake is damned good to steal from," he introduced the younger artist to Joseph Johnson, his only commercial publisher. In 1810 he was re-elected professor at the Royal Academy. His pupils included Sir Thomas Lawrence, Sir David Wilkie, William Etty, W. Mulready, B. R. Haydon, Sir Charles Eastlake and Sir Edwin Landseer, his "little dog-boy." He died on April 16, 1825, at Putney Hill, and is buried in St. Paul's cathedral.

His diminutive size and bitter wit made him one of the best-known figures in London artistic life. His mannered drawings of elongated women and dreamlike paintings had and still have an influence on European imaginative painting.

BIBLIOGRAPHY.—Life by John Knowles, prefixed to the collected *Works* (1831); Eudo C. Mason (ed.), *The Mind of Henry Fuseli* (1951); Nicolas Powell, *The Drawings of Henry Fuseli* (1951); Frederick Antal, *Fuseli Studies* (1956). (C. N. P. P.)

FUSEL OIL, the term applied to the mixture of volatile, oily liquids of characteristic odour and taste produced during alcoholic fermentation processes.

The fusel oil alcohols and their esters find wide use as specialty solvents and plasticizers in the lacquer, plastic coating and pharmaceutical industries.

In industrial alcohol plants, fusel oil alcohols and ethyl alcohol are recovered from the fermented liquors and separated from each other by complicated distillation processes. Very little fusel oil is recovered by the beverage industry. In small doses fusel oil alcohols cause thirst and headache. In larger doses they are convulsive poisons.

The amount produced is comparatively small and is dependent on the raw materials used and the conditions of fermentation. The gallons of fusel oil produced per 1,000 gal. of ethyl alcohol for the principal fermentation raw materials are: blackstrap molasses 4–5; evaporated cane juice 1–2; corn 4–5; degerminated corn 2.5–3.0; wheat 2–3; rye 2–4; potatoes 5–11; sulfite liquor 2–3.

Fusel oil is a mixture of n-amyl, active amyl, isoamyl, isopropyl, *n*-propyl, *n*-butyl and isobutyl alcohols with traces of various esters. As indicated by the table the percentage composition varies with the raw materials used.

A typical fusel oil will contain 60%–70% of amyl alcohols, the remainder being lower alcohols, primarily *n*-propyl and isobutyl alcohol. Distribution of the amyl alcohols present is approximately 80%–85% isoamyl alcohol, 10%–15% active amyl alcohol, with

Constituent	Corn	Molasses	Potatoes	Rye
Isopropyl alcohol	—	0.6	—	—
n-Propyl alcohol	20.4—11.7	24.3	6.85	—
Isobutyl alcohol	23.9—12.2	7.4	24.35	15.7
n-Butyl alcohol	—	8.1	—	—
d-Amyl alcohol	14.6—23.4	55.3	68.76	77.8
Isoamyl akohol	36.3—59.7	—	—	—
n-Amyl alcohol	—	4.3	—	—
Undetermined	4.8— 3.0	—	0.04	6.5

perhaps a trace of n-amyl alcohol.

Unlike ethyl alcohol the fusel oil alcohols do not seem to be produced by the action of the yeast enzyme zymase on glucose, but rather by its action on the protein impurities and protein decomposition products (amino acids) present in the fermentation liquors. (D. G. Z.)

FUSIBLE ALLOYS, which generally are composed of bismuth, lead and tin, possess the property of melting at comparatively low temperatures, below the melting point of tin. They are used as soft solders and for safety plugs in boilers, oxygen tanks, sprinkler systems, etc. Newton's fusible alloy (named after Sir Isaac Newton) contains 50 parts of bismuth, 31.25 of lead and 18.75 of tin; that of Jean Darcet (1725–1801), 50 parts of bismuth with 25 each of lead and tin; and that of Valentin Rose the elder (1736–71), 50 of bismuth with 28.1 of lead and 24.1 of tin. These melt between 91° and 95° C. Mercury also is sometimes used as an ingredient. The addition of cadmium gives still greater fusibility; in Wood's metal, for instance, which is Darcet's alloy with half the tin replaced by cadmium, the melting point is lowered to 66°–71° C.; while another alloy containing 15 parts of bismuth, 8 of lead, 4 of tin and 3 of cadmium softens at about 55° and is completely liquid a little above 60°. By the addition of mercury to Darcet's alloy the melting point may be reduced as low as 45°.

These fusible alloys have the peculiarity of expanding as they cool; Rose's alloy, for instance, remains pasty for a considerable range of temperature below its fusing point, contracts somewhat rapidly from 80° to 55°, expands from 55° to 35°, and contracts again from 35° to 0°. For this reason they may be used for taking casts of anatomical specimens, making impressions of woodcuts, etc., the expansion on cooling securing sharp impressions.

By suitable modification in the proportions of the components, a series of alloys can be made which melt at various temperatures above the boiling point of water; for example, with eight parts of bismuth, eight of lead and three of tin the melting point is 123°, and with eight of bismuth, 30 of lead and 24 of tin it is 172°. With tin and lead only in equal proportions it is 241°. Such alloys are used for making the fusible plugs inserted in the furnace crowns of steam boilers, as a safeguard in the event of the water level being allowed to fall too low. When this happens the plug, being no longer covered with water, is heated to such a temperature that it melts and allows the contents of the boiler to escape into the furnace. In automatic fire sprinklers the orifices of the pipes are closed with fusible alloys which melt and liberate the water when an outbreak of fire in the room raises the temperature above a predetermined limit.

FUSION. In business and finance, fusion is a term signifying a complete combination of several concerns into one. Fusion is accomplished by two methods, by merger and by consolidation. When the fusion of two or more business organizations takes place by merger one of them absorbs the other or others, maintaining its own corporate existence under its own charter (amended if necessary), and taking either its own name or that of one of the concerns absorbed. All of the concerns to a merger which are absorbed into the remaining one give up their charters and corporate existence.

When fusion by consolidation takes place two or more companies organize a new company, transfer to it all of their assets, and then dissolve their own respective organizations. In popular usage the terms fusion, merger, consolidation, and several others are often confused and used incorrectly. Fusion is the general term embracing both mergers and consolidations. If companies *A*, *B* and *C* fuse by merger, two of them, let us say B and C, will go out of existence and all of their assets will go to build up the enlarged company *A*. If, however, companies X, Y and *Z* are to be consolidated, all of them will go out of existence and their assets will go to form the new company under a new charter.

For Fusion in Physics see HEAT.

FUST, JOHANN (c. 1400–1466), early German printer, belonged to a rich and respectable burgher family of Mainz, which is known to have flourished from 1423, and to have held many civil and religious offices. Johann Fust appears to have been a money-lender or banker. He advanced money to Gutenberg (apparently 800 guilders in 1450, and another 800 in 1452) for carrying on his experiments in printing, and, in 1455, brought a suit against Gutenberg to recover the money he had lent, claiming 2,020 (more correctly 2,026) guilders for principal and interest. It appears that he had not paid in the 300 guilders a year which he had undertaken to furnish for expenses, wages, etc., and, according to Gutenberg, had said that he had no intention of claiming interest. The suit was apparently decided in Fust's favour, Nov. 6, 1455, in the refectory of the Barefooted Friars of Mainz, when Fust made oath that he himself had borrowed 1,550 guilders and given them to Gutenberg. The 42-line Bible known as Gutenberg's, of which the Mazarin library copy bears the date of 1456, is thought by a preponderance of bibliographers to have been printed by Fust and Peter Schöffer, of Gernsheim, who is known to have been a scriptor at Paris in 1449. To him, probably about 1455, Fust gave his only daughter, Dyna or Christina, in marriage. Their first certain publication was the Psalter, Aug. 14, 1457, a folio of 350 pages, the first printed book with a complete date, and remarkable for the beauty of the large initials printed each in two colours, red and blue, from types made in two pieces. The Psalter was reprinted with the same types, 1549 (Aug. 29), 1490, 1502 (Schoffer's last publication) and 1516. In addition to the works already mentioned Fust and Schöffer printed: Durandus, *Rationale divinorum officiorum* (1459), folio, 160 leaves; the *Clementine* Constitutions, with the gloss of Johannes Andreae (1460), 51 leaves; *Biblia* Sacra *Latina* (1462), folio, 2 vols., 242 and 239 leaves, 48 lines to a full page; the Sixth Book of Decretals, with Andreae's gloss, Dec. 17, 1465, folio, 141 leaves; Cicero, *De officiis* (1465), 4to, 88 leaves, the first edition of a Latin classic and the first book containing Greek characters, while in the colophon Fust for the first time calls Schoffer "puerum suum"; the same, Feb. 4, 1466; *Grammatica rhytmica* (1466), folio, 11 leaves. They also printed in 1461–62 several papal bulls, proclamations of Adolf of Nassau, etc.

Fust is said to have gone to Paris in 1466 and to have died of the plague which raged there in August and September. He was formerly often confused with the famous magician Dr. Johann Faust, who, though an historical figure, had nothing to do with him (*see* FAUST).

See the articles GUTENBERG, JOHANN and TYPOGRAPHY.

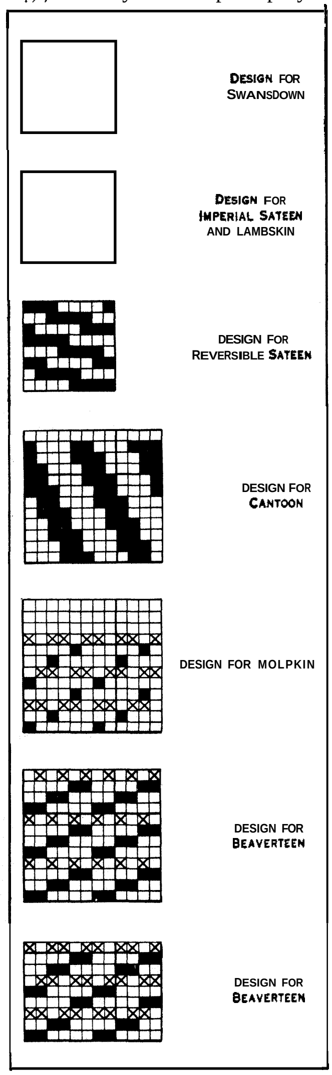
FUSTEL DE COULANGES, NUMA DENIS (1830–1889), French historian, was the originator of the scientific approach to the study of history in France. He was born in Paris on March 18, 1830, of Breton descent. After studying at the

École Normale Supérieure he was sent to the French school at Athens in 1853, directed some excavations at Chios and wrote a historical account of the island. From 1860 to 1870 he was professor of history at the faculty of letters at Strasbourg, where he had a brilliant career as a teacher. Subsequent appointments included a lectureship at the École Normale Supérieure in Feb. 1870. a professorship at the Paris faculty of letters in 1875, the chair of medieval history at the Sorbonne in 1878 and the directorship of the École Normale in 1880. He died at Massy, Seine-et-Oise, on Sept. 12, 1889.

Fustel's historical thought had two main tenets: the importance of complete objectivity and the unreliability of secondary sources. By his teaching and example he thus established the modern idea of historical impartiality at a time when most French historians wrote like Chateaubriand and when few had any qualms about combining the careers of historian and politician, and his insistence on the use of contemporary documents led to the very full use of the French national archives in the 19th century. Fustel. however, was no paleographer and his fondness for manuscript sources was occasionally responsible for major errors of judgment. His work has long been superseded, but his influence on the development of historical studies in France will endure.

Apart from *La Cite' antique* (1864), a study of the part played by religion in the political and social evolution of Greece and Rome, most of Fustel's work was related to the study of the political institutions of ancient France and of the Germanic invasions under the Roman empire. The first volume of the *Histoire des institutions politiques de l'ancienne France* appeared in 1875; it was subsequently recast and published in three volumes: *La Gaule romaine* (1891); *L'Invasion Germanique et la fin de l'empire* (1891); and *La Monarchie franque* (1888), to which were added *L'Alleu et le domaine rural pendant l'e'poque mérovingienne* (1889); *Les Origines du système fe'odal: le bénéfice et le patronat* (1890); and *Les Transformations de la royauté pendant l'époque carolingienne* (1892).

See J. M. Tourneur-Aumont, *Fustel de Coulanges, 1830–1889* (1931); J. Herrick, *The Historical Thought of Fustel de Coulanges* (1954). (B. J. R.)



FIGS. 1 TO 7.—FUSTIAN DESIGNS

FUSTIAN, a technical term descriptive of an important class of cotton fabrics comprising several distinctive types and varieties of which moleskin, corduroy, and velveteen are the three principal types. Each of these types also comprises various modifications in respect of the minor details of their construction, such as beaverteen, cantoon or diagonal. imperial sateen or swansdown, lambskin and other varieties. Fustian fabrics, with the exception of swansdown and velveteen, are firm and compact textures of great strength and durability, adapted for hard wear and chiefly employed in the production of clothing for both sexes. These characteristics are obtained by employing warp threads usually of folded yarn and of great strength, in combination with a relatively high rate of picks per inch, of soft-spun single weft.

The simplest varieties of fustian fabrics are those known as imperials, comprising swansdown, lambskin and reversible sateen, of which the designs showing the weave structures are given in figs. 1, 2 and 3 respectively.

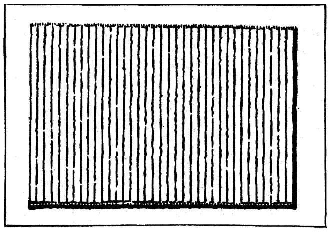


FIG. 8.—FINE-RIBBED THICKSET CORDUROY FABRIC WOVEN FROM DESIGN IN FIG. 9

Swansdown.—Swansdown is based on the five-end weft face satin weave, but with two contiguous warp threads raised together, instead of singly, as indicated in tne design, fig. 1. After weaving, these fabrics are submitted to an operation of perching or raising, in order to develop on the face side of the fabric a soft furry nap or down which characterizes a swansdown fabric and gives it additional warming properties suitable for underclothing and night attire. One quality of swansdown contains 60 warp threads per inch, of 18s T., and 120 picks per inch, of 20s soft weft of good quality to develop a good nap.

Imperial Sateen.—Imperial sateen is virtually swansdown of stronger and heavier texture and based on the eight-end weft face satin weave structure, but with two contiguous warp threads raised together, as indicated in the design, fig. 2. This weave produces relatively longer weft floats and permits of a greater density of picks being inserted in the fabric. When perched on the face side, imperial sateen is sold as lambskin, from the long, soft and woolly nap. It is also sometimes dyed and finished to imitate a light texture of moleskin. A good quality of lambskin contains 46 warp ends of 2/20s, and 450 picks of 20s weft, per inch; while a medium quality of dyed imperial sateen contains 68 warp ends of 16s T. and 150 picks of 16s weft, per inch.

Reversible imperial is a variation of imperial sateen simply by floating the weft equally on both sides of the fabric, as indicated in the design, fig. 3, showing the weave structure of this variety of which a good quality contains 62 warp ends of 14s T. and 330 picks of 30s weft, per inch.

Cantoon.—cantoon or diagonal is a strong and compact texture produced with fine diagonal cords or ribs of twill running at a low angle of about 18°, and based on the twill weave structure indicated in fig. 4. It is usually dyed a fawn or a drab hue, perched on the back, and largely employed for men's and ladies' riding and sporting habits. A good quality of cantoon contains 54 warp ends of 2/20s, and 400 picks of zos weft, per inch.

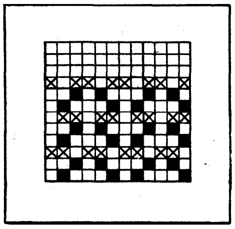


FIG. 9—DESIGN FOR FINE-RIBBED CORDUROY FABRIC

Shown in Fig. 8, containing two pile picks to one back pick

Moleskin.—Moleskin is a thicker, stronger, and heavier texture than other varieties of fustian and is more suitable for men's clothing requiring very hard wear and durable qualities, and especially for rough occupations as iron and brass moulding, navvying, and similar work. Moleskin is a semicompound texture consisting of one series of warp threads and two series of weft, viz., face picks and back picks (of the same kind of weft) inserted in the ratio of two face picks to one back pick, uniformly, as indicated in fig. 5, showing a design tor a moleskin fabric which is virtually a stronger and heavier texture of uncut velveteen (*q.v.*), as described in a separate article. A moleskin of good quality contains 38 warp ends of 3/34s and 400 picks of 14s weft, per inch.

Beaverteen is virtually a light texture of moleskin which, after weaving, is dyed, printed, and perched on the back to produce a short nap. Two designs for beaverteen are given in figs. 6 and 7. The design fig. 6 will produce what is practically a tabby back beaverteen, with three face picks to one back pick; while the design fig. 7, will produce a fabric with two face picks to one back pick, and a three-end weft twill back which is better for perching. A good quality of beaverteen contains 32 warp ends of 2/18s, and 280 picks of 18s weft, per inch.

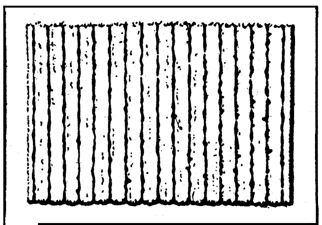


FIG. 10.—CORDUROY FABRIC WITH WIDE RIBS, WOVEN FROM THE DESIGN IN FIG. 11

Corduroy and Velveteen.—Unlike other varieties of fustian fabrics, corduroy and velveteen are characterized by having a short plush or velvet weft pile formed on the face of the fabric. In corduroy, the pile is formed in a series of more or less crowned ribs or cords of uniform width extending lengthwise of the fabric, in the direction of warp threads; while in velveteen, the pile forms an even and level surface. In both of these types of fabric the pile surface is developed subsequent to weaving, by submitting the cloth to an operation of fustian cutting in which the face or pile picks of weft are severed, either manually or mechanically, by means of special knife blades or circular discs, thereby causing the severed weft threads to assume a vertical position and thus constitute the tufts of pile which characterize these fabrics.

Corduroy fabrics consist of a foundation texture based on the three-end or four-end twill or other simple weave structure that will ensure sufficient stability in the fabric. The cords are usually of uniform width, and sometimes of different width, in the same fabric. When the cords are of uniform width, they are formed at regular intervals ranging from three to 16 or 20 warp threads, uniformly, chiefly according to the width of cords required and the style of clothing for which the fabric is intended, as, for example, suits for artisans, or for sporting and riding suits for both men and women.

Corduroy fabrics are produced in a variety of different textures, styles and qualities, according to the special purpose for which they are intended. The simplest variety, and one of the neatest styles employed for boys' and men's clothing is commonly termed thickset corduroy of which an example is illustrated in fig. 8. This fabric is constructed with two pile picks to one back pick, uniformly, in accordance with the design shown in fig. 9, which is for a corduroy fabric formed with a three-end twill back, though it may be formed with a tabby back. The cords in this example recur on the smallest possible number of warp threads, viz., three, with two cords constituting one repeat of the design which, therefore, repeats on six warp threads, as indicated. A corduroy fabric constructed with much wider and bolder cords is illustrated in fig. 10, of which the design is given in fig. 11. This example is based on the four-end 2 x 2 twill foundation texture. with two pile nicks to one hack pick, and with the cords recurring at regular intervals of eight warp threads, uniformly, as indicated in the design. Corduroy fabrics comprise many other modifications of structure both in respect of their foundation textures and also in the particular manner of intersecting the pile picks with the stitching or binding warp threads that form the cuttings or furrows between the cords: hut the two examples here given will serve to indicate the general principle of their construction. See also the article VELVETEEN.

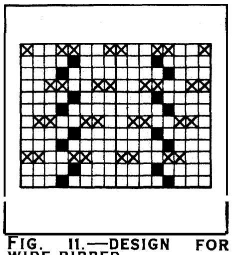


FIG. 11.—DESIGN FOR WIDE-RIBBED CORDUROY FABRIC, SHOWN IN FIG. 10, CONTAINING TWO PILE PICKS TO ONE BACK PICK

See H. Nisbet, *Grammar of* Textile *Design* (1927). (H. N.)

FUSTIC, YELLOWWOOD or **OLD FUSTIC,** is the wood of a large tree (*Chlorophora tinctoria*) of the mulberry family (Moraceae, *q.v.*) growing in the West Indies and tropical America. The best quality comes from Cuba and the poorer from Jamaica and Brazil. It is still employed in the form of extract for wool dyeing. mainly in conjunction with other dyewoods, for the production of browns, olives and compound colours, and for deadening the shade of blacks. The mordant mainly in use is bichromate of potash, and the olive yellow thus obtained is fairly fast to light. In other respects, the dyeing properties of this wood closely resemble those of quercitron bark. It contains two colouring matters, morin and maclurin, of which the former is the more important. The dyestuff termed young fustic, or zante fustic and Venetian sumach, is the wood of the smoke tree (*Rhus Cotinus*), a southern European and Asiatic shrub of the Cashew family (Xnacardiaceae). (A. G. P.)

FUTURE FARMERS OF AMERICA is the national organization of boys studying vocational agriculture in the public secondary schools under provisions of the national vocational education (Smith-Hughes) acts. Organized in 1928, it serves to motivate and vitalize the systematic instruction offered to students of vocational agriculture, and to provide further training in farmer-citizenship. It is a nonprofit, nonpolitical, farm youth organization of voluntary membership with dues of ten cents per member per year. The motto of the organization is:

"Learning to do
Doing to learn
Earning to live
Living to serve"

There are four grades 'or degrees of active membership: "Green Hand," "Chapter Farmer," "State Farmer" and "American Farmer." The first two of these grades or degrees are under the control of the local chapters. The state FFA organizations specify the requirements for "State Farmer" membership and the national FFA determines the requirements for the "American Farmer" title. In addition to the youthful officers of the local, state and national FFA organizations, teachers of vocational agriculture serve as local chapter advisers. and state and national supervisors of agricultural education serve as state and national advisers. The executive secretary and the treasurer of the FFA are adults, officials in national vocational agricultural education. The national adviser is the chief of the agricultural education service of the U.S. office of education.

Programs of work participated in by all members are set up annually by most chapters, each state association and the national organization. All FFA activities are boy-initiated and boy-directed. Local chapters often engage in crop and animal husbandry projects to supplement their class work. In many cases the crops and animals raised are sold at community auctions with financial benefits both to the individual members and to the treasury of the local group. In some cases FFA products are exhibited at local fairs.

An official statement of specific aims and purposes of the FFA lists twelve specific purposes as follows:

"1. To develop competent, aggressive, rural and agricultural leadership.
2. To create and nurture a love of country life.
3. To strengthen the confidence of farm boys and young men in themselves and their work.
4. To create more interest in the intelligent choice of farming occupations.
5. To encourage members in the development of individual farming programs and establishment in farming.
6. To encourage members to improve the farm home and its surroundings.
7. To participate in wotthy undertakings for the improvement of agriculture.
8. To develop character, train for useful citizenship and foster patriotism.
9. To participate in cooperative effort.
10. To encourage and practice thrift.
11. To encourage improvement in scholarship.
12. To provide and encourage the development of organized rural recreational activities."

National headquarters of the Future Farmers of America is located in the agricultural education service; United States office of education. National conventions are held annually in Kansas City, Mo., at the time of the American Royal Livestock show.

See also RCRAL EDUCATION. (W. W. Wx.)

FUTURES, contracts which consist of a promise to deliver specified quantities of some commodity. foreign exchange, etc., at a specified future time. The obligation is usually for a single quantity in a given month; *e.g.,* 10,000 bu. of, wheat in May. Futures are thus a form of security, analogous to a bond or promissory note. They are traded like any other security. and may be bought and sold many times before the date of maturity. In a competitive market their price is determined. like any other, at the level where the quantity demanded is equal to the quantity supplied. If a contract to deliver 10,000 bu. of wheat in May is sold for $9,000, the price of "May wheat" is said to be 90 cents per bushel. The price of futures depends mainly on the expected future course of their prices. and on the expected "spot" price (*i.e.,* the price of the commodity in current transactions) at the date of maturity of the contract. Thus if the price of "May wheat" in December is high, this indicates a general expectation that wheat will be scarce and its spot price high in May. There is no necessary limit to the extent by which the spot price can exceed the futures price. There is, however, a limit on the extent to which the futures price can exceed the spot price. as commodities can be held for sale at a future date. Thus if it costs 5 cents per bushel to carry wheat from December to May, and if in December the spot price is 90 cents and the futures price $1.05 per bushel, an operator by buying spot wheat and selling May futures in December, and fulfilling his futures contract by delivering in May the wheat bought in December, would make a profit of 10 cents per bushel. The prospect of these profits would bring a rush of buyers into the December spot market, raising the price there, and a rush of sellers into the May futures market, lowering the price there. and the difference between the two prices would soon fall to 5 cents or less.

The main justification of the futures contract is that it permits specialization between two elements of the economic process—the function of holding commodities (or other assets) and the function of bearing the risk of price changes. Without the futures contract anyone who held stocks of goods in the course of business would have to take the risk of changes in the price of these goods. By selling futures that mature in the month when he expects to sell his stock, the holder removes from his calculations any uncertainty about the future price of the goods at the time when he expects to sell them. Thus if a grain dealer has in October a stock of 5,000 bu. of wheat that he expects to sell in December, he can sell 5,000 bu. of "December futures"—*i e.,* he enters into a contract to deliver 5,000 bu. in December at a price fixed in October. This is the simplest form of the operation known as "hedging." It may be used by anyone who in the regular course of his business finds himself obliged to hold stocks of-goods, and who wishes to avoid speculation as to changes in the price of this stock. On the other hand the speculator who buys futures, in the hope of selling them later at a profit, or of buying spot at a lower price when the contract matures, is enabled to speculate on price changes without the burden oi holding title to the commodity.

Although hedging makes the future price certain, it is not necessarily advantageous. If the "hedger" thinks that the spot price in December mill be so much higher than the current price of December futures, that the risk of this expectation not being fulfilled is worth taking, he will not hedge but will simply hold his stock for sale at the spot price. The lower the futures price relative to the anticipated spot price, the greater is the premium paid for insurance against price changes, and the less advantageous it is to hedge.

With the abandonment of the international gold standard in 1931, and the subsequent wide fluctuations in foreign exchange rates, the futures, or "forward market" in ioreign exchange became an important part of the mechanism of international trade. As before, it resulted in a specialization between "traders" and "speculators," with possible advantage to both. (K. E. B.)

FUTURISM: *see* PAINTING; POST-IMPRESSIONISM.

FUX, JOHANN JOSEPH (1660–1741), Austrian musician, was born at Hirtenfeld. Styria. In 1696 he was organist at one of the principal churches of Vienna, and in 1698 was appointed by the emperor Leopold I as his "imperial court-composer," with a salary of about £6 a month. At the court of Leopold and of his successors Joseph I and Charles VI, Fux remained for the rest of his life. To his various court dignities that of organist at St. Stephen's cathedral was added in 1704. Fux died at Vienna on Feb. 14, 1741. The 18 operas which Fux wrote do not differ essentially from the style of the Italian *opera seria* of the time. Oi greater importance are his sacred compositions, psalms, motets, oratorios and masses, among the latter the celebrated *Missa canonica* which is written in canon throughout. As a contrapuntist and musical scholar generally, Fux was unsurpassed by any of his contemporaries, and his great theoretical work, the *Gradus ad Parnassum* (Vienna. 1725), written in Latin, long remained by far the most thorough treatment of counterpoint and its various developments.

FUZULI (d. 1556), Turkish poet, is the outstanding figure in the classical school of Turkish literature. Very little is known of his life. His real name was Mohammed bin Suleyman and, probably born at Hilla, he never left Iraq. When in 1534 Suleiman the Magnificent conquered Baghdad, Fuzuli presented a *kaside* (congratulatory poem) to him. He received little favour, however, and he never seems to have achieved the status of the court poets of Istanbul. His famous *Shikeyetname* ("Complaint") sarcastically comments upon his failure to receive even the small pension granted to him. Victim of a plague, he is buried at Kerbela. Although born in an Azeri Turkish-speaking area and himself writing in this dialect, he studied also early Ottoman poets, particularly the great Chagatai poet Nevai, and achieved a synthesis of all these influences and the Persian classics, soon becoming recognized as the great poet of the Turkish world. There is a pervading strain of melancholy in his work. This is very evident in his romance of the unhappy love of *Leyla and Mecnun,* a story well known in Moslem literature, which is imbued with mystic passion and contains some of his best poetry. His *Divan* (book of collected poems) contains most of his other works. Fuzuli's intense sincerity overcomes the restrictive clichés of conventional literary forms and communicates to the reader the poet's own emotion.

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FYN or FÜNEN, one of the larger Danish islands, second in size to Zealand (Själland) lying between that island and south Jutland. Area, 1,151 sq.mi. Its physical features are similar to those of eastern Jutland. Pop. (1955) 366,323. *(See* DENMARK.)

FYRD, the name given to the English militia during the Anglo-Saxon period *(see* MILITIA). In early times the ealdorman of the shire was probably charged with the duty of calling out and leading the fyrd, which appears always to have retained a local character, as during the time of the Danish invasions we read of the fyrd of Kent, of Somerset and of Devon. It is probable that originally all free landholders were required to attend the fyrd. and exemption from this duty was only very sparingly granted. The fyrd was gradually superseded by the gathering of the thegns and their retainers. but it was occasionally called out for defensive purposes even after the Norman Conquest.

FYT, JAN (1611?–1661), Flemish painter of animals, was horn at Antwerp. He was registered apprentice to Hans van den Berghe in 1621. At 20, young Fyt entered the gild of St. Luke as a master, and from that time until his death in 1661 he produced a vast number of pictures in which the bold facility of Snyders is united to the powerful effects of Rembrandt. There never was such a master of technical processes as Fyt in the rendering of animal life in its most varied forms. He was not clever at figures. and he sometimes trusted for these to the co-operation of Cornelius Schut or Willeborts, while his architectural backgrounds were sometimes executed by Quellyn. "Silenus amongst Fruit and Flowers," "Diana and her Nymphs with the Produce of the Chase." and "Dead Game and Fruit in front of a Triumphal Arch" are specimens of the co-operation respectively of Schut, Willeborts and Quellyn. These pictures are also Eyt's masterpieces. The earliest dated work of the master is a cat grabbing at a piece of dead poultry near a hare and birds, and executed in 1644. The latest dated work of Fyt is a "Dead Snipe with Ducks," of 1660. Great power is shown in hunting scenes.

FYZABAD, properly FAIZABAD. a city, the headquarters of a tehsil. a district and division of Uttar Pradesh, India. The city, comprising the municipal area of Faizabad-cum-Ajodhya and cantonment. stands on the left bank of the Gogra river, 78 mi. by rail east of Lucknow. Pop. (1951) of city 76,582; of tehsil (355 sq.mi.) 366,577. To the east of Faizabad is the ancient site of Ajodhya (*q.v.*).

Faizabad was founded about 1730 by Sa'adat Ali Khan. It received its present name in the reign of his successor, and Shuja ud-Daulah. the third nawab, laid out a large town and fortified it. It was afterward the residence of the begums of Oudh. On the outbreak of the mutiny the officers of the Indian garrison were almost all murdered by their own troops.

Faizabad is the headquarters of a military subarea. There is a government college, the Shri Saket Mahavidyalaya college affiliated to Agra university. Sugar refining and trade in agricultural produce are important.

FAIZABAD DISTRICT, lying between the two great rivers Gogra and Gumti, has an area of 1,710 sq.mi. It is entirely alluvial and well wooded, and has a good climate. Pop. (1951) 1,481,796. Tanda, with a population in 1951 of 29,288, has the largest production of cotton goods in Oudh.

FAIZABAD DIVISION has an area of 12,069 sq.mi., and comprises the six districts of Faizabad, Gonda, Bahraich, Sultanpur, Partabgarh and Bara Banki. Pop. (1951) 8,362,713.

G THE history of this letter began with the Latin alphabet. The Greek alphabet from which, through Etruscan, the Latin was derived, represented the voiced velar stop by its third letter gamma Γ, < or C. This passed into Latin and was used in its rounded form C, to represent the same sound in early times, *e.g.,* in the word RECEI (probably an early dative form of rex, "king"), occurring in an early Latin inscription. The letter, however, came to represent the unvoiced velar stop, thus ousting K. This was probably due to Etruscan influence. To avoid confusion a new letter G was differentiated from C and used to represent the voiced velar, while C henceforward stood for the unvoiced velar only. The new letter was placed in the alphabet in the place of Greek Z (zeta) which was not required in the Latin alphabet. (See ALPHABET.)

The uncial form of the letter in the 6th and 7th centuries was ς or ς. The form with rounded head g, from which our minuscule g is derived, appears first in Latin cursive writing about the beginning of the 7th century taking the place of such earlier forms as ʃ. It was Standardized in Carolingian as g. The minuscule flat-headed form was adopted by Irish writing of the 6th and 7th centuries, *e.g.,* ʒ or ʒ. Such a form had been in use in Latin cursive, *e.g.,* ʒ (5th cent.), ʒ (late 7th cent.), ʒ (7th or 8th cent.). A form ʒ appears in Merovingian (pre-Carolingian French) writing in the 8th century, and a descendant of this was adopted into the Carolingian hand, not being entirely ousted by the round-headed form till the 11th century.

The flat-headed form was adopted by the early English hand from the Irish and remained the only form of the letter in use in England until introduction of Carolingian writing by Norman scribes in the 12th century. Meanwhile certain changes had taken place in the sound represented by the letter. The voiced velar had become palatalized before the front vowels e and i. Thus the flat-headed form of the letter, the only form in use in pre-Norman England, represented the velar before back vowels, the palatal before front vowels. It also stood for the sound now represented by y initially before front vowels. In Middle English the palatal stop developed into the sound now represented by j, a similar change having taken place in the development of the Latin velar on the continent. This sound was therefore introduced to English ears by the Normans, and in the Middle English period we find the two forms of the minuscule letter in use to represent different sounds. g represented the voiced velar (modern "hard" g) and the sound of *j*, ʒ represented the palatal stop (y) and the sound of y. As the palatal stop (in such words as might, high, enough, etc.) disappeared from the language, the use of the flat-headed form was discontinued. It survived in remote parts, and by its similarity to the form of *z* produced confusion with the latter.

In modem English the letter represents two sounds: (1) the voiced velar; (2) the sound of j (dž) before the vowels e, *i* and y

NAME OF FORM	APPROXIMATE DATE	FORM OF LETTER
PHOENICIAN	B.C. 1,290	˥
CRETAN	1,100-900	Λ
THERAEAN	700-600	7, 1
ARCHAIC LATIN	700-500	(G)
ATTIC	600	Λ
CORINTHIAN	600	>)
CHALCIDIAN	600	<
IONIC	403	1
ROMAN COLONIAL	PRE-CLASSICAL AND CLASSICAL TIMES	(G
URBAN ROMAN		G
FALISCAN		>
OSCAN		>
UMBRIAN		(K)
CLASSICAL LATIN AND ONWARDS		G

THE DEVELOPMENT OF THE LETTER "G" FROM THE PHOENICIAN. THROUGH THE LATIN DOWN TO MODERN FORM

in words of Romance origin—gesture, ginger, gymnastics (contrast give, gilt). The combination gh often has the sound of f (as in cough, rough, laugh), yet not consistently, for in some words it is silent (ought, though, through). (B. F. C. A.; J. W. P.)

In music, G is the name of the seventh note of the musical alphabet or otherwise the fifth note of the scale of C. It gives its name also to the treble (or violin) clef, the distinguishing sign of which denotes the G line. To which it may be added that the said sign itself was originally nothing but a capital G which in the course of time has come to assume, as the result of various changes of shape, the conventionalized form with which we are now familiar.

GA'ALIIN, see ARABS.

GABARDINE, the term applied in the cloth trade originally to a particular type of waterproofed fabric employed for the manufacture of raincoats, but later as a general description of several varieties of worsted, cotton, silk and union or mixture fabrics, embodying certain features in common and chiefly made into suits and overcoat's. It is a relatively strong and firm cloth somewhat resembling whipcord, but of lighter texture.

Covert coating fabrics are virtually gabardines of a lighter texture suitable for summer wear and for use in hot climates.

Because of the predominance of warp over weft threads in gabardine fabrics, the weft lies entirely at the back and is therefore not visible from the front, a circumstance which allows the use of weft of inferior quality without loss of durability, for only the warp surface is exposed to wear.

Although all varieties of gabardine fabrics have the same general textural appearance; they vary considerably in respect to the particular twill weave and in the character. quality and counts of material employed in their construction, as well as in the number of warp threads and picks of weft per inch in the fabric.

Some gabardine fabrics are produced entirely from cotton yarn. The better qualities of these are made from super-grades of combed twofold warp and weft, while those of coarser texture and inferior quality are made from single yarn both for warp and weft.

A so-called "voile gabardine" fabric of a more open and much lighter texture is produced entirely of silk. (H. N.; X.)

GABBRO, in petrology, is a group name for medium- or coarse-grained rocks consisting primarily of calcic plagioclase feldspar and pyroxene (*qq.v.*); essentially gabbro is the plutonic equivalent of basalt. The word is of Florentine origin but unknown etymology. Xlthough basalt is often remarkably homogeneous in mineralogy and composition over vast areas, the gabbros are exceedingly variable. Gabbroic complexes may include sizable masses consisting almost entirely of plagioclase (anorthosite); of pyroxene and olivine (peridotite); of pyroxene alone (pyroxenite, hyperite); of pyroxene and plagioclase (norite). Banded or layered complexes in which these and other mono- or bimineral varieties (dunite, troctolite, etc.) are well developed have been described from Montana, the Bushveld in South Africa and the island of Skye. There are also gabbro complexes which, while locally streaky and inhomogenous, are not regularly layered. Among these may be cited the great Sudbury, Ont., basinlike intrusion or lopolith and some of the larger diabase sills, like those of Beaver Bay, Minn., the Palisades, N.J., and many of the Karoo diabases in South Africa. (For a brief description of lopoliths, sills and other forms *see* the article SILLS.)

Prominent among the unlayered gabbro complexes are the so-called "massive" anorthosites, rocks consisting largely or entirely of plagioclase, exemplified by the famous Adirondack anorthosite, the Laramie, Wyo., complex and the anorthosites of eastern Quebec.

Gabbros and anorthosites are considerably less abundant than either basalt or granite, but the complexes in which they occur are nevertheless often of immense size. About 60,000 sq.mi. of eastern Canada is underlain by anorthosite, for instance, the Saguenay mass alone accounting for a tenth of this. The Morin anorthosite in the same area occupies 1,000 sq.mi. and the nearby Adirondack anorthosite is exposed over an area of about 1,500 sq.mi. The Bushveld complex underlies an area of about 20.000 sq.mi. and the Great Dyke of Rhodesia, another layered complex, has been traced for more than 300 mi.

Although these large masses are generally supposed to provide the best sample of the deep lithosphere, they often appear to be floored over most of their outcrop area; they are usually laccoliths, lopoliths or sills. The Canadian anorthosites are thought to be laccolithic, the Adirondack anorthosite a floored sheet. The thickness of the Sudbury lopolith is estimated at two miles, that of the Bushveld at three miles.

Gabbros are sometimes quarried for dimension stone (the "black granite" of commerce) and the San Marcos gabbro of southern California is used for gauge blocks, but the direct economic value of gabbro is slight. Far more important are the primary mineralizations of nickel, chromium and platinum, which occur almost exclusively in association with gabbroic or related ultrabasic rocks. Primary magnetite (iron) and ilmenite (titanium) mineralizations are often intimately associated with gabbroic complexes.

Origin and Composition. — In the layered gabbroic complexes it is rather generally assumed that segregation is attributable to some form of rhythmic or oscillatory crystal fractionation of basaltic magma under gravity control. Xlthough there is much incidental laboratory support for the notion that any one of these varieties could crystallize from a magma of approximately basaltic composition, the notion that they in fact do so is substantially an *ad hoc* hypothesis, and the details of the process, particularly as regards the rhythmic or oscillatory nature of the fractionation, are vague. In the gabbro complexes that are not regularly layered, the passage between different members of a complex tends to be gradational rather than discontinuous, as in the layered variety. Interstitial micropegmatite, practically unknown in the sharply layered complexes, is common in these, in which it is not infrequently concentrated in rather irregularly bounded zones: seams or pods. Sometimes considered to be of hydrothermal origin, it is more often regarded as an end-stage derivative of crystal fractionation. At Pigeon point (Minn.), Beaver Bay, Sudbury and Duluth (Minn.) the micropegmatite occurs in masses large enough to collect and, sometimes, large enough to map. Field associations of this kind, together with much laboratory evidence based on phase equilibria, led to N. Bowen's hypothesis of the origin of granitic magma by crystal fractionation of basaltic magma. *(See* GEOCHEMISTRY: *Geochemistry of the Lithosphere: The Reaction Series).*

The plagioclase of the anorthosite members of layered complexes is ordinarily labradorite or bytownite but, in the absence of layering, plagioclase more basic than calcic andesine is uncommon. Anorthosite dikes are very rare, and effusive equivalents of anorthosite are unknown. The massive anorthosites, like the layered ones, are probably crystal accumulates: as suggested by Bowen, though the scale at which the process takes place must be staggering.

The Duluth lopolith is a notable exception to the rather arbitrary dichotomy between layered and unlayered gabbro complexes. The lower part of this mass has the average composition of an olivine gabbro but is strongly banded, individual bands varying in composition from anorthosite to peridotite. The upper portion is a comparatively homogeneous feldspathic gabbro, locally patchy and streaky but not sharply banded. Between the two major divisions, and again at the top of the feldspathic gabbro, is a zone of so-called "red rock," granophyre or micropegmatitic granite.

What is actually visible of most gabbro complexes is conveniently summarized by supposing that they are in general either of the sharply banded type, with ultrabasic derivatives: or of the unbanded type, with associated granitic or granophyric derivatives. The geology of the Duluth mass suggests that this distinction reflects observational limitations rather than any fundamental petrological distinction. (In this connection it may be noted that a granophyre facies occurs in the Bushveld complex, though there is much controversy about its relation to the gabbro.)

(F. Cs.)

GABELENTZ, HANS CONON VON DER (1807–1874), German linguist and ethnologist, born at Altenburg on Oct. 13, 1807, was the only son of Leopold von der Gabelentz, chancellor and privy-councillor of the duchy of Altenburg. He studied at Leipzig and Gottingen and after 1830 held various public offices. He died at Lemnitz, in Saxe-Weimar, on Sept. 3, 1874.

Gabelentz is said to have learned no fewer than 80 languages, 30 of which he spoke fluently. Immediately after quitting the university, he followed up his Chinese researches by a study of the Finno-Ugrian languages, which resulted in the publication of his *Eléments de la grammaire mandchoue* in 1832. In 1837 he became one of the promoters, and a joint-editor, of the *Zeitschrift für die Kunde des Morgenlandes.* His works include: *Grundziige der syrjänischen Grammatik* (1841); a complete edition (with J. Lobe), with translation, glossary and grammar, of Ulfilas's Gothic version of the Bible (1843–46); articles on the languages of the Swahilis, the Samoyedes, the Hazaras, the Aimaks, the Formosans and other widely-separated tribes in the *Zeitschr. d. deut. morgenland. Gesell.; Beiträge zur Sprachenkunde* (1852) containing Dyak, Dakota, and Kiriri grammars; a *Gramnzatik* u. *Wörterbuch der Kassiasprache* (1857); an edition of the Manchu translations of the Chinese Sse-shu, Shu-king and

Shi-king, with a dictionary (1864); and *Die melanesischen Sprachen nach ihrem grammatischen Bau und ihrer Verwandschaft unter sich und mit den malaiisch-polynesischen Sprachen untersucht* (1860–73). The last-named work treats of the language of the Fiji islands, New Hebrides, Loyalty islands, New Caledonia, etc., and shows their radical affinity with the Polynesian class.

GABELLE, a term which, in France, was originally applied to taxes on all commodities, but was gradually limited to the tax on salt. In process of time it became one of the most hated and most grossly unequal taxes in the country, but, though condemned by all supporters of reform, it was not abolished until 1790. First imposed in 1286, in the reign of Philip IV., as a temporary expedient, it was made a permanent tax by Charles V. Repressive as a state monopoly, it was made doubly so from the fact that the government obliged every individual above the age of eight years to purchase weekly a minimum amount of salt at a fixed price. When first instituted, it was levied uniformly on all the provinces in France, but for the greater part of its history the price varied in different provinces. There were five distinct groups of provinces, classified as follows: *(a)* the *Pays de grandes gabelles,* in which the tax was heaviest, *(b)* the *Pays de petites gabelles,* which paid a tax of about half the rate of the former; *(c)* the *Pays de salines,* in which the tax was levied on the salt extracted from the salt marshes; *(d)* the *Pays rédimés,* which had purchased redemption in 1549; and *(e)* the *Pays exempts,* which had stipulated for exemption on entering into union with the kingdom of France. *Greniers à sel* (dating from 1342) were established in each province, and to these all salt had to be taken by the producer on penalty of confiscation. The *grenier* fixed the price which it paid for the salt and then sold it to retail dealers at a higher rate.

See Necker, *Compte rendu* (1781); J. J. Clamagéran, *Histoire de l'impôt en France* (1876); A. Gasquet, *Précis des institutions politiques de l'ancienne France* (1885).

GABELSBERGER, FRANZ XAVER (1789–1849), inventor of the German system of stenography, was born on Feb. 9, 1789, at Munich. His system was tested at the first session of the Bavarian estates in 1819, and he was placed in charge of the stenographic reports of the Bavarian Chamber. His system is explained in his *Anleitung zur deutschen Redezeichenkunst oder Stenographie* (1834; new ed. 1900), and *Neuen Vervollkommungen der deutschen Redezeichenkunst* (1843; new ed. 1904) (*see* SHORTHAND). Gabelsberger also invented a calculating machine.

See A. K. Stubenrauch, *Gabelsberger und der deutsche Geist* (1924), and J. G. Schwaebl, *Erinnerungen an Gabelsberger* (1925).

GABERDINE or GABARDINE, any long, loose overgarment, reaching to the feet and girt round the waist. It was commonly worn in the middle ages by pilgrims, beggars and almsmen.

GABES, a town of Tunisia, at the head of the gulf of the same name. and 70 mi. by sea S.W. of Sfax, with which it is connected by rail. It occupies the site of the Tacape of the Romans and consists of an open port and European quarter and several small Arab towns built in an oasis copiously watered by the Wad Gades.

The European quarter is situated on the right bank of the Wad near its mouth. Adjacent are the Arab towns of Jara and Menzel. The houses of the native towns are built largely from the ruins of Tacape.

The population of the municipality (1956) was 24,420. There is a considerable export trade in dates. The port was used by the axis for reinforcements from Dec. 1942. It was recaptured by the British 8th army. March 28, 1943.

GABII, an ancient city of Latium, 12 mi. E. of Rome, on the Via Praenestina, which was in early times known as the Via Gabina. Its early history is obscure, though its importance was considerable; but we only hear of it again in the 1st century B.C. as a small and insignificant place, though its desolation is no doubt exaggerated by the poets. Its baths were well known, and Hadrian, who was responsible for much of the renewed prosperity of the small towns of Latium, appears to have been a very liberal patron, building a senate-house and an aqueduct. Its bishops continue to be mentioned in ecclesiastical documents till the end of the 9th century. The primitive city was on the eastern bank of the lake, the citadel being now marked by the ruins of the mediaeval fortress of Castiglione, while the Roman town extended farther to the south. The most conspicuous relic of the latter is a ruined temple, generally attributed to Juno, probably belonging to 250–200 B.C. To the east of the temple lay the Forum, where excavations were made by Gavin Hamilton in 1792. All the objects found were placed in the Villa Borghese, but many of them were carried off to Paris by Napoleon after his conquest of Italy in 1797, and are in the Louvre.

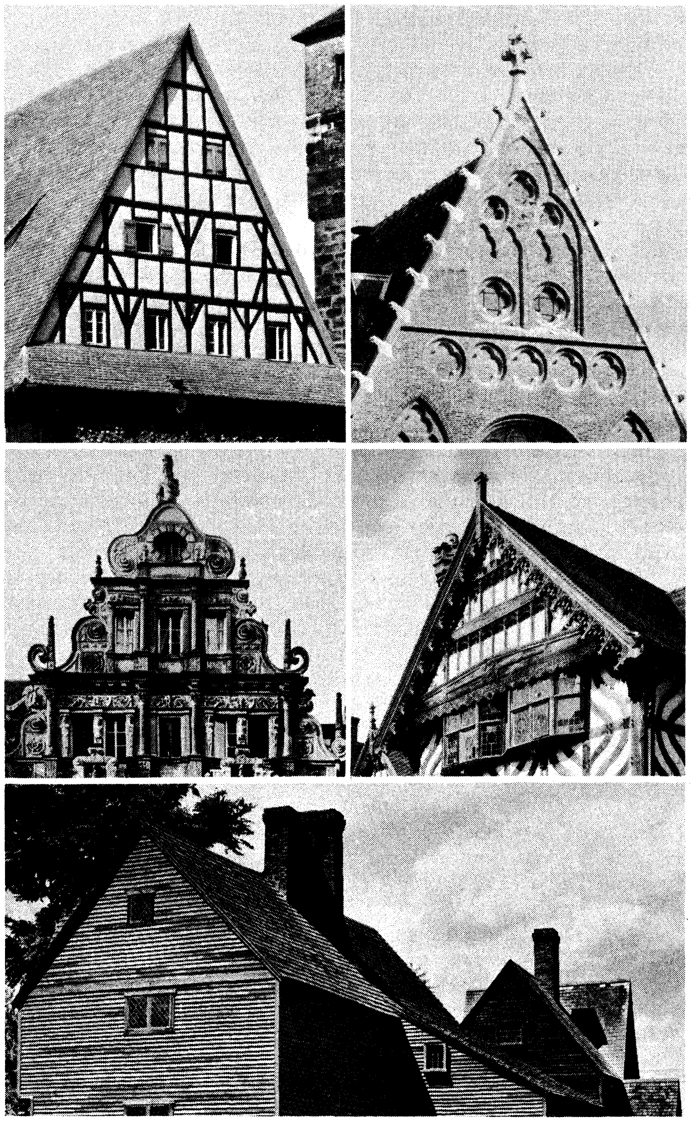
See E. Q. Visconti, *Monumenti Gabini della Villa Pinciana* (Rome, 1797, and Milan, 1835); T. Ashby in *Papers of the British School at Rome,* i. 180 *seq.;* G. Pinza in *Bull. Com.* (1903), 321 seq. for archaeological information. (T. A.)

GABINIUS, AULUS, Roman statesman and general, and supporter of Pompey. In 67 B.C., when tribune of the people, he brought forward the *Lex Gabinia,* conferring upon Pompey the command in the war against the Mediterranean pirates, with absolute control over that sea and the coasts for 50m. inland. By other measures of Gabinius loans of money to foreign ambassadors in Rome were made non-actionable (as a check on the corruption of the senate) and the senate was ordered to give audience to foreign envoys on certain fixed days (1st of Feb.–1st of March). In 58 he was elected consul, not without suspicion of bribery. During his term of office he helped Clodius to send Cicero into exile. In 57 Gabinius went as proconsul to Syria. On his arrival he reinstated Hyrcanus in the high-priesthood at Jerusalem, suppressed revolts, introduced important changes in the government of Judaea, and rebuilt several towns. During his absence in Egypt, whither he had been sent by Pompey, without the consent of the senate, to restore Ptolemy Auletes to his kingdom, Syria was devastated by robbers. and an insurrection had arisen against Hyrcanus. With some difficulty Gabinius restored order, and in 54 handed over the province to his successor, M. Licinius Crassus. The tax-farming interests, which had suffered from the disorders, had him impeached on his return. Gabinius went into exile, and his property was confiscated. After the outbreak of the civil war, he was recalled by Caesar in 49, and entered his service, but took no active part against Pompey. He died on service in Dalmatia against M. Octavius in 48 or early 47.

See Dio Cassius xxxvi. 23-36, xxxviii. 13. 30, xxxix. 55-63; Plutarch, *Pompey,* 25. 48; Josephus, *Antiq.* xiv. 4–6; Appian, *Illyrica,* 12, *Bell. Civ.* ii. 24. 59; Cicero, *ad Att.* vi. 2, *ad* Q. *Fratrem,* ii. 13, *Post reditum in senatu,* 4-8, *Pro lege Manilia,* 17, 18, 19; exhaustive article by Bähr in Ersch and Gruber's *Allgemeine Encyclopädie;* and monograph by G. Stocchi, *Aulo Gabinio e i suoi processi* (1892)

GABLE, the upper part of the end walls of a building covered by a roof that slopes down from the centre to each side; hence the gable is always pointed in general form and usually triangular. In cases like the gambrel roof (*q.v.*) where the roof is in two slopes on each side, the gable becomes pentagonal. In classic work, where the slopes are low and where a cornice is continued across the end walls connecting the eaves, the gable is called a pediment (*q.v.*). The architectural treatment of the gable results from the effort to find a beautiful solution to the problem of keeping water out of the intersection of walls and roof. This was done either by carrying the roof out over the top of the end walls and finishing it with a molding, sloping cornices or a projecting, bracketed board known as a bargeboard (*q.v.*); or by carrying up the end ualls above the roof level and capping them with a waterproof coping or cap. The former method is general in wooden buildings, and in those of small size or little architectural formality; the latter in larger and more monumental masonry structures, particularly in the Gothic and early Renaissance styles.

In north and west areas of Europe, where roofs of steep pitch are general, gables are often richly decorated and finished at the top with a series of steps or fantastic breaks often curved, and in the Renaissance period further ornamented with obelisks, urns, statues and scrolls, as in the town hall of Bremen (1609), the Friedrichsbau at Heidelberg castle (*c.* 1590) or the town hall of Xntwerp (1561). In England, stepped and curved sided gables



BY COURTESY OF (BOTTOM) AMERICAN IRON AND STEEL INSTITUTE; PHOTOGRAPHS (TOP LEFT) GERMAN TOURIST INFORMATION OFFICE, (TOP RIGHT) CEVIRUM. (CENTRE LEFT) AUTHENTICATED NEWS. (CENTRE RIGHT) A F KERSTING

GABLED BUILDINGS: TOP LEFT: WEINSTADEL (WINE STORE). NÜRNBERG, GER.. 1446–48; TOP RIGHT: KNIGHTS' HALL. THE HAGUE. NETH., 1280: CENTRE LEFT: RITTER HOTEL. HEIDELBERG. GER.. RENAISSANCE PERIOD; CENTRE RIGHT: WHITWICK MANOR. STAFFORDSHIRE. ENG.; BOTTOM: IRONMASTER'S HOUSE. SAUGUS. MASS.. 17TH CENTURY

were common during the Elizabethan and Jacobean periods, as in many of the colleges of Oxford and Cambridge; more complicated forms rich with scrolls and strap work were used as decorations for wall coverings, as in Wollaton hall, Nottingham (last quarter of the 16th century).

During the Gothic period gables were decorated with crockets (*q.v.*) and finials (*q.v.*), and sometimes, especially from the 14th century on, with tracery. Gables were also used purely as decoration, without roofs behind; the French flamboyant churches are unusually rich with examples of pierced and traceried gables, very similar to those of the porch of St. Maclou at Rouen (begun 1432).

Gables are important features in the architecture of China and Japan. In north China and Japan, gables follow the roof slope and are ornamented with rich projecting roof tiles, grotesque animals at the ridge and eaves. and occasionally with surface patterns. In south China stepped gables are more common.

See also ROOF.

GABLONZ: see JABLONEC NAD NISOU.

GABORIAU, EMILE (1835–1873), French novelist, was born at Saujon (Charente Inferieure). He became secretary to Paul Féval, and, after publishing some novels and miscellaneous writings. found his real gift in *L'Affaire* Lerouge (1866), a detective novel which was published in the Pays and at once made his reputation. The story was produced on the stage in 1872 A long series of detective novels, which are classics in their kind, followed. Among them are: Le Crime *d'Orcival* (1867), *Monsieur* Lecoq (1869), *La* Vie *infernale* (1870), Les *Esclaves* de Paris (1869), *L'Argent* des autres (1874). Gaboriau died in Paris on Sept. 28, 1873.

GABRIEL, in the Bible, the heavenly messenger (see ANGEL) sent to Daniel to explain the vision of the ram and the he-goat, and to communicate the prediction of the Seventy Weeks (Dan. viii. 16, ix. 21). He was also employed to announce the birth of John the Baptist to Zacharias, and that of the Messiah to the Virgin Mary (Luke i. 19, 26). Because he stood in the divine presence (see Luke i. 19; Rev. viii. 2; and cf. Tobit xii. 15), both Jewish and Christian writers generally speak of him as an archangel. In the Book of Enoch "the four great archangels" are Michael, Uriel, Suriel (Raphael). and Gabriel.

GABRIEL, JACQUES ANGE (or ANGE JACQUES) (1698–1782), French architect, creator of the Petit Trianon at Versailles. was born and died in Paris. Most celebrated of a family of accomplished architects, he was the son of Jacques V (1667–1742), whom he succeeded as premier architect of Louis XV and director of the Academy of Architecture in 1742. Among his royal commissions were the enlargements of Fontainebleau (1749) and the Louvre (1755), the chdteaux at Compiègne (1751) and Choisy (1752), the grand project for Versailles (1763), and the École Militaire (1752). The magnificent Place Louis XV (now Place de la Concorde) in Paris (1755) shows him to have been an accomplished urban planner. His best-known work. believed to be one of the most beautiful buildings ever built, is the gracefully precise Petit Trianon at Versailles (1762). The simple, highly refined architecture of Gabriel was esteemed for its elegance in an age that regarded elegance as commonplace.

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(H. MN.)

GABRIELI, a family of great Italian musicians of the 16th century, of whom ANDREA and his nephew and pupil GIOVANNI were the most important.

ANDREA GABRIELI (*c.* 1510–1586), Venetian composer and teacher, was born in Venice, in the quarter called Canareggio, about 1510. He became a pupil of the Flemish master Willaert, maestro di cappella at St. Mark's. In 1566 he succeeded Merulo as second organist of St. Mark's and was later appointed first organist, a post which he held until his death in 1586. Willaert, who had settled in Venice in 1527, was the virtual founder of the new Venetian school, for it was under his pupils Andrea Gabrieli and Joseffo Zarlino that Italian music began to free itself from the supremacy of the Netherland masters, which had been unshaken for nearly a century. The rambling "Ricercar" for organ was given form and meaning by the two Gabrielis, in whose hands it finally became the "canzone alle francese," the first canzoni for organ being those written by Andrea in 1571. The canzone form was also adopted for combinations of strings or other instruments. Another form associated with Andrea is the Toccata, which was the earliest form of virtuoso composition for organ. Andrea enjoyed great fame as a teacher. His most celebrated pupils were his nephew Giovanni and Leo Hassler.

His works include: *Psalmi* Davidici, qui *poenitentiales nuncupantur, tum omnis* generis *instrumentorum, tum* ad *vocis modulationum* accomodati sex vocum (Venice 1583); Sacrae cantiones *quinque vocum, liber primus* (1565); *Madrigali,* lib. 1 a 5 (1566), lib. 2 a 5, 6 *&* 8 (1570); *Missarum* sex *vocum,* lib. *primus* (1572), *Canzoni* alla francese per *l'organo* (1571); *Madrigali* a 6 v (1574); a 3 v. (1575); *Cantiones ecclesiasticae* (1576); *Canti* concerti a 6, 7, *8, 10* e 16 v. (incl. 10 pieces by Giovanni) 1587; Choruses for Oedipus *tyrannus* (printed 1588); *Mascherate* (1601); a *Missa brevis* and motets in Proske's *Musica divina;* 6 vocal pieces in Torchi's *Arte musicale* in *Italia* vol. ii, and 4 organ pieces in vol. iii; and organ compositions, printed with Giovanni's, in 3 vols. of *Ricercari* (1593–96). A Ricercar in 8 parts has been published by Dr. Riemann (Augener). *See* Eitner: *Quellenlexikon;* Spemann: *Goldenes Buch der Musik.*

GIOVANNI GABRICLI (1557–1612?), nephew and pupil of Andrea, was born in Venice in 1557. He became first organist of St. Mark's in 1585. His monument in San Stefano gives the date of his death as Aug. 12, 1613, but this may be a mistake for 1612 as his post was filled on Aug. 12 of that year. He was a brilliant contrapuntist and, like his uncle, became a celebrated teacher. Heinrich Schütz, Alois Grani and Michael Praetorius were the most famous of his pupils. He experimented boldly with new combinations of instruments, new forms and new harmonies. New editions of some of his organ works appear in Ritter's *Zur Geschichte des Orgelspieles* (1884) and J. v. Wassilievski's *Gesch. d. Instrumentalmusik im 16 Jahrhundert* (1878).

See Karl v. Winterfeld: *Johannes Gabrieli und sein Zeitalter* in 3 vols. (1834) of which one vol. contains mus. examples.

GABRIELINO. This extinct Shoshonean group of California Indians inhabited Santa Catalina island; named from the Franciscan mission of San Gabriel. They numbered about 5,000. They shared their arts with the adjoining Chumash of Santa Barbara channel and had developed a religion with named gods. A form of this, referring to the supreme deity Chungichnish, and making use of *Datura* as a vision-producing narcotic, continued to spread to neighbouring tribes until after 1850.

GABRILOWITSCH, OSSIP (1878–1936), pianist and conductor, was born in St. Petersburg (now Leningrad), on Feb. 7, 1878. He studied music at the Imperial Conservatoire in that city in the class of Tolstov and under the personal supervision of Anton Rubinstein, winning the Rubinstein prize in 1894. Later he continued his studies under Leschetizky in Vienna. At 18 he toured in Germany, Austria and England. In 1900 he toured the United States, and again in 1902, 1907–08. He married Mark Twain's daughter, Clara Clemens, the singer, in 1909. After having conducted in Munich and Vienna he became conductor of the Detroit symphony orchestra in 1918.

GABROVO, a town of Bulgaria, situated on the upper Yantra, in the northern foothills of the Balkan mountains, on a branch of the Transbalkan railway from Stara Zagora to Trnovo. Pop. (1956) 37.919. It is the centre of the textile and tannery industry. The old gabled wooden houses along the Yantra are particularly fine specimens of Balkan architecture, and the Turkish bridge is also famous. The first Bulgarian national school was opened in 1835 at Gabrovo, which thus became to some extent the cradle of the national resurrection. About 10 miles away is the Sokol monastery.

GABUN (or GABON), former territory of French Equatorial Africa. became an autonomous republic within the French Community in Nov. 1958 and an independent republic on Aug. 17. 1960. It derives its name from the Gabun estuary or Rio de Gahao, so named by the Portuguese navigators who discovered it in 1485 because of its imagined likeness to the *gabão* or cabin. In 1839 the French founded their first settlement on the left bank of the Gabun. and in 1849 on the right bank they established Libreville. the capital of the territory. When during the second half of the 19th century the French gradually occupied the hinterland, the name Gabun was applied to the whole region.

Gabun covers 102,317 sq.mi. and had in 1950 a population of 408.778 The dense rain forests with hard woods, oil palms and rubber-bearing plants represent the territory's chief economic assets. (H. A. WF.)

GACE BRULÉ (d. *c.* 1220), French *trouvère,* was a native of Champagne. It has generally been asserted that he taught Thibaut of Champagne the art of verse, an assumption which is based on a statement in the *Chroniques de Saint-Denis:* "Si fist entre lui [Thibaut] et Gace Brulé les plus belles chançons et les plus délitables et melodieuses qui onques fussent oïes." This has been taken as evidence of collaboration between the two poets. The passage will bear the interpretation that with those of Gace the songs of Thibaut were the best hitherto known. Paulin Paris, in the *Histoire littéraire de la France* (vol. xxiii.), quotes a number of facts that fix an earlier date for Gace's songs. Gace is the author of the earliest known *jeu parti.* The interlocutors are Gace and a count of Brittany who is identified with Geoffrey of Brittany, son of Henry II. of England. Gace appears to have been banished from Champagne and to have found refuge in Brittany. A deed dated 1212 attests a contract between Gatho Bruslé (Gace Brulé) and the Templars for a piece of land in Dreux. It seems most probable that Gace died before 1220, at the latest in 1225.

See Gédéon Busken Huet, *Chansons de Gace Brulé,* edited for the Société des Anciens Textes Français (1902), with an exhaustive introduction. Dante quotes a song by Gace, *Ire d'amor qui en mon cuer repaire,* which he attributes erroneously to Thibaut of Navarre (*De vulgari eloquentia,* p. 151, ed. P. Rajna, Florence, 1896).

GACHARD, LOUIS PROSPER (1800–1885), Belgian man of letters, was born in Paris on March 12, 1800. He entered the administration of the royal archives in 1826, and was appointed director general, a post which he held for 55 years. Gachard died at Brussels on Dec. 24, 1885. Among his best known works are: *Don Carlos et Philippe II.* (1863), *Etudes et noticss historiques concernant l'histoire des Pays-Bas* (1863), *Histoire de la Belgique au commencement du XVIII^e siècle* (1880), *Histoire politique et diplomatique de P. P. Rubens* (1877), all published at Brussels.

GAD, a Semitic name. 1. A god of fortune, originally, perhaps, Aramaean, whose name occurs not infrequently in compound place names. The god himself is mentioned in Is. lxv. 11 (R.V.).

2. The name of a seer at the court of David, 1 Sam. xxii. 5, xxiv., 1 Chron. xxix. 25, 2 Chron. xxix. 25.

3. An Israelite tribe claiming descent from Jacob and Zilpah, Leah's maid.

The name is now generally supposed to be that of the god (1), but the traditional derivation is that which connects it with a word meaning "a raiding troop" (*cf.* Gen. xlix. 19). The territory of Gad lay to the east of Jordan, between Manasseh (Machir) and Reuben, and the more usual term for this district is Gilead. From Jud. v. 17, where Gilead is condemned for not following Barak, we gather that this name might be used for the tribe as well as for its territory. Gad is mentioned in the inscription of Mesha, and it is noteworthy that by this time Reuben has entirely disappeared, having been absorbed, apparently, partly by Gad and partly by Moab. Gad belonged nominally to the northern kingdom of Israel, but was liable to be raided from the desert, while it was also exposed to attack from the Syrians of Damascus in the north and from Moab in the south; hence the control exercised by the court of Samaria was uncertain and irregular.

GADAG (GARAG), a tonn and taluka in Dharwar district. Mysore state. India. 43 mi. E. of Dharwar town. Pop. (1951) 65.509; taluka (413 sq.mi.) 144,260. It is an important junction on the Central railway, with trade in cotton and silk and cotton stuffs, factories for ginning and pressing cotton and a spinning and neaving mill. Its temples exhibit fine carving, with inscriptions from as early as the 10th century A.D.

GADARA, an ancient city of Trans-Jordan, a member of the Decapolis, capital of Peraea (so at least Josephus), and political centre of the district of Gadaris It is now represented by the group of ruins, Umm Kēs. which are spread over the summit of a hill 1,193 ft high and about 6 m. S E. of the southern end of the Sea of Galilee "There could hardly be found a second point in this part of ʿAjlūn which combines so perfectly the advantages due to a magnificent soil and a commanding position"

Although the Mishna asserts that it was fortified by Joshua, Gadara was probably of Greek origin and it certainly maintained a religious interest in Zeus. It first appears in history as a place which fell to Antiochus the Great after his victory over Scopas at Paneas (Bāniās). Alexander Jannaeus took it after 10 months siege (*c.* 100 B.C.). Pompey restored it (64–63 B.C.) and Augustus gifted it to Herod the Great (30 B.C.). During the Jewish revolt Vespasian took possession of the city, the inhabitants pulling down the walls as an earnest of peace. Josephus knew it as a "place of strength with many rich citizens" and during the time of the Antonines it was adorned with buildings of some magnificence.

There exist to-day the remains of three large theatres, a basilica, a temple, a colonnaded street, a reservoir, the city wall, and an aqueduct which brought water from the Hauran. On the eastern side of the site there is a large necropolis with rock-hewn tomb-chambers (many with stone doors), which some of the modem inhabitants use as dwellings, together with numerous carved sarcophagi.

About 3 mi. to the north beside the river Yarmuk (Hieromax) are the celebrated hot springs and baths of Amatha described by Eusebius and Strabo. "To Gadara the pleasure-loving Romans, after having enjoyed the restorative effects of the hot springs, retired for refreshment, enjoying the cooler heights of the city and solacing their leisure with the plays performed in the theatres." From its leisured populace it produced many fine littérateurs; Philodemus, the Epicurean and epigrammatist; Meleager the anthologist; Menippus the satirist; Theodorus the rhetorician, and others.

The healing of the demoniac in the Gospel narrative has nothing to do with Gadara, but is rather to be associated with Kersa on the eastern shore of the Sea of Galilee.

See C. Warren in *Hustings Dictionary of the Bible; G.* Schumacher, *Northern 'Ajlūn* (1890); G. A. Smith, *Hast. Geog. of the Holy Land* (1895). (E. Ro.)

GADDI, the name of a celebrated family of 14th-century Italian painters, active in Florence, 1318–96, comprising Gaddo di Zanobi (documented 1318/19, still alive in 1327), by whom no works are known, his son Taddeo, and his grandsons Agnolo and Giovanni. Two of these painters, Taddeo and Agnolo, were among the most important Florentine artists of their time.

Taddeo Gaddi *(c.* 1300–1366), a pupil of Giotto, is sometimes assumed to have participated in Giotto's altarpiece of the Coronation of the Virgin in the Baroncelli chapel in Sta. Croce, and to have been responsible, while in close association with Giotto, for a panel of St. Stephen (Horne museum. Florence). His earliest authenticated work is a small triptych in the Kaiser Friedrich museum, Berlin, signed and dated 1334. In 1341–42 he seems to have been employed in S. Miniato al Monte outside Florence and in S. Francesco at Pisa. His most extensive works, the frescoed scenes from the life of the Virgin in the Baroncelli chapel in Sta. Croce, were probably completed in 1338. In these the figure style stems from Giotto, but is modified by a new concern with light. Between 1347 and 1353 Taddeo Gaddi painted a polyptych for S. Giovanni Fuorvicitas at Pistoia, while a "Virgin and Child" in the Uffizi gallery, Florence, from S. Lucchese at Poggibonsi. is signed and dated 1355. The latter work maintains much of the dignity and weight of Giotto's figure style. Possibly about 1338, Taddeo Gaddi decorated the sacristy cupboards in Sta. Croce with panels representing scenes from the lives of Christ and of St. Francis; with one exception (in Berlin) these panels are in the Accademia in Florence. Enclosed in decorative frames, these are perhaps the most distinguished narrative panels of the generation after Giotto's. In 1363 Taddeo painted a fresco (lost) in the Mercanzia Vecchia and in 1366 is mentioned in documents for the last time. G. Villani and F. Sacchetti supply evidence of Taddeo Gaddi's considerable reputation,-and his work is highly praised in the *Commentari* of the sculptor Lorenzo Ghiberti.

Agnolo Gaddi *(c.* 1350–1396), son of Taddeo, was employed in Rome in 1369, as an assistant of his brother Giovanni (d. 1383) on frescoes for Pope Urban V. Between 1383 and 1386 he designed medallions of the Virtues for the Loggia dei Lanzi in Florence, which were carved by Jacopo di Piero Guidi. and between 1387 and 1395 his name appears as the designer or gilder of sculptures carved for the façade of the Duomo. His death in 1396 left unfinished the Altar of the Crucifixion in S. Miniato al Monte outside Florence. His most ambitious works are the frescoes in the choir of Sta. Croce in Florence, probably painted in the mid-1380s and certainly completed before 1395. They illustrate the Legend of the Cross, and in their figure style, their loose, flat compositions and their light palette are redolent of late Gothic mannerism. Between 1394 and 1396 Agnolo painted a cycle of scenes from the life of the Virgin and the legend of the Holy Girdle in the Cappella della Cintola in the cathedral at Prato, and subsequently (with G. Starnina) decorated the Castellani chapel in Sta. Croce in Florence. A facile and prolific painter, Agnolo Gaddi commanded neither the gravity of his father nor the decorative charm of his follower, Lorenzo Monaco.

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GADE, NIELS VILHELM (1817–1890), Danish composer, was born at Copenhagen, on Feb. 22, 1817, his father being a musical instrument maker. Though he studied the violin under Wexschall, and theory under Weyse and Berggreen, he was largely self-taught. In 1840 his *Aladdin* and his overture of *Ossian* attracted attention, and in 1841 his *Nachklänge aus Ossian* overture gained the local musical society's prize, the judges being Spohr and Schneider. A further stipend from the king enabled him to go to Leipzig and Italy. In 1844 Gade conducted the Gewandhaus concerts in Leipzig during Mendelssohn's absence, and on the latter's death became chief conductor. In 1848, on the outbreak of the Holstein War, he returned to Copenhagen, where he was appointed organist and conductor of the Musik-Verein. In 1852 he married a daughter of the composer J. P. E. Hartmann. He became court conductor in 1861, and was pensioned in 1876—the year in which he visited Birmingham to conduct his *Crusaders.* This work, and the *Frühlingsfantasie,* the *Erlkönigs Tochter, Frühlingsbotschaft* and *Psyche* (written for Birmingham in 1882) enjoyed great popularity. Of his eight symphonies the best are the first and fourth. A friend of Mendelssohn and of Schubert, Gade was a romanticist. whose music owes much to Scandinavian folk-song. He died at Copenhagen on Dec. 21, 1890.

See W. Behrend, *Niels* W. *Gade* (1917); C. Kjerulf, *Niels* W. *Gade, Hans Liv og Kunst* (1917).

GADIDAE, a family of fishes including the cod, whiting, haddock, etc., inhabiting the waters of the northern hemisphere. *See* Cod; Fishes; Whiting.

GADOLINIUM [symbol Gd; atomic number 64; atomic weight 157.26; stable isotopes Gd^{152} (0.21%), Gd^{154} (2.14%), Gd^{155} (14.86%), Gd^{156} (20.61%), Gd^{157} (15.66%), Gd^{158} (24.75%), Gd^{160} (21.71%)] is a metallic element belonging to the rare-earth group. The early history of this element is in a rather confused state. J. C. G. Marignac in 1880 obtained a new rare earth in an impure condition and termed it Yα; in 1886 he gave it the name gadolinium in honour of the Finnish chemist J. Gadolin.

Fairly pure gadolinium salts were secured by E. A. Demarcay in 1900. It occurs in many minerals, some varieties of Norwegian ytterspar being quite rich sources; other common sources are gadolinite, samarskite and monazite. Gadolinium was formerly concentrated from other members of the rare-earth group by the fractional crystallization of the double magnesium nitrates. The more soluble fractions of these nitrates were then converted to the bromates and further purified by fractional crystallization. From 1945 it was separated fairly rapidly by means of ion exchange columns. This separation can be more readily carried out if advantage is taken of the fact that the two close neighbours to gadolinium — samarium and europium — exist in the divalent state. Usually these elements are removed from the rare earth mixtures by means of a sodium amalgam separation from aqueous solution before the rare-earth chloride mixtures are adsorbed on the ion exchange columns. Small amounts of samarium can also be removed from gadolinium by reducing the chloride to the gadolinium metal, using calcium as a reductant. Under these conditions samarium does not reduce to the metal but remains in the slag. Gadolinium oxide (Gd_2O_3) is white. Solutions of the salts are colourless and give absorption bands in the ultraviolet region of the spectrum; they are strongly paramagnetic. The metal has been produced by thermoreduction of $GdCl_3$ with calcium. It possesses a hexagonal close-packed structure ($a=3.622$ A, $c=5.748$ A) and has a calculated density of 7.948 g. per cubic centimetre. The metal is a silver white and is strongly ferromagnetic below room temperatures. Gadolinium salts are of particular interest because they were the first salts used in obtaining temperatures below 1° K. (below $-272°$ C.) by means of magnetic cooling. Gadolinium is of particular interest in atomic fission because two of its isotopes, 155 and 157, have large capture cross sections for thermal neutrons and can act as powerful poisons in destroying chain reactions. See RARE EARTHS. (F. H. SP.)

GADSDEN, JAMES (1788–1858), U.S. soldier, diplomat and railroad president, was born in Charleston, S.C.. May 15, 1788. He graduated from Yale college in 1806 and engaged in business in his native city until 1812, when he was appointed a lieutenant of engineers in the U.S. army. In 1820 he was made responsible for the establishment of military posts in Florida and supervised the removal of the Seminole Indians to southern Florida in 1823. Gadsden negotiated the treaty for the removal of the Seminoles to the west in 1832 and served in the war which followed the refusal of some Seminoles to leave Florida. (See also FLORIDA: History.) In 1840 he became president of a railroad in South Carolina.

Gadsden's most important public service followed his appointment as U.S. minister to Mexico in 1853. He was instructed to negotiate a treaty for the purchase of territory south of the Gila river through which ran the most desirable route for a railroad from the southern states to the Pacific. He succeeded in adjusting certain minor issues and in gaining a cession of territory in what is now southern New Mexico and Arizona. This added territory, which included the route of the proposed southern railroad, is generally known as the Gadsden Purchase (*q.v.*). Gadsden died at Charleston, Dec. 26, 1858. (H. W. BY.)

GADSDEN, a city of northeastern Alabama, U.S., the seat of Etowah county, is on the Coosa river, 65 mi. N.E. of Birmingham, in the foothills of the Appalachian mountain system. Pop. (1960) city 58,088; standard metropolitan statistical area (the entire county, including the town of Attalla) 96,980. (For comparative population figures see table in ALABAMA: Population.) Alabama City was annexed by Gadsden in 1932.

Gadsden is in the iron and coal region of Alabama and has abundant hydroelectric power from the Coosa river. Among its manufactured products are iron and steel, textiles, automobile tires and metal fabricated products. It is also in a rich agricultural region. The principal products are cotton, produce, grain and livestock.

The city was founded in 1840 and named for James Gadsden, southern railroad promoter, who later, in 1853, while serving as minister to Mexico, negotiated the Gadsden Purchase. Emma Sansom, Confederate heroine, lived near Gadsden. In 1863 she guided Gen. Nathan Bedford Forrest across flood-swollen Black creek, enabling him to capture Col. Abel D. Streight and his command. Gadsden was incorporated as a city in 1871. (B. CR.)

GADSDEN PURCHASE. While it ended the bitter Mexican War, the treaty of Guadalupe Hidalgo (Feb. 1848) did not resolve all difficulties between the United States and the republic of Mexico. Article xi made the U.S. government responsible for preventing Indian raids into northern Mexico, but Apache depredations were heaviest in the years immediately following the treaty. The dominating problem, however, concerned the international boundary. The 1848 treaty established the natural boundary of the Rio Grande as the international line from El Paso eastward to the Gulf of Mexico, but it failed to provide a positive demarcation west of El Paso to the Pacific. Stipulating no longitude or latitude, the 1848 treaty merely declared that the boundary from El Paso westward should coincide with the line shown on Disturnell's map (1847).

When a joint Mexican-American survey party met in 1851 to locate landmarks on Disturnell's line, the map was found to be seriously inaccurate in that El Paso mas placed 34 mi. N. of its actual site. This gave Mexico an unexpected advantage, which its commissioner, P. G. Condé, was determined to maintain. Condé's eventual compromise with the U.S. commissioner, J. R. Bartlett, was acceptable to the Whig administration of President Fillmore; but it was repudiated immediately by the Democratic expansionists who returned to office under Franklin Pierce in 1853. The Bartlett-Condé agreement was particularly noxious to the new secretary of war, Jefferson Davis of Mississippi, because it would mean the loss of about 3,000,000 ac. in the Mesilla valley, just west of El Paso. Davis strongly advocated a southern route in the construction of any transcontinental railroad; he argued, and with good reason, that the most practical route to California was across the Mesilla valley and then through the Gila river valley, which was altogether on the Mexican side of the 1848 line.

On the urgent recommendation of Davis, the South Carolinian railroad president James Gadsden (*q.v*) was sent to Mexico as US. minister in May 1853. The major object of Gadsden's mission was to acquire all the territory needed for a transcontinental railway route—and as much additional land as President Santa Anna might be willing to sell. Gadsden was instructed to propose five alternative cessions to Santa Anna, the largest to include all of Lower California, and he was authorized to offer as much as $50,000,000. On Dec. 30, 1853, Gadsden concluded a treaty nith Santa Anna, by which Mexico would relinquish the Mesilla valley and would cede 19,000,000 ac. south of the Gila river. Other adjustments were also incorporated: article xi of the 1848 treaty was abrogated; Mexico agreed to drop all claims for Indian depredations; and the United States assumed the Tehuantepec claims of the New York speculators P. A. Hargous and A. G. Sloo. The payment to Santa Anna's government was to be $15,000,000.

Gadsden had struck an admirable bargain, but his treaty became the subject of violent sectional debate when it reached the U.S. senate. Northern spokesmen, fearing as always the possible extension of slavocracy into the new lands of the southwest and still hoping to see a transcontinental railroad built elsewhere, argued that the territory was worthless. But protreaty lobbying by the New York speculators was vigorous, and southern senators finally achieved ratification by drastically amending the whole document.

The revised version was approved by a close vote on April 25, 1854, but not until the payment to Mexico had been cut to $10,000,000 and the total area of the cession reduced proportionately. Santa Anna placidly accepted these alterations, and the treaty was proclaimed on June 30, 1854. In Mexico the transaction was loudly denounced by Santa Anna's many rivals, and that veteran politician's career ended with banishment on a charge of high treason in 1855.

The Gadsden Purchase, as the cession came to be called, was the last addition to the continental domain of the United States. It should be viewed as the final step in the Democratic program of "Manifest Destiny" that dominated the decade of the 1840s. As finally defined by the senate, the cession was bounded on the east by the Rio Grande, on the north by the Gila and on the west by the Colorado. Its area has often been given as 45,535 sq.mi., but this figure is much too large. In his Report on the United States and Mexican Boundary Survey (1857–59), Maj. William H. Emory set the total at 26,185 sq.mi. A more exact modern approximation is 29,640 sq.mi., of which 27,305 are within the present limits of Arizona and comprise 24% of the area of that state.

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GADWALL, the common name of the duck *Chaulelasmus streperus.* Its habits and distribution are very similar to those of the common wild duck (see DUCK). It breeds in Iceland, southeast England, across northern and eastern Europe and northern Asia to Kamchatka and in North America from southern British Columbia and Saskatchewan south to southern California, Colorado, Nebraska and Wisconsin. It usually. occurs in twos and threes, or in mixed flocks with other ducks. It is also known as gray duck or canvas belly. Its small head, flat back, elongated form and elevated stern render it easily recognizable. In coloration the two sexes are almost equally sombre, but the drake exhibits chestnut upper-wing coverts. Both resemble the female of the mallard in colour, but the white secondary quills form one of the most readily perceived characteristics of the species. The gadwall is increasing as a breeding species in Britain. It has been always esteemed for the table (G F. Ss.)

GAELIC LANGUAGE. The term Gaelic is used for the surviving Celtic languages other than Welsh, Cornish and Breton. *i.e.*, for Erse, Manx and Scottish Gaelic. In these languages the qu sound is often used nhere the *p* sound would be used in the other group. Gaelic spread from Ireland to Scotland with the Dalriadic Scots. Scottish Gaelic has given up the nasal mutation (or eclipse). e g , Scottish or *bò*, "our cow," Irish ar m-bd; Scottish *mantêr* "of the countries." Irish *na* d-tir. See also CELTIC LAYGUAGES: IRISH LANGUAGE.

GAELIC LITERATURE: see IRISH LITERATURE : Gaelic; SCOTTISH LITERATURE: Gaelic.

GAETA, a town in Latina province, Lazio (Latium). Italy, a seaport and naval station and the seat of an archbishopric, lies 72 km (45 mi) N W. of Naples. on the Via Flacca which links it with Rome and Naples Pop. (1957 est) 19.188 (commune). Outside the walls the town has a modern appearance, but within them the character of a fortified square is preserved. The cathedral (1106. restored 1892) suffered considerable damage in World War II; it has a romanesque-Moorish campanile (12th–13th centuries), a banner of the victor of Lepanto and contains a nunnery. The castle, of Norman origin, the lower part of which dates from c. 1289. dominates the old town from the south Monte d'Orlando (a public park) is supposedly the site of the grave of Caieta, the nurse of Aeneas. after whom the town was named. The tombs of the consuls L. Munatius Plancus (d. after 22 B C.), the founder of Lyons, and L S Atratinus are also located there. West of this eminence. near the sanctuary of the Trinity, is the "cleft mountain." a vertical fissure running down to sea level. There is an oil refinery and a glassworks. Fishing. other maritime activities and agriculture are additional occupations. The principal import is raw petroleum; chief exports are petroleum products, bottles, fresh and preserved fish, vegetables. wine and fruit. Gaeta first came into contact with the Romans after the first Samnite War (see ROME: The Republic). A road was built *c.* 184 B.C. connecting the town with the port and the place became a holiday resort After the fall of the western empire Gaeta remained loyal to Byzantium and preserved its freedom throughout the Gothic and Saracen invasions. In the 8th century it was a marine republic and after 915 an autonomous duchy. It capitulated to the Normans in 1140 and under them achieved importance. In the 15th century it was the centre of struggles for succession to the throne of Naples. The town was occupied by the Austrians from 1707–34. In 1806. after a heroic defense, it fell to the French (see NAPLES, KINGDOM OF).

The capitulation of Gaeta in 1861 marked the unification of Italy. (P. Co)

GAETULIA, a district in the north of Africa, which in the usage of Roman writers comprised the wandering tribes of the southern slopes of Mt. Aures and the Atlas, as far as the Atlantic ocean, and the oases in the northern part of the Sahara. They were distinguished from the Negro people to the south, and belonged to the Berber race which formed the population of Numidia (*q* v).

The tribes to be found there at the present day are probably of the same race, and retain the same wandering habits. They were noted for the rearing of horses, were clad in skins, lived on flesh and milk. and the only manufacture connected with their name is that of purple dye.

GAGARIN, YURI ALEKSEYEVICH (1934–), who made the first manned space flight, was born near Gzhatsk in the oblast of Smolensk, U.S.S.R., on March 9, 1934. The announcement of the flight revealed that Gagarin, a major in the Soviet air force. was launched at 9:07 A.M. MOSCOW time on April 12, 1961, in the $4\frac{3}{4}$-ton spaceship "Vostok." He circled the earth in 1 hr. 48 min at a maximum speed of 18.000 m.p.h. and at a maximum height of 187 mi., landing at a predetermined spot in the Soviet Union without ill effects. During the flight he maintained radio contact with earth and was able to operate controls and make notes while in the state of weightlessness

The son of a carpenter on a collective farm, Gagarin's early education was interrupted by World War II In 1951 he graduated with distinction as a molder at a vocational school near Moscow. He later studied at the industrial college at Saratov and concurrently took a course in flying. On completing this course in 1955 he entered the military aviation school at Orenburg.

Gagarin, hailed throughout the world as "the Columbus of Interplanetary Space," was awarded the Order of Lenin, and given the titles of Hero of the Soviet Cnion and Pilot Cosmonaut of the Soviet Union. (W. J. BP.)

GAGE, THOMAS (1721–1787), British general and governor of Rlassachusetts. The second son of the first Viscount Gage, he entered the army in 1741 and saw service in Flanders and in the battle of Culloden. In 1754 he sailed with his regiment (the 44th) to America and took part in Gen. Edward Braddock's disastrous expedition. In 1758 he organized and became colonel of a regiment of light infantry (the 80th) and served in Jeffery Amherst's operations against Montreal. He was made governor of Montreal, promoted major general in 1761 and lieutenant general in 1770. In 1763 he succeeded Amherst as commander in chief of the British forces in North America, the most important and influential British post in the colonies, which he continued to hold until 1775. In 1774 he was appointed governor of Massachusetts and in that capacity was entrusted with carrying into effect the Boston Port act. The difficulties which surrounded him in the execution of his office at this time of the gravest unrest culminated in 1775. and the action of April 19 at Lexington initiated the American Revolution (*q.v.*). After the battle of Bunker Hill, Gage was superseded as commander in chief by Howe and returned to England. He became general in 1782 and died on April 2, 1787.

See John *R.* Alden, *General Gage in America (1948)*; Clarence E. Carter (ed.), *The Correspondence of General Thomas Gage, 2* vol. *(1931–33).* (B. KN.)

GAGERN, HANS CHRISTOPH ERNST, BARON VON (1766–1852), German statesman and political writer, was born at Kleinniedesheim, near Worms, on Jan. 25, 1766. After studying law at the universities of Leipzig and Gottingen, he entered the service of the prince of Nassau-Weilburg. He was the prince's envoy at Paris until 1811, and in 1812 he took part in the abortive attempt to excite a second insurrection against Napoleon in Tirol. He joined the headquarters of the Prussian army (1813), and became a member of the board of administration for north Germany. In 1814 he was appointed administrator of the Orange principalities; and, when the prince of Orange became king of the Netherlands, Baron Gagern became his prime minister. In 1815 he represented him at the congress of Vienna, and obtained for the Netherlands a considerable augmentation of territory. From 1816 to 1818 he was Luxemburg envoy at the German diet, but was recalled, at the instance of Metternich, owing to his too independent advocacy of state constitutions. In 1820 he retired with a pension to his estate at Homau, near Hochst, in Hesse-Darmstadt, where he died on Oct. 22, 1852. Baron von Gagern wrote some historical works, but the best known is his autobiography, *Mein* Anteil **an** der *Politik,* 5 vols. (Stuttgart and Leipzig, 1823–1845).

Of Hans Christoph von Gagern's sons three attained considerable eminence:—

FRIEDRICH BALDUIN, Freiherr von Gagern (1794–1848), the eldest, took service in the Austrian army, fought in the Russian campaign of 1812, and at Dresden, Kulm and Leipzig. He then entered the Dutch service, took part in the campaigns of 1815, and, after studying another year at Heidelberg, was member for Luxemburg of the military commission of the German federal diet (1824, 1825). In 1830 and 1831 he took part in the Dutch campaign in Belgium, and in 1844, was sent on a military mission to the Dutch East Indies. In 1847 he was appointed governor at the Hague, and commandant in South Holland. In the spring of 1848 he commanded the Baden forces against the insurgent "free companies" (Freischaaren). At Kandern, on April 20, he was mortally wounded. His Life, in 3 vols. (Heidelberg and Leipzig, 1856–1857), was written by his brother Heinrich von Gagern.

HEINRICH, Freiherr von Gagern (1799–1880), the third son, fought at Waterloo in the Nassau contingent. After the war, he studied law at Heidelberg, Gottingen, Jena and Geneva. As a student he had been a member of the *Burschenschaft,* and he now threw himself into open opposition to the unconstitutional spirit of the Hessian government, and was dismissed from the state service in 1833. Henceforth he lived in retirement at Monsheim until the February revolution of 1848 and its echoes in Germany recalled him to active political life. At the Heidelberg meeting and the preliminary convention (*Vorparlament*) of Frankfort he deeply impressed the assemblies; and when the German national parliament met (May 18), he was elected its first president. He was mainly instrumental in imposing the principle of a united empire aith a common parliament. and in carrying the election of the Archduke John as regent. On Dec. 15, when Schmerling and the Austrian members had left the cabinet, Gagern became head of the imperial ministry. and on the 18th he introduced a programme (known as the Gagernsche *Programm*) according to which Austria was to be excluded from the new federal state, but bound to it by a treaty of union. After a severe struggle this proposal was accepted; but on May 20 Gagern and his friends resigned. He died at Darmstadt on May 22, 1880.

MAXIMILIAN, Freiherr von Gagern (1810–1889), the youngest son, nas a member of the German national parliament in 1848. Throughout the revolutionary years he supported his brother's policy, and. after the collapse of the national movement, returned to the service of the duchy of Nassau. In 1855 he entered the Austrian service in the department of foreign affairs. In 1871 he retired and in 1881 was nominated a life member of the upper chamber (*Herrenhaus*). He died at Vienna on Oct. 17, 1889.

See Allgemeine *deutsche Biographie,* Band viii, p. 301, etc. (1878) and Band xlix, p. 654 (1904).

GAG LAWS, a series of resolutions passed in the U.S. house of representatives, between 1836 and 1840, providing that all petitions relating to the subject of slavery would be tabled without being printed, referred to committee or discussed. There was no similar action taken by the senate. These petitions flooded congress after the foundation of the American Anti-Slavery society (1833), reaching a total of 412,006 in 1838–1839, signed by more than 2,000,000 persons. The first gag rule was the Pinckney resolution of 1836. It was followed by the Hawes and Patton resolutions (1837), the Atherton resolution (1838) and the Johnson resolution (1840), which was adopted as standing rule 21 on Jan. 28, 1840. Abolitionists were greatly disturbed by these infringements on the constitutional right of petition and gained increased support nationally. They supplied expert advisers, such as Theodore Dwight Weld, to a house group, led by former Pres. John Quincy Adams (*q.v.*) and Joshua R. Giddings (*q.v.*), which attempted to get rule 21 repealed at the start of each session, finally succeeding on Dec. 2, 1844.

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GAILLARDIA, a genus of showy North American herbs of the Compositae (*q.v.*) family, consisting of about 20 species. mostly from the far west and commonly known as gaillardia or blanketflower. All have yellow or yellow and red sterile ray flowers and fertile purple disk flowers. Two annual species. G. *amblyodon* and G. *pulchella,* are popular and widely grown in gardens and borders, and the perennial species, G aristata, one of the last plants in the garden to die in autumn, for the large handsome heads. All are easily grown in most garden soils and preferably in full sun. (J. M. BL.)

GAINESVILLE, a city in north-central Florida. U.S.. is situated approximately 70 mi. S.W. of Jacksonville and 140 mi. N. of Tampa. Founded in 1854 as the seat of Alachua county and named for Gen. Edmund Pendleton Gaines (1777–1849), U.S. army officer. it was incorporated as a town in 1869 and as a city in 1907. (For comparative population figures see table in FLORIDA: *Population.*)

During the 19th century. Gainesville mas an agricultural trading centre, first for cotton farmers and later for citrus and vegetable producers Freezes in the 1890s destroyed orange groves, and both citrus culture and truck gardening were moved to more southerly regions of the state. The East Florida State seminary, established in Ocala in 1853, was relocated in Gainesville in 1866 and was the cultural centre of the tonn. which contained less than 4,000 people at the turn of the century.

In the 20th century the city's growth paralleled that of the University of Florida. In 1905 Florida reduced the number of state-supported colleges from eight to three, and led by merchant William N. Wilson and Mayor William R. Thomas, Gainesville offered land, money and free water in perpetuity to win the University of Florida (so named in 1903) from Lake City, where it was located. The university and East Florida seminary were then consolidated as the new state university. The few hundred students of the first years in Gainesville increased in number to more than 13,000 by the middle of the 20th century. A medical centre, with a medical school and a teaching hospital, was added to the university in 1956; the hospital serves an area with a population of more than 1,000,000. The Florida State museum, with a large collection of Indian artifacts and wildlife specimens, and the Sunland Training centre for exceptional children who are unable to care for themselves are located in Gainesville.

Agriculture and industry also contributed to the city's growth. Watermelons, cucumbers, squash, tomatoes and other truck-garden crops are shipped from Gainesville in late spring and early summer. Electronics, wood products, meat packing, building materials, moss processing and other light industries provide employment.

Gainesville has a council-manager type of government, in effect since 1920. Broad avenues divide the city into quadrants. but within them are many narrow streets and few parks. Oak, pine, magnolia, dogwood, redbud, azaleas and camellias shade and beautify streets and yards. Near the city are Newnan's lake; the Devil's Millhopper, a picturesque sinkhole; and Payne's prairie, a wildlife preserve. The latter perpetuates the name of a Seminole Indian chief whose people once inhabited the area, and who in 1812 led his warriors in battle against the forces of Col. Daniel Newnan. (R. W. PA.)

GAINSBOROUGH, THOMAS (1727–1788), one of the foremost English painters of portraits and landscapes, was born at Sudbury, in Suffolk, the youngest son of John Gainsborough, a maker of woolen goods. About 1740 he was sent to London to study and worked in the studio of Hubert Gravelot, the French painter and engraver. Gainsborough must have met Francis Hayman, who undoubtedly influenced his work. but there is no evidence that he was his pupil, as is suggested in most of the early biographies. In 1746 he married, in London, Margaret Burr, the illegitimate daughter of the duke of Beaufort. Soon after this he returned to Suffolk and about 1752 settled in Ipswich, where he made the acquaintance of his first biographer, Philip Thicknesse, and of Joshua Kirby, the first president of the Society of Artists. Gainsborough early acquired some reputation both as a portraitist and landscape painter and had no difficulty in making a living. In 1759 he moved to Bath, where his studio was soon thronged with visitors. He moved in musical and theatrical circles, and among his friends were members of the Linley family, whose portraits (now in the Dulnich gallery, London) he painted. It was also at Bath that he met David Garrick, nho became a lifelong friend. His devotion to the work of Van Dyck was fostered by a visit to Wilton, where he made a free copy of the famous portrait of the Pembroke family. In spite of the demands for portraits, however, he continued to paint landscapes.

In 1761 he sent a portrait — the "Earl Nugent" — to the exhibition at the Society of Artists, and in the following year the first notice of his work appeared in the London press. Throughout the 1760s he exhibited regularly in London and in 1768 was elected a foundation member of the Royal Academy. In 1774 he moved to London and settled in part of Schomberg house in Pall Mall In the early part of 1781 Gainsborough was commissioned to paint King George III and Queen Charlotte, whose portraits appeared in the Royal Academy exhibition of that year, and after this he was in constant demand at court. In 1784 he quarreled with the academy about the hanging of his portrait "Three Elder Princesses," and removed all the pictures intended for showing that year. He never again showed at the Royal Academy but held private exhibitions at Schomberg house. In the 1780s Gainsborough painted some of his best-known landscapes and a series of "fancy pictures." portraits of pretty country children. He died on Aug. 2, 1788, and was buried at Kew, Surrey.

Unlike most of his contemporaries Gainsborough did not go abroad to study, and was contemptuous of the fashion for history painting. He knew, however, that the language of his art must be learned somewhere and he turned his attention to the Dutch and Flemish painters. His early landscapes show the influence of J. Wynants and J. van Ruisdael in the detailed treatment of the foliage and plants and in the general design, notably the "Cornard Wood" (National gallery, London) finished in 1748. The "View of Dedham" (National gallery of Ireland) is more original in its feeling for the gray light of England. and in the background to "Mr. and Mrs. Andrews" (collection of G. W. Andrews) he approached

BY COURTESY OF NATIONAL GALLERY, LONDON

"THE MORNING WALK" BY THOMAS GAINSBOROUGH. IN THE NATIONAL GALLERY. LONDON

the realism of Constable. But this soon gave place to a more generalized and poetic view of landscape, reflecting the French pastoral tradition and also the landscapes of Gaspar Poussin, then so popular in England. Gainsborough relied on memory rather than direct study of nature and often worked from model landscapes set up in his studio. "The Harvest Wagon" (Barber institute, Birmingham) painted in the 1760s is one of his loveliest landscapes, a perfect blend of the ideal and the real. Among the best-known of his later landscapes are "The Watering Place" (1775, Tate gallery, London) and "The Market Cart" (1786, National gallery, London). During the years in London he painted a number of pictures of idealized country scenes including "The Cottage Door" (Huntington collection, San Marino, Calif.). He also painted some sea pieces somewhat in the Dutch manner. Some of the "fancy pictures" of country children painted in these years, *e.g.*, the "Cottage Girl with a Pitcher," show a quasi-Wordsworthian approach to nature and are experimental not only in subject matter but also in technique, very thin oil paint being used almost as water colour.

Gainsborough was the only one of the great English portrait painters of the 18th century who also composed landscape drawings in great numbers and in a variety of techniques, including chalk, wash and water colours, some of them varnished. He made in addition a number of soft-ground etchings and constructed his own magic lantern with a number of glass slides painted by himself (now in the Victoria and Albert museum. London).

Gainsborough said landscapes were his real love but he was continually distracted by the demands of portrait painting. The portrait heads painted in Suffolk, if sometimes a little stiff, are penetrating character studies and are delicately penciled. Among the most distinguished are the "Self Portrait" (collection of Lady Cholmondeley) and "Mr. and Mrs. Kirby" (Fitzwilliam museum, Cambridge). While in Suffolk he painted a number of delightfully spontaneous portrait groups—small figures in landscapes, closely related to conversation pieces—that included "Mr. and Mrs. Brown" (collection of Lady Cholmondeley) and the more sophisticated "Heneage Lloyd and his Sister" (Fitzwilliam museum, Cambridge). The "Painter's Daughters Chasing a Butterfly" (National gallery), composed in the last years at Ipswich, is, in its easy naturalism and sympathetic understanding, one of the best of English portraits of children.

After he moved to Bath, Gainsborough had to satisfy a more worldly clientèle, and although he tried to preserve the simple unconventional character of his early work, he had to combine it with a more formal and elegant style which he based on that of Van Dyck. "Miss Ford" (1760, Cincinnati Art museum) is an essay in the grand manner. but "Mrs. William Henry Portman" (c. 1768, collection of Viscount Portman) is a fine character study, full of humanity, and distinguished by rhythmical drawing and delicate gray tones. Some of his best portraits of men date from this time, notably "Sir Benjamin Truman" (collection of Messrs. Truman, Hanbury and Co.).

When he went to Iive in London his portraits of women became more ethereal, and their flickering ribbons and laces seem to melt into the landscape background. "Mrs. Sheridan" (c. 1785, Washington, D.C., National gallery) and "Mrs. Robinson" (1781, Wallace collection, London) are insubstantial characters, but exquisitely painted. Unlike his great rival Sir Joshua Reynolds, he was less successful with men at this time, particularly public figures, but "Johann Christian Fischer" the hautboy player (1780, Buckingham palace. London) is one of his most inspired works of this period. "The Morning Walk" (1785, National gallery, London), a picture of Squire Hallet and his wife, sums up both the elegance and the informality of the 18th century. Gainsborough's many other works include "The Blue Boy" (Master Jonathan Buttall; Huntington collection, California) and "Mrs. Siddons" (National gallery. London).

Of all the English 18th-century painters, Gainsborough was the most versatile and original, always prepared to experiment with new ideas and techniques. He was not, like Reynolds, a master of formal composition, but was devoted to his craft and always sensible of the poetry of paint. His letters reveal a lively character with a pretty wit and a genius for friendship.

See also PAINTING: *Great Britain;* PORTRAIT PAINTING: *Baroque and Rococo.*

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GAINSBOROUGH, a market town and urban district in the Parts of Lindsey and in the Gainsborough parliamentary division of Lincolnshire, Eng., on the right bank of the Trent, 18 mi. N.W. of Lincoln by road. Pop. (1951) 17,513. Area 3.7 sq.mi. A tidal bore or eagre of the Trent reaches the town. Gainsborough (Gegnesburh in 1013) was probably inhabited by the Saxons on account of the fishing in the Trent. The Anglo-Saxon Chronicle states that in 1013 the Danish king Sweyn landed there and subjugated the inhabitants. Gainsborough was probably a borough by prescription, for mention is made of burghal tenure in 1280. Mention is made in 1204 of a Wednesday market and in 1258 Henry III granted a Tuesday market to William de Valence, earl of Pembroke who also obtained from Edward I in 1291 licence for an annual fair on All Saints' day, and the seven preceding and eight following days. A fair was granted to John Talbot by Henry III in 1243, and two fairs were granted to Thomas, Lord Burgh, by Elizabeth I in 1592. The Tuesday market is still held, and the fair days are Tuesday and Wednesday in Easter week and the Tuesday and Wednesday after Oct. 20. The parish church of All Saints is classic of the 18th century, excepting the Perpendicular tower. The Old hall, of the 15th century, improved in the 16th, forms three sides of a quadrangle, partially timber framed, but having a beautiful stone bay window. Gainsborough possesses a grammar school founded in 1589 by a charter of Elizabeth I. There is carrying trade on the Trent and neighbouring canals. There are iron foundries and malt kilns and extensive agricultural and general engineering works. Shipbuilding is also carried on. Flour and cattle provender mills are established and corsetry, hosiery and woollen wear industries have been introduced. Gainsborough is the St. Ogg's of George Eliot's *Mill on the Floss.*

GAIRLOCH, a village and civil parish of Ross and Cromarty, Scot.. on the sea loch of Gairloch, 74 mi. W.N.W. of Inverness by road. Pop. (1951) 1,991. The parish includes Loch Maree, the Ben Eighe nature reserve and Invereme garden (owned by the Scottish National trust) with subtropical plants. Gairloch, with its sandy beaches, is a holiday place; it also has extensive herring, cod and salmon fisheries. Of the islands round the coast, only Isle Ewe in Loch Ewe is still inhabited.

GAISERIC or **GENSERIC (c. 390–477),** king of the Vandals. son of King Godegisel (d. 406) and king on the death of his brother Gonderic in 428. In 428 or 429 he led a host of Vandals from Spain into Roman Africa, and took Mauretania, and later Hippo. Having pillaged and conquered almost the whole of Roman Africa, the Vandal king concluded a treaty with the emperor Valentinian III. in 435, by which he retained his conquests. This peace was broken, and in Oct. 439 he captured Carthage, which he made the capital of his kingdom. In 455 he plundered Rome and returned to Africa laden with spoil. Among his captives was the empress Eudoxia, who is said to have invited the Vandals into Italy. The Romans made two unsuccessful attempts to avenge themselves, one by the Western emperor, Majorianus, in 460, and the other by the Eastern emperor, Leo I., eight years later. Gaiseric brought Sicily, Sardinia, Corsica and the Balearic Islands under his rule, and even extended his conquests into Thrace, Egypt and Asia Minor. Having made peace with the Eastern emperor Zeno (476), Gaiseric died Jan. 25, 477.

Gaiseric was a cruel and cunning man, possessing great military talents and superior mental gifts. Though the effect of his victories was afterward neutralized by the successes of Belisarius his name long remained the glory of the Vandals. *See* VANDALS.

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GAITÁN, JORGE ELIÉCER (1902–1948), Colombian statesman and penologist, was born in Bogota on Jan. 26, 1902. He studied law at the National university, Bogotá, and continued his studies in Rome, nhere he was a student of Enrico Ferri and followed closely the early development of fascism.

In Colombia he became known as a champion of the people and founded a short-lived party called Union Nacional Izquierdista Revolucionaria or UNIR (Left Revolutionary National union). His maiden speech as a congressman was a polemic argument on the Santa Marta banana plantations owned by the United Fruit company (1928). He served as mayor of Bogotá (1936) and minister of education (1940).

In 1945, as the leader of the more radical factions of Liberals, he ran for the office of president in opposition to the officialLiberal party candidate. Gabriel Turbay. As a result of this split in the ranks of the Liberals the victory went to the Conservative party candidate, Mariano Ospina Pérez. Gaitán's growing popularity, which was scarcely surpassed by that of his contemporaries, seemed to indicate that his eventual election to the presidency was assured, but he was assassinated in Bogotá on April 9, 1948, while the ninth International Conference of American States was meeting. The infuriated populace rioted and set fire to the central part of the city. (G. As.)

GAIUS (CAIUS), **SAINT,** pope from 283 to 296, is said to have been a Dalmatian and even a relative of the emperor Diocletian. His epitaph was found in the cemetery of Callistus. His feast day is April 22. (J. V. HN.)

GAIUS, a celebrated Roman jurist of the 2nd century A.D. Of his personal history very little is known. It is impossible to discover even his full name. Gaius or Caius being merely the personal name (*prae-nomen*) so common in Rome. His works were composed between the years 130 and 180, at the time when the Roman empire was most prosperous and its government the best. Most probably Gaius lived in some provincial town, and hence we find no contemporary notices of his life or works. After his death, however, his nritings were recognized as authoritative; and the emperor Valentinian III named him, along with Papinian, Ulpian, Modestinus and Paulus, as one of the five jurists whose opinions were to be followed by judicial officers in deciding cases. The works of these jurists accordingly became most important sources of Roman law.

Besides the *Institutes,* which are a complete exposition of the elements of Roman law, Gaius was the author of a treatise on the *Edicts of the Magistrates,* of *Commentaries on the Twelve Tables,* of a treatise on the important *Lex Papia Poppaea* and of several other morks. His interest in the antiquities of Roman law makes his work valuable to the historian of early institutions. In the disputes between the two schools of Roman jurists he generally attached himself to that of the Sabinians, who were said to be folloners of Xteius Capito. Many quotations from the works of Gaius occur in the *Digest* of Justinian, and so acquired a permanent place in the system of Roman lam; while a comparison of the *Institutes* of Justinian with those of Gaius shows that the whole method and arrangement of the later work were copied from that of the earlier, and numerous passages are word for word the same.

Unfortunately the work was lost to modern scholars until, in 1816. a manuscript, probably of the 5th century, was discovered by B. G. Niebuhr in the chapter library of Verona, in which certain of the works of St. Jerome were written over some earlier writings, ahich proved to be the lost work of Gaius. The greater part of the palimpsest was painstakingly deciphered, and comparison with other sources enabled some missing passages to be filled in. Two other important additions were made by the Oxyrhynchus papyri of about 250 and the important Antinoite or Egyptian fragments of the 4th or early 5th century.

The *Institutes* of Gaius are divided into four books—the first treating of persons and the differences of the status they may occupy in the eye of the law; the second of things and the modes in which rights over them may be acquired, including the law relating to wills; the third of intestate succession and of obligations; the fourth of actions and their forms.

For editions of the *Institutes,* see P. Kriiger and W. Studemund, 7th ed (1923); B. Kübler, 8th ed. (1939); and F. de Zulueta. 2 vol. (1946–53), which contains an English translation and full commentary.

For further information *see* ROMAN LAW. (J. F. LR.)

GAIUS CAESAR: *see* CALIGULA

GAJO (GAYO). According to tradition the Gajo and Alas peoples of northern Sumatra came from Batak lands to the highlands neighbouring the Achinese (*q.v.*). There they lived in relative isolation, yet not without modifying contacts. Indian influence introduced the idea of a hereditary chieftain and a graded society. However, this did not result in a powerful court of elaborate ceremonial life. During a period of Menangkabau supremacy they accepted Islam but its precepts were not fully understood. Mosques were feu in number and even in the 1960s only a minority performed the full religious rites. In the 17th century the Achinese imposed district rulers and strengthened the whole governmental structure. In later years these innovations tended to wane, and the *adat* or customary law became all-powerful.

A village consists of large community houses, each occupied by several families related in the male line. These structures are raised above the ground and consist of a men's gallery, a women's section and a common area which is divided into family compartments. A Gajo family consists of parents, children and married sons and their families. Theoretically all male members are related but adoption and other practices may modify this. A price is paid for the bride; then she and her offspring belong to the husband's clan. Polygyny is allowed but is rare.

In physical type the Gajo-Alas are proto-Malays but they show some intermixture with the Negrito and Malay. They probably do not exceed 100,000 in number. See also SUMATRA: *Population.*

See E. M. Loeb, *Sumatra (1935).* (F.-C. CE.)

GALAGO (**BUSH** BABY), the name of the long-tailed African lemurlike primates (*q.v.*); classed with the lorises and pottos in the family Lorisidae. They are extremely agile tree dwellers, characterized by the great elongation of the upper portion of the feet (tarsus) and the power of folding the large ears. They pass the day in sleep but are active at night. feeding on fruits, insects and small birds. When they descend to the ground they sit upright, and move about by jumping with their hind legs like jerboas. They are pretty little animals, varying from the size of a small cat to less than that of a rat, with large eyes and ears, soft woolly fur and long tails

There are several species, of which G. *crassicaudatus* from central Africa is the largest

GALAPAGOS ISLANDS (ARCHIPIÉLAGO DE COLÓN), a group of 14 main islands and numerous smaller islands scattered over 23,000 sq.mi. of equatorial Pacific ocean, between 500 and 700 mi. W. of Ecuador. Total land area is 3,028 sq.mi., about half of which is contained in the largest (1,754 sq.mi.) and highest (5,500 ft.) island, Albemarle (Isla Isabela).

There has been much speculation concerning the origin of the islands in the absence of conclusive evidence. Geological and bathymetric data indicate that they probably were never connected with the American mainland. The islands are comprised largely of lava piles dotted with volcanoes, mostly extinct. One on Albemarle erupted in 1948, 1953 and 1957.

The climate is characterized by such tropical anomalies as a markedly low rainfall along the coast (annual average 3–4 in.). low air temperatures (70°–85° F.) and low ocean temperatures at the surface (63°–86° F.). Largely responsible for this climatic regime are the chilling waters of the Humboldt or Peru current which upwells around Galápagos. Thundershowers may occur from January to April, and a mist (*garúa*) periodically blankets the area from May to December.

Treelike cactus, spiny shrubs and dwarf deciduous trees dominate the coastal regions. Native guava and unique sunflower trees flourish on the volcanic uplands.

Homever. the Galápagos are best known for their unusual animals. the most dramatic being the large spiny marine and land iguanas. The archipelago is named after the enormous land tortoises (*galápago,* old Spanish name for "tortoise"), considered among the oldest living creatures on earth, which may weigh 500 lb. or more. Other zoological curiosities include a four-eyed fish, distinct species of penguin, flightless cormorant and albatross, as well as a group of 13 species of very tame finches, one of which employs a stick as a tool to obtain food. Charles Darwin, who visited Galapagos in 1835 as naturalist of the "Beagle," was so impressed with the interisland variations in shape of the tortoise shells (some saddlelike, others domelike) and the finch bills (some like a warbler, others like a grosbeak) that they inspired many of his views on natural selection.

The Galápagos Islands were discovered by Tomás de Berlanga. bishop of Panamá, while en route to Peru in 1535, and named Las Encantadas ("the bewitched"). Sites on several of the islands have yielded Inca pottery fragments providing evidence of pre-Spanish occupation. Numerous Spanish voyagers stopped at the islands during the 16th century, and in the late 17th century pirates used the islands as a hideout. About 1800 freebooting gave way to whaling. The buccaneers and whalers named many of the islands after English personalities of the period. At the beginning of the war of 1812, American gunboats executed sea raids around Galapagos designed to harass British shipping. In 1841 the novelist Herman Melville visited the islands, which became the locale for his charming essay, Las Encantadas. Kineteenth-century sealers slaughtered untold thousands of fur seal and nearly exterminated this species. Since the earliest visits to the islands by man, domestic animals have escaped or have been put ashore, so that now cattle, horses. donkeys. goats, pigs, dogs and cats are running wild. The tortoises suffered the most from predation by pigs and dogs and from human exploitation for their meat and fat, and several forms have become extinct. The government of Ecuador made the Galipagos (in part) a wildlife sanctuary in 1935 and again in 1959.

The islands had been unclaimed for almost 300 years before colonization began on Charles Island (Isla Santa Maria) in 1832, when Ecuador took official possession of the archipelago and assigned Spanish names to the islands. Other colonies were started subsequently on Chatham Island or Isla San Cristóbal (the territorial capital), at Wreck bay (Bahia de Naufragio) and at Villamil on Albemarle Island. From about 1920 to 1940 a few European emigrants reached the islands, but most of them left because of food and water shortages. A few, however, settled on Indefatigable Island (Isla Santa Cruz) around Academy bay (Bahia de la Academia). In 1942 the United States constructed an air base (defunct since 1946) on South Seymour Island (Isla Baltra). Since then, Ecuadorians have been gradually settling on the arable islands. The population in 1960 was 1,900. Phenomenal yields of coffee, potatoes and lemons in the highlands and a plentiful supply of fish (tuna and groupers) along the coasts form the basis of the economy. There are small deposits of sulfur. The territory of Archipiélago de Colón is administered through Guayas province.

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GALASHIELS, a small burgh of Selkirkshire, Scot. Pop. (1961) 12,374. It is on Gala Water within a short distance of its junction with the Tweed, 33 mi. S.S.E. of Edinburgh by road. The town stretches for more than 2 mi. along both banks of the river. the mills and factories occupying the valley by the stream. The municipal buildings were enlarged as a World War I memorial.

The Scottish Woollen Technical college (1909) is devoted to instruction in woolen manufacture. which dates there from the close of the 16th century. It is now mainly confined to the weaving of tweeds and the making of knitwear. Galashiels was originally a village built for accommodation of pilgrims to Melrose abbey (4 mi. S.E.). and was created into a burgh of barony in 1599. The Catrail or Picts' Work begins near the town and passes immediately to the west. Clovenfords, 33 mi. W., is noted for the large Tweed vineries.

Two miles farther southwest is Ashiestiel, where Sir Walter Scott resided from 1804 to 1812. Abbotsford (*q.v.*), his later house. lies to the south of the town, across the Tweed.

GALATIA. I. In the strict sense this is the name applied to a large inland district of Asia Minor occupied by Gaulish tribes in the 3rd century B.C. It was bounded on the north by Bithynia and Paphlagonia, west by Phrygia, south by Lycaonia and Cappadocia, east by Pontus.

Galatia is part of the great central plateau of Asia Minor, there ranging from 2,000 to 3,000 ft. above sea level: and falls geographically into two parts separated by the Halys (*Kizil* Irmak), a small eastern district lying chiefly in the basin of the Delije Irmak. the principal affluent of the Halys, and a large western region drained by the Sangarius (Sakaria) and its tributaries. On the north side Galatia consists of a series of plains with fairly fertile soil, lying between bare hills. But the greater part is a stretch of barren, undulating uplands, intersected by tiny streams and passing gradually into the vast level waste of treeless plain that runs south to Lycaonia; these uplands are little cultivated but afford pasturage for large flocks of sheep and goats.

The Gaulish invaders appeared in Asia Minor in 278–277 B.C. They numbered 20,000 of which only one-half were fighting men; not long after their arrival we find them divided into three tribes, Trocmi, Tolistoboii and Tectosages. They had split off from the army which invaded Greece under Brennus in 279 B.C., and crossed over to Asia at the invitation of Nicomedes I. of Bithynia, who required help in his struggle against his brother. For about 46 years they were the scourge of the western half of Asia Minor, ravaging the country without any serious check, until Attalus I., king of Pergamum, inflicted several severe defeats upon them, and about 232 B.C. forced them to settle permanently in the region to which they gave their name. In the settlement of 64 B.C. Galatia became a client-state of the Roman empire, and three chiefs were appointed, one for each tribe. But this arrangement soon gave way before the ambition of the chief Deiotarus (*q.v.*), the contemporary of Cicero and Caesar, who was recognized by the Romans as king of Galatia. On the death of the third king, Amyntas, in 25 B.C., Galatia was incorporated by Augustus in the Roman empire, and few of the provinces were more enthusiastically loyal.

The population of Galatia was not entirely Gallic. Before the arrival of the Gauls, western Galatia up to the Halys was inhabited by Phrygians, and eastern Galatia by Cappadocians and other native races. This native population remained, and constituted the majority of the inhabitants of the rural parts and almost the sole inhabitants of the towns. They were left in possession of two-thirds of the land (Caesar, *B.G.* i. 31) on condition of paying part of the produce to their new lords, and agriculture and commerce with all the arts and crafts remained in their hands. They ranked as "Galatians" equally with their overlords, and it was from their numbers that the "Galatian" slaves were drawn. The conquerors, who were few in number, formed a small military aristocracy, living not in the towns, but in fortified villages, where the chiefs in their castles kept up a barbaric state, surrounded by their tribesmen. With the decline of their warlike vigour they began gradually to mix with the natives and to adopt their religion: the amalgamation was accelerated under Roman influence and ultimately became complete; but they gave to the mixed race a distinctive tone and spirit, and long retained their national characteristics and social customs, as well as their language (which continued in use, side by side with Greek, in the 4th century A.D.). In the 1st century, when St. Paul made his missionary journeys, even the towns Ancyra (mod. Angora), Pessinus and Tavium (where Gauls were few) were not hellenized; while the rural population was unaffected by Greek civilization. Hellenic ways and modes of thought begin to appear in the towns only in the later 2nd century. In the rustic parts a knowledge of Greek begins to spread in the 3rd century; but only in the 4th and 5th centuries, after the transference of the centre of government to Constantinople placed Galatia on the highway of imperial communication, was Hellenism in its Christian form gradually diffused over the country. (See also ANCYRA; PESSINUS; GORDIUM.)

II. The Roman province of Galatia, constituted 25 B.C., included the greater part of the country ruled by Amyntas, viz., Galatia Proper, part of Phrygia towards Pisidia (Apollonia, Antioch and Iconium), Pisidia, part of Lycaonia (including Lystra and Derbe) and Isauria. For nearly 100 years it was the frontier province, and the changes in its boundaries are an epitome of the Roman advance to the Euphrates. Under Diocletian's reorganization Galatia was divided, about 295, into two parts, and the name retained for the northern. After suffering from Persian and Arabic raids, Galatia was conquered by the Seljuk Turks in the 11th century and passed to the Ottoman Turks in the middle of the 14th.

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GALATIANS, EPISTLE TO THE, a letter of Paul usually printed as the ninth book in the New Testament. The authenticity of this letter has never been questioned save by occasional critics who have refused to admit the genuineness of any of the Pauline letters. The excitement under which it was written, the sweeping (and at times reckless) statements, the omission of a complimentary paragraph of thanksgiving at the beginning and of a group of salutations at the end, regular parts of a Pauline letter—all these indicate the free hand of one who felt under no obligation to make his composition resemble the work of another. Nor is there any reason to question the integrity of the letter. At times the Greek is awkward, with frequent breaks in construction (anacoloutha) and daring ellipses of thought, but these simply indicate the emotional strain under which the writer was labouring.

Content.—The temper of the letter and, in part, the situation which evoked it are evident in the opening words. Although Paul regularly styled himself an apostle, he here insists that his apostleship is not from men, but from God. His authority has been challenged. At once he proceeds to the attack, with no time or thought for any complimentary paragraph of thanksgiving; obviously at the moment he has little to thank God for as he views the attitude of these "foolish Galatians." Instead his word is: "I marvel that ye are so quickly removing from him that called you in the grace of Christ unto a different gospel." This "different gospel" is actually no gospel at all; it is simply the work of men nullifying the saving work of God. The gospel which Paul had preached had been divinely revealed to him; hence, any deviation from it is false and its champions are accursed (i, 1–9). This he attempts to justify by a brief recital of his own experiences. God had called him at a time when he was attempting to persecute the church, had made him an apostle and had revealed to him his message. Thus, his message was literally from God, not from men. He had had only the slightest contacts with those whom he styles "apostles before me." They had taught him nothing during his two brief visits to Jerusalem; on the latter occasion they had had to admit that he had been divinely commissioned as an apostle to the gentiles. Later when Peter was at Antioch, he (Paul) maintained his independence and had even publicly rebuked him, although to do so had meant to stand alone. Since his gospel is thus completely from God, he can speak as he does. Actually, since he has been "crucified with Christ," when he speaks, it is Christ who speaks in him (i, 10–ii, 21). Then follows an attack upon his opponents' contentions. The new freedom which they had received through his earlier preaching to them was the result of their faith in Christ, not of their adherence to the works of the law. It is folly then to slip back into the bondage from which they had been freed by God's grace (iii, 1–iv, 11). Then with a swift change of tone he reminds them of their former love for him and urges them to hearken to him, not to their false friends who are seeking to lead them astray (iv, 12–20). Once again the tone changes, and with a clumsy allegory about Ishmael and Isaac he seeks to undercut his opponents' contention (iv, 21–31). Frequently it has been asserted that at v, 2 a new main section begins. It is perhaps less artificial to regard v, 1–10 as a summary of the whole preceding section (iii, 1–v, 10), with the last main section, beginning at v, 11, a blistering attack upon his critics and concluding with the insistence that liberty (freedom) is far from being licence but demands the strictest sort of moral purity, not because of any demand in the Mosaic law but because one who is "in Christ" can do no other. The whole requirement is summed up in the one command: "Thou shalt love thy neighbour as thyself" (v, 11–25). Following a brief but detailed application of this command (vi, 1–10), he quickly concludes the letter with the briefest of benedictions and without the customary personal greetings or requests. This concluding section (vi, 11–18) was apparently written by Paul personally, the rest of the letter dictated to an amanuensis (*cf.* Rom. xvi, 22).

Occasion and Purpose. — While such critical problems as the date of the letter, the place from which Paul is writing and the exact location of the "churches of Galatia," have always been recognized as obscure, the occasion and purpose have seemed self-evident. From beginning to end the letter has seemed to have been directed against a group who mere insisting that gentile Christians must be circumcised and observe the Jewish law. Following Paul's departure after establishing these churches, Judaizers (Jewish Christians), perhaps from Jerusalem, had arrived and as at Antioch (Acts xv, 1 ff.) had insisted that full adherence to the Jewish law (including circumcision) was mandatory upon all Christians, Jewish and gentile alike. Far from being an apostle as were the Twelve, Paul was a dangerous latitudinarian. Not only had he preached an emasculated gospel, but his insistence upon freedom from the Jewish law could not fail to result in a moral breakdown. It was against this attempt to discredit him and his gospel that Paul directed his stinging reply.

That a group which may be styled Judaizers are attacked in this letter by Paul is obvious; that they are his only opponents is far less certain. The query, "But I, brethren, if I still preach circumcision, why am I still persecuted?" (v, 11), has always caused difficulty for the interpreter who saw only Judaizers as Paul's opponents. Why should they so charge Paul? Rather it sounds like an indignant denial of the charge that he was still so preaching. Again the ringing and detailed insistence upon moral probity, that liberty must not degenerate into licence, is not easily understood if directed to Judaizers. Finally, the nature of the autobiographical section, with its denial of contact with Jerusalem, is not easily explained if directed against a group who were insisting that he had proved false to the gospel which he had received (from them). On this assumption, the only possible explanation of this opening section would be: You claim that I have proved false to the gospel I received. Your contention is absurd. I have not "proved false" to it, for I never received it from you at all.

Aside from these obvious difficulties is the fact that there seem to be direct references in the body of the letter to a quite different sort of opposition. The stinging jibe, "ye who are spiritual" (vi, 1), would seem to be directed against a group which had arrogated to themselves that title, much as had a group in Corinth. To meet these obvious difficulties W. Liitgert (Gesetz *und* Geist [1919]) and J. H. Ropes (The Singular Problem of the Epistle to the Galatians [1929]) argued that there were two factions against whom Paul was contending and that both were resident in the region, not strangers who had followed him in. Some of the Galatian converts, although themselves gentiles, had become enamoured oi Jewish practices. They may well have felt that they were proving faithiul to the spirit of Paul's teaching, for to gentiles Paul undoubtedly seemed far closer to Judaism than he himself fancied that he was. Perhaps encouraged by local Jews these new and inexperienced "sons of Abraham" attempted to introduce Jewish practices, including circumcision, into the churches.

This ill-advised action provoked a crisis, for to many of the converts the one attractive note in Paul's preaching had been his insistence upon freedom. Their mystic union with Christ ("in Christ") seemed to them to remove all restraints. They were in Christ and hence were guided by the spirit, even as was Paul himself. The contention of their fellow Christians accordingly proved most unwelcome. If, as is far irom unlikely, these latter claimed Paul's support for their innovations, it would not be surprising that this had heightened the growing dissatisiaction of the "spirituals" for Paul and his inconsistent and galling moral restraints.

Word came to the absent Paul of the difficulty. Not being able to come personally, he wrote this letter. Both groups are before his eyes and both receive his indignant protest: the Judaizers for ignorantly nullifying his gospel of freedom from enslavement to the law and for provoking a crisis, the consequences of which no one could foresee; the spirituals for blatantly charging him with precisely those qualities which he was sure were not his. He had not suffered ostracism from his own race for his denial of precisely that with which his converts were now charging him? Furthermore, they were denying the validity of his one great confidence: that his gospel had come from God, not from men. And finally, in their arrogance they were so distorting his teaching of freedom as to endanger the good name of all Christians and even to make Christ himself a reproach. Caught between these two fires, it is not surprising that he wrote in passionate and at times extravagant and bitter words.

Readers. — The location of the "churches of Galatia" to which the letter is directed is far from certain. During the 4th and 3rd centuries B.C. Gauls had pushed south into the Italian and Grecian peninsulas. About 279 they had made their way into central Asia Minor and had set up a small kingdom. Following some years of independence, they had come under the sway of Cappadocia and Pontus and eventually (A.D. 25) together with Pisidia and parts of Lycaonia had become a Roman province. During the following years this newly constituted province had been increased by Paphlagonia and Pontus Galaticus. Thus, at the time of Paul's ministry the Roman province was iar larger than the old kingdom, and many of the provincials were not Gauls (Celts) but Phrygians and Lycaonians. Had we only the letter itself, probably no one would have thought of denying that the old kingdom of Galatia, centring about Ancyra, was indicated. To be sure, "churches of Galatia" might conceivably have been found in such southern cities as Pisidian Antioch, Iconium, Lystra and Derbe, but the address, "O foolish Galatians" (iii, 1), would certainly have seemed to indicate those who were such by race, not Phrygians, Lycaonians or Pisidians who chanced to be resident in the larger political unit.

But according to Acts, Paul is represented as working in these southern cities on his so-called first missionary journey (Acts xiii, 1–xiv, 28) and as passing through several of them on his second journey (Acts xvi, 1–5). There is no mention in Acts that he established any churches in northern Galatia or, in the judgment of some scholars, that he even visited this region. Thus, some concluded that the letter was addressed to churches in these four southern cities. This is the South Galatian hypothesis.

Two passages in Acts, however, provide distinct difficulties for this hypothesis — xvi, 6 ff. and xviii, 23. The most natural interpretation of the former is that Paul did not go through "Phrygia and Galatia" until after he had been prevented from entering the province of Asia. Unable to go to Ephesus, he had turned north, had skirted the east frontier of Mysia and had finally reached Troas. According to Acts xviii, 23 he left Syrian Antioch and "went through the region of Galatia and Phrygia, in order, establishing all the disciples." While this passage can be interpreted to mean that he retraced his steps, and is so interpreted by those who hold the South Galatian hypothesis, the change of order from "Phrygia and Galatia" to "Galatia and Phrygia" would seem to be intentional and to suggest that on this trip he did not go through Cilicia but instead entered Galatia via Cappadocia, and having left Galatia passed through Phrygia and so into Asia and eventually to Ephesus. The chiei objection to the North Galatian hypothesis is not the remoteness of the region — there is no occasion to assume with J. B. Lightfoot and his predecessors that he traversed the whole region, but only the western edge of it, in consequence of his inability at that time to enter Asia or Mysia — or the phrase "Galatic region," which most interpreters who hold the rival hypothesis insist is a deliberate substitute for "Galatia" to indicate territory subsequently added to Galatia proper, but the fact that Acts thus passes by in silence his activity in Galatia but recounts work in the southern cities to which, if the North Galatian view be adopted, no letter of Paul is extant. This objection is by no means fatal — to many it does not appear particularly serious — in view of the iact that the account in Acts is by no means complete even for the portion of the story outlined. Furthermore, that we have no letter to these cities in the south is no more surprising than the fact that we have no letter to Eeroea, Laodicaea or to the churches in the "region of Syria and Cilicia."

Date. — The date and place of composition are also obscure, and most divergent answers have been given, ranging all the way from Antioch, prior to the visit to Jerusslem recounted in Acts xv, to Rome, at the end of Paul's career. It has been frequently maintained that prior to writing this letter Paul had twice visited the region, once when he established the churches and once subsequently. In support of this contention two lines of argument have been advanced (1) "But ye know that because of an infirmity of the flesh I preached the gospel unto you the first time" (iv, 13). That the words τὸ πρότερον must be rendered "the first time" or "on the former oi two occasions" is by no means certain although often asserted. It may be remarked in passing that this verse does suggest that Paul had not intended a conquest of Galatia but had been taken ill while passing through the region after having been denied entrance into Asia. Paul was never a man to let an opportunity escape. (2) There are several statements in the letter which have been understood of a second visit, viz., i, 9; iv, 16, 20; v, 3. Neither argument appears decisive to the present writer.

The possibilities of dating the letter are thus seen to be many. For those who hold the Iiorth Galatian view it must have been subsequent to Acts xvi, 6 and thus scarcely before his arrival at Corinth on the second journey, for some time must be allowed for the rise oi the schism and for its report to reach Paul. If two visits be postulated— and most of those who hold the North Galatian view so maintain — the earliest and most likely time would be during his three years in Ephesus. For those who hold the South Galatian view a still wider latitude is possible. If but one visit is postulated, any time after returning to Antioch at the end of the first journey; if two visits seem demanded, any time after reaching Corinth in the course of the second journey.

Any adequate discussion of these several possibilities would require a detailed examination of a complicated and thorny problem: Paul's contact with Jerusalem (prior to his final visit which ended in his arrest) in the light of the fact that Paul would seem to recount but two such visits(Gal. i, 18 f.; ii, 1–10), while Acts mentions three (Acts ix, 26–30; xi, 27–30; xv, 1–35). A brief discussion of the problem and of what is involved may be found in M. S. Enslin's *Christian Beginnings*, pp. 226–32.

Perhaps the most likely situation for the composition of the letter was during the latter part of Paul's stay in Ephesus, that is, A.D. 54. The principal advantage of this hypothesis is that it would account for the similarity in tone. often remarked, between this blistering letter whose pages are "blotted by tears" and the so-called severe letter to Corinth (II Cor. x–xiii) and also for the marked similarity in content but the vastly more cautious and dispassionate tone and form of statement in Romans, written perhaps six months later from Corinth, which in many ways seems almost a revision or restatement of the diatribe to the churches of Galatia, perhaps at a time when both the rebellious Corinthians and the foolish Galatians had yielded to Paul's demands.

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(M S EN.)

GALATZ (Rum. GALAŢI), a city of Rumania, in the region of the same name; on the left bank of the Danube river, 90 mi. W. by N. of its mouth at Sulina. Pop. (1956) 95,646. The Danube is joined by the Seret 3 mi. S.W. of Galatz, and by the Pruth 10 mi. E. Galatz is built on a slight eminence among the marshes which line the intervening shore and form, beside the western bank of the Pruth, the wide but shallow mere called Lake Bratych (Bratesul). It is the seat of the Rumanian 3rd army corps, the Rumanian naval school, the bishopric of the lower Danube, a prefecture, the main Danubian shipping companies and chambers of commerce. Galatz contains a cathedral and many other churches; St. Mary's church contains the tomb of Mazeppa.

Galatz is the chief Rumanian port of entry for imports, and the chief port of export for timber, while in grain it comes second to Braila

GALAX, an evergreen herb of the Diapensiaceae family containing a single species, the beetleweed (G. *aphylla*), which has a thick matted tuft of creeping rhizomes beset with fibrous red roots, and sending up stiff, shiny, veiny heart-shaped or rounded leaves, 3–16 cm. across, and a slender spikelike flower stalk bearing small white flowers. It is native in open woods from West Virginia to Georgia and Alabama in the U.S., and is cultivated and escaped northward to Massachusetts. The leaves are collected in quantities in the mountains of Worth Carolina and Virginia, especially in autumn when they show a beautiful bronze colour, and are much used by florists in wreaths and other decorative pieces.

(J. M. BL.)

GALAXY, the system of stars, appearing projected on the sky as the Milky U'ay (Greek, *galaxias* kyklos, the milky way), in which the solar system and all stars visible to the naked eye are located. The derived term "galaxies" refers to external systems similar to the Galaxy and is normally equivalent to extragalactic nebulae. The present article is limited to our own galaxy.

Nature of the Galaxy and Position of Solar System Within It.—Inspection of the Milky Way with a small telescope shows it to be resolved into myriads of faint stars. In fact, most classes of stars are concentrated to the Milky Way belt, the degree of concentration increasing as the stars studied become fainter, as was shown by the prolonged star counts (or gauges) carried out by Sir William Herschel at the end of the 18th century and extended to the southern hemisphere by his son, Sir John Herschel, in 1834–38. These counts were continued in selected areas, with the aid of photography and astrographic telescopes, by J. C. Kapteyn and his colleagues at Groningen in 1900–20. They found that the number of stars per unit volume of space decreased uniformly with distance in all directions in the Milky Way belt and concluded that our solar system is near the centre of a highly flattened discoidal system of stars with a radius of the order of 2.000 parsecs (1 parsec = 3.26 light years = 3.1×10^{13} km.). The conclusions as to the size of the system and our central position were quite mistaken because the obscuring effect of interstellar dust clouds (also concentrated in the Milky Way) was not realized at the time.

A more accurate picture was derived by Harlow Shapley from a study of the globular clusters, highly concentrated spheroidal systems, each with an average content of 1,000,000 stars. The 100 or so known globular clusters are equally numerous on either side of the galactic plane (the plane running centrally through the

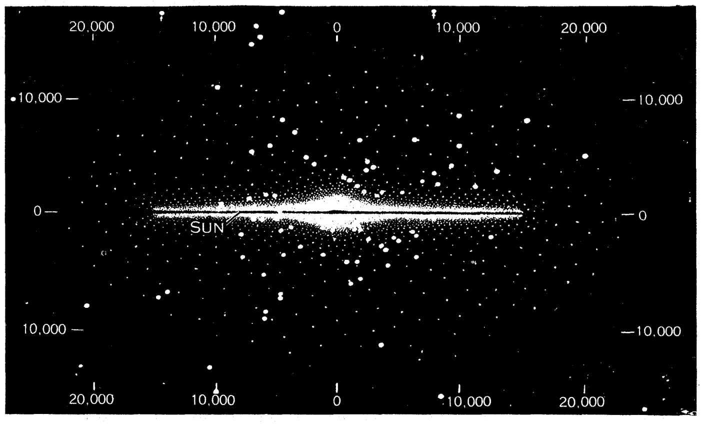

FIG. 1.—MODEL OF THE GALAXY
Numbers denote distances in oarsecs

Milky Way belt) and undoubtedly describe orbits about the centre of the galaxy, but most of them are situated in or near the direction of Sagittarius mhile the rest are almost all in that half of the sky. The globular clusters are rich in variable stars, pulsating with periods of a few hours. known as RR Lyrae stars or cluster-type variables; by fitting the period-luminosity relation for Cepheid variables (first discovered from observations of Cepheids in the extragalactic Magellanic Clouds and calibrated by Shapley himself from observations of galactic Cepheids) to these RR Lyrae stars, Shapley estimated the distances of several globular clusters and concluded in 1918 that the centre of the system of globular clusters (and thus the centre of the galaxy) is situated in the Milky Way at a distance of 30,000 parsecs toward a point in Sagittarius.

This conclusion as to the solar system's peripheral position in the galaxy remains valid today. but the distance of the centre turns out to be only about 8,200 parsecs when the effect of interstellar absorption (which makes the cluster stars look fainter than they would in a transparent medium) is allowed for.

Fig. 1 (after J. H. Oort) gives an idealized picture of the galaxy as seen edge-on from an external point in the plane of the Milky Way. The brighter region, containing the hottest, brightest stars and clouds of interstellar gas and dust, forms a highly flattened disk with the solar system about halfway out from the centre. The thickness of the disk is very small at the edges and perhaps about 5,000 parsecs in the central bulge. Surrounding this disk is a halo or corona of much lower mean density; the globular clusters (shown as large dots) are the most striking members of this nearly spherical subsystem. W. Baade's photographs of the Andromeda Nebula, which is probably very close to being a twin of our own galaxy, suggest that the spherical subsystem has a larger radius than the disk and may contain over 90% of the mass of the whole system.

Galactic Co-ordinates.—It is convenient to define a system of angular celestial co-ordinates based on the central plane of the Milky Way, also known as the galactic plane or galactic equator, which is inclined at about 63° to the celestial equator. Galactic latitude (b) is the angular distance from a point of the sky to the nearest point of the galactic equator, while galactic longitude (l) is the angular distance of this latter point (measured in the direction of increasing right ascension) from the intersection of the galactic and celestial equators in Aquila. The co-ordinates of the galactic centre are $b = -1°$, $l = 328°$, so that the sun is slightly north of the galactic plane. In 1959 a new system of galactic co-ordinates was adopted with $l = 0°$ in the direction of the galactic centre.

Rotation of the Galaxy.—Like other spiral nebulae, the galactic system rotates in its own plane. As might be expected from dynamics, the rotational speed is greatest in the highly flattened disk and least in the nearly spherical system of the globular clusters, which latter accordingly show a systematic drift velocity of about 250 km. per second toward Carina. B. Lindblad (1925) was the first to show how the phenomena of star streaming, and the drift velocities and spatial distributions of stars of various classes,

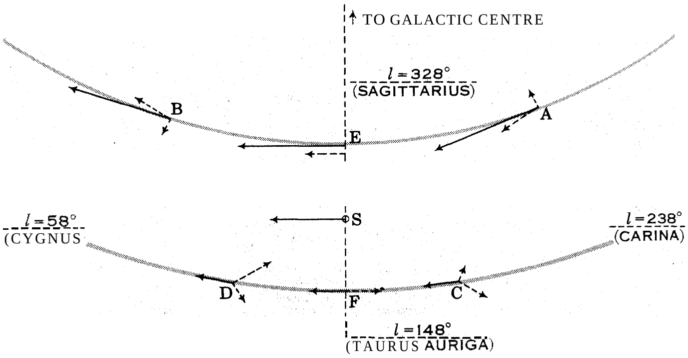

FIG. 2—DIFFERENTIAL ROTATION OF THE GALAXY

S represents the solar system. A and B represent two stars closer to the galactic centre and thus traveling around faster than the sun; C and D are two stars farther away from the galactic centre and traveling more slowly. The arrows with full lines represent velocities relative to the galactic centre; arrows with broken lines represent velocities along and perpendicular to the line of sight

could be understood in terms of a series of concentric spheroidal subsystems with the rotational speed and degree of flattening increasing from one subsystem to the next. In the inner portion of the galaxy. in which most of its mass is concentrated, it rotates more or less like a rigid body. but. in the outer parts of the disk, containing the sun and majority of observable stars, the angular velocity diminishes outward from the centre as with planets in the solar system. Thus, if a group of stars surrounding the solar system is taken, those between us (the solar system) and the centre will be gaining on us and those farther away will be lagging behind. Hence stars nearer the centre and ahead of us, and stars farther away and behind us (see B and C in fig. 2) will both show a systematic velocity of recession when their velocity in the line of sight is measured; while those nearer the centre and behind us, or farther out and ahead of us (A and D) will show a systematic velocity of approach.

For distances up to about 2,500 parsecs, this effect of differential galactic rotation (first definitely established by Oort in 1927) increases uniformly with distance at a rate of about 18 km. per second per 1,000 parsecs in those directions where the effect is at its maximum (positive or recession 1 = 13° and 193°, negative or approach 1 = 103° and 283°), a result based on extensive measurements in the spectra of hot stars by J. S. Plaskett and J. A. Pearce (1934). The efiect is thus most readily observed from the spectra of distant stars; for the nearer stars it is obscured by the presence of random velocities (such as the solar velocity of 20 km. per second toward Hercules) due to the fact that galactic orbits are not exactly circular.

A further effect of differential rotation appears in stellar proper motions, with a maximum effect in the directions toward and away from the galactic centre (see E and F in fig. 2). This is independent of distance and corresponds to a maximum proper motion of 0.15 sec. of arc per century, corresponding to a velocity of 8 km. per second per 1,000 parsecs. From the magnitudes of the effects in proper motion and radial velocity, it follows that the sun completes its orbit about the galactic centre in about 200.000.000 years; its velocity is less easy to estimate, since it depends on the distance of the galactic centre, but it is probably between 200 and 300 km. per second. From the speed of rotation it is possible to estimate the approximate mass of the galaxy, which is of the order of 3×10^{44} g. or 160,000,000,000 times that of the sun. From velocities perpendicular to the galactic plane, assuming that a condition of statistical equilibrium has been set up. it is possible to estimate the density of material in the solar neighbourhood. Oort (1930) found this to be 7×10^{-24} g. per cubic centimetre (or 0.1 of the mass of the sun per cubic parsec), slightly more than half of which is probably due to stars while the rest represents interstellar matter.

Relative to the "local standard of rest," a hypothetical point moving in a truly circular galactic orbit, the peculiar motions of most of the nearby stars (up to ±30 km. per second) tend to be toward or away from a vertex in the galactic plane about 22" away from the galactic centre. This phenomenon of star streaming nas discovered by J. Kapteyn (1904) and reinterpreted by K. Schwarzschild in terms of spatial distribution of the peculiar velocities over the surface of an ellipsoid with its long axis pointing toward the vertex. H. H. Turner and Lindblad explained this effect as a consequence of slight eccentricities in galactic orbits; the deviation of the vertex (which in the simple theory should be toward the galactic centre) may be due either to the gravitational effect of local concentrations of stars and interstellar matter or to the significant influence of a few rich, moving clusters on the statistics

High-Velocity Stars.—Many stars exist in the solar neighbourhood which do not share in this pattern of motion in and perpendicular to the galactic plane; they are known as high-velocity stars and belong either to the spherical population associated with the globular clusters or to an intermediate population with a lower degree of concentration ton ard the galactic plane than is possessed by the hot bright stars and clouds of interstellar matter. Although the high-velocity stars have a much greater spread of velocities (±100 km per second) than the low-velocity stars (±30 km per second), corresponding to very elongated galactic orbits. their motions relative to the sun are all toward the half of the sky centred on $b = 0°$. $1 = 238°$, *i* e., they are actually all lagging behind the solar system in galactic rotation. This is probably because stars overtaking the sun nith a high enough speed to be identified as having high velocity would be moving so fast as to escape from the galaxy altogether

Spiral Structure of the Galaxy.——Analogy with other galaxies having stellar populations similar to that in our own neighbourhood suggests that our own galaxy should be a spiral nebula. The spiral arms of external galaxies are rich in hot, bright stars and interstellar clouds of gas (mainly hydrogen) and dust; these same features serve as indicators of the spiral structure in our own system. The first evidence of spiral arms was obtained in 1951 by W. W. Morgan and various collaborators. From the spatial distribution of hot, bright stars (studied in collaboration with J. J. Nassau. A. E. Whitford and A. D. Code) and of regions of ionized hydrogen emitting the red H-a line (photographed in conjunction with S. Sharpless and D. E. Osterbrock). Morgan was able to identify portions of three spiral arms (see fig. 3): the Orion arm, stretching from Cygnus through Cepheus, Perseus, Orion and Monoceros and including the dust lane which causes the Great Rift in the Milky Way; the Perseus arm, farther off and with its nearest portion in roughly the same direction; and the Sagittarius

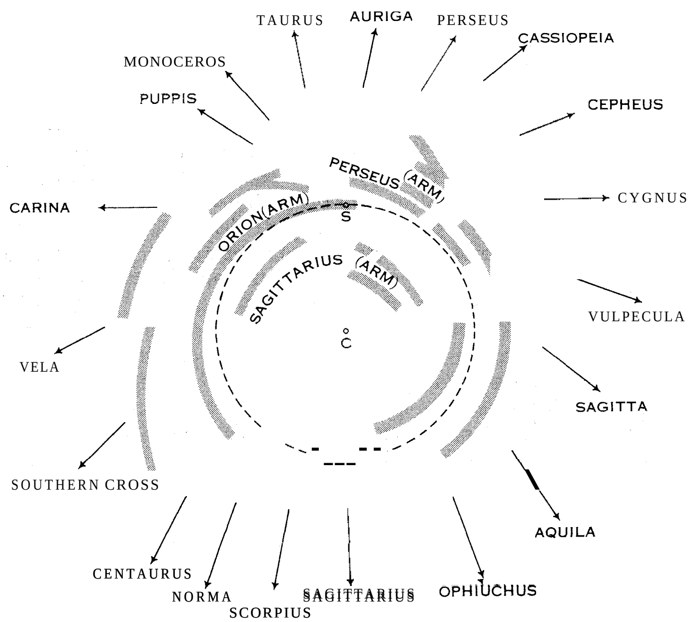

FIG. 3.— SPIRAL STRUCTURE OF THE GALAXY IN RELATION TO CONSTELLATIONS OF THE MILKY WAY FROM OPTICAL AND RADIO OBSERVATIONS

S represents the solar system and C the centre of the galaxy. The sense of galactic rotation is clockwise

arm toward the galactic centre.

The solar system appears to be situated toward the inner edge of the Orion arm: which is about 400 parsecs wide, while the Perseus arm is about 2,000 parsecs away in the direction away from the centre. These conclusions were confirmed and extended shortly afterward by observations of the 21-cm., radio-frequency emission of neutral hydrogen by H. C. van de Hulst, C. A. Muller and Oort. and by F. J. Kerr and J. V. Hindman in the southern hemisphere. Using Oort's theory of galactic rotation, the distances of the neutral hydrogen clouds were obtained from their motions in the line of sight, derived from the Doppler shift in the frequency at which emission is a maximum.

The radio method penetrates to far greater distances than the optical methods and has led to the fairly extensive picture of spiral structure shown in fig. 3. G. Münch has shown that the interstellar absorption lines in the spectra of hot stars in the Perseus arm split into two groups with velocity shifts corresponding to the differential galactic rotation effects in the Orion and Perseus arms, respectively. Furthermore, the profiles of the interstellar lines closely resemble those of the 21-cm. line observed in the same direction.

The results of these and other investigations suggest that our galaxy is a spiral nebula of E. P. Hubble's type Sb, with both spiral arms and nucleus well developed, closely resembling the Andromeda Nebula.

Stellar Populations and Evolution of the Galaxy.—In 1941, Baade succeeded in resolving the nucleus of the Andromeda Nebula into stars by using red-sensitive plates, in contrast to the more usual blue-sensitive plates with which the brightest stars in the spiral arms had been picked out long before. His success resulted from recognition of the fundamental difference between the stellar population in the disk and especially the spiral arms (Population I) in which the brightest stars are hot and therefore blue, and that distributed spherically with a concentration toward the galactic nucleus (Population II) in which the brightest stars are cool red giants. Population I includes most stars in our neighbourhood, Cepheids. galactic open clusters and interstellar clouds. while Population II includes globular clusters. RR Lyrae stars, novae. planetary nebulae and some of the high-velocity stars. The physical differences between the two populations arise from the fact that Population I includes many young stars which have recently condensed from the interstellar medium, while star formation virtually ceased nearly 10,000,000,000 years ago in Population II; there the most massive stars, which run through their supplies of nuclear fuel the most rapidly, have become cool giants or have disappeared from view, *e.g.*, as white dwarfs.

Elliptical galaxies, which show no spiral arms and are free from interstellar dust clouds, consist entirely of Population II; in spirals, Population II probably accounts for most of the mass, but the hot, bright stars and ionized hydrogen clouds are the most conspicuous feature. Probably the Population II stars were the first to be formed from the contracting cloud of gas and dust from which the galaxy and its companions in the "local group" of galaxies are believed to have been formed; the remaining interstellar material could then have continued contracting and been spread out into a disk by the resulting increase in its speed of rotation.

Spiral structure might arise from the differential rotation of long filaments held together by an interstellar magnetic field. Population I stars have presumably been formed continuously in the spiral arms, but some older members have undoubtedly drifted into the inter-arm region since their formation. There is also evidence that the older Population I stars in our neighbourhood have galactic orbits of higher eccentricity than the young stars and clouds of interstellar matter. It has not been possible to say whether the heterogeneous structure of the galaxy, with numerous individual star clusters and larger groups showing common streaming motion, is a permanent feature or an initial stage mhich will ultimately be reduced to a more uniform distribution by stellar encounters, and by disruption through the tidal effect of galactic gravitation. However, it is to be expected that the interstellar material required for star formation will ultimately be used up, so that hot. bright stars and the associated spiral structure must ultimately disappear, leaving a stellar population in mhich the brightest stars are cool red giants as in the present Population II.

See also STAR; NEBULA; INTERSTELLAR MATTER; RADIO ASTRONOMY; SPECTROSCOPY, ASTRONOMICAL.

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GALBA, SERVIUS SULPICIUS, Roman emperor (June A.D. 68 to Jan. 69). born near Terracina, Dec. 24, 5 B.C. He came of a noble family and was a man of great wealth, but unconnected either by birth or by adoption with the first six Caesars. In his early years it is said that both Augustus and Tiberius prophesied his future eminence (Tacitus, *Annals*, vi, 20; Suetonius. *Galba*, 4). Praetor in 20, and consul in 33, he acquired a well-merited reputation in the provinces of Gaul. Germany, Africa and Spain. On the death of Caligula, he refused the invitation of his friends to make a bid for empire, and loyally served Claudius. For the first half of Nero's reign he lived in retirement until, in 61, the emperor gave him the province of Hispania Tarraconensis. In the spring of 68 Galba was informed of Nero's intention to put him to death, and of the insurrection of Iulius Vindex in Gaul. He was at first inclined to follow the example of Vindex, but the defeat and suicide of the latter renewed his hesitation. When news came that Nero had been killed and the praetorians had declared for him, he marched to Rome. At first he was welcomed by the senate and the party of order, but he was never popular with the soldiers or the people. He incurred the hatred of the praetorians by scornfully refusing to pay them the reward promised in his name, and disgusted the mob by his meanness and dislike of display. Otho's successful conspiracy followed. Galba was murdered by some cavalry near the Lacus Curtius. Tacitus rightly says that all would have pronounced him worthy of empire if he had never been emperor (*"omnium consensu capax imperii nisi imperasset"*).

GALBANUM, a gum resin, the product of *Fcrula galbaniflua*, indigenous to Iran. It occurs usually in irregular, more or less translucent and shining lumps, or occasionally in separate tears, of a light-brown, yellowish or greenish-yellow colour. and has a bitter taste and musky odour. It contains about 8% terpene, 65% of a resin that contains sulfur. 20% gum and a small quantity of the colourless crystalline substance umbelliferone. Galbanum is one of the oldest drugs. In Ex. xxx, 34 it is mentioned as a sweet spice. Hippocrates employed it in medicine, and Pliny ascribed to it extraordinary curative powers. Its use in medicine is obsolescent.

GALBULIDAE, a family (order Piciformes) of small to medium-sized tropical American birds comprising several species popularly called jacamar (*q.v.*).

GALE, ZONA (1874–1938), U.S. author whose *Miss Lulu Bett* established her as a promising novelist of the rising realistic school, was born at Portage, Wis.. on Aug. 26, 1874. She graduated from the University of Wisconsin in 1895 and received her M.A. there in 1899. For two years she worked for various Milwaukee newspapers then, in 1901, became a reporter for the *New York World*. After the publication of her first short story, in 1904, she gave her full time to writing.

Her books include *Romance Island* (1906); *The Loves of Pelleas and Etarre* (1907); *Friendship Village* (1908); *When I Was a Little Girl* (1913); *Heart's Kindred* (1915); *A Daughter of Tomorrow* (1917); *Birth* (1918); *Miss Lulu Rett* (1920); *Faint Perfume* (1923); and *Preface to a Life* (1926). Her early writings were in the sentimental, local colour tradition.

The dramatization of *Miss Lulu Bett* won her the Pulitzer prize in 1920. Other plays were Mr. *Pitt* (1924), a dramatization of *Birth*, and *Evening Clothes* (1932). She died in Chicago on Dec. 27, 1938.

See August Derleth, *Still Small Voice* (1940).

GALE. A wind of considerable force, specifically, in nautical and meteorological terminology, a wind classified on the Beaufort scale (*q.v.*) as force 8, g or 10 and, in some definitions, also force 7. This represents a range of wind speeds of from 32 to 63 m.p.h., or, including force 7, beginning at 25 m.p.h. The terms fresh gale, strong gale, etc., are used without standardization among the various countries, but a wind of force 10, or 55 to 63 m.p.h., is universally designated as a whole gale. (H. R. B.)

GALEN (*c.* A.D. 130-*c.* zoo), Greek physician, founder of experimental physiology and, after Hippocrates, the most distinguished physician of antiquity, was born in Pergamum, the capital of Mysia in Asia Minor, a city renowned for its magnificent library, the creation of Attalid kings. Galen is sometimes wrongly spoken of as Claudius Galen, but the cognomen Claudius has no authenticity and is a result of a misunderstanding on the part of Renaissance scholars. From his earliest years Galen was familiar with the Platonic, Peripatetic, Stoic and Epicurean schools of thought. He began the study of medicine in 146, and two years later went to Smyrna to attend the lectures of Pelops, a celebrated physician. In search of knowledge he roamed through Greece, Cilicia, Phoenicia, Palestine, Crete,' Cyprus and finally visited the famous medical school at Alexandria.

Settling at Rome in 164, Galen became acquainted with some of the highest officers of the state, among them the consul Boethius and the future emperor Lucius Septimius Severus. Many of these eminent persons attended his lecturesand demonstrations. Galen used an unsparing pen against medical sects, the methodists, dogmatists, pneumatists and empirics then flourishing in Rome, and thus provoked the hostility of his professional brethren. He belonged to no particular school, though in philosophy he favoured Aristotelianism. Later he left Rome for Pergamum, but was recalled by the emperor Marcus Xurelius for service in the Germanic wars. This he managed to evade, returning to Rome to look after the health of the youthful Commodus, heir of Marcus Aurelius. Little is known of the rest of his life. Apparently he was in Rome during the fire of 191, when many of his works mere burned, and he was still lecturing in the reign of Pertinax. He probably died in Sicily in A.D. 200.

Galen mas the author of about 400 treatises, written in clear Attic Greek. In his *De Libris propiis* he mentions 124 purely philosophical treatises, which include commentaries on the *Categories* and *Analytics* of Aristotle, and on the *Timaeus* and *Philebus* of Plato. He wrote five treatises on ancient comedy which are lost. Only an insignificant fraction remains of his nonmedical works. Of the surviving medical works 98 are held to be genuine, 19 doubtful. 45 spurious and 19 are merely fragments.

Researches in Anatomy. — Galen's anatomical investigations were unrivaled in antiquity for their fullness and accuracy. He was an indefatigable dissector, describing mainly what he actually saw. He dissected apes and lower animals, though much that is relevant to the human body is incorporated in his works. As a specimen of his accuracy it may be mentioned that he recognized the lacteal vessels, and described the ducts of the lingual and submaxillary glands, though he was unaware of their function.

Many structures to which names of 16th- and 17th-century anatomists are attached were observed by Galen; *e.g.*, the aqueduct of Sylvius and the *foramen ovale* known as *le trou Botal*. The mode of closure of the *foramen ovale,* Galen describes in language hardly since excelled.

Researches in Physiology. — Galen's physiological investigations were revolutionary. He knew of insensible perspiration, he ligatured the recurrent laryngeal nerve, he performed section of the spinal cord at various levels and observed the resulting sensory and motor disturbances and incontinence. He correctly interpreted the effect of cutting above the origin of the phrenic nerve. He described the heart with its three layers of fibres, which he hesitated to call muscle. The reasons for his reluctance are greatly to his credit: first, he noted that the cardiac substance presented characteristics different from those of ordinary muscle, as, for instance, in that its action was independent of volition; second, he recorded that section of its nerve supply was not followed by cessation of its activities. The valves of the heart are accurately described by him, and it is probable that he knew of the anastomosis of the vessels. One of his greatest contributions was the demonstration that the arteries contain blood and not air as the Alexandrian school had taught for over 400 years. He partially grasped the principle of the lesser circulation, as William Harvey (*q.v.*) pointed out.

Galen described aneurism, differentiating the traumatic from the dilated variety, and he was also familiar with the use of the catheter. His facile teleology led him. however, to some strange errors. Among them was the elaborate hypothesis which he formulated concerning the *pneumata* or spirits, to the influence of which he attributes many vital processes. He is also the author, or at least the propagator. of the fateful theory that the septum of the heart was pierced by imperceptible foramina, through which some of the blood was supposed to exude from the right into the left ventricle.

Monotheistic Views. — Apart from his medical work, Calen occupies a position of considerable interest in the history of both religion and philosophy. He was a firm believer in a supreme creator of the universe in all its parts. He had set himself to prove that the bodily organs are in such perfect relation to the functions to which they minister that it is impossible to imagine any better arrangement. Thus, following the Aristotelian principle that nature makes naught in vain, he develops the problem of final causes along definite lines. These lines amount to determinism with God as determiner.

The peculiar feature of Galen's doctrine, however, is neither his determinism nor his monotheism (both of which were familiar to the thinkers of the day), but his extraordinary claim that God's purposes could be elicited in great detail from the examination of his works. This comes out most strikingly, perhaps, in his famous description of the hand, contained in his treatise *On the* Uses *of the Parts of the Body of Man.*

In several places in his works Galen mentions both Judaism and Christianity, though without much respect. In the great anatomical work under discussion he explains that in his belief God always works by law, and that it is just for this reason that natural law reveals him. and he adds that "in this matter our view . . . differs from that of Moses." It seems probable that he had read some books of the Bible. His position can thus be summed up as intermediate between Stoicism and Christianity. On the one hand he accepted the natural law of the Stoic philosophy, but rejected its astrological corollary. On the other, he accepted the divine guide and architect of the universe which corresponded to the Christian scheme, but rejected all idea of miracle.

Influence on Logic. — Galen is held to have had a certain influence on the development of logic. He was, however, simply purveying the ordinary Peripatetic doctrines of his day. Nevertheless he is of some importance as the carrier or transmitter of these doctrines by reason of the avidity with which his medical works were read during the middle ages. He is thus in some sense responsible for both scholastic methods and scholastic philosophy. His chief philosophical influence, however, is to be traced in the medieval doctrine of *pneuma* and the resulting conception of the nature of life. His monotheism no doubt contributed to his popularity in the ages that followed him.

Though nearly all writings were lost to western Europe after the break-up of the Roman empire, they were translated into Arabic and about the 11th century the *Methodus Medendi* and the *Ars Parva* or so-called *Microtegni* were recovered in Latin versions. The 15th and 16th centuries saw the effective completion of the Galenic canon in Greek by humanist scholars such as Thomas Linacre and Guinter von Andernach. Latin translations were studied in the medical schools until the 19th century.

Editions. — The standard edition of Galen is still that of C. G. Kühn in 20 (22) vol. (1821–33). A critical edition was produced in the *Corpus Medicorum Graecorunz.* A French translation of the important anatomical and physiological writings is that of C. Daremberg, 2 vol. (1854). A section of the *De anatomicis administrandis,* of which the Greek original is lost, is edited with German translation by M. Simon in *Sieben Bucker der Anatomie des Galen,* 2 vol. (1906). *On the Natural Faculties* is available in English translation by A. Brock (1916).

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GALEN, CLEMENS AUGUST, GRAF VON (1878–1946), German Roman Catholic prelate, the most effective opponent of Nazism among the German Catholic bishops, was born at Dinklage. Oldenburg. March 16. 1878. A descendant of one of the oldest noble families of Germany, he studied theology and philosophy and was ordained priest in 1904. He became bishop of Münster in 1933.

The Nazis mere willing to accept him in view of his general conservative views; these, however, were the very reasons why he felt it necessary to oppose them.

Galen's fight against the Nazis began with his first pastoral letter, issued for Easter 1934, and continued relentlessly afterward, culminating in three major incidents: In Oct. 1934 he took under his protection a hook severely criticizing Alfred Rosenberg's *Myth of the Twentieth Century*, which no one had dared publish, adding a vigorous preface; the Gestapo interfered but was unable to prevent 200,000 copies reaching the public. When in Nov. 1936 the Nazi administration of Oldenburg had all crucifixes removed from the schools. Galen protested so vigorously that a public demonstration, unparalleled under the Third Reich. occurred; the order was rescinded. Finally. in July and Aug. 1941 Galen, stung hy the seizure of religious houses and the killing of "unproductive" sick and old people. preached three sermons which. in the strongest, terms: scored these specific acts. as well as the general lawlessness of the Gestapo; as a result, the "mercy killings" were temporarily halted. Documents discovered later showed that the Nazis were close to a decision to hang him when Josef Göbbels interfered with the argument that such a step should he postponed until "after final victory." These incidents seem to confirm Galen's view that the risk of a more daring opposition to the Nazis than his fellow-bishops held possible was worth taking.

Galen was created a cardinal on Feb. 18, 1946, and died in the same year. at Münster on March 22.

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GALENA, a city of Illinois. U.S.. seat of Jo Daviess county, is situated on the Galena river. 4 mi. from the Mississippi river in the far northwest corner of the state. The population is about 5.000. A quaint and picturesque town. Galena takes its name from the rich sulfite of lead deposits in the area.

Indians mined lead by 1700 and in the 1320s hopeful miners swarmed into the country. The town was laid out in 1826 and incorporated in 1835. For a time it prospered as a midpoint for Mississippi river traffic between Ft. Armstrong (Rock Island) and Ft. Snelling (St. Paul'). As the mining industry and river commerce declined. so did the town. By the 1960s Galena became a tourist centre. It also manufactures foundry products, mining machinery and dairy products. The restored home of Pres. Ulysses S. Grant. given to him by the people of Galena, is open to the public. (C. C. W.)

GALENA, lead sulfide (PbS), is the chief ore of lead. This mineral was mentioned by Pliny under the name black lead (*plumbum nigrum*) and it is sometimes known as lead glance (German *Bleiglanz*). It crystallizes in the cubic system; well-developed crystals are of common occurrence. The usual form of the crystals is that of the cube, cubo-octahedron or (less often) the octahedron. The mineral is most easily recognized by its perfect cubic cleavage and the brilliant metallic lustre of its freshly fractured surfaces. Galena also occurs in massive aggregates, sometimes with a fine or granular structure and occasionally fibrous or plumose. The colour of the mineral and of its streak is lead gray; it is opaque; the hardness is 2.5 and the specific gravity is 7.5.

Galena is one of the most widely distributed sulfide minerals and often occurs in metalliferous veins (Freiberg, Saxony: Broken Hill, Xustr.; Coeur d'Alene. Ida.; Clausthal. Ger.; Cornwall. Eng.) associated with sphalerite, pyrite. marcasite. chalcopyrite. cerussite, anglesite, dolomite, calcite, quartz, barite and fluorite. Large deposits are also found as replacements of limestones or dolomites (Santa Eulalia, Mex.). In deposits of contact metamorphic origin galena is associated with lime silicates and fluorite (Darwin, Calif.). The mineral has occasionally been observed as a recent formation replacing organic matter such as wood, and it is sometimes found in beds of coal. In many occurrences galena contains small amounts of silver, rarely exceeding 0.1%, presumably due to included silver minerals such as argentite or tetrahedrite. Often the galena is mined as a source of silver as well as lead.

In the upper oxidized part of a deposit the galena alters to produce secondary lead minerals such as cerussite, anglesite, pyromorphite, mimetite, phosgenite and cotunnite. Banded nodules of anglesite and cerussite nith galena cores are often found.

The electrical properties of galena have made it of considerable importance in the electronics industry. The point contact between a conducting metal and the cleavage surface of a crystal of galena is an efficient rectifier for small currents of radio frequency. This property made galena one of the most commonly used crystals in the early crystal radio sets. Its capability, when properly treated. of acting as either a P-(positive) type or N-(negative) type semiconductor (see TRANSISTOR) greatly enhances its use as an electronic circuit element. See also LEAD. (A. J. F.)

GALENA PARK, Texas: see HOUSTON.

GALERIUS (GALERIUS VALERIUS MAXIMIANUS), Roman emperor from A.D 305 to 311. was born near Sardica in Thrace. He served nith distinction as a soldier under Aurelian and Probus, and in 293 was designated Caesar along with Constantius Chlorus. In 305 on the abdication of Diocletian and Maximianus, he at once assumed the title of Augustus with Constantius his former colleague and having procured the promotion to the rank of Caesar of Flavius Valerius Severus, a faithful servant and Daia (Maximinus), his nephen, he hoped on the death of Constantius to become sole master of the Roman world. This scheme, however, nas defeated by the sudden elevation of Constantine at Eboracum (York) on the death of his father, and by the action of Maximianus and Maxentius in Italy.

In 307 he elevated his friend Licinius to the rank of Augustus, and devoted the remaining years of his life "to the enjoyment of pleasure and to the execution of some works of public utility." It was at his instance that the first of the celebrated edicts of persecution against the Christians was published, on Feb. 24. 303, and this policy of repression was maintained by him until the appearance of the general edict of toleration (311), issued in his own name and in those of Licinius and Constantine.

Galerius died in May 311.

GALESBURG, a city of western Illinois. U.S., about 170 mi. S.W. of Chicago, the seat of Knox county. Rev. George Washington Gale (1789–1862) of Whitesboro, N.Y., a Presbyterian minister for whom the city was named, selected the site for a colonization society to establish a college-centred community. In 1836 the first settlers arrived, and in 18.37 a charter was granted to the Knox Manual Labour college. The city was incorporated in 1857 and the institution was renamed Knox college. City and college played an important role in the abolition movement. and in 1858 one of the historic Lincoln-Douglas debates on the slavery issue was held on the Knox campus. Knox is now a private, nondenominational. coeducational. liberal arts college; in 1930 it absorbed Lombard college, founded by the Universalists in 1851.

Galesburg is the commercial centre of an agricultural and coal mining area. It is a division headquarters of the Burlington railroad which. with its freight yards, shops and tie plant, is one of the city's largest employers. Other industries produce a wide variety of goods ranging from refrigeration equipment to building supplies. from farm gates to outboard motors. A 30-mi. pipeline brings Mississippi river water to the city.

Galesburg is the birthplace of Carl Sandburg, the poet and Lincoln biographer. The Galesburg State Research hospital is a mental institution. Lake Storey. a beautiful artificial lake, once a railroad-owned water reservoir, has been transformed into a popular city-owned recreational park.

For comparative population figures see table in ILLINOIS: *Population*. (E. HG.)

GALGACUS, or perhaps rather CALGĀCUS, a Caledonian chief who led the tribes of North Britain against the invading Roman army under Iulius Agricola about A.D. 85 and was defeated at the battle of Mons Graupius.

GALIANI, FERDINANDO (1728–1787), Italian writer and economist was born at Chieti on Dec. 2, 1728, and was educated for the church. He went to Paris as secretary to the Neapolitan ambassador and remained from 1759 to 1769, lionized as a wit in the salons and befriended by the Encyclopaedists. Abbé Galiani enjoys a reputation in both French and Italian literature.

As an economist, he published a treatise on money, *Della moneta* (1750), and one on the grain trade. *Dialogues sur le commerce des blés* (1770), both remarkable for their clarity and methodical presentation. In the first, he evolves a theory of value based on utility and scarcity. which has been greatly praised for its originality but which follows scholastic tradition. In the second. Galiani stresses the necessity of regulation, opposing the Physiocrats who advocated complete freedom. After his return to Naples, he carried on a spirited correspondence with Madame d'Epinay and other Parisian friends. His letters are of interest for literary history and shed light on Galiani's debate with Abbé Morellet, the spokesman of the Physiocrats. Galiani died in Naples! Oct. 30. 1787.

See Fausto Nicolini, *Il pensiero dell'abate Galiani* (1909); Joseph Rossi, *The Abbe' Galiani in France* (1930). (R. DE R.)

GALIB DEDE (SHEYH GALIB), pseudonyms of MEHMED ESAD (c. 1758–1798), was the last of the five great classical Turkish poets. Born in Istanbul, the son of a Mevlevi dervish, he became the sheik of the Galata monastery. He had as his patrons Sultan Selim III, himself a poet and musician, and rnany princesses who admired his work. The monastery became a centre for poetry and music in Istanbul where leading men of letters and musicians gathered. In his divan (collected poems) and his allegorical romance *Hüsn ü Ashk* ("Beauty and Love") he happily combines the mystic enthusiasm of Jalal-ud-din Rumi (*q.v.*), the complex imagery of the Persian "Indian school" and the warm, flowing language of Nedim (*q.v.*). Classical poetry's strict forms did not hamper his originality—his power of imagination, colourful similes and descriptions infused fresh breath into Turkish literature.

See E. Gibb, *A History of Ottoman Poetry,* iv (1905). (F. I.)

GALICIA was the name formerly applied to that portion of Poland lying on the northern slopes of the Carpathians, which constituted an Austrian *Kronland* between 1772 and 1918. It is now called Halica and is part of the Ukraine. U.S.S.R. The area before World War I was 30.299 sq.mi., population 7,980,477.

'The early history of west Galicia is that of Poland (*q.v.*). In the east. an independent Ruthenian principality of Halicz appears in the 11th century. It grew in importance with the decay of Kiev, whence many refugees emigrated to Galicia. In the 12th century Galicia. under its prince Osmomysl. was one of the chief principalities of Russia. Many towns were founded, and much trade passed through Lemberg (Lwow), from Asia and the Black sea to Europe. Galicia failed, however. to achieve stability. largely owing to the character of its own nobles. who are described as rebellious to their king and tyrannical to their serfs. It was alternately allied and at war with the neighbouring principality of Lodomeria; and Poland, Hungary and Novgorod intrigued for possession of both districts. Hungary became master for short periods in 1190 and 1215; but the powerful native dynasty founded by Roman of Lodomeria (d. 1205) retained its independence. Roman's son, Daniel (1205–64), was one of the strongest princes of eastern Europe, and was even crowned by a Papal Legate. temporarily deserting the Orthodox Church. In 1223. however. he lost his eastern provinces to the Mongols, who overran and ruined all Galicia in 1241. In 1324 the Romanov line died out, and Casimir of Poland occupied Galicia in 1340. Lodomeria in 1366. On his death both provinces again came under Hungary. but reverted to Poland in 1372. Under the Jagellion kings prosperity revived, to sink again when the world trade routes changed.

At the partitions of Poland, Galicia (including Lodomeriai was assigned to, Austria, for the first time in 1772, definitively. with a slightly altered frontier in 1814, Cracow becoming an independent republic. Austrian rule introduced improvements. but progress mas slow. The Polish patriotic uprising of 1830 affected Galicia little, but Austria allowed legions to be formed here, and sheltered refugees from Russian Poland. In 1846, however, widespread and almost unconcealed preparations for revolution, to break out in mid-February, were made by the Polish nobles. The danger for Austria was averted by a rising of the Polish (not Ruthenian) peasants, whom disastrous floods had reduced to great misery. The peasants massacred a number of nobles in the Tarnów district. The revolt soon broke down, but as it had been largely directed from Cracow, Metternich took this pretext of incorporating the city in Galicia, as from Nov. 11, 1846.

In 1848 the Austrian Government countered the revolutionary movement among the Polish nobles by winning the peasants through land reforms, and the Governor of Galicia, Count Stadion, also for the first time encouraged the Rutheninns and won their support against the Poles. A period of centralized bureaucratic rule followed, during which Galicia was divided, on roughly ethnographical lines; into first three, and later two administrative districts; but the Polish nobles supported the Hungarian in their demand for decentralization, and after the Hungarian "Ausgleich" of 1867, Galicia, thanks to the efforts of Count Goluchowski, obtained more liberty than any other Austrian province. Under a special minister for Galicia, the Poles enjoyed *de facto* home rule and a free hand against the Ruthenians, Galicia being reunited into a single province with Polish as the official language. In return, the Poles formed the chief support of the successive Austrian Governments, and took a large part in directing Austrian policy, the Polish irridenta in Galicia never being serious. Besides being the largest Austrian province, Galicia was now acquiring great importance owing to the discovery and exploitation of its oil fields, although these were mainly in Jewish hands and the provincial budget to the last was subsidized from the Austrian treasury; the strategic importance was also great, and was probably the main reason why the Austrian Government never yielded to the wish of the German nationalists to give Galicia an independent status within the monarchy. The Ruthenian national movement made slow progress, discouraged by Poles and Austrians alike. while Russia pave it no support. for fear of awaking a national movement in the Ukraine.

The Neo-Slav movement had by 1910 laid the foundations for a reconciliation between Poles and Russians. The Galician Poles ceased to be safe supporters of the Austrian Government, which in return reverted to the idea of encouraging the "loyal" Ruthenians; but this new development was cut short by the war of 1914. The Central Powers were obliged to grant the Poles wider independence, and to promise them still more; and by 1918 Galicia was virtually independent of Austria. The Poles renounced allegiance to Austria in Oct. 1918, claiming all Galicia for the new Polish state. The Ruthenians, however, who had also been promised greater liberty after the I'eace of Brest-Litovsk, also claimed the right to self-determination, and in November formed a Government under Dr. Petrushievicz in Lwow, this being recognized by the liquidating Austrian Government. The Poles occupied Lwow (Nov. j), and the Ruthenian Government retired finally to Vienna. The Ruthenian troops joined the Ukrainian army of Petlura; the latter marched against the Poles and claimed East Galicia for the Ukrainian Republic—a claim first recognized, but later disallowed by Petrushievicz. Fighting continued throughout 1919. On May 8, 1919, the supreme council assigned West Galicia to Poland, and on June 25 allowed East Galicia the right of self-determination, while authorizing the continued Polish occupation. In December it announced that East Galicia should be granted autonomy under a Polish protectorate for 25 years, after which the League of Nations was to decide on its future. Petlura had meanwhile abandoned his claim to Galicia in return for recognition by Poland in the Ukraine; but he was overthrown by the Soviet troops, who continued the struggle with Poland until the treaties of Riga (Oct. 12, 1920, and March 18, 1921) finally reaffirmed the old Galician frontier. The Ruthenian Governments, of which there were many, were quite helpless, from lack of funds and internal dissension. Finding their repented appeals ignored. some of them made terms with Soviet Russia, which carried on a lively agitation in East Galicia. some were reconciled to Poland, a few abandoned politics. Poland continued to treat East Galicia as an integral part of herself. and it was recognized as such by the Council of Ambassadors on March 15. 1923. Under her minority legislation, Poland subsequently accorded her Ruthenian population a limited degree of self-government. All of Polish Galicia fell to Germany in the first stages of World War II. (C. A. M.; X.)

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GALICIA (the ancient *Gallaecia* or *Callaecia,* Καλλαικία or Καλαικία), a captaincy-general, and formerly a kingdom. countship and province. in the north-western angle of Spain: bounded on the north by the Bay of Biscay, east by León and Asturias, south by Portugal and west by the Atlantic ocean. Pop. (1960 est.) 2,714,163; area 11.365 sq.mi. In 1833 Galicia was divided for administrative purposes into the provinces of La Coruña (*q.v.*), Lugo, Orense and Pontevedra. The high land north of the headwaters of the Miño forms the sole connecting link between the Cantabrians properly so-called and the mountains of central and western Galicia. The average elevation of the province is considerable. and the maximum height (6,706 ft.) is reached in the Peña Trevinca on the eastern border of Orense.

The principal river is the Miño (Portuguese *Minho;* Lat. *Minius;* so named. it is said. from the *minium* or vermilion found in its bed). Rising near Mondoñedo, within 25 mi. of the northern coast, the Miño enters the Atlantic near the port of Guardia, after a course of 14i mi. south and south-west. Of its numerous affluents the most important is the Sil. Among other rivers having a westerly direction may be mentioned the Tambre. the Ulla and the Lerez or Ler. which falls into the Atlantic by estuaries or *rias* called respectively Ria de Muros y Noya, Ria de Arosa and Ría de Pontevedra.

Gallaecia, the country of the Galacci, *Callaici* or *Gallaici,* seems to have been very imperfectly known to the earlier geographers. According to Eratosthenes (276–196 B.C.) the entire population of the peninsula were at one time called *Galatae.* The region properly called by their name, bounded on the south by the Douro and on the east by the Navia. was first entered by the Roman legions under Decius Junius Brutus in 137–136 B.C. (Livy lv., lvi., *Epit.*); hut the final subjugation cannot be placed earlier than the time of Augustus (31 B.C.–A.D. 14).

The coast line of Galicia. extending to about 240 m., is everywhere bold and deeply indented. presenting a large number of secure harbours. and in this respect forming a marked contrast to the neighbouring province. The Eo. which bounds Galicia on the east, has a deep estuary, the Rivadeo or Ribadeo, which is a good harbour. Vivero bay and the Ria del Rarquero y Vares are of a similar character: while the harbour of Ferrol is an important naval station. On the opposite side of Retanzos bay (the μέγας λιμήν or *Portus Magnus* of the ancients) is the great port of La Coruña (Corunna). The principal port on the western coast is that formed by the deep and sheltered bay of Vigo, but there are also some good roadsteads at Corcubión, at Marín and at Carril.

The rainfall is exceptionally heavy, and snow lies on some of the high ground for a considerable portion of the year. Much timber is grown on the high lands, and the rich valley pastures support large herds of cattle, while the abundance of oaks and chestnuts favours the rearing of swine. In the lowland districts good crops of maize, wheat, barley, oats and rye, as well as of turnips and potatoes, are obtained. The *dehesas* or moorlands abound in game, and fish are plentiful in all the streams. The mineral resources of the province, which are considerable, were known to some extent to the ancients. Strabo (*c.* 63 B.C.–A.D. 21) speaks of its gold and tin, and Pliny (A.D. 23–79) mentions the *gemma Gallnica,* a precious stone. Galicia is also remarkable for the number of its sulphur and other warm springs, the most important of which are those at Lugo and Orense.

The largest town in Galicia is La Coruña; Santiago de Compostela is the ancient capital and an archiepiscopal see; Lugo, Tuy, Mondofiedo and Orense are bishoprics.

See Annette B. Meakin, *Galicia, the Switzerland of Spain* (London, 1909); A. F. G. Bell, *Spanish Galicia* (London, 1922).

GALILEE, a Roman province of Palestine, bounded on the south by Samaria and Carmel, on the east by Jordan, on the north by the river Leontes (Lītānī), and on the west by the Mediterranean. It has a maximum length of 60 mi. and a breadth of 30. Galilee represents a relatively low, but detached, continuation of the Lebanon ranges. The basic formation of its hills is limestone, and on this the vulcanism of a later geological age has superimposed extensively a layer of lava whose crumbling has produced a soil remarkable for its fertility. The province was divided into two districts, Upper and Lower, reflecting a change in the configuration of the land distinct enough in nature, but not easy to recognize on the map. The dividing line is a ridge running east and west, reaching the Jordan valley at a point midway between Lake Huleh and the Sea of Galilee.

Upper Galilee is the northern district and is in substance a broad mountain range up-tilted towards the Sea of Galilee. The eastern slopes dominating the Jordan valley are abrupt and rise to a height of 2,800 feet. On the west, the descent towards the sea and the plain of Acre is more gradual. In the southern part of the district the rocky range of Jebel Meyron reaches a height of 3,963 feet. The whole region is well watered. The height of the mountains causes a relatively heavy rainfall, and springs abound. Hence the valleys are full of vegetation and the mountain slopes are clothed on the west with small oaks, and on the east with scrub. The occasional level stretches and gentler slopes are covered with fertile grain fields. Upper Galilee was proverbially famous for its fine olives and vines. "It is easier," says the Talmud, "to raise a legion of olives in Galilee than to bring up a child in Palestine." Safad, the chief town, has a population of 10,586 of whom one half are Jews. It suffered severely in the earthquake of 1837, when 4,000 of its inhabitants perished.

Lower Galilee is the southern district of the province. Its highest hills are not more than 1,800 ft. Across the province, at its southern end, stretches the plain of Esdraelon (also called Jezreel). Triangular in shape it is drained by the river Kishon which, springing from the Gilboa hills, winds through the plain. For the most part a dry torrent bed in the height of summer, it becomes almost impassable at times during the rains, as when the hosts of Sisera were discomfited on its banks and "the River Kishon swept them away, that ancient river, the River Kishon." The eastern end of the plain forms the chief gateway to Palestine from regions beyond Jordan. The whole of Lower Galilee is well supplied with water. Springs abound in eastern Esdraelon, Wady-el-Melek and in the plain El-Buttauf. The great plains of Galilee, Esdraelon, El-Buttauf and the plateau of Sahel el-Ahma, are exceedingly fertile, producing wheat, cotton, maize, sesame, tobacco, millet and a variety of vegetables. The principal towns are Nazareth (*q.v.*); Tiberias (*q.v.*); Seffuriyeh (Sepphoris), a rival to Tiberias as capital and for a short period the abode of the Sanhedrin when it first transferred to Galilee; Jenin (En-Gannim), on the southern edge of the plain of Esdraelon; Jezreel (*q.v.*), now a poor village (Zer 'in) but once a royal residence, situated on Mt. Gilboa; Endūr (Endor, *q.v.*); Nein (Nain, the scene of one of Christ's miracles); Lejjūn (the Legio of the Romans), now identified with ancient Megiddo, on the west side of the plain, where the mighty empires of Egypt and Hattiland met in a famous conflict in the 15th century B.C.; Jefāt, a town amongst the hills north of El-Buttauf, the Jotapata which Josephus so vigorously defended against Vespasian; Kefr Renna probably Cana (*q.v.*) of Galilee, and Kānā, 6 m. north of it, another suggested identification with Cana.

Galilee of old was a highly prosperous land peopled by bold and hardy hillmen, who knew how to defend their homes, as, indeed, they had often occasion to do, since "they were encompassed with so many nations of foreigners." Josephus (*Bell. Jud.* iii. 3, 2), who in his capacity of military governor of the Galilees, knew the country well, gives an interesting account of the people and the land of his time. "The Galileans are inured to war from their infancy, and have been always very numerous; nor hath the country ever been destitute of men of courage, nor wanted a numerous set of them; for their soil is universally rich and fruitful and full of the plantations of trees of all sorts . . . and no part of it lies idle. Moreover, the cities lie here very thick, and the very many villages are full of people." The Galilee of to-day is not so prosperous nor so populous as in the days of Josephus, but faith in its future is not wanting. Within recent years 16 Jewish colonies have been established by Jewish organizations within its borders.

History. — The name (in origin, a "circle" or "circuit") was in early times loosely applied. In Isaiah (ix. 1) the full name of the district is given as "Galilee of the Gentiles," viz., the Phoenicians, Syrians and Aramaeans, who hemmed it in. In 1 Kings (xv. 29) it is the name of a district whose population was deported by Tiglath Pileser. The fortunes of the tribe, with its loose and varying territorial connections, interested the Hebrew more than the political history of a rigidly delimited district. Hence Galilee can hardly be said to have, as a whole, a history. The return of the Jews from captivity concentrated re-awakened national interest and prestige at Jerusalem, and Galilee was frowned upon and left to the hybrid race evolved from the mingling of the Jewish residue and fresh Assyrian colonization. The date of Galilee's reconquest for the Israelites is uncertain, but it is generally ascribed to John Hyrcanus; and the sturdy race which peopled its hills and valleys soon developed a fervid patriotism and nationalistic spirit. The contempt of the metropolitan for the Galilean provincial was probably intensified by the latter's uncouth speech, emphasized by his inability to pronounce some of the Hebrew consonants. The jibe "Out of Galilee cometh no prophet" (although Deborah, Jonah, Elisha and perhaps Hosea were Galileans) is not so much a reflection on the religious and cultural interest of the Galilean as a reflection of the biased and prejudiced mind of the metropolitan. We cannot forget that it was amongst the hills of Galilee and by its sea that Christianity was shaped and developed. In the Persian period too, the Mandaean religion took final shape in lone Galilee.

Galilee was moulded into a province by the Romans and became a tetrarchate governed by members of the Herod family. Galilee was the land of Christ's childhood and the chief centre of his ministry. In the neighbourhood of its great lake some of his chief discourses were uttered, and the scenes and incidents of its landscape inspired his parables. When the destruction of Jerusalem left the Rabbinic Schools homeless they sought refuge in despised Galilee, and Safad and Tiberias (*q.v.*) became their chief centres. It is in Galilee that the remains of ancient synagogues are found, and within its confines lie buried many Jewish doctors and philosophers whose tombs are still venerated.

Archaeology. — In Galilee there are relics of the Stone Age in dolmens and menhirs. Rock-cut tombs and wine presses, remains of Byzantine monasteries, the churches and fortresses of Crusading times bring archaeological interest down to a more recent time. **A** discovery of particular interest, furnishing a link with Palaeolithic man, was that made in a Galilean cave in 1925. In a cave in the Wady el 'Amūd, a valley abutting on the plain of Gennesareth, were unearthed portions of a human skull of the Neanderthal species. The fragments consist of nearly the whole of the frontal bone, the right zygomatic bone, and the right half of the sphenoid bone.

In 1927 Professor Garstang announced the discovery in the Huleh basin of a large permanent camp, about 1,000 metres in length and 400 across, at a point about $3\frac{1}{2}$ m. west of the point where the Jordan leaves the lake. Occupation throughout the three phases of the Bronze Age is indicated, and an identification with Hazor, Jabin's royal city, has been suggested.

The great Galilean field of excavation, however, is the Plain of Esdraelon. At Tell-Husn (Beisān, *q.v.*) extensive excavations are being carried out with important results. At Ta'annak (the Taanach of Judges v. 19), the walls were laid bare, traces of child sacrifice discovered, and several cuneiform tablets of the Amarna period unearthed. Excavations are proceeding at Megiddo, on the western border of the plain, and the soundings made at Tell Harbaj in the plain of Acre, near to its junction with the plain of Esdraelon make it reasonably certain that it, rather than Hārithīyeh, is the site of Harosheth of the Gentiles. Of great interest are the ancient synagogues,, of which about a dozen have been discovered at ancient sites, such as Capernaum (*q.v.*), Kerāzeh, Kefr Bir'im, Irbid, Meirūn, and elsewhere. The architecture is generally held to be a peculiar and debased imitation of the classical style associated with the and century A.D.

Crusading fortresses were spread over the land in the 12th century as outposts of the kingdom of Jerusalem. Torou (Tibnin) on the summit of the mountains of Upper Galilee, Bēauvoir (Iiaukab el-Haw), south-west of the Sea of Galilee. Chateau Neuf (Hunin), above Huleh lake, Belfort (Esh-Shakif). on the north bank of the Lītāni, Montfort (Kala'at el-Kurn), north-east of Acre, and the castle at Bāniās formed a strong chain of frontier fortresses.

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GALILEE, SEA OF, a lake in Israel through which flows the river Jordan. It is 13 mi. long. 7 mi. broad. has a superficial area of 64 sq.mi. and lies 696 ft. below the level oi the Mediterranean sea. Its maximum depth is 157 ft. The excessive depth which Lortet believed he had discovered at the northern end of the lake has been disproved. The shape of the lake has been likened to a harp or a pear. In the Old Testament it is known as the Sea of Chinnereth or Chinneroth. In the books of the Maccabees and Josephus it is named Gennesar; in the Gospels it is usually the Sea of Galilee. Once it is called the Lake of Gennesaret (Luke v. 1), and twice the Sea of Tiberias (John vi. 1, xxi. 1), a name which has survived in the modern *Bahr Tabarīyeh.*

The sea of Galilee lies in the great Jordan valley trough-fault. During the Pluvial period almost the whole of this depression was occupied by a great inland sea extending from Huleh to a point 40 m. beyond the present southern limit of the Dead sea. Late in geological time the lava which flowed from the volcanoes amongst the southern Galilean hills into the depression combined with lava which flowed down the Tarmuk valley to the east, as well as with the silt washed down later to cause a blockage behind which the waters of the Jordan were pent to form a lake.

The hills which close in upon the sea on the south-west side recede from the shore towards the north to form a great natural amphitheatre with the Plain of Gennesareth as arena. On the east the plateau of Jaulan presents its steep and heavily-scored side towards the lake. Yet, unlike the Dead sea, there is between the water's edge and the foot of the hills a clear passage all round the lake. The Jordan enters it on the north, emerging from a narrow gorge and having on its left bank the marshy plain of El-Batihah. On the north-western shore is the plain of El-Ghuweir, generally supposed to be the plain of Gennesareth whose wonderful fertility is so glowingly described by Josephus. It is a land which "supplies men with the principal fruits, with grapes and figs continually, during ten months of the year, and the rest of the fruits as they become ripe together through the whole year." *(Bell. Jud.* iii. 10. 8.) The plain, which is to-day covered with rank grass and bushes, has been purchased by the Jews and may be expected to recover some of its former glory. North of El-Ghuweir are several warm springs of moderate temperature. At Hamath (Emmaus), a short distance south of Tiberias, are seven hot springs the largest of which has a temperature of 137° F. The lake is well stocked with fish of the genera *Chromis, Barbus, Capoeta, Discognathus, Nemachilus, Blennius* and *Clarias.* There is a close affinity between the fish of Galilee and those of the East African lakes and streams. The *Chromis Simonis,* according to popular belief. is the fish from which Peter took the piece of money (Matt. xvii. 27). Bird life is abundant. Grebes of all kinds. gulls and pelicans frequent the lake. On its shores are to be found tortoises and mud turtles, crayfish and sandhoppers.

The hills surrounding the sea are brown and bare in the summertime but in the spring are clothed with vegetation. Oleander brakes flourished round the lake and the tall papyrus plant is found on the north shore. The lake is set deep among hills and consequently subject to sudden squalls and violent storms, which develop rapidly; sailing is not unattended with risk.

Archaeology. — The principal sites of archaeological interest in the area of the lake are (1) *Kerāzeh* (Chorazin), 2 mi. from the north shore in a wady of the same name. Its ruins include a notable synagogue built with black basalt. (2) Tell-Hzlm (Capernaum, *q.v.*), on the lake shore south of Kerāzeh, with the remains of an early synagogue and possibly a church. (3) *Khān Minyeh,* with extensive ruins at the north end of the plain of Gennesareth. Its identification with Bethsaida is suggested. (4) Tell *'Ureimeh,* between Khān Minyeh and Tell-Hum, the site of an Amorite city whose name has been forgotten. (5) *Mejdel* (Magdala), south of the plain of Gennesareth, with rock-cut tombs. (6) *Tabariyeh* (Tiberias), with remains of the medieval period. (7) Khirbet Kerak, at the south-west corner of the lake, with a ruined citadel and traces of a large and important town. It has been generally identified with Taricheae but more recently an identification with the Beth-Yerah of the Talmud, called by the Greeks Philoteria, has been advocated. (8) *Sinn en-Nabreh* (Sennabris), near to Kerak, where Vespasian fixed his camp in his advance from the south on Taricheae and Tiberias. (9) Khirbet *Susieh,* on the eastern shore, identified with Hippos one of the cities of the Decapolis. (10) Kal 'at *el-Husn*, opposite Tiberias, exhibiting ruins of a city that was walled. broken sarcophagi and rock-cut tombs; suggested identification with the Gamala of Josephus. (11) Fik, about 2 mi. E. of Kal 'at el-Husn, a large village with ruins of ancient buildings, identified by Eusebius with hphek. (12) Khirbet Kersa, opposite Mejdel, the Gerasa or Gergesa of the 4th century. The *Wady el-'Amūd,* where the "Galilee skull" was found: opens onto the plain of Gennesareth. (See GALILEE.) (E. Ro.)

GALILEO GALILEI (1564–1642), Italian mathematician, astronomer and physicist, who made three significant contributions to the founding of modern scientific thought. (1) As the first man to use the telescope to study the skies, Galileo amassed evidence that proved the earth revolves around the sun and is not the centre of the universe as had been believed. His system was such a radical departure from accepted thought that Galileo was tried by the Inquisition in Rome, ordered to recant and forced to spend the last eight years of his life under house arrest. (2) Galileo informally stated the principles later embodied in Newton's first tmo laws. Because of his pioneer work in gravitation and motion and in the combining of mathematical analysis with experimentation, Galileo often is referred to as the father of modern mechanics and experimental physics. (3) Perhaps the most far-reaching of Galileo's achievements was his re-establishment of mathematical rationalism against Aristotle's logico-verbal approach, and his insistence that the "Book of Nature is written in mathematical characters." Through this he was able to found the modern experimental method. (See RATIONALISM: *Epistemological Rationalism.*)

Legend of the Lamp. — Galileo was born at Pisa on Feb. 15, 1564. the son of Vincenzo Galilei, a musician. He received his early education at the monastery of Vallombrosa near Florence, where his family had moved in 1574, and in 1581 entered the University of Pisa to study medicine. While in the Pisa cathedral during his first year at the university, Galileo supposedly observed a lamp swinging and found that the lamp always required the same amount of time to complete an oscillation, no matter how large the range of the swing. Later in life Galileo verified this observation experimentally and suggested that the principle of the pendulum might be applied to the regulation of clocks.

Until he supposedly observed the swinging lamp in the cathedral, Galileo had received no instruction in mathematics. Then a geometry lesson he overheard by chance awakened his interest, and he began to study mathematics and science with Ostilio Ricci. But in 1585, before he had received a degree, he was withdrawn from the university because of lack of funds. He returned to Florence, lectured at the Florentine academy and in 1586 published an essay describing the hydrostatic balance, the invention of which made his name known throughout Italy. In 1588 a treatise on the centre of gravity in solids won for Galileo the honourable but not lucrative post of mathematics lecturer at the University of Pisa.

Galileo then began his resenrch into the theory of motion, first disproving the Aristotelian contention that bodies of different weights fall at different speeds. Because of financial difficulties, Galileo in 1592. applied for and was awarded the chair of mathematics at Padua, where he was to remain for 18 years and perform the bulk of his most outstanding work. At Padua he continued his research on motion and proved theoretically about 1604 that falling bodies obey nhat came to be known as the law of uniformly accelerated motion. He also gave the law of parabolic fall nith its inertial component. The legend of his dropping neights from the leaning tower of Pisa apparently has no basis in fact.

Research With the **Telescope.**—Galileo became convinced early in life of the truth of the Copernican theory but was deterred from avowing his opinions — as shown in his letter of April 4, 1597, to Kepler — because of fear of ridicule. While in Venice in the spring of 1609, Gaiileo learned of the recent invention of the telescope. After returnmg to Padua he built a telescope of threefold magnifying power and quickly improved it to a power of 32. Because of the method Galileo devised for checking the curvature of the lenses, his telescopes were the first that could be used for astronomical observation, and they soon were in demand in all parts of Europe.

As the first person to apply the telescope to a study of the skies, Galileo in late 1609 and early 1610 announced a series of astronomical discoveries. He found the surface of the moon was irregular and not smooth as had been supposed; he observed that the Milky Way was composed of a collection of distant stars; he discovered the satellites of Jupiter and named them Sidera Medicea in honour of his former pupil and future employer, Cosimo II, grand duke of Tuscany. Galileo also observed spots on the sun, the phases of Venus and nhat appeared to him as the three forms of Saturn. His first decisive astronomical observations nere published in 1610 in *Sidereus Nuncius* (see TELESCOPE: *Early* History).

Although the Venetian senate had granted Galileo a lifetime appointment as professor at Padua because of his findings with the telescope, he left in the summer of 1610 to become "first philosopher and mathematician" to the grand duke of Tuscany, an appointment that enabled him to devote more time to research.

Conflict With Rome. — In 1611 Galileo visited Rome and demonstrated his telescope to the most eminent personages at the pontifical court. Encouraged by the flattering reception accorded to him, he ventured in his Letters on the *Sunspots,* printed at Rome in 1613, to take up a more definite position on the Copernican theory. Movement of the spots across the face of the sun, Galileo maintained, proved Copernicus was right and Ptolemy wrong.

The great expository gifts of Galileo and his choice of Italian, in which he was an acknowledged master of style, made his thoughts popular beyond the confines of the universities and created a powerful movement of opinion. The Aristotelian professors, seeing their vested interests threatened; united against him. They strove to cast suspicion upon him in the eyes of ecclesiastical authorities because of contradictions between the Copernican theory and the Scriptures. They obtained the cooperation of the Dominican preachers, who fulminated from the pulpit against the new impiety of "mathematicians" and secretly denounced Galileo to the Inquisition for blasphemous utterances which had been freely invented. Galileo, gravely alarmed, agreed with one of his pupils: B. Castelli, a Benedictine monk, that something should be done to forestall a crisis. He accordingly wrote letters meant for the grand duke and for the Roman authorities (letters to Castelli. to the grand duchess dowager, to Monsignor Dini) in which he pointed out the danger, reminding the church of its standing practice of interpreting scripture allegoricallp whenever it came into conflict with scientific truth. quoting patristic authorities and warning that it would be "a terrible detriment for the souls if people found themselves convinced by proof of something that it was made then a sin to believe." He even went to Rome in person to beg the authorities to leave the way open for a change. X number of ecclesiastical experts were on his side. Unfortunately, Cardinal Bellarmine. the chief theologian of the church, was unable to appreciate the importance of the new theories. He clung to the time-honoured belief that "mathematical hypotheses" have nothing to do with physical reality. He only saw the danger of a "scandal" which might undermine Catholicity in its fight with Protestantism. He accordingly decided that the best thing would be to check the whole issue by having Copernicanism declared "false and erroneous" and the book of Copernicus suspended by the congregation of the Index. The decree came out on March 5, 1616. On the previous Feb. 26, however, as an act of personal consideration. Cardinal Bellarmine had granted an audience to Galileo and informed him of the forthcoming decree, warning him that he must henceforth neither "hold nor defend" the doctrine, although it could still be discussed as a mere "mathematical supposition."

For the next seven years Galileo led a life of studious retirement in his house in Bellosguardo near Florence. At the end of that time (1623). he replied to a pamphlet by Orazio Grassi, S.J., about the nature of comets; the pamphlet clearly had been aimed at Galileo. The reply, titled *Saggiatore* . . . ("Assayer . . ."), was a brilliant polemic on physical reality and an exposition of the new scientific method. Galileo distinguished in it between the primary (*i.e.,* mathematical) properties of matter and the others. and wrote the famous pronouncement that the "Book of Nature is written in mathematical characters." The book was dedicated to the new pope. Urban VIII. who as Maffeo Barberini had been a longtime friend and protector of Galileo. Pope Urban received the dedication enthusiastically.

In 1624. Galileo again went to Rome, hoping to obtain a revocation of the decree of 1616. This he did not get, but he obtained permission from the pope to write about "the systems of the world" both Ptolemaic and Copernican, so long as he discussed them noncommittally and came to the conclusion dictated to him in advance by the pontiff, that is, that we cannot presume to know how the world is really made because God could have brought about the same effects in ways unimagined by us, and we must not restrict His omnipotence. These instructions were confirmed in writing by the head censor. Monsignor Riccardi.

Galileo returned to Florence and spent the next several years working on his great *Dialogo dei Massimi Sistemi* "Dialogue of the Two Chief World Systems"). As soon as it came out in 1632, with the full imprimatur of the censors, it was greeted with a tumult of applause from every part of Europe as a literary and philosophical masterpiece.

On the crisis which followed we have only inferences. It was pointed out to the pope that despite its noncommittal title, the work was a compelling and unabashed plea for the Copernican system. The strength of the argument made the prescribed conclusion at the end look anticlimatic and pointless. The Jesuits insisted that it could have worse consequences on the established system of teaching "than Luther and Calvin put together." The pope in anger ordered a prosecution. The author being covered by license, the only legal measures would be to disavow the licensers and prohibit the book. But at that point a document was "discovered" in the file, to the effect that during his audience with Bellarmine on February 26, 1616, Galileo had been specifically enjoined from .'teaching or discussing Copernicanism in any way," under the penalties of the Holy Office. His license, it was concluded. had therefore been "extorted" under false pretences. (The consensus of historians, based on evidence made available when the file was published in 1877, has been that the document was a plant and that Galileo was never so enjoined.) The church authorities, on the strength of the "new" document. were able to prosecute him for "vehement suspicion of heresy." Notwithstanding his pleas of illness and old age. Galileo was compelled to journey to Rome in Feb. 1633 and stand trial. He was treated with special indulgence and not jailed. In a rigorous interrogation on April 12, he steadfastly denied any memory of the 1616 injunction. The commissary general of the Inquisition, obviously sympathizing with him, discreetly outlined for the authorities a way in which he might be let off with a reprimand, but on June 16 the congregation decreed that he must be sentenced. The sentence was read to him on June 21: he was guilty of having "held and taught" the Copernican doctrine and was ordered to recant. Galileo recited a formula in which he "abjured, cursed and detested" his past errors. The sentence carried imprisonment but this portion of the penalty was immediately commuted by the pope into house arrest and seclusion on his little estate at Xrcetri near Florence. where he returned in Dec. 1633. The house arrest remained in effect throughout the last eight years of his life.

Although confined to his estate, Galileo's prodigious mental activity continued undiminished to the last. In 1634 he completed his *Discorsi e Dimostrazioni Matematiche intorno a due nuove scienze* . . . ("Dialogue on Two New Sciences . . ."), in which he recapitulated the results of his early experiments and his mature meditations on the principles of mechanics. This, in many respects his most valuable work. was printed by the Elzevirs at Leiden in 1638. His last telescopic discovery—that of the moon's diurnal and monthly librations—was made in 1637, only a few months before he became blind. But the fire of his genius was not even yet extinct. He continued his scientific correspondence with unbroken interest and undiminished acumen: he thought out the application of the pendulum to the regulation of clockwork, which Christiaan Huygens put into practice in 1656; he was engaged in dictating to his disciples, Viviani and Torricelli, his latest ideas on the theory of impact when he was seized with the slow fever which resulted in his death at Xrcetri on Jan. 8, 1642.

Value of His Work.—The direct services of permanent value a-hich Galileo rendered to astronomy are virtually summed up in his telescopic discoveries. A puzzling circumstance is his neglect of Kepler's laws, which were discovered during his lifetime. But, then he believed strongly that orbits should be circular in order to keep the fabric of the cosmos in its perfect order. This preconception prevented him from giving the full formulation of the inertial law. which he himself discovered although it usually is attributed to Descartes. Galileo believed that the inertial path of a body around the earth must be circular. Lacking Newtonian gravitation, he hoped this would allow him to explain the path of the planets as circular inertial orbits around the sun. His name is nevertheless justly associated with a vast extension of the bounds of the visible universe, and his telescopic observations are a standing monument to his ability. Within two years after their discovery, he had constructed approximately accurate tables of the revolutions of Jupiter's satellites; and he proposed their frequent eclipses as a means of determining longitudes on land and at sea. The idea. though ingenious, has been found of little use at sea. His observations on sunspots are noteworthy for their accuracy and for the deductions he drew from them with regard to the rotation of sun and the revolution of the earth.

The idea of a universal force of gravitation seems to have hovered on the borders of this great man's mind. but he refused to entertain it because, like Descartes, he considered it an "occult" quality. More valid instances of the anticipation of modern discoveries may be found in his prevision that a small annual parallax would eventually be found for some of the fixed stars, and that extra-Saturnian planets would at some future time be ascertained to exist, and in his conviction that light travels with a measurable although extremely great velocity. Although Galileo discovered, in 1610, a means of adapting his telescope to the examination of minute objects, he did not become acquainted with the compound microscope until 1624. when he saw one of Cornelis Drebbel's instruments in Rome and, with characteristic ingenuity, immediately introduced several improvements into its construction.

A most substantial part of his work consisted undoubtedly of his contributions toward the establishment of mechanics as a science. Some valuable but isolated facts and theorems had previously been discovered and proved, but it was Galileo who first clearly grasped the idea of force as a mechanical agent. Although he did not formulate the interdependence of motion and force into laws, his writings on dynamics are everywhere suggestive of those laws, and his solutions of dynamical problems involve their recognition. In this branch of science he paved the way for Newton. The extraordinary advances made by him were due to his happy method of applying mathematical analysis to physical problems.

Galileo was the first man who perceived that mathematics and physics, previously kept in separate compartments, were going to join forces. He was thus able to unify celestial and terrestrial phenomena into one theory, destroying the traditional division between the world above and the world below the moon. The method which was peculiarly his consisted in the combination of experiment with calculation — in the transformation of the concrete into the abstract and the assiduous comparison of results. He created the modern idea of experiment, which he called *cimento* or "ordeal." This method was applied to check theoretical deductions in the investigation of the laws of falling bodies, of equilibrium and motion on an inclined plane and of the motion of a projectile. The latter, together with his definition of momentum and other parts of his work, implied a knowledge of the laws of motion as later stated by Newton. In his *Discorso intorno alle cose che stanno in su l'acqua* ("Discourse on Things That Float"), published in 1612, he used the principle of virtual velocities to demonstrate the more elementary theorems of hydrostatics, deducing from it the equilibrium of fluid in a siphon, and worked out the conditions for the flotation of solid bodies in a liquid. He also constructed in 1607 an elementary form of air thermometer.

See ASTRONOMY: *The Founding of Modern Astronomy;* CAUSALITY (CAUSATION): *Historical Development;* GRAVITATION; MOTION. PRINCIPLES AND LAWS OF; *see* also references under "Galileo Galilei" in the Index volume.

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GALIUM, a genus of plants of the madder family (Rubiaceae), comprising 250 species of world-wide distribution, mostly slender herbs. Of these. about 60 species are found in North America and 10 in Great Britain. *See* CLEAVERS; RUBIACEAE.

GALL, SAINT (fl. c. 600). Irish monk from Bangor, County Down, accompanied St. Columban (*q.v.*) to France and Burgundy. When Columban proceeded to Italy. Gall stayed behind among the Alamanni. He lived as a hermit on the banlrs of the Steinach river, preaching to the people of the district. which was still semipagan, and died there at an unknown date during the 7th century. His feast day is Oct. 16.

Little is known about. Gall from authentic sources. The biographer of Columban, Jonas of Bobbio, who knew Gall personally, relates merely that he once disobeyed Columban in a trifling matter. The earliest life of St. Gall, of which only a fragment survives, dates from the 8th century; most popular during the middle ages was the life by Walafrid Strabo of Reichenau, written about 833. Some incidents in these and other lives of Gall might be substantially historical.

The abbey of St. Gall, founded about 720 on the site of Gall's hermitage, had close links with Ireland especially during the 9th century and acted then as a channel for Irish influences on the continent, but there is no evidence of a continuous Irish tradition from the death of Gall to the abbey's golden age.

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GALL, FRANZ JOSEPH (1758–1828), anatomist. physiologist and founder of phrenology. was born at Tiefenbronn, Baden, Ger., on March 9, 1758, and studied at Baden. Strashourg and Vienna. Gall gradually reached the conviction that the talents and dispositions of men are dependent upon the functions of the brain. and that they may be inferred with precision from the external appearances of the skull. His phrenological lectures in Vienna met with increasing success until in 1802 they were interdicted by the government as dangerous to reiipion. Gall left Vienna in 1805 and eventually settled in Paris, where he practised medicine, lectured and wrote a number of books setting forth his theories. He died in Paris on Aug. 22. 1828. *See* PHRENOLOGY.

GALL, a digestive fluid secreted by the liver and known also as bile. The term is sometimes used also for the gall bladder, the pear-shaped diverticulum of the bile duct that forms a reservoir for the bile. From the extreme bitterness of the secretion, "gall," like the Latin *fel,* is ured for anything extremely bitter, whether actually or metaphorically.

"Gall," meaning a sore or painful swelling, especially on a horse, may be derived from an early use of the word as meaning "poison." But in Romance languages. the French *galle,* Spanish *agalla,* a wind gall or puffy distention of the synovial bursa on the fetlock joint of a horse, is derived from the Latin *galla,* "oak apple," from which comes the English "gall," meaning an excrescence on trees caused by certain insects. *See* DIGESTION; GALL BLADDER: GALLS; LIVER.

GALLA, a Cushitic-speaking people of eastern Africa, scattered over central parts of Ethiopia to the neighbourhood of the Sabaki river in Kenya. They appear to have occupied the southern part of their present territory since the 16th century. They are ethnically mixed, with high foreheads, brown skins and wavy hair.

The Galla include both cultivators and nomadic pastoralists. Each tribe has its chief, who in all public concerns must take advice of the fathers of families in council. Most Galla tribes of highland Ethiopia are either Christian or Moslem, but the pastoral Galla to the south are predominantly pagan. Among the more important groups are the Arusi, Xararetta. Boran, Ittu, Macha, Rendile. Tulama. Wallaga and Wollo.

GALLAIT, LOUIS (1810–1887), Belgian painter of historical scenes. was born at Tournay, Hainaut. on May 9, 1810. He studied at Tournay under Hennequin. and at Antwerp under Van Brée. He then settled in Paris, sending from there to the Belgian salons a series of important historical pictures. He was then urged to return to Brussels, where the latter half of his life was spent, and where he died on Nov. 20, 1887.

Among his most famous works are: "The Abdication of Charles V" (1841), "The Last Honours Paid to Counts Egmont and Horn by the Corporations of the Town of Brussels" and "The Death of Egmont." His art was that of a skilled painter. but superficial. As an artist employed by the state, he exercised considerable influence and was a leader of public taste in Brussels.

GALLAND, ANTOINE (1646–1715), French orientalist, archaeologist and numismatist whose translation of the *Arabian Nights* introduced the tales to Europe and remains the standard French translation. was born at Rollot (Somme), April 4, 1646. After walking to Paris at 14 to learn Greek and Hebrew, he studied at the Collège de France and accompanied the French ambassador to Coustantinople (1670), returning twice to the Levant for further studies. He was admitted to the Académie des Inscriptions (1710), was made "antiquary to the King" and was offered the chair of Arabic at the Collège de France (1709). He died in Paris, Feb. 17, 1715.

In addition to *Les Mille et une nuits*, 12 vol. (1704–17), Galland's works include *Paroles remarquables, bons mots et maximes des orientaux* (1694; Eng. trans. 1795); *De l'Origine et du progrès du cafe'* (1699); and many archaeological and numismatic treatises. A translation of the Koran and a history of the Turkish sultans remain unpublished. *Contes et fables indiennes de Bidpaï et de Lokman* were published posthumously in 1724. His *Journal pendant son séjour à Constantinople, 1672–73*, was edited by C. Schefer (1881); the *Journal parisien, 1708–1715*, with his *Autobiographie, 1646–1715*, was edited by H. Omont (1919). *See* also the article THOUSAND AND ONE NIGHTS.

GALLARATE, a town of Lombardy, Italy, in the province of Varese, 25 mi. N.W. of Milan by rail. Pop. (1951) 25,849. The town is of medieval origin. It is remarkable for its textile factories. Many Italian looms were established in and around the town to produce annually thousands of metres of cotton cloth. It is also the centre of the machine embroidery trade.

GALLAS, MATTHIAS, COUNT OF CAMPO, DUKE OF LUCERA (1584–1647), Austrian soldier, first saw service in Flanders, and in Savoy with the Spaniards, and subsequently joined the forces of the Catholic League as captain. On the general outbreak of hostilities in Germany, he distinguished himself, at Stadtlohn (1623) and elsewhere. In 1630 he was serving as General-Feldwachtntezster under Collalto in Italy, and was mainly instrumental in the capture of Mantua. Made count of the Empire for this service, he returned to Germany for the campaign against Gustavus Adolphus, covered Bohemia against the Swedes in 1631–1632, and served at the Alte Veste and also at Lützen sgainst Bernhard of Saxe-Weimar, rising to be lieutenant-general in the Emperor's own army. He was one of the chief conspirators against Wallenstein, and after the tragedy of Eger was appointed to the command of the army which Wallenstein had formed and led. At Nordlingen (Aug. 23, 1634) in which the army of Sweden was almost annihilated, Gallas commanded the victorious Imperialists. In northern Germany, where he commanded against the Swedish general Banér in 1637 and 1638, and in later crises he was unsuccessful. He resigned his command, and died in 1647 at Vienna.

His army had earned a reputation as the most cruel and rapacious force even in the Thirty Years' War, and his *Merode Brüder* have survived in the word marauder.

GALLATIN, ALBERT (1761–1849), American statesman, was born in Geneva, Switzerland, on Jan. 29, 1761, of an old and noble family. His father died in 1765, his mother five years later, and he was cared for by his grandparents and by a Mlle. Pictet, an intimate friend of his mother. In 1779 he graduated with honour from the college in Geneva, and, giving up iortune and social position, slipped away from home and embarked for America despite the wishes of his relatives. In July 1780 Gallatin and his friend Henri Serre (d 1784) landed in Massachusetts and entered business; but, conditions in the country being unsettled, they failed. For a time Gallatin taught French in Harvard college, then removed to the backwoods of Pennsylvania and Virginia, where he engaged in land speculation.

Beginning his service in Congress in Dec. 1795, Gallatin immediately made himself a conspicuous figure and before his first term was over became the Federalists' most dangerous opponent in Congress, and they attacked him not only politically but personally. for at this time they were opposed to the French Revolution and so resented Gallatin's ancestry. Gallatin became the financier of his party and succeeded in inaugurating the committee on finance, which is now the ways and means committee, and fought for his cardinal doctrines of simplicity and economy in government. In debate (1796) over the Jay Treaty he defended the constitutional right of the House to consider treaties, admitting that the President and Senate had the right to make treaties, but maintaining that the House could refuse to pass the finances to carry them out. When in May 1797 President Adams asked for appropriations for war because of France's refusal to receive American ambassadors, Gallatin struggled successfully to keep down appropriations and to prevent the three United States frigates from being equipped for sea. He continued his opposition to a strong navy, the mainspring of Washington's foreign policy, and in the following year helped to defeat a resolution for the preparation of 16 armed vessels and a declaration of war against France. He also opposed (Jan. 1798) commercial treaties and diplomatic intercourse, maintaining that all political intercourse should be gradually given up, and commercial intercourse protected by the consular system.

The greatest period of Gallatin's career in Congress was in 1798, when, after the publication of the famous X.Y.Z. despatches had inflamed the people against France and given the Federalists control of the Government, he was attacked as a French agent, and Jefferson believed that the Sedition bill was intended to drive him from office. However, the strong measures of the Federalists shocked the country, and the Republicans carried the elections of 1800. Gallatin led his party in the contest in the House of Representatives, which elected Jefferson over Burr.

When Jefferson became President (1801) he made James Madison secretary of State and Gallatin secretary of the Treasury. Gallatin made few changes in Hamilton's arrangements, but he did seek for simplicity of Government and the extinction of the public debt. He preferred to bribe the Barbary pirates to spending the money to subdue them, wished to avoid commercial warfare at all costs, and thought that (1803) the government should seize east Louisiana and west Florida. Despite the fact that he could not reduce naval expenditures as he wished, he achieved his goal and, despite the Louisiana Purchase (1803), reduced the public debt by $14,260,000 within six years and acquired a surplus. However, relations with Europe became strained and in Dec. 1807 Jefferson put into execution the embargo, though Gallatin. recognizing the consequences, declared, "I prefer war to a permanent embargo," and reported that a continuous embargo would necessitate a loan while war would not. The embargo proved futile and was repealed (1809) in favour of the nonintercourse act, after causing a deficiency in the treasury, and Jefferson retired to be succeeded by Madison. Madison had regarded Gallatin as his successor as secretary of state; but a cabal in the senate opposed him and Gallatin was left as secretary of the treasury.

In June 1812 war was declared against England. This shattered Gallatin's cherished schemes, for he believed war was fatal to prosperity and progress. However, he put the finances in the best order he could, and set himself to attain an early peace. With this end in view he grasped at the proffered mediation of Russia, and with Madison's permission sailed with James A. Bayard for Europe in May 1813 without resigning as secretary of the treasury. Great Britain refused to negotiate through Russia, and in addition Gallatin heard that the senate had refused to confirm his appointment because he was still secretary of the treasury. He sent in his resignation and worked unofficially until his second appointment was confirmed. In the meantime Great Britain had expressed its willingness to proceed with direct negotiations. The English and U.S. commissioners finally met at Ghent, Gallatin, Bayard and John Quincy Adams, who was minister to Russia, being supplemented by Jonathan Russel and Henry Clay. In the tedious discussions which followed, Gallaiin played the leading part. preserving peace among his colleagues and establishing a reputation as a diplomatist. He refused to push the U.S. claim to Florida, but stood firmly on other points with his colleagues. Peace rewarded them; the treaty was signed on Dec. 24, 1814.

While still in Europe he had been asked by Madison to become minister to France; this appointment he accepted in Jan. 1816, and adhered to his acceptance in spite of his being asked in April 1816 to serve once more as secretary of the treasury. He remained in France for the next seven years, and in 1818 assisted Richard Rush, then United States minister in London, in negotiating a commercial convention.

In June 1823 he returned to the United States, where he found himself in the bitter struggle then in progress for the presidency. His favourite candidate was his personal friend, William H. Crawford, with whom he consented in May 1824 to stand for the vice-presidency. The contest was bitter and full of intrigue. Martin Van Buren, then in the Crawford interest, came to the conclusion that Gallatin, by his foreign origin, weakened the ticket, and in October Gallatin retired from the contest. The election was thrown into the house, and resulted in the choice of John Quincy Adams, who in 1826 drew Gallatin from his retirement and sent him as minister to England. In Nov. 1827 he once more returned to the United States and bade farewell to public life.

Taking up his residence in New York, he was in 1832–39 president of the National Bank (afterwards the Gallatin bank) of New York. By writing his *Synopsis of the Indian Tribes Within the United States East of the Rocky Mountains and in the British and Russian Possessions in North America* (1836), and by founding the American Ethnological Society of New York in 1842, he earned the title of "Father of American Ethnology." He died in Astoria, L.I., on Aug. 12, 1849.

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GALLAUDET, THOMAS HOPKINS (1787–1851), U.S. educator of the deaf-mute, was born in Philadelphia, Pa., of French Huguenot ancestry, on Dec. 10, 1787. He graduated at Yale in 1805 and studied theology at Andover. Eventually he determined to devote his life to the education of deaf-mutes. He visited Europe and studied the methods of the abbé Sicard in Paris, and of Thomas Braidwood and his successor Joseph Watson in Great Britain. Returning to the United States in 1816, he established at Hartford, Conn., a school for deaf-mutes, in support of which congress made a land grant. Gallaudet presided over the school with great success until ill-health compelled him to retire in 1830. He died at Hartford on Sept. 10, 1851.

GALL BLADDER. The gall bladder in man is a pear-shaped, hollow organ situated on the undersurface of the liver; it acts as a storage place for bile, the digestive fluid secreted by the liver. The base of the gall bladder is called the fundus; the main portion, the body; and the narrow end, the neck. The latter terminates in the cystic duct, which joins the common bile duct. The wall of the gall-bladder consists of three layers: (1) an inner mucous layer of surface epithelium, (2) a middle fibromuscular layer consisting of smooth muscle and connective tissue and (3) a serosa that covers that portion of the organ not in contact with the liver. The walls of the gall bladder are distensible, and its capacity varies considerably. The gall bladder receives its blood supply from the cystic artery, a branch of the hepatic artery, and from vessels reaching it from the liver. The veins of the gall bladder empty into the portal vein. It has a dual nerve supply, sympathetic and parasympathetic. It is generously supplied with lymphatics.

Although a gall bladder is present in most of the higher species of animals, there are several that do not possess it. It can be removed surgically nithout causing untoward effects. The gall bladder serves as a reservoir for bile. The liver secretes bile continuously, but bile is not required during the interdigestion periods. When there is no food in the intestine, a sphincteric mechanism closes the terminal end of the common bile duct and the bile passes into the gall bladder. Water is absorbed from the bile by the wall of the gall bladder until the bile is concentrated eight to ten times. In this manner it is possible for a relatively small organ to function as an important reservoir. This organ is emptied by contraction of the smooth muscle contained in its malls. The gall bladder may be caused to empty by ingestion of a meal of fat, such as egg yolk and cream, and specifically by a hormone, cholecystokinin, which is found in the mucosa of the upper portion of the intestine. The gall bladder is subject to many diseases such as inflammation and formation of calculi (gall stones) within it. *See* also DIGESTION; LIVER.

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GALL BLADDER, BILIARY TRACT AND LIVER, DISEASES OF, include a large number of disorders of the liver, the gall bladder and the bile ducts that link them with each other and with the small intestine. The anatomy and function of these organs are described in the articles GALL BLADDER and LIVER.

LIVER

The liver is the largest and functionally the most complex organ in the body. Its many vital activities concern the removal of bilirubin (bile pigment) from the blood, excretion of bile into the intestine, metabolism of proteins, carbohydrates and fats, utilization of vitamins, storage of materials essential to the formation of blood and protection against infections and poisons. The symptoms and consequences of liver disease depend upon the degree to which these functions are disturbed. Fortunately, the reserve capacity of the liver is tremendous, and it may function adequately until approximately 90% of its substance is destroyed.

Infectious Hepatitis — This disease (also called catarrhal jaundice) is an inflammation of the liver cells caused by a virus. It exists in sporadic or endemic form throughout the world, but increases in frequency under conditions of crowding and poor sanitation. Persons of all races and all ages are susceptible. The infection is transmitted usually from person to person and by water or food contaminated with infected fecal material; ordinary methods of purifying the water supply do not eradicate the resistant virus. Fifteen to thirty days usually elapse between exposure and the appearance of symptoms.

The illness is characterized by loss of appetite, nausea, a curious distaste for tobacco, weakness, headache, fever, chills, respiratory complaints, diarrhea and discomfort or pain in the upper abdomen. Jaundice (*q.v.*) develops gradually and increases in intensity; it may be absent in mild forms of hepatitis. The liver is large and tender; the spleen may increase in size. Laboratory tests show impaired liver function. The disease ordinarily is self-limited, with complete recovery in four to six weeks; however, it may persist for several months In a small percentage of cases, because of poor nutrition, insufficient rest, intercurrent infection or the use of alcohol, infectious hepatitis becomes chronic. The mortality rate is low. Treatment includes a substantial intake of carbohydrate and protein and a moderate amount of fat in the diet, vitamins and adequate rest; glucose solutions intravenously may be required. The return to full activity should be very gradual. Administration of immune serum globulin intramuscularly to persons in close contact with the patient generally is recommended as a prophylactic measure.

Homologous Serum Jaundice. — This is a similar viral infection, transmitted by the injection of human blood or its products; by plasma convalescent serum or vaccines, and by any type of hypodermic injection with a poorly sterilized syringe. The incubation period extends from 40 to 190 days. One attack probably confers substantial but not absolute immunity against reinfection. There is no cross-immunity between the two types of hepatitis. The mortality rate varies, perhaps approximating 35%. Treatment is the same as for infectious hepatitis. The control of serum jaundice is aided by the detection of carriers among prospective blood donors and upon the use of plasma stored at room temperature instead of under refrigeration.

In severe viral hepatitis, with extensive destruction of the liver, there may be temporary obstruction to the flow of bile from the small bile ducts to the small intestine, so-called medical obstructive jaundice. A similar situation may complicate bacterial inflammation of the liver, excessive accumulations of fat in the liver cells (as in severe malnutrition) and certain defects in enzyme systems within liver cells; the latter category includes deficiency of the enzyme glucuronyl transferase. In the Dubin-Johnson syndrome, the liver cells, though seemingly normal, apparently are unable to excrete properly the normally formed bilirubin-glucuronide.

Toxic Hepatitis. — Toxic hepatitis is an acute disease caused by a variety of poisons: commercial solvents containing carbon tetrachloride or chloroform. phosphorus. mercury, gold, snake venom and poisonous mashrooiris. The disease also may follow certain infections. Thz central portions of the liver lobules usually are destroyed; oiher changes include large accumulations of fat and shrinkage of the liver. Tne extent of liver injury and the outcome depend upon the injurious agent, the quantity of the toxic dose, the duration and frequency of contact and the nutritional state of tne iiver. Symptoms resemble those of infectious hepatitis but are more severe; the mortality rate is high. Treatment is limited to rest, diet vitamins and glucose intravenously. British antilewisite (BAL) may be effective when arsenic or mercury is the cause.

The liver also may be injured occasionally by medicinally prescribed drugs, including chlorpromazine, methyltestosterone, marsilid, thiouracil, methimazole, arsenicals, phenylbutazone, para-amino sulfonic acid, sulfanilamide, trinitrotoluene and cinchophen, among many others. The microscopic changes in the liver include bile stasis. inflammation around the portal tracts, mild degeneration of cells and proliferation of bile ducts. Symptoms may develop within four days to five weeks of the onset of the treatment, and include nausea, vomiting, anorexia, malaise, jaundice, itching and abdominal pain. The symptoms and laboratory findings suggest interference with the normal flow of bile. The liver and spleen may increase in size. Since this problem occurs only in a small percentage of patients receiving medication, hypersensitivity to the drug and individual susceptibility have been suggested as causative factors. Treatment consists in discontinuance of the medication, the general measures for liver disease and, occasionally, ACTH and the adrenal steroids. Recovery usually is complete; in a small number of cases, the illness may terminate fatally.

Primary Cholangiolitic Hepatitis. — This uncommon inflammatory disease of the liver occurs predominantly in young women. The cause is not known; the metabolism of lipids in the liver appears to be disturbed. The symptoms include, in addition to jaundice, itching and variable ahdorninal distress. There may be increased pigmentation of the skin and deposition of lipid around the eyes. the creases of the palms and on the elbows, producing striking lesions (xanthomata). The liver is enlarged, and the spleen may be normal or large. The urine is dark in colour. The laboratory findings are compatible with an obstruction to the flow of bile; namely. an increase in the serum bilirubin, cholesterol, alkaline phosphatase and bile acids; the pattern of the plasma proteins also is normal. Gallstones (cholelithiasis) develop occasionally. There is no completely satisfactory treatment. Therapy includes the usual measures for liver disease; adrenal steroids may provide symptomatic improvement, though the underlying disease is not improved. Linoleic acid, as ethyl linoleate, and as a modified milk in which all the butter fat is replaced by safflower oil, has been recommended.

Portal Cirrhosis.—Portal cirrhosis is the result of chronic diffuse liver injury, characterized by destruction of cells, deposition of fat, excessive scarring and distortion of the liver. The flow of blood within the liver is disturbed, causing enlargement of the spieen and the development of accessory venous channels (varices). especially around the esophagus. The liver becomes large, hard arid irregular. Chronic alcoholism and malnutrition are the most important causes; however, cirrhosis may develop after any injury to the liver cells associated with cell destruction and the accumulation of fat. Symptoms may be absent, but loss of appetite, nausea, jaundice and fever are common. Spiderlike dilatations of small blood vessels may appear on the face and upper portion of the body. Bleeding may occur into the skin or after the rupture of varices. Fluid inay accumulate within the abdomen (ascites, or dropsy) or in the tissues (edema). The accumulation of fluid within the abdominal cavity is attributable to several factors: interference with the outflow of blood from the liver; increased communications between the major blcod vessels of the liver; excessive production of hormones. such as aldosterone, from the adrenal gland; retention of salt in the body; decreased protein in the circulating blood; increased output of antidiuretic hormone; and excessive production of lymph from the liver.

Treatment is directed to resroration of normal nutrition and the control of complications. It includes the avoidance of alcohol, a diet rich in carbohydrate and protein, and vitamins, especially the B complex. Ascites and edema are treated by a low-salt diet. drugs facilitating the elimination of salt and the replenishment of body proteins with diet, blood transfusions and albumin: drainage of the excess fluid may be necessary. Various "shunting" operations, redirecting the flow of blood, may be required for recurrent bleeding. The liver cells may be so diseased as to result in serious metabolic and chemical disturbances.

Hepatic Coma. — Patients with severe liver disease may pass into a coma, continuing for days to weeks and often ending fatally. The onset is very gradual and is characterized by vague, almost imperceptible changes in emotion, including untidiness, inappropriate behaviour and nocturnal wakefulness. These symptoms are followed by mental confusion, a characteristic flapping tremor of the outstretched hands and fingers, and then by coma, accompanied by typical changes in the brain wave pattern of the electroencephalogram. The cause of this complication often is not apparent. Precipitating factors may include gastrointestinal bleeding from esophageal varices or peptic ulcer, removal of fluid from the abdominal cavity, excessive intakes of protein, infection, administration of drugs containing ammonium, diuretics, opiates, sedatives and other drugs. The laboratory findings frequently indicate severely impaired liver function and its associated metabolic disturbances, and often but not invariably an increased amount of ammonia in the blood. Important factors in the development of liver coma include abnormal bacterial action upon the proteins within the bowel, inability of the diseased liver to remove adequately the excessive ammonia from the portal blood stream draining the digestive tract, and rapid transfer of the excessive ammonia and other toxic substances into the general circulation. Other disturbances in protein metabolism and defective carbohydrate and vitamin metabolism also may be implicated.

The management of liver coma is difficult. Avoidance of those factors known to precipitate the complication is important. Treatment usually requires skilled nursing care; adequate fluids; glucose and vitamins intravenously; limitation of the protein intake, at least temporarily; saline enemas to eliminate excessive protein from the alimentary tract; antibiotics such as neomycin, chlortetracycline or oxytetracycline to decrease the bacterial content of the bowel and thereby reduce the production of ammonia and other toxic materials. Glutamic acid and I-arginine or arginine glutamate have been administered to decrease the ammonia content of the blood and the brain. In the most severely ill patients. corticotropin (ACTH) and adrenal steroids have been administered in very large quantities, with occasionally spectacular, though usually temporary, improvement. The outlook for patients with liver coma, though not necessarily hopeless, is grave, since the complication denotes very serious, often irreversible disease.

Biliary Cirrhosis. — This is characterized by excessive scar tissue formation, an increase in the number of small bile ducts within the liver, and inflammation of the bile channels (cholangitis). In the primary (cholangiolitic) type, the larger bile passages and the gall bladder are normal, and the process is confined to the smaller bile ducts within the liver. The cause is not known, although infectious hepatitis may be implicated. Biliary cirrhosis often is the result of persistent, incomplete obstruction of the common bile duct by impacted gallstones, adhesions or scar tissue developing after operations on the gall bladder, or by new growths.

Symptoms include jaundice, itching of the skin and attacks of chills, fever, sweats and abdominal pain. The urine is dark and the stools are light in colour. The liver and the spleen are large. The inadequate flow of bile into the intestine interferes with the metabolism of fats and with the absorption of fat-soluble vitamins. Treatment consists in rernoval of the obstruction, whenever possible. rest. diet, vitamins and control of infection with sulfonamides and antibiotics.

Abscess of the Liver. — Liver abscess most often is of the pyogenic type, with many small abscesses caused by bacteria brought to the liver via the blood stream from infected areas (as the appendix) within the abdomen. The characteristic symptoms are intermittent fever. chills, sweats, jaundice and toxemia. The liver becomes large and tender. Treatment consists of sulfonamides, penicillin or other antibiotics, and drainage of the abscess. "Tropical" abscess of the liver usually is single and large and almost always the result of infection with *Endamoeba histolytica* (the cause of amoebic dysentery). The administration of antiamoebic drugs and aspiration of the abscess usually are effective. Other less frequent causes of liver abscess are injury, the penetration of a foreign body or infection of an echinococcus cyst.

Weil's Disease.—This is an acute infection of the liver caused by the spirochete *Leptospira icterohaemorrhagiae.* It is transmitted via food or water contaminated with the urine of infected rats. The organisms may enter the body through the skin. eyes, mouth or intestine. Men coming in contact with rats—miners, fishermen, farmers and workers in sewers, railroad yards and rice or sugar-cane fields—often are affected. The illness begins suddenly nith fever, aching in the muscles and joints, headache. prostration and jaundice The liver and spleen become enlarged, hemorrhages occur in the skin, and the kidneys and central nervous system become involved. There is no specific treatment: penicillin and other antibiotics appear to be of value.

Syphilis of the Liver.—This is no longer common. The left lobe is especially involved, either by diffuse scarring or large masses called gummata. The liver is large, hard and very nodular Treatment consists in the administration of antisyphilitic drugs (see VENEREAL DISEASES).

Hemochromatosis.—Hemochromatosis of the liver is a metabolic disorder of unknown cause, characterized by the deposition of two pigments, hemosiderin (an iron-containing pigment) and hemofuscin. in the liver and pancreas and sometimes in the skin, The disease affects chiefly men during the ages of 50 or 60; it occurs in conjunction with chronic malnutrition and pellagra among the Bantu of South Africa. The symptoms are related to those of diabetes and cirrhosis. The skin occasionally assumes a rusty or bronze pigmentation, and there may be loss of body hair and atrophy of the testes. Treatment is directed to the diabetes, utilizing proper diet and insulin, if necessary. The management of the cirrhosis is similar to that outlined above.

Malignant Disease.—Primary cancer (*q.v.*) of the liver generally is uncommon, though the incidence is high in the far east and South Africa. where parasitic infestations and malnutrition are common. The tumour may arise in the liver cells or the bile ducts, in association with cirrhosis. Secondary involvement of the liver by cancer occurs in approximately 50% of patients with tumours originating elsewhere in the body, especially the stomach, colon, pancreas, lungs and breast. Symptoms include pain in the upper abdomen. loss of appetite and weight, fever and weakness. Jaundice results from invasion and obstruction of the larger bile ducts; ascites from obstruction of the portal vein; and hemorrhages from rupture of the esophageal varices. Treatment is limited to the relief of pain.

GALL BLADDER

The gall bladder is a thin, pear-shaped structure, with the capacity of one to two ounces, situated on the undersurface of the right lobe of the liver. Its principal activities are to store the bile excreted by the liver for digestive purposes, and to regulate the pressure in the biliary system, preventing back-pressure on the liver in its continuous production of bile. The gall bladder is not an essential organ, and its removal by operation does not deprive the body of any vital function; nor does removal of the gall bladder decrease the quantity of bile entering the digestive tract. Bile is of value in aiding the digestion of fat, and as a means of excreting certain toxins and poisons removed from the body by the liver.

Acute **Cholecystitis.**—This is an inflammation of the gall bladder caused usually by the following sequence of events: obstruction of the cystic duct (leading from the gall bladder to the common bile duct) by gallstones, stasis of bile and chemical inflammation, induced by constituents of bile. Bacterial infection may or may not be present.

There is a sudden onset of pain in the upper quadrant of the abdomen. often radiating to the back or shoulder, fever, nausea, vomiting and occasionally jaundice. Symptoms may continue for several hours to several weeks, depending upon the severity of the attack. The disease may be complicated by softening or gangrene of the gall bladder, nith rupture and peritonitis, or by inflammation of adjacent portions of the liver. Treatment comprises bed rest, relief of pain, avoidance of liquid and food by mouth, glucose and salt solutions intravenously, and the use of sulfonamides and antibiotics. In cholecystitis without jaundice, the flow of bile into the intestine is unimpeded; hence there is no need for bile salts or laxatives. Surgical removal of the gall bladder may be performed promptly or deferred until the inflammation subsides.

Cholelithiasis.—This term designates stones in the gall bladder; *i.e.*, gallstones (see CALCULUS). Several factors are involved: stasis of bile with concentration and precipitation of cholesterol (as in the latter months of pregnancy); infection of the gall bladder (typhoid fever); precipitation of calcium carbonate in obstruction of the cystic duct; and increased concentration of bilirubin, as in hemolytic anemia with destruction of red blood cells and excessive formation of bilirubin. Gallstones may develop at all ages and in both sexes, but they occur more often in obese women. after pregnancy. They may be present for a lifetime without producing symptoms. The complaints of belching. flatulence and intolerance for fatty or fried foods, commonly attributed to gall bladder disease. frequently develop in the presence of a normal gall bladder and are related to gastrointestinal irritability. The passage of, stones into the cystic or common bile channels causes stretching and spasm of these ducts and sudden, severe, cramping pain in the right upper abdomen, radiating to the back and right shoulder. Chills and fever reflect an accompanying cholecystitis; jaundice indicates an obstruction to the flow of bile. Biliary colic often occurs during the night, several hours after a heavy meal and the attack usually subsides within several hours. There may be an associated inflammation of the pancreas (acute pancreatitis), diagnosis of nhich is facilitated by measurement of one of the enzymes produced by the pancreas (serum amylase). X-rays may reveal calcium-containing gallstones; or the gall bladder may fail to visualize, indicating nonfunction. Opiates often are required to relieve the pain. Gallstones cannot be dissolved, nor can stones be evacuated from the gall bladder via the intestine. Surgical removal of the gall bladder is the only curative procedure. Recurrent or continuing symptoms after surgery may be caused by a remnant of the cystic duct overlooked at the time of operation. A more serious problem is that of injury to the main bile duct at surgery, producing partial or complete interference with the normal flow of bile into the intestine; infection of the bile ducts within the liver and extensive disease of the liver usually ensue.

New Growths.—Tumours and cancer of the gall bladder are uncommon, benign tumours being found in approximately 5% of gall bladders removed surgically. These conditions include papilloma, adenoma, fibroma and lipoma. Cholesterol stones imbedded in the wall of the gall bladder may simulate benign tumours. The diagnosis is made only at X-ray examination or operation. Cancer of the gall bladder usually occurs in association with gallstones. Symptoms are caused by the stones or by an accompanying cholecystitis. The principal physical findings are jaundice and a hard, irregular mass in the region of the gall bladder. Cancer of the bile ducts also is rare. Symptoms consist of progressively increasing jaundice, itching of the skin, fever, loss of appetite and weight, and bleeding. These diseases usually are fatal; early surgical removal offers the only hope of cure.

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GALLE or Point de Galle, a town and port of Ceylon on the southwest coast. Galle is hardly noticed in the native chronicles before 1267, and Ibn Batuta, in the middle of the 14th century. distinctly states that Kali—that is. Galle—was a *small* town. It was not until the period of Portuguese occupation that it rose to importance. The opening of the Suez canal in 1869, and the construction of a breakwater at Colombo, leading to the transfer of the mail and most of the comimercial steamers to the capital of the island. seriously diminished the prosperity of Galle. The export trade is chiefly represented by coconut oil, rubber, coir yarn, fibre, rope and tea. The town is administered by a municipal council. Pop. (1953) 55,848 (mun.).

GALLEGOS, RÓMULO, (1884–) eminent Spanish-American novelist, educator and former president of Venezuela, was born Aug. 2, 1884, in Caracas, Venez. He began his literary career in 1909 as coeditor of *La alborada,* a periodical in which he published his first works, political and social essays.

His first short stories were published in El *cojo ilustrado* in 1910. After a brief attempt at the drama in 1915, Gallegos continued writing short stories until 1920, when his first novel. *El último Solar,* appeared., In 1925, a second novel, *La trepadora,* prepared the way for *Doña Bárbara* in 1929 (Eng. trans. by Robert Malloy; 1931, 1948). With *Doña Bárbara* he became an internationally known literary figure and one of the leading novelists of Spanish America. Two more major novels, *Cantaclaro,* 1934, and *Canaima,* 1935, followed. In 1936, Gallegos began an active political career that led to the ministry of education and finally to the presidency in 1947. His government was overthrown by a military coup in Nov. 1948, and he was sent into exile in December.

A historical novel, *Pobre negro,* 1937, was followed by three other novels: El *forastero* (1942), *Sobre la misma tierra* (1943) and *La brizna dc paja en el viento* (1952).

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GALLEN-KALLELA, AKSELI VALDEMAR (186;–1931). Finnish painter, was born on April 26, 1865, at Pori. He established himself in 1884 in Paris. He is best known for his symbolic scenes from the *Kalevala* epic, for his landscapes, especially snow scenes, and for some admirable portraits, notably one of Maxim Gorky. He also executed work in black and white. His illustrations for *Seitsemän Veljestä,* by Aleksis Kivi (1906–07), are well composed and imaginative. He died at Stockholm, March 7, 1931.

GALLEY, a long single or half-decked vessel of war; with low freeboard, propelled primarily by oars or sweeps, but also having masts for sails. The word is used generally to refer to the ancient war vessels of Greece and Rome of various types, whose chief propelling power was the oar or sweep, but its more specific application is to the medieval war vessel which survived in the navies of the Mediterranean sea powers after the general adoption of the larger many-decked ship of war, propelled solely by sail power. Lepanto (1571) was the last great naval battle in which the galley played the principal part. It became the custom among the Mediterranean powers to sentence condemned criminals to row in the war galleys of the state. Traces of this in France can be found as early as 1532, but the first legislative enactment is in the *Ordonnance d'Orléans* of 1561. In 1564 Charles IX forbade the sentencing of prisoners to the galleys for less than ten years. The galley slaves were branded with the letters Gal. At the end of the reign of Louis XIV the use of the galley for war purposes had practically ceased, but the corps of the galleys was not incorporated with the navy until 1748. The name *galérien* was still given to all convicts, though the galleys had been abandoned. and it was not till the French Revolution that the name was changed to *forçat.* In modern nautical use, the galley is a ship's kitchen. *See* also Ship; Shipping, History of: *Developments in Ship Design and Navigation.*

GALLFLY, a name applied to a number of different kinds of insects that cause the production of galls in plants. In Diptera (*q.v.*), any gall-making fly belonging to the families Cecidomyidae or gall midges (*q.v.*), or to the family Trupaneidae or Trypetidae (*see* Fruit Fly). In Hymenoptera (*q.v.*), any member of the family Cynipidae, usually called gall wasps.

The name may also be applied to gall makers of the family Aphididae of the order Homoptera (formerly a suborder under Hemiptera). The galls are usually diagnostic for the species making them. (C. H. Cn.; X.)

GALLIA CISALPINA, that portion of northern Italy north of Liguria and Umbria and south of the Alps which was inhabited by various Celtic and other peoples, of whom the Celts were in continual hostility to Rome and rendered assistance to Hannibal. In early times it was bounded on the south by Liguria and the Aesis; Sulla readjusted the boundaries and in Caesar's time the southeast boundary was the Rubicon. For the early Celtic and other peoples and the later history of the district *see* Italy: *History;* Rome: *History, Ancient.*

GALLIARD (Fr. *Gaillard,* meaning "lively"; It. *Gagliarda),* is a gay dance of the 15th century. Coupled with the pavane, it became the earliest of court dances. Although the music was in $\frac{3}{4}$ time, the dance was performed, often without holding hands, to counts of six (2 measures), with various kicking and jumping steps (*petit saut*) on 1, 2, 3. 4, a *saut majeur* ("high jump") or *saut moyen* ("medium jump") on 5, with a cadence posture on 6. Hence it acquired the name of *cinque-pas* (the English cincopace). Musicians usually wrote pavanes and galliards in pairs, the galliard tune becoming a rhythmic adaptation of that of the pavane which it followed. It retained its vogue as a court dance from c. 1530 to 1620. (L. Ht.)

GALLIC ACID occurs in many plants either in the free state or combined as gallotannin *(see* Tannin). It is present to the extent of 40%–60% combined as gallotannic acid in tara, and in Aleppo or Chinese galls *(see* Galls) from which it is obtained commercially by the action of acids or alkalies.

Gallic acid is 3,4,5-trihydroxybenzoic acid and has the formula $(HO)_3C_6H_2.CO_2H$. When heated to 200°–250° C. it splits into carbon dioxide and pyrogallol (pyrogallic acid), the photographic developer. With iron salts it gives a deep blue-black colour, the basis of writing ink *(see* Ink). It is used in the manufacture of a few dyes and as bismuth subgallate it has been employed in medicine as a mild skin antiseptic and astringent. Esters of gallic acid, principally propyl gallate, are important antioxidants for the prevention of rancidity in edible oil and fats. (V. H. W.)

GALLICANISM, a name for various theories maintaining that both the church and the state in France had ecclesiastical rights of their own, independent and exclusive of the jurisdiction of the pope. These theories were developed in opposition to ultramontanism (*q.v.*). As regards the church, it was held that infallible authority was committed to pope and bishops jointly; the pope decided in the first instance, but his judgments must be tacitly or expressly confirmed by the bishops before they had the force of law. And as regards the state, Gallicanism goes back to the protests raised against the theocratic pretensions of the mediaeval popes. They claimed that they, as vicars of Christ, had the right to interfere in the temporal concerns of princes, and even to depose sovereigns of whom they disapproved. Gallicanism answered that kings held their power directly of God; hence their temporal concerns lay altogether outside the jurisdiction of the pope. During the troubles of the Reformation era, when the papal deposing power threatened to become a reality, the Gallican theory became of great importance. It was incorporated by Bossuet in a solemn declaration of the French clergy, made in 1682. This document lays down: (1) that the temporal sovereignty of kings is independent of the pope; (2) that a general council is above the pope; (3) that the ancient liberties of the Gallican church are sacred; (4) that the infallible teaching authority of the church belongs to pope and bishops jointly. This declaration led to a violent quarrel with Rome, and was officially withdrawn in 1693, though its doctrines continued to be largely held. In 1802 Napoleon contented himself by embodying Bossuet's declaration textually in a statute. Long before his time, however, the issue had been narrowed down to determining exactly how far the pope should be allowed to interfere in French ecclesiastical affairs. Down to the repeal of the Concordat in 1905 all French governments continued to uphold two of the ancient "Gallican Liberties." The secular courts took cognizance of ecclesiastical affairs whenever the law of the land was alleged to have been broken; and papal bulls were not allowed to be published without the leave of the state. *See* FEBRONIANISM; ULTRAMONTANISM.

GALLI-CURCI, AMELITA (1889-), Italian-American coloratura soprano, was born at Milan, Italy, on Nov. 18, 1889, of Italian and Spanish parentage. After a general education in the schools of Milan she entered the Royal Conservatory in the same city and studied piano and harmony. As a vocalist, however, she was self-taught. Her operatic début was at Rome in 1909 as Gilda in Verdi's *Rigoletto*. She later toured the smaller cities in Italy, appeared at Barcelona and Madrid in Spain, and had several successful seasons in South America, Cuba and Mexico. Her fame in these countries was immediate, but she was almost unknown in the United States when in 1916 she was engaged by the Chicago Opera association. Her Chicago début on Nov. 18, 1916, was again as Gilda in *Rigoletto*. She was re-engaged for nine seasons. On Jan. 27, 1918, she appeared for the first time in New York city in the title role of Meyerbeer's *Dinorah* at the Lexington opera house She joined the Metropolitan Opera company in 1920, opening the season that year as Violetta in La *Traviata*. Besides the roles mentioned, her favourite repertory included the roles of Juliette in *Romeo et Juliette,* Lucia in *Lucia de Lammermoor,* Mimi in *La Bohème* and Leila in Bizet's *Pearl Fishers*. Her voice reached astonishing heights with tone smooth, warm and well rounded. It had great fluency, enabling its owner to sing many intricate roles with simplicity and naturalness. Ill health brought about her retirement in 1930, except for a brief reappearance in 1936.

GALLIENI, JOSEPH SIMON (1849–1916), French general and statesman, is immortalized by his share in the strategically decisive victory of the Marne (*q.v.*). He was born at St. Béat, Haute-Garonne, on April 24, 1849. He left the military academy of St. Cyr in July 1870 as second lieutenant in the marines, becoming lieutenant in 1873 and captain in 1878. He saw service in the Franco-German War, and from 1877 to 1881 took an important part in the explorations and military expeditions which extended the French dominion in the basin of the upper Niger. In March 1881 he obtained a treaty from Ahmadu, almany of Segu, giving the French exclusive rights of commerce on the upper Niger, for ahich he received the gold medal of the Société de Géographie. From 1883 to 1886 Gallieni was stationed at Martinique. On June 24, 1886, he became lieutenant colonel and on Dec. 20 governor of Upper Senegal. He obtained several successes against Ahmadu in 1887, and compelled Samory to agree to a treaty abandoning the left bank of the Niger. *(See* SENEGAL: *History)*. In 1891 he was promoted colonel, and from 1893 to 189; he commanded the second military division of Tongking.

In 1896 Madagascar was made a French colony and Gallieni was appointed resident general (afterward governor general) and commander in chief. He completed the subjugation of the island, which was in revolt against the French. He also destroyed the political supremacy of the Hovas and restored the autonomy of the other tribes. The application of the French customs and other similar measures disastrous to British and U.S. trade were matters for which Gallieni was not wholly responsible. His policy was directed to the development of the economic resources of the island and was conciliatory toward the non-French European population. He also secured religious liberty for the Protestants. In 1905, when he resigned the governorship, Madagascar enjoyed peace and cocsiderable prosperity. In 1906 Gallieni was appointed to command the 14th army corps at Lyons.

Gallieni had reached the age for retirement in April 1914 but was retained on the active list without duty, and on mobilization in 1914 he was notified that in case of need he would be the successor of the commander in chief, Gen. J. J. Joffre, who had been appointed on his recommendation. On Aug. 26, in face of the imminent approach of the invading German armies, he was appointed military governor of Paris. He took energetic steps for the defense of the capital, abandoned by the government, and in addition to the garrison Gen. M. J. Maunoury's 6th army was placed under his control. Visualizing his role as one not merely of passive defense, his close watch on the German armies and his military intuition led him to see and seize the opportunity for a counterstroke. From air information received during Sept. 3, Gallieni concluded that the German forces marching on Paris had inclined to the southeast, thus offeringhim an exposed flank. He convinced Joffre first of the opportunity, and ultimately that the attack ought to be made on the line of the Ourcq north of the Marne. On the night of Sept. 4 Joffre issued orders for a general counteroffensive on Sept. 6. The outcome was the retreat of the right wing and with it the turning of the tide of World War I. Controversy has raged over the distribution of credit for this achievement, but it is at least indisputable that the first perception of the opportunity and the initiative to seize it were Gallieni's. With the German retreat the operations passed out of the zone over which Gallieni held command.

Joffre showed no haste to offer Gallieni a more active command, but on Oct. 29, 1915, the latter became minister of war in Aristide Briand's cabinet. In this office he sought to bring about reforms in the administration and higher command, while defending Joffre against the growing storm of criticism. The German attack on Verdun (*q.v.*), however, revealed a serious failure of foresight on the part of the higher command. Gallieni then proposed an extensive scheme of reorganization for the better co-ordination of the whole war effort of France. In the military sphere this involved a clearer separation between the strategical direction and the administration of resources, and to implement it Joffre was to be brought back to Paris as the commander in chief of all the French armies, while Gen. Edouard de Castelnau was placed in executive command of the field armies on the western front. Finding that his colleagues in the cabinet shrank from the risk of causing a political crisis, Gallieni resigned, ostensibly for reasons of ill health, on March 16, 1916. The pretext was, in part, justified for in order to fit himself for active service he underwent an operation without taking the preliminary rest that had been prescribed. The first operation was not successful and after a second he died at Versailles on May 27, 1916. His body was given a state funeral and lay for a time under the dome of the Invalides. He was buried at St. Raphael. On April 21, 1921, the dignity of marshal of France was conferred on him posthumously.

He published *Mission d'exploration du Haut-Niger, 1879–1881* (1885); *Deux campagnes au Soudnn français* (1891); *Trois colonnes au Tonkin* (1899), *Rapport d'ensemble sur la situation générale* de *Madagascar* (1899); and *Neuf ans à Madagascar* (1908).

See also *Les Carnets* de *Gallieni, publiés par son fils,* *Gaetan Gallieni, notes de P B Gheusi* (Paris, 1932).

GALLIENUS, PUBLIUG LICINIUS EGNATIUS, Roman emperor from A.D. 260 to 268, son of the emperor Valerian, was born about 218. From 253 to 260 he reigned conjointly uith his father, during which time he gave proof of military ability. But when his father was taken prisoner by Shapur I of Persia, in 260, Gallienus made no effort to obtain his release or to withstand the incursions of the invaders who threatened the empire from all sides. He deprived the senators of their military and provincial commands, which were transferred to equites. During his reign the empire was ravaged by a pestilence, and the chief cities of Greece were sacked by the Goths. His generals rebelled against him in almost every province of the empire, and this period of Roman history came to be called the reign of the Thirty Tyrants. Gallienus was killed at Mediolanum by his soldiers while besieging Aureoius, who was proclaimed emperor by the Illyrian legions. His sons Valerianus and Saloninus predeceased him.

Life by Trebellius Pollio in *Script. Hist. Aug.;* on coins *see* articles in *Numism. Zeit.* (1908) and *Riv. ital. d. num.* (1908).

GALLIFFET, GASTON ALEXANDRE AUGUSTE, MARQUIS DE, Prince de Martignes (1830–1909), French army officer. was born at Paris on Jan. 23, 1830. He entered the army in 1848, and served with distinction at the siege of Sevastopol in 1855. Under Napoleon III he served in several campaigns in Algeria, Italy and Mexico, and by 1867 became colonel of the 3rd Chasseurs d'Afrique. He commanded this regiment in the Franco-German War of 1870 and on Aug. 30 became general of brigade. At the battle of Sedan he led his brigade in the heroic charge of Gen. J. A. Margueritte's cavalry division (see SEDAN). He was taken prisoner at the capitulation, but returned to France and in the suppression of the Commune his severity earned him the bitter enmity of the Left. His military career continued until 1895; he suppressed an Algerian rebellion in 1872. was promoted general of division in 1875, and became a member of the Conseil Supérieur de la Guerre in 1885. In later life he became a politically controversial figure, being sponsored by L. Gambetta, who respected his military talents, and in 1899 became minister of war in the René Waldeck-Rousseau cabinet after the turmoil of the Dreyfus case. Although regarded by the moderates as a good "republican," he remained the object of great animosity on the Left. He died on July 8, 1909.

See L. Thomas, *Le général* de *Galliffet,* new ed (1941). (D. TN.)

GAELIFORMES, an order of birds, comprising the game birds (see CURASSOW; FOWL; FRANCOLIN; GAME BIRDS; GROUSE; MEGAPODE; BIRD (for classification); PHEASANT; PTARMIGAN; QUAIL: TURKEY).

GALLINULE, the name for about 10 genera and 23 species of fresh-water birds of the family Rallidae, about the size of a bantam hen but compressed like the rails and the coots (*qq.v.*). The common European gallinule (*Gallinula chloropus*), blackish with a scarlet forehead plate, is known as moor hen (*q.v.*), its North American race (G. c. cachinnans) as the Florida gallinule. They are noisy birds. They lay 7 to 11 brown-spotted creamy eggs in a bulky nest of rushes on or near the ground.

The larger purple gallinule or swamp hen of Mediterranean shores is Porphyrio *porphyrio,* with related species over Africa, Madagascar, southern Asia to Australia, the Philippines and southwest Pacific islands. The purple gallinule. water hen or sultana of America is *Porphyrula martinica,* with bright olive-green and purplish-blue plumage, light-blue forehead plate, red and yellow bill, yellow legs and feet. It is found from South Carolina and Texas to northern Argentina; an allied species, P. *parva,* occurs from central Brazil and Paraguay to the Guianas, and P. alleni is seen over Africa and Madagascar.

Many peculiar flightless island forms are found throughout South America. Africa, southern Asia, Australia and islands of western and southwestern Pacific: among those extinct or nearly so are the island hen of Tristan da Cunha (*Porphyriornis* nesiotis); the mountain cock of Gough Island (P. *comeri*); the white swamp hen of Lord Home Island (*Porphyrio albus*); the huge moho of New Zealand (*Notornis mantelli*); and *Pareudiastes pacificus* of Samoa. (G. F. Ss.; X.)

GALLIO, IUNIUS ANNAEUS (originally LUCIUS ANNAEUS NOVATUS), son of the rhetorician L. Annaeus Seneca and the elder brother of L. Annaeus Seneca the philosopher, was born at Corduba (Córdova) about the beginning of the Christian era. At Rome he was adopted by L. Iunius Gallio, a rhetorician. Both Seneca and Statius speak of his charm of disposition. It is probable that he was banished to Corsica with his brother and that both returned to Rome when Agrippina selected Seneca to be tutor to Nero. For a few years Gallio was proconsul of the newly constituted senatorial province of Achaea. During his tenure of office (in A.D. 53) he dismissed the charge brought by the Jews against the apostle Paul (Acts xviii). His behaviour on this occasion ("But Gallio cared for none of these things") shows the impartial attitude of the Roman officials toward Christianity in its early days. He survived his brother Seneca but was put to death by order of Nero (in 6j) or committed suicide.

GALLIPOLI (Turk. GELIBOLU), a seaport and city of European Turkey, in the province of Canakkale; at the northwestern extremity of the Dardanelles, on a narrow peninsula 132 mi. W.S.W. of Istanbul and 90 mi. S. of Adrianople. Pop. (1960) 12,956. Nearly opposite is Lapsaki on the Asian side of the channel, which is there about 2 mi. wide. There are several mosques, none of them remarkable, and many interesting Roman and Byzantine remains, especially a magazine of the emperor Justinian (483–565), a square castle and tower attributed to Bayezid I (1389–1403) and some iumuli on the south, popularly called the tombs of the Thracian kings. It has two good harbours. From its position as the key of the Dardanelles, it was occupied by the allied French and British armies in 1854. Then the isthmus a few miles north of the town, between it and Bulair, was fortified with strong earthworks by English and French engineers, mainly on tne lines of the old works constructed in 1357. These fortifications were enlarged in Jan. 1878. on the Russians' threatening to take possession of Constantinople. The peninsula thus isolated by the fortified positions has the Gulf of Saros on the northwest and extends about 50 mi. S.W.

The district (sanjak) of Gallipoli is exceedingly fertile and well adapted for agricuiture. It comprises four *kazas* (cantons), namely (1) Maidos: (2) Keshan, lying inland north of Gallipoli, near which are lignite mines; (3) Myriofyto; and (4) Sharkeui (Peristeri) on the coast of the Sea of Marmora. Copper ore and petroleum are worked at Sharkeui, and the neighbourhood formerly produced wine. For an account of the Gallipoli campaign in World War I, see DARDANELLES CAMPAIGN.

GALLIPOLIS, a city of southern Ohio. U.S., on the Ohio river, 100 mi. S.E. of Columbus. the seat of Gallia county. It mas founded in 1790 by the Ohio company as a town of 80 cabins for stranded French immigrants who had been beguiled by agents of the Scioto company to purchase land certificates which were .worthless (see OHIO COMPANY): the name Gallipolis means "city of the Gauls." It was incorporated as a village in 1842 and as a city in 1865. Its municipal government is by the council-manager plan in effect since 1918.

The city has a small number of manufacturing industries and is the shipping centre for a farming and coal mining region. Rio Grande college. a private college founded in 1876, is 12 mi. distant. The Gallipolis State institute for epileptics and mentally defective children was established in 1890. Hospital and medical services are provided by the Holzer I-Iospital foundation, consisting of a clinic, a hospital and a school of nursing, and the Gallipolis clinic.

Gallipolis, the third settlement on the Ohio river within the limits of the state of Ohio; has several points of historical interest. Our House, built as a tavern in 1819, is now a museum of the Ohio Historical society.

For comparative population figures see table in OHIO: *Population.* (G. J. BL.)

GALLITZIN, DEMETRIUS AUGUSTINE (1770–1840), U.S. Roman Catholic priest, known as the "Apostle of the Alleghenies," was born at The Hague. Neth., on Dec. 22, 1770, during the tour of duty there of his father: Prince Dmitri Aleksevich Golitsyn, as Russian ambassador to Holland. Both his parents were fiiled with the spirit of the Enlightenment, but at the age of 17 Demetrius joined the Roman Catholic Church. Traveling to America, he began studying for the priesthood and was ordained in Baltimore, Md., in 1795 Bishop John Carroll (*q.v.*), sent him to Carnbria county, Pa., where immigrant Catholics mere settling in the foothills of the Alleghenies. He was one of the first priest missionaries during the colourful immigrant period of American history, and was soon, like so many of his 19th-century counterparts, deeply engrossed in land and colony projects to attract Catholic immigrants into the west and onto the land. Known as "Mr. Smith" in the United States, Gallitzin was a benevolent and eccentric despot who at the same time exercised a great power for good among his parishioners. At the time of his death, on May 6, 1840, there were around 10,000 Roman Catholics living in his district. where 40 years earlier he had found a scant 12.

Gallitzin wrote controversial religious tracts and pamphlets in defense of the Catholic religion against attacks by frontier Protestant sects. Most typical of these polemics is his A *Defense of Catholic* Principles (1816). A collection of his letters was published in 1940.

BIBLIOGRAPHY.—A contemporary biography in German by his assistant, Peter H. Lemcke, *Life and Work of Prince Demetrius Augustine Gallitzin,* tr. by Joseph Plumpe (1940); several popular biographies typical of which is Daniel Sargent's *Mitri* (1945). (C. J. By.)

GALLIUM, a chemical element that is a bluish-white metallic solid. which becomes a liquid at slightly above room temperature. Gallium is a member of Group III of the periodic table and is generally associated with aluminum and boron in the main group, but in some forms of the table gallium, indium and thallium are placed in the subgroup. The symbol for Gallium is Ga; the atomic number is 31 and the atomic weight is 69.72.

Gallium was discovered in 1875 by Paul Émile Lecoq de Boisbaudran, who observed its principal spectral lines (λ 4172.2 Å and 4033 2 Å [sic]) while examining material isolated from zinc blende of Pierrefitte, Hautes-Pyrénées, France. He recovered a sample of the metal and studied its properties. A few years previously D I. Mendeleyev had predicted the existence of a number of elements, not yet discovered, each corresponding to a blank space in his periodic table. He gave the provisional name eka-aluminum to the missing element lying between aluminum and indium and predicted its principal physical and chemical properties. His predictions relative to eka-aluminum were verified by the discovery of gallium, whose properties were found to coincide almost exactly with those predicted.

Applications. — Gallium has not been extensively used, although its unique properties indicate some interesting possibilities. Because of its low vapour pressure and long liquid range, it would be a suitable material, enclosed in clear quartz, for a high-temperature thermometer. Its uses as a coating for optical mirrors, as a liquid seal in strongly heated apparatus and as a substitute for mercury in ultraviolet lamps have been suggested. Gallium has been considered as a possible heat-exchange medium in nuclear reactors, although it has a high neutron cross section. Gallium attacks a great many metals such as titanium, iron, nickel and copper, forming compounds or solid solutions; it must therefore be enclosed in a resistant material. Radioactive Ga^{72} shows some promise in the study of bone cancer; a compound of this isotope is absorbed by the cancerous portion of the bone, which may thus be more accurately identified.

Gallium may be quantitatively separated by extraction from an acid solution with a chloroform solution of 8-hydroxyquinoline and determined by the use of the spectrophotometer. It is also determined by spectrographic methods.

Occurrence and Production. — It has been estimated that gallium constitutes about 0.0015% of the earth's crust, although it is widely distributed and has not been found in concentrated deposits. It is a constituent of many coals and some of the ores of zinc, aluminum, iron, copper, germanium and chromium. The zinc blendes of the Missouri-Oklahoma-Kansas district contain up to 0.02% of gallium; aluminum-bearing minerals, particularly bauxite, contain up to 0.01%; germanite, a complex sulfide mineral found in the lead copper ores of the Tsumeb district of South-West Africa, contains up to 0.8%.

Gallium is extracted as a by-product from zinc and aluminum ores or from flue dust by processes which involve the separation of small quantities of its compounds from those of other metals and a subsequent electrolytic reduction. In an older method for the recovery of zinc the roasted ore is smelted in retorts and the gallium accumulates in the retort residues when the zinc is distilled. The metals in the residue are converted to chlorides and the more volatile gallium trichloride is separated by distillation. The more recent process involves leaching of the roasted zinc ore with sulfuric acid and neutralization of the excess acid to precipitate such impurities as gallium, aluminum and iron. The precipitate is treated with sodium hydroxide, which dissolves the aluminum and gallium compounds, and these are reprecipitated by neutralizing the solution with acid. The precipitate is then dehydrated to make insoluble any silicon dioxide which may be present, and treated with hydrochloric acid. The gallium trichloride is extracted from the concentrated acid solution by ether, the aluminum salt and some of the other impurities remaining in the hydrochloric acid solution. Gallium metal is obtained by the electrolysis of a sodium hydroxide solution of the gallium sait. The metal is purified by washing alternately with water, hydrochloric acid and nitric acid and by successive crystallizations from the supercooled liquid.

Gallium is recovered from the alkaline solutions of bauxite, which are prepared by treating the aluminum ore with hot sodium hydroxide. The concentrated solution, containing mostly sodium aluminate, is seeded with aluminum hydroxide and cooled. The hydrated aluminum oxide crystallizes and is separated from the waste liquor, which contains the gallium and considerable aluminum hydroxide. More of the aluminum compound is removed and the gallium compound is precipitated, redissolved in sodium hydroxide and electrolyzed.

In England gallium is commercially recovered from flue dusts which contain also iron and germanium. The dust is smelted with sodium carbonate, lime, carbon and copper oxide. A button or mass of metal containing most of the germanium and gallium thus formed beneath the slag is treated with chlorine under ferric chloride solution. The germanium tetrachloride is removed from the solution by distillation. The residue liquid containing the gallium is further purified by precipitation of the copper salts and other precipitable metals while the iron is reduced to the ferrous state. The gallium chloride is then extracted by ether. After removal of the ether by distillation, the gallium chloride is treated with sodium hydroxide and the gallium metal recovered by electrolysis.

Properties. — Gallium is a bluish-white metal with an unusually low melting point (29.78" C.). It expands upon solidification and supercools readily, remaining in the liquid phase at temperatures as low as 0° C. Gallium remains in the liquid phase over a temperature range of more than 2.000° C. with a very low vapour pressure up to about 1,500° C., the longest useful liquid range of any element. It has a hardness of 2–3 on Mohs' scale and at fairly low temperatures is brittle. Two stable isotopes with mass numbers 69 (60.1%) and 71 (39.9%) are known, and a number of radioactive isotopes have been prepared. The crystal structure of the metal is orthorhombic, with each atom surrounded by seven others, one at 2.44, two each at 2.70, 2.73 and 2.79 Å. The structure probably contains Ga_2 molecules. Gallium is diamagnetic. Additional physical and atomic properties are listed in the table.

Numerical Properties d [sic] Gallium

Outer electron configuration	$4s^2,4p^1$	Melting point, ° C.	29.780
Mass number and half life, radioactive isotopes	64 (2.5 min.)	Boiling point, ° C.	2,070
	65 (15 min.)	Vapour pressure (mm. Hg)	
	66 (9.4 hr.)	1,315° C.	1.0
	67 (78 hr.)	1,726" C.	100
	68 (68 min.)	Ionization potential, volts	
	70 (21 min.)	1st electron	6.00
	72 (14.1 hr.)	2nd electron	20.43
	73 (5 hr.)	3rd electron	30.6
	74 (~8 min.)	Potential for $Ga \rightleftarrows Ga^{+++} + ge$ at 25° C., volts	0.52
Density at 20° C., g. per c.c.	5.907	Specific heat 29°–127° C., cal. per g.	0.0977
29.65" C. (solid)	5.9037	Covalent radius Å	1.245
29.8° C. (liquid)	6.0948	Ionic radius of ba t++, Å	0.62
Atomic volume of solid c.c.	11.76		

The chemical properties of gallium resemble in some respects those of aluminum. It oxidizes slowly in moist air to form a thin surface film of oxide, but the oxidation does not proceed much further even under mere favourable conditions. The wetting of glass and similar surfaces by the metal is attributed to the presence of traces of the oxides. Gallium does not react with water at temperatures up to roo° C. but reacts slowly with hydrochloric and other mineral acids. The action of nitric acid is slow at room temperatures for, like aluminum, gallium becomes passive. The passivity is probably attributable to the formation of a protective film of the oxide, which on the liquid metal is tenacious and somewhat elastic. Hot nitric acid and aqua regia react on the metal more rapidly. Gallium is amphoteric and reacts with sodium or potassium hydroxide solutions, forming a gallate and liberating hydrogen. The halogen elements attack vigorously.

Compounds. — In most of its compounds gallium is trivalent; a few divalent salts, in particular the halogens, are known. There is no evidence of a monovalent gallium except in the sulfide, Ga_2S, and possibly the selenide, Ga_2Se.

All four of the trihalides of gallium are known. The hydrated fluoride, $GaF_3.3H_2O$, is prepared from gallic hydroxide and hydrofluoric acid; the anhydrous gallic fluoride is made by heating the complex salt. ammonium fluorogallate, $(NH_4)_3GaF_6$, in a stream of fluorine. The chloride, $GaCl_3$, the bromide, $GaBr_3$, and the iodide, GaI_3, are prepared by treatment of the metal with the respective halogen elements. The latter three gallic halides volatilize at relatively low temperatures and may be purified by distillation in *vacuo*. They dissolve in water but are extensively hydrolyzed. In the vapour phase the chloride, the bromide and to a lesser degree the iodide are dimeric and probably have bridge structures. Gallic chloride has been found to be more effective than aluminum chloride as an acid catalyst in the Friedel-Crafts synthesis of benzophenone and similar reactions. The anhydrous gallic fluoride. GaF_3, sublimes at temperatures above 800° C. and is only slightly soluble in water. The trihalide molecules are electron pair acceptors and thus classified as Lewis acids.

Gallium hydroxide. $Ga(OH)_3$, is amphoteric but slightly more acid than its aluminum analogue and when heated decomposes to the oxide. Ga_2O_3. Other trivalent gallium salts are: the sulfate, $Ga_2(SO_4)_3$, which forms alums with the sulfates of ammonium or the alkali metals; the nitrate. $Ga(NO_3)_3$; the perchlorate, $Ga(ClO_4)_3$; the sulfide, Ga_2S_3; and the nitride, GaN.

On the basis of electronic configuration) the existence of divalent gallium compounds seems improbable, yet several halides, the sulfide and probably the oxide have been prepared. Gallous chloride, $GaCl_2$, originally prepared by Lecoq de Boisbaudran, decomposes into the trichloride and the metal when heated above 200" C. Vapour density studies indicate the presence oi a considerable number of molecules of $GaCl_2$ with some polymers. Since the solid dichloride is diamagnetic. it is inferred that the polymers have Ga-Ga linkages. The fused salt is a conductor of electricity, dissolves in benzene but reacts with water, liberating hydrogen. Gallium dibromide and diiodide have also been prepared.

A hydride. Ga_2H_6, a methyl hydride, $Ga_2(CH_3)_4H_2$ and a methyl borohydride, $(CH_3)_2GaBH_4$, of gallium have been reported. Gallium forms a number of compounds with organic groups; *e.g.*, gallium trimethyl, $Ga(CH_3)_3$; triethyl, $Ga(C_2H_5)_3$; triphenyl, $Ga(C_6H_5)_3$; gallium acetylacetonate, $Ga(C_7H_5O_2)_3$; and a number of chelated oxy-compounds.

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GALL MIDGE, any member of the family Cecidomyiidae of the order Diptera (*q.v.*); minute. delicate flies with beaded antennae and few veins in the very short-haired wings. The larvae are frequently orange in colour and live in flowers, axils of leaves and in the leaves themselves, usually causing the formation of galls, some of which are inconspicuous; pupation takes place in the gall or in the soil; the winter is passed in the immature stages. A few are beneficial, the orange-coloured larvae of *Aphidoletes* being predaceous on plant lice or aphids, hiding in axils of leaves or under the aphid colonies during the hot part of the day. A great many kinds are injurious to crops and ornamentals. The Hessian fly (*q.v.*) is the most serious pest. The chrysanthemum midge, *Diarthronomyia hypogaea*, attacks these plants in Europe and North America, making small galls in the leaves; in northern latitudes they occur chiefly in greenhouses. Nicotine spray is used to control them. The rose midge, *Dasyneura rhodophaga*, infests the young buds and shoots of roses in greenhouses and is a serious pest, occurring but rarely outside. Some other serious pests are the wheat midge, sorghum midge, rice midge, clover midge, pear midge. Tobacco fumigation and use of dust on soil controls them. The pine cone gall on willow results from the bunching of the terminal growth. The beneficial ones are predaceous on mites, scale insects and bark beetle larvae, in addition to aphids.

For classification *see* E. P. Felt, *Key to American Gall Insects*, New York State Museum, Bull. No. zoo (1918). (C. H. CN.)

GALLON, an English measure of capacity, usually of liquids, but also used as a dry measure for grain. A gallon contains four quarts. The word was adapted from an O.h'or.Fr. *galon*, Central Fr. *jalon* and was Latinized as *galo* and *galona*. It appears to be connected with the modem French *jale*, a bowl, but the ultimate origin is unknown; it has been referred without much plausibility to Gr. γαυλός, "milk pail." The British imperial gallon of iour quarts contains 277.274 cu.in. The old English wine gallon of 231 cu.in. capacity is the standard. gallon of the United States.

GALLOWAY, JOSEPH (*c.* 1731–1803), American colonial statesman and Loyalist, who introduced "A plan of a proposed Union between Great Britain and the Colonies" at the first Continental Congress in Philadelphia, Pa., in 1774, was born at West River, Anne Arundel county. Md., the son of Peter B. Galloway and Elizabeth Rigbie. Galloway studied law in Philadelphia. Beginning practice in 1747, he distinguished himself by pleading cases before the supreme court of Pennsylvania before he was 20 years of age. He married Grace Growdon. daughter of a wealthy provincial councillor in 17j3. In his practice Galloway became an authority on disputed land claims which often involved questions of provincial administration. His prominence was recognized by his election to the Pennsylvania assembly in 1756 where he occupied the powerful post of speaker from 1766 to 177j Probably his interest in colonial governmental theory began with his association with Benjamin Franklin's antiproprietary or Popular party, which endeavoured to tax the large proprietary estates. His writings exhibit a lawyer's concern for precedent and property rights. Galloway's plan of 1774 provided for a president general, appointed by the king, and a colonial legislature, the grand council, which had "like Rights Liberties and privileges as are held and exercised by and in the House of Commons." Members of the legislature were to be selected triennially by the colonial assemblies, and bills could be initiated either in parliament or in the colonial legislature but had to have the assent of both to become law. Galloway's plan was rejected by only one vote after a day's debate. The radicals opposed him because he believed differences between the American colonies and Britain could be solved by a written constitution for the empire rather than by rebellion. Because he thought the Revolution unreasonable and unjust he left Philadelphia and joined Gen. William Howe's army. He returned to the city as a civil administrator during the British occupation, but with the re-entry of the Patriots in 1778 he fled to England where he .remained until his death on Aug. 29, 1803. Although Galloway was a Tory, he was liberal in his views. He has been unjustly criticized by historians who attributed to him a conservative plan of union which was probably written in 1785 by Jonathan Sewell, the New England Loyalist. Galloway drew up several plans of union aiter the Declaration of Independence with the hope that they might be used when the rebels were defeated. These plans consistently demonstrate his respect for representative government. His appeal was addressed to men's judgment and reason, not to their emotions. Galloway was, perhaps, the greatest of the colonial Loyalists, a man who was exiled from his wife. his estates and the country of his birth because of his convictions.

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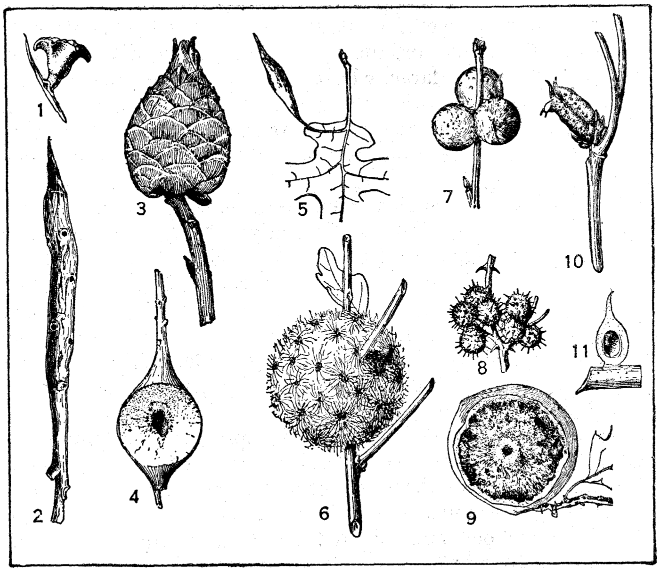
GALLOWAY, a district in southwest Scotland, comprising the counties of Kirkcudbright (East Galloway), Wigtown (West Galloway) and, until the end of the 12th century, Carrick (now part of Ayrshire). The name is derived from the Gallgaidhel or Gallwyddel, who were the Celtic Gauls of this region and the Novantae of the Romans. The last "king" of Galloway died in 1234, and during the 14th century the Baliols and Comyns were the chief families! succeeded about 1369 by the Douglases (until 1458) and in 1623 by the Stewarts. The polled black Galloway cattle are indigenous.

GALLOWS: *see* CAPITAL PUNISHMENT; *HANGING*.

GALLS. Galls are enlargements or hypertrophies of plant parts or organs caused by insects, mites. bacteria, fungi and possibly other organisms. The work of leaf and other miners and distortions of plant parts are not included except where there are enlargements or thickenings of tissue.

How Galls Are Produced.—Galls may be produced by either mechanical or chemical stimulus. An excellent example of the former is seen in stem swellings on roses caused by the closely placed spiral galleries of the rose stem girdler, *Agrilus viridis.*

Chemical stimulation is important, probably most important in the production of galls, although it may be supplemented by directive feeding or stimulation. The irritant fluid may be in the egg, as in sawflies, since the galls are full size before the eggs hatch. The ash midrib gall produced by *Contarinia canadensis* is evidently caused by larval or maggot fluids since there is no eroding, and size is proportional to the number of larvae.



FROM FELT, "PLANT GALLS AND GALL MAKERS" (COMSTOCK PUB. CO.)

TYPICAL GALLS CAUSED BY INSECTS

1. Flower-like gall on cypress. 2. Willow-twig gall. 3. Willow pine-cone gall. 4. Goldenrod ball gall. 5. Stemmed oak gall. 6. Wool-sower gall on oak. 7. Oak bullet gall. 8. Spiny rose gall. 9. Oak apple. 10. Blasted oak bud gall. 11. Hackberry flask gall

The eggs of the chrysanthemum midge, *Diarthonomyia hypogaea,* and of hickory leaf gall midges, *Caromyia* species, are deposited on leaf surfaces, rhe larva irritating the tissues and eventually becoming enclosed in a gall. Plant lice galls grow up around and enclose their producers.

Location and Form of Galls.—Insect galls occur upon all parts of plants including the flowers, even stamens in some cases, the fruit or leaf buds, branches, trunks and roots. They develop in or from the meristematic or softer growing tissues, such tender parts as buds and developing leaves. Twig, branch and root galls mostly originate in the cambium or meristem.

The structure of highly developed galls is suggestive of a seed. The gall maker occupies the place of the seed. The nutritive layers surrounding the gall maker are aaalogous to those of the embryo seed. The outer layers in both are protective. They may bear abundant plant hairs or spines. The development is somewhat comparable to that of buds.

There is a possible significance in the lobed splitting of the hickory leaf stem gall with its suggestion of the divided shuck of the nut. Some galls ripen and droplike seeds, namely, the hickory tube gall and the jumping, occasionally abundant "flea seeds" of western oaks.

The pear midge, *Contarinia pyrivora,* and the birch seed midge, *Oligotrophus betulae,* are fruit or seed infesting insects. The many species of gall wasps belonging to the genus *Neuroterus* produce a large variety of leaf galls on both European and hmerican oaks. The grape phylloxera, *Phylloxera* or *Peritymbia vitifoliae,* develops in leaf and root galls, the latter most injurious to European grapes.

The size and shape of galls are extremely variable. The largest, *Andricus championi,* has a diameter of more than 4 in. Globular galls vary in internal structure. The interior may be mostly hard tissue as in bullet galls, *Disholcaspis* species. The oak apples, *Amphibolips* species, have a thin outer shell and a spongy interior. The central cell may be supported by threads or, as in *Andricus palustris,* free-rolling.

The stemmed spindle shape in *Andricus pedicellatus* on oak and *Rhopalomyia pedicellata* on goldenrod are suggestive of modified leaves. Conical, cylindrical, disk-shaped or saucer-shaped galls, "oak spangles," are relatively common on oak and hickory leaves. Fig-shaped galls may originate from a common center and form a segmented sphere. The gall of the wool-sower, *Callirhytis seminator,* is a mass of stemmed hairy cells, the pink and white filaments interlacing to form a daintily tinted sphere nearly 2 In. in diameter and encircling cak twigs.

The determinate galls are produced mostly by the more highly developed insects such as gall wasps or Cynipidae.

Deiormations of growing tips of galls vary from plainly aborted buds to large swellings of the terminal parts, as in the cone flower gall, *Asphondylia conspicua.*

The willow wheat ear gall, *Rhabdophaga triticoides,* dwarfs sterns normally several feet in length to irregular swellings 3-4 in. long.

The open-mouthed galls, mostly globular or conical in shape, are pioduced by aphids or gall mites, the latter with the entrance guarded by plant hairs.

The indeterminate galls are mostly irregular swellings, the shape being modified largely by the vigour of the plant and the degree of infestation.

The hairy or pilelike growths, *erineums,* upon leaf surfaces are produced by plant mites or Eriophyids. They may be identified by the usually yellowish microscopic mites.

Geographical Distribution of **Galls.**—Plant galls occur in most places where plant life exists. They are more abundant in areas where there is a large and varied flora. A series of general works on galls appearing between 1911 and 1933 permits general comparisons. The total number of galls listed in these works from the various areas approximates 1400–1500 each for the Netherlands Indies, southern Europe, North America and South and Central America, with 1100 listed for Europe.

Gall Maker Preferences.—The general works cited below indicate gall maker preferences and the close relation between producers and plants. In southern Europe 569 galls are listed on willows and only 115 and 117 in North America and Moravia respectively. On the beeches and oaks of Asia there were 304, in southern Europe, 993, in North America, 419 and in Moravia, 143 galls. The data for rose galls were 109, 499, 130 and 113 and for the composites, 181, 660, 182 and 41, respectively.

The 419 Cynipid galls in the oak family in North America in 1918 was raised to 740 in E. P. Felt's *Plant Galls and Gall Makers* (1940). Many unknown galls await discovery.

Marked food preferences are indicated in *Plant Galls and Gall Makers.* In the beech family there are 740 Cynipid galls, all but 9 on oak and 39 midge galls; for the rose there are 41 and j6 respectively, while in the composites there are 17 gall wasps and 172 gall midges. The records show species of *Rhabdophaga* limited mostly to willow, *Cincticornia* to oak, *Caryomyia* and *Phylloxera* to hickory.

Gall Makers.—Gall wasps are highiy specialized, small four-winged insects with a strongly compressed abdomen. The maggots are usually white and without a distinct head. Gall wasps attack plants referable to only 6 botanical families and assignable to less than 20 plant genera. In America nearly 750 produce galls on oak, 34 on acorns or the acorn cup, 21 in flowers, 275 in leafy structures, 175 in woody galls, 45 in buds and 41 on roots.

The gall wasps, *Diplolepis* or *Rhodites,* produce 65 galls on plants of the rose family, 50 being on rose.

Gall midges, delicate two-winged flies usually yellowish or reddish, sometimes darker and with marked structural variations, are represented by a long series which produce mostly closed galls upon a great variety of plants. They occur in 69 of the 78 plant families attacked by gall insects. The larvae are mostly yellowish, with a distinct head and usually with a breastbone or anchor process. Many midge larvae winter in the galls. A few desert them in the spring and enter the soil prior to transforming.

Most of those in the softer leaf and fruit tissues drop and winter in the ground. Food preferences are indicated by the 37 species on willow, 37 on oak, j6 on the rose family, 25 on the pulse family, 21 on the vine family and 172 on various composites.

The beetles, Coleoptera, and moths, Lepidoptera, produce only a few plant galls, mostly the result of mechanical injury.

Plant lice, winged or wingless. with a proboscis and honeytubes, produce relatively few galls. The 29 species of *Phylloxera* on hickory, 7 *Adelges* on spruce and 5 *Pemphigus* on poplar represent better-known forms.

The 9 species of jumping plant lice, *Pachypsylla,* are limited to hackberry.

Plant mites are microscopic in size, pale yellowish or orange coloured. pear shaped and with but four legs. They produce relatively simple, mostly open galls in buds and on leaves and occur upon a large variety of plants; 158 galls are recorded from 38 of the 78 plant families.

A number of deformities such as the black knot, *Plowrightia morbosa,* on plum, and the cedar apple, *Gymnosporangium virginianiae,* and witches'-brooms on various trees are produced by fungi.

Diverse appearing blister-like thickenings on the leaves of aster and Solidago are produced largely by gall midges, *Asteromyia,* and not by fungi.

Crown gall, *Pseudomonas tumifasciens,* causes the very prevalent clown gall, mostly root infections.

The large woody swellings on the trunks of such trees as spruce, fir, poplar, oak and hickory are believed to be bacterial in origin.

Alternation of Generations. — This exists in many gall wasps or Cynipidae. The relationship was suspected by H. F. Bassett, an American, in 1873 and demonstrated in 1875 by Dr. H. Adler. The oak potato gall, *Neuroterus batatas,* and the noxious oak gall, *Neuroterus noxiosus,* develop in similar deformities, the perfect generation appearing in the summer and that represented only by females in early spring. A marked difference in the galls produced by the two generations of *Plagiotvochus punctatus,* occurs in the irregular twig swellings of oak and the blister-like leaf galls on or near leaf veins.

A relatively large number of both U.S. and European oak gall wasps have alternating generations. The relation between the tuo generations has been established for comparatively few. The series of galls on roses produced by Cynipids, *Diplolepis* or *Rhodites* have no alternate generation.

There is an approach to an alternation of generations among certain gall producing aphids except that it is an alternation of a series of generations. In the spiny witch hazel gall, *Hamamelistes spinosus,* the alternate series cause irregular corrugations on birch leaves.

The spruce gall aphid, *Adelges abietis,* is well-known in the U.S. because of the abundant pineapplelike gall on Norway spruce. The woolly aphids, *Adelges cooleyi,* on the needles of Douglas fir, produce the long cone gall on the Colorado blue spruce. The aphids from the globular, lipped leaf-stem gall of poplars, *Pemphigus populitransversus,* migrate in summer to the roots of cruciferous plants, cabbage, rape and turnip.

Honeydew Producing Galls.—A considerable series of galls produce honeydew. The sweetness of the ribbed bud gall of *Callirhytis gemmaria* draws swarms of insects in early sutnmer. The pip galls of the fall form of *Callirhytis operator* are also attractive. Several hickory leaf galls, *Caryomyia* species, are sticky with a sweet secretion. L. H. Weld states that the galls of *Disholcaspis eldoradensis* on *Quercus lobata* produce so much honeydew that bees in California may store 30-40 lb. of honey per hive from this source.

Galls Commercially Valuable.—The Eurasian *Cynips gallae-tinctoriae* produces the well-known gall nut of commerce containing 65% tannic acid. An eastern acorn gall contains 50% tannic acid. A Chinese sumac gall contains over 60% tannic acid and is produced by a species of *Pemphigus* related to the American *Pemphigus rhois.*

Some insect galls are used in medicine because of their astringent properties and a few serve as food, such as the catmint gall of *Aylax glechomae.*

A black oak gall, *Dryoscosmus deciduus,* is so abundant some years in Missouri and Arkansas as to constitute an important food for chickens, turkeys, cattle, hogs and sheep.

Injurious Gall Insects. — These are mostly introduced, prolific and relatively free from natural enemies. The Hessian fly *Phytophaga destructor,* and the wheat midge, *Thecodiplosis mosellana,* have destroyed large wheat areas. The clover-head seed midge, *Dasyneura leguminicola,* prevents the growing of clover seed in sections. Fruit trees are injured by the pear blister mite, *Eriophyes pyri,* the pear midge. *Dasyneura pyri,* and the closely related apple midge, *Dasyneura mali*

Severe losses to greenhouse men are caused by the rose midge, *Dasyneura rhodophaga,* the violet midge. *Phytophaga violicola,* and the chrysanthemum midge, *Diarthronomyia hypogea.*

Horticulturists are troubled by the spruce gall aphid, *Adelges abietis,* on the Norway spruce and a similar gall, *Adelges cooleyi,* on the Colorado blue spruce. The branch galls on oak caused by species of the *Plagiotrochus* are unsightly though usually not seriously injurious The killing of buds by gall wasps, notably *Neuroterus minutus,* may be serious.

Natural Enemies.—Gall insects in spite of their protecting shelters are attacked by considerable series of small parasites and in the gall midges there are slender predaceous larvae which prey on the gall producers Birds eat galls, notably the oak pill gall The large oak apple is fed on by gray squirrels. Mice gnaw into the goldenrod stem galls produced by *Gnorimoschema.* Woodpeckers drill the globular stem galls of *Eurosta solidaginis.*

Collecting and Rearing Gall Insects. — The collection and study of plant galls is easy and fascinating. Those with woody tissues require no special preparation. Many noody galls and herbaceous bud galls produce insects in the early spring. Keep the galls in containers at room temperatures, fairly moist and out of the sun. The rearing of species which winter in the earth is more difficult since it is difficult to provide normal conditions and not include other species in the soil or debris of the rearing jar. A good microscope is necessary as well as a collection and articles on the group studied Comprehensive, well illustrated guides are the most helpful for beginners.

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(E. P. F.)

GALLUP, a city of northwest New Mexico, U.S., at an altitude of 6.514 ft., on the Puerco river, about 20 mi. from the Arizona line and 140 mi. W.N.W. of Albuquerque; the seat of McKinley county. The city was established in 1882 and named for David L. Gallup, paymaster for the Atlantic and Pacific railroad. Prior to that time it served as a Westward Overland stagecoach stop. It was incorporated in 1891.

Gallup's economy is primarily mercantile; it serves as a trading centre for the Navaho and Zuñi Indians in a trade area exceeding 15,000 sq.mi. The city's leadership in the field of Indian arts and crafts and its proximity to Indian reservations and national parks and monuments have also established it as a tourist centre. At the Intertribal Indian ceremonials, held each year in August, southwestern Indians from as many as 40 different tribes present their ceremonial dances and display their native arts and crafts. For comparative population figures *see* table in New Mexico: *Population.*
(J. G. O'C.)

GALLUPPI, PASQUALE (1770–1846), Italian philosopher, was born at Tropea, in Calabria. He was professor of logic and metaphysics at Naples. Galluppi's works, which have importance in the history of Italian philosophy, include: *Sull' analisi e sulla sintesi* (1807); *Letters filosofiche* (1827); *Saggio filosofico sulla critica della conoscenza* (1819–32); *Filosofia della volontà* (1832–42, incomplete); *Considerazioni filosofiche sull' idealismo trascendentale* (1841), a memoir on the system of Fichte; *Storia della filosofia* (i. 1842).

GALLUS, GAIUS CORNELIUS (*c.* 70–26 B.C.), Roman soldier and poet, is famous for his four books of poems to his mistress "Lycoris" (the actress Volumnia; stage name, Cytheris). He also translated works of the Greek poet Euphorion. Born at Forum Julii (Fréjus on the French riviera coast). he was a friend of Augustus and Vergil and, having distinguished himself in the war against Mark Antony. was made governor of Egypt. There, however, his imprudent conduct led to his disgrace and suicide. The lass of his works is regrettable, for Quintilian ranks him with Tibullus Propertius and Ovid as one of the great Roman elegists. Vergil celebrated him in the tenth *Eclogue,* which contains many echoes of his poetry, and Parthenius dedicated to Gallus his book on unhappy love affairs. (E. J. KY.)

GALLUS, G. VIBIUS TREBONIANUS, Roman emperor A.D 251–253 or 254, held a command in the army that opposed the first invasion of the Goths in 251, and, according to a possibly inaccurate tradition, contributed by his treachery to the disaster that followed, in which Decius and Herennius were killed. Gallus uas then elected emperor and made peace with the invaders, who kept their plunder and were offered a tribute to bribe them not to return; it is the disgrace with which this treaty covered his name that makes the tradition of his earlier conduct suspect. In 252 fresh hordes arrived but were routed by Aemilianus whom his troops proclaimed emperor. Gallus went to meet him, but was defeated and killed at Interamna.

GALOIS, ÉVARISTE (1811–1832), French mathematician famous for his contributions to higher algebra, gave his name to the Galois theory of groups. He was born Oct. 25, 1811, at Bourg-la-Reine, where his father was mayor, and entered the Lycée Louis-le-Grand in Paris in 1823. Despite his genius for mathematics he was evidently a difficult student. He failed twice in the entrance examinations to École Polytechnique; he was accepted at the École Normale in 1830 but expelled the same year for a newspaper letter about the actions of the director during the July Revolution. In 1831 he was arrested for a threatening speech against King Louis Philippe, but acquitted; then shortly afterward he mas sentenced to six months in jail for illegally wearing a uniform and carrying weapons. He died May 31, 1832, when only 20 years old, from wounds received in a duel, possibly with an *agent provocateur* of the police.

Galois published onlv a few small papers; three larger works on the theory of equations were refused by the French Academy. Knowledge of his mathematical achievements stems mainly from a letter to his friend Auguste Chevalier written on the eve of his fatal duel and from posthumous manuscripts. Nevertheless, the Galois theory of groups has become one of the most penetrating concepts of modern mathematics. In the letter to Chevalier, published in the *Revue Encyclopédique,* Sept. 1832, Galois outlines the content of three mathematical treatises. One concerns elliptic integrals and the integrals of aigebraic functions. The other two, one of which was completed ("Mémoire sur les conditions de résolubilité des equations par radicaux"), deal with the theory of equations. Galois emphasizes the use of domains of rationality to which ail roots of the given equation have been adjomed, now called Galois fields Next he introduces the fundamental concept of the (Galois) group of an equation, consisting of all the permutations of the roots which may be applied to any existing rational relations between them. In modern form this leads to the one-to-one correspondence between the subfields of the Galois field and the subgroups of the Galois group. Galois applies the theory to express a general condition for the solvability of equations by radical expressions. Among other concepts associated with Galois's name are the Galois imaginaries, now usually considered as the elements of finite fields.

See also FIELDS; GROUPS; EQUATIONS, THEORY OF.

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GALOP, a spirited dance of German origin in 2–4 time. It was introduced into Paris in 1829 and subsequently became a favourite dance of the Victorian era.

GALSWORTHY, JOHN (1867–1933), British playwright and novelist and Nobel prize winner in literature, was born at Coombe. Surrey, on Aug 14, 1867. Educated at Harrow and New college, Oxford, he was called to the bar in 1890, but devoted himself to literature. His first novel, *Jocelyn,* appeared in 1898, but he attracted wider attention in 1904 with *The Island Pharisees,* and *The Man of Property* (1906). The latter uas the first novel of the sequence to be known as *The Forsyte Saga,* the others being *The Indian Summer of a Forsyte* (1918), *In Chancery* (1920), *Awakening* (1920), and *To Let* (1921). As a detailed picture of upper middle-class society during the later Victorian and Edwardian eras. the sequence is a remarkable achievement. That picture was supplemented by the greater number of Galsworthy's other novels. of uhich it is the characteristic social setting. among them *The Country House* (1907), *Fraternity* (1909), *The Patrician* (1911). *The Freelands* (191j).

In 1924 Galsworthy published *The White Monkey,* the first volume of a new trilogy which endeavoured to do for London after World War I uhat *The Forsyte Saga* had accomplished for a generation uith more certain standards. Soames Forsyte appears in all three of the new series—The *Silver Spoon* (1926) and *Swan Song* (1928) being the other two. The new trilogy, together with two interludes, was collected in 1929 under the title of *A Modern Comedy.* The whole work is rather erratic in form. Galsworthy's sympathy with youth and beauty is tenderly displayed in *The Silver Spoon;* but the new world was too much for him. and much of all three books betrays passing reactions of an observer in a changing world rather than deeper reflections on human nature. Galsworthy's later novels were *On Forsyte 'change* (1930); *Maid in Waiting* (1931) and its sequel *Flowering Wilderness* (1932); and the posthumous *Over the River* (1933). He also wrote *The Dark Flower* (1913) and short stories, collected as *Caravan* (1925); essays; and a wartime commentary, *The Burning Spear.*

As a dramatist also, Galsworthy enjoyed a deserved fame. His plays, for the most part, are based on ethical or social problems and are marked by a scrupulously judicial effort to display the opposing points of view typified by his characters. Some have partaken too much of this scrupulousness to be counted as having an essentially dramatic quality, but at their best Galsworthy's plays reflect a keen sense of dramatic values.

Galsworthy was the first English dramatist of importance to adopt a strictly natural style of dialogue, in strong contrast to the laboured, rather stagey style favoured by A. W. Pinero and the dialectically charged manner of G. B. Shaw. In consequence his plays do not read so well, and unless acted by players of exceptional gifts, they are too easily infected by the commonplace, prosaic quality which is so characteristic of the spoken English of his day, especially the spoken English of the inarticulate upper and upper middle class which figure largely in his theatre. In *Escape* (1926) Galsworthy experimented in a technique suggested by the cinematography. Among his plays are *The Silver Box* (1906), *Joy* (1907), *Strife* (1909), *Justice* (1910), *The Pigeon* (1912), *The Eldest Son* (1912), *The Fugitive* (1913), *The Skin Game* (1920), *Loyalties* (1922), *The Forest* (1924). He was awarded the Order of Merit. June 3, 1929.

See S Kaye-Smith, *John Galsworthy* (1916); André Chevrillon, *Trois Études Anglaises* (1924); L. Schalit, *John Galsworthy* (1928).

GALT, SIR ALEXANDER TILLOCH (1817–1893), Canadian statesman, was the youngest son of John Galt (*q.v.*), author. Born in London on Sept. 6. 1817, he emigrated to Sherbrooke in Canada in 1835, where he entered the service of the British American Land company, of which he rose to be chief commissioner. Later he was one of the contractors for extending the Grand Trunk railway westward from Tordnto. In 1849 he became Liberal member for the county of Sherbrooke, but opposed the chief measure of his party, the Rebellion Losses bill, and signed a manifesto in favour of union with the United States, believing that in no other way could Protestant and Anglo-Saxon ascendancy over the Roman Catholic French majority in his native province be maintained. The same year he retired from parliament but re-entered it as chief representative of the English-speaking Protestants of Quebec province (1853–72).

On the fall of the Brown-Dorion administration in 1858 he was called on to form a ministry. but declined and became finance minister under Sir John Macdonald and Sir George Cartier on condition that the federation of the British North American provinces should become a part of their program. He was finance minister, 1858–62 and again in 1864–67; he introduced the decimal system of currency and adopted a policy of protection to Canadian manufactures. To his diplomacy was attributed the coalition in 1864 between Macdonald, Brown and Cartier, which carried the federation of the British North American provinces, and throughout the three years of negotiation which followed his was one of the chief influences.

He became finance minister in the first Dominion ministry, but resigned on Nov. 4, 1867. After his retirement he gave intermittent support to the administration of Sir John Macdonald, but advocated independence as the final destiny of Canada. In 1877 he was the Canadian nominee on the Anglo-American fisheries commission at Halifax. In 1880–83 he was Canadian high commissioner to Great Britain. During this period he advocated imperial federation. He was Canadian delegate at the Paris Monetary Conference of 1881, and to the International Exhibition of Fisheries in 1883. From this date until his death on Sept. 19, 1893. he lived in retirement. (W. L. G.; X.)

GALT, JOHN (1779–1839), Scottish novelist, was born at Irvine, Ayrshire, and educated in his native town and at Greenock. In 1804 he settled in London. Charged with a commission from a merchant firm to find methods of evading the Berlin and Milan decrees, he was traveling in the Mediterranean when he met Byron and Hobhouse at Gibraltar. He traveled with Byron to Malta, and met him again at Athens. In 1814 he visited France and Holland on similar business for a Glasgow firm. In 1826 he went to America as secretary of the Canada Land company. Galt opened up a road between Lakes Huron and Erie through the forest country, and founded Guelph in Upper Canada. The town of Galt was named after him. But, though his work was successful, he returned home practically a ruined man. All his life he had been a voluminous writer, and he now devoted himself entirely to literature. The last years of his life were spent at Greenock, where he died on April 11, 1839.

His masterpieces are *The Ayrshire Legatees* (1820), *The Annals of the Parzsh* (1821). *Sir Andrew Wylze* (1822), *The Provost* (1822), *The Entail* (1823) and *Lawrie Todd* (1830). *The Ayrshire Legatees* gives. in the form of letters. the adventures of the Rev. Pringle and his family in London. The letters are made the excuse for endless tea parties and meetings of kirk session in the rural parish of Garnock. *The Annals of the Parish* are told by the Rev. Micah Balwhidder, Galt's finest character. This work (which existed in manuscript before *Waverley* was published) is a humorous and truthful picture of the old-fashioned Scottish pastor and the life of a country parish. In *Lawrze Todd* the life of a Canadian settler is depicted with imaginative power.

GALTON, SIR FRANCIS (1822–1911), English scientist, explorer and anthropometrist, best known as the initiator of the study of eugenics, was born of Quaker ancestry on Feb. 16, 1822, near Sparkbrook, Birmingham. A cousin of Charles Darwin, he was educated at Birmingham General hospital, King's college, London, Trinity college, Cambridge. and St. George's hospital, London. After traveling in the Balkans, Egypt, the Sudan and the Levant, he undertook a 1,700-mi. journey in southwest Africa (1850–51), later visiting Spain. He received the Royal Geographical society's annual gold medal for his African explorations in 1853 and was elected a fellow of the Royal society in 1856. The following year he settled in London to devote himself to science, the latter part of his life being chiefly concerned with eugenics (*q.v.*), or improving the biological make-up of the human species by selective parenthood. In his analysis of men of famous families, given in his classic *Hereditary Genius* (1869), he tended to underestimate the role of social environment in the development of the individual.

In 1863 Galton indicated the significance in meteorology of anticyclones. a term coined by him. He was a pioneer in the development of composite photographs and in the use of fingerprints for personal identification. To interpret his numerous "family records" and the data obtained for more than 9,000 subjects examined in the anthropometric laboratory he established at the International Health exhibition in London, 1884–85, he devised new statistical methods, culminating in the correlational calculus, perhaps his greatest scientific achievement. The family records provided him with material for the quantitative assessment of heredity through correlating the physical and mental attributes of kinsmen, and his recognition that two characters measured on an organism are not independent but associated arose from his interest in anthropometry. His investigations of identical twins and of sterility arising from marriage with heiresses (who as sole issue of unprolific parents might tend themselves to be infertile) are of particular importance. He was knighted in 1909. He died at Haslemere on Jan. 17, 1911, leaving an endowment for a chair in eugenics at the University of London.

Galton's other principal works are *English Men of Science* (1874); *Inquiries Into Human Faculty* (1883); *Noteworthy Families* (1906); *Essays in Eugenics* (1909).

See his *Memories of My Life* (1908); Karl Pearson's *Life of Francis Galton,* 4 vol. (1914–30); C. P. Blacker's *Eugenics: Galton and After* (1952). (*J. C* TR.)

GALUPPI, BALDASSARE (1706–1785), Italian composer, was born on Oct. 18, 1706, on the island of Burano near Venice, and was named I1 Buranello His father, a barber, and violinist at the local theatre, was his first teacher. He studied at the Conservatorio degli Incurabili at Venice, under Antonio Lotti. After producing two operas in collaboration with G. B. Pescetti, in 1728 and 1729, he began to compose operas for the Venetian theatres, writing sometimes as many as five in a year. He visited London in 1741, and arranged a *pasticcio, Alexander in Persia,* for the Haymarket. Burney considered his influence on English music to have been very powerful In 1740 he became *vice-maestro di cappella* at St. Mark's and *maestro* in 1762. In 1749 he began writing comic operas to libretti by Goldoni, which enjoyed an enormous popularity. He was invited by Catherine II. in 1766 to Russia where he composed his opera *Ifigenia in Tauride* (1768). He returned to Venice in 1768, where he had held the post of director of the Conservatorio degli Incurabili since 1762. He died on Jan 3, 178j.

Galuppi's best works are his comic operas, of which *Il Filosofo di Campagna* (1754), known in England as *The Guardian Trick'd* (Dublin, 1762) was the most popular. His melody is attractive rather than original, but his workmanship in harmony and orchestration is generally superior to that of his contemporaries. He was one of the first to extend the concerted finales of Leo and Logroscino into a chain of several separate movements, working up to a climax.

GALVANI, LUIGI (ALOISIO) (1737–1798), Italian physiologist, an early experimenter in electricity, was born at Bologna on Sept. 9, 1737. He was appointed lecturer in anatomy at Bologna in 1762, and gained repute as a comparative anatomist from his researches on the organs of hearing and genitourinary tract of birds. He enunciated his theory of animal electricity in 1791. In the course of some experiments on frogs he had noticed what appeared to be a correlation between muscle twitching and simultaneous contact with both iron and copper. He proceeded to construct a device of two different metals; one metal he placed in contact with a frog's nerve, the other with a muscle; contraction of the muscle occurred. In Galvani's view the contraction was the result of the union, by means of the metallic "arc," of the arc's (exterior) negative electrical charge with positive electricity traveling along the nerve from the inner nerve substance (a process named galvanism). He had, of course, produced an electric current. Galvani died at Bologna on Dec. 4, 1798.

GALVANIZED IRON AND STEEL. A zinc coating applied to iron or steel protects it against rusting by sealing it from the atmosphere and is commonly known as galvanizing.

When porosity develops in the coating with age. if discontinuities of the coating occur, galvanic (electrolytic) action ensues and then protection of the steel is by sacrificial corrosion action, the zinc being the anode and the steel the cathode. (See ZINC: *Applications.*) When a galvanized coating has been properly applied protection from atmospheric corrosion may last for 1j to 30 years or more.

Zinc is applied by two general methods: hot dipping and electrolytic deposition, the former representing the bulk of the application. This article deals with the industrial processes used in galvanizing.

For production and uses of galvanized iron and steel see SHEETS, IRON AND STEEL; WIRE.

HOT-DIP PROCESSES

There are three general hot-dip processes: (1) hand dip for small steel articles; (2) mechanized operations for continuous sheet coating; (3) continuous-wire galvanizing. Other specific methods are sherardizing and metal spraying.

Before galvanizing, the object must be cleaned to remove oil or grease lubricants by immersion in weak alkali solutions or by vapour degreasing. After cleaning, the object is descaled (pickled) and then passed into the molten zinc.

Pickling. — Sulfuric acid solution (60° C.) is generally used at a concentration of 5% to 20%. This acid acts galvanically and to some extent chemically, and mechanically causes dislodgment of the scale, which after its separation is insoluble.

Hydrochloric acid (5% to 10%) acts chemically on both the scale and the underlying metal. Hence a greater loss of steel is sustained when this acid is used.

Inhibitors are used to avoid excessive acid attack of the steel without unduly restricting descaling. These compounds may be

A B

FIG. 1. — DRAWING OF ZINC-IRON ALLOY LAYERS SHOWING (A) SERRATED BOUNDARY BETWEEN ALLOY LAYERS AND OUTER ZINC AND (B) SMOOTH BOUNDARY OBTAINED BY CLEANING

inorganic, such as arsenic, or organic, such as oils, molasses, bran, etc.

Fundamentals. — The cross section of a hot-dip coating (fig. 1) shows the alloy-layer structure between the steel and the zinc, brittle when thick and causing the coating to crack when the sheet is bent. The portion of this multiple layer next to the steel is usually termed $FeZn_3$ or low-zinc alloy. It is frequently invisible or extremely thin. Next is the iron-zinc alloy, $FeZn_7$, high in zinc and forming an irregular boundary with the outer zinc layer which approximates the composition of the zinc bath.

The relation of the iron in the structure to the ductility of the coating lies largely in the smoothness of the boundary between this alloy layer and the outer zinc coating. The smoother and cleaner the steel surface the less rapidly and less irregularly the alloy grows.

If a clean descaled steel sheet is passed through a strong solution of zinc chloride (25%) or zinc ammonium chloride before entering the zinc bath, a thinner alloy layer and more ductile coating is obtained. When the steel surface is not cleaned from sulfates, chlorides or pickling products, the salts are reduced to sponge iron by the action of the molten zinc (a prime source of iron for dross in the zinc bath) and cover the steel surface with irregular jagged points of alloy.

Spangles.—Hot-dip coatings have characteristic crystalline surface patterns known as spangles. The size and shape of these metal crystals are influenced by several factors! principally the surface condition of the steel, the kind and amount of impurities present in the bath, metal additions to the bath and the rate of cooling (see fig. 2). Large spangles may be produced by the addition of metals such as tin and by slow-cooling of the freshly coated sheet.

FIG. 2. — SPANGLES ON SURFACE OF GALVANIZED SHEET STEEL

Effect of Metal Impurities and **Additions.**—Metals commonly present in the zinc bath, other than iron, are cadmium and lead in small fractions of 1%; these impurities come from the ore used in the production of the zinc. Metals commonly added to the bath for specific effect are tin and aluminum and sometimes antimony.

Tin promotes fluidity of the bath and imparts brightness to the coated sheet. Aluminum also promotes fluidity. The formation of thick viscous zinc oxide on the surface of the bath is retarded by a thin layer of aluminum oxide. Aluminum has a further beneficial effect in retarding the reaction between iron and zinc, thereby reducing the thickness of the iron-zinc alloy layer and making the coating more ductile.

Galvanizing Practice. — For actual galvanizing, a welded steel kettle is used to hold the molten zinc and is kept at approximately 8j0° F. by applying heat to the kettle sides (see fig. 3). The cleaned sheet is passed through a box containing a mixture (or compound) of zinc-ammonium chloride flux having a variable composition. This flux, floating in a confined area on the molten zinc bath, serves to evaporate the surface water on the sheet prior to its entrance into the zinc. and also to remove residual oxides. A system of multiple rolls receives and guides the sheet and partly controls the thickness of the zinc deposit. The amount of zinc taken up on the surface of the sheet may vary from one-half to two ounces per superficial square foot, depending upon the kind of process used, the quality of operation and the service intended.

The Effect of Steel Composition.——Great difficulty is experienced in securing a ductile heavy zinc coat on pure iron wire and steel of low carbon content when conventional practice is followed. A continuous process for galvanizing iron and low-carbon steel has been developed and is known as the Sendzimir Zincgrip process ("Armco," American Rolling Mill Co., Middletown, O.). Its aim is to obtain a surface, prior to galvanizing. which is absolutely free from oxides. This is accomplished by forming a thin layer of iron oxide integral with the steel. reducing it in an atmosphere of hydrogen at 1,100° F. and passing the hot strip, in the absence of air, into a relatively small kettle of molten zinc, the temperature of which is maintained by the aforesaid hot strip (see fig. 4).

Wire Galvanizing.—Wire galvanizing is also a continuous process. The wire is drawn through successive pickling, annealing and washing operations. It is frequently dried before passing into the galvanizing pan and is drawn out through wipers of charcoal,

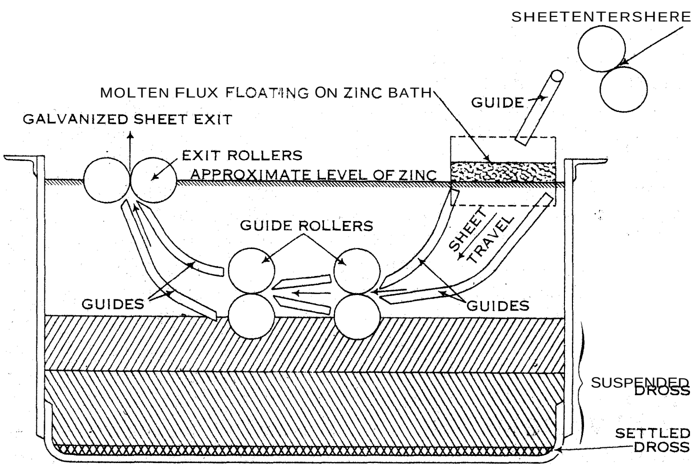

FIG. 3. — SCHEMATIC DRAWING OF SHEET GALVANIZING BATH, HOT-DIP PROCESS

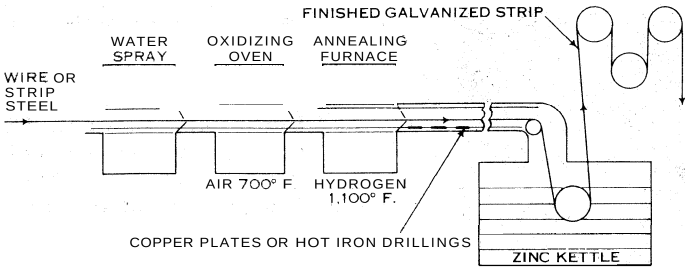

FIG. 4.—SCHEMATIC DRAWING OF ZINCGRIP PROCESS

saturated carbon. coke. sand or asbestos A 20% hydrochloric acid solution at 135° to 150° F is used for pickling, which must be rapid because of the high speed of the wire.

Low-Temperature **Processes.**—*Sherardizing* Process.—This is a process of forming intermetallic compounds of iron and zinc on the surface of a steel article by heating it in the presence of finely divided zinc below the melting point of the zinc.

Metallic Spraying (*Schoop* Process).—This is a process which consists of applying a fine spray of molten zinc to the surface of steel which has been cleaned, roughened, as by sandblasting, and narmed In this process the zinc, in the form of a wire, strip or powder, is fed at a uniform rate through an oxygen-hydrogen or other flame or through an electric arc, and then projected onto the surface to be coated. There are no chemical reactions to form compounds. the zinc adhering directly to the surface.

ELECTROGALVANIZING PROCESSES

The cold or electrogalvanizing process is used for certain classes of work. Its advantages over hot-galvanizing are: (1) greater economy in the use of zinc and somewhat healthier conditions; (2) complete control over thickness of coating; (3) deposition of a coat of pure zinc (no alloy of iron-zinc as found in the hot-dip process); (4) suitability for articles that would be adversely affected by the temperature of molten zinc if coated by the hot-dip process; and (5) no distortion of the coating of flat surfaces as with the hot process.

Its disadvantages are that greater care is required and greater difficulties are encountered in obtaining a correct coat than with hot-galvanizing; for articles that have to be made watertight the electrolytic process does not have the same "soldering" effect as the hot process.

There are two general processes of electrogalvanizing or electroplating (*q.v.*) with zinc, distinguished by (1) soluble anodes in zinc sulfate solution of low acid content; (2) insoluble anodes in zinc sulfate solution of high acid content.

In the soluble anode process the wire or strip is generally annealed by passing it through molten lead; tight scale is generally removed by pickling in hydrochloric acid solution. The coating, being free from the brittle alloy layer, possesses great ductility, uniformity and adherence; the latter is a mechanical bond.

In the insoluble anode process, roasted zinc ore is leached with dilute sulfuric acid, the solution purified and the soluble zinc electroplated on wire (or strip) at high current density. The cathodic deposit from this solution using a lead-silver alloy anode (1% silver) is exceptionally pure (99.99% zinc) and ductile; the galvanized wire can be wound around its own perimeter without cracking.

For annealing, wires enter near the bottom of a pan of molten lead at 1,000° F. and pass upward in an inclined position. As they leave the lead they enter a molten caustic soda bath (700° F.) and are cleaned by cathodic electrolysis. The wires are then washed and pass into the electrolytic zinc cell in which a current of 700 to 1,500 amp. per square foot is applied. The coated wires are washed in water and then highly polished by a rotary mechanism using hard abrasive. Adherence of the zinc coating is greater than by the hot-dip process. (HT. R. H.)

GALVANOMETER. An instrument for measuring an electric (galvanic) current. See INSTRUMENTS, ELECTRICAL MEASURING.

GALVESTON, a city of Texas, U.S., the seat of Galveston county, a major port and resort area on the Gulf of Mexico, is about 50 mi. S.E. of Houston on the east end of Galveston Island, which extends east and west off the Texas coast for about 32 mi. The island is connected to the mainland by causeways, and a super-highway gives rapid access from Houston to Galveston and seven other county communities. Access from the east is by ferry from Bolivar peninsula across Galveston harbour. Pop. (1960) city. 67,175; standard metropolitan statistical area (Galveston county! including Texas City (140,364). (For comparative population figures see table in TEXAS: *Population.*)

Shipping and its allied industries, insurance. banking and resort business are the city's major economic assets. The county's economy was enriched after 1945 by expansion of the petrochemical industries centred at Texas City on Galveston bay. Galveston's port is publicly owned and tax-exempt. Chief exports are cotton. grain and sulfur; imports are sugar, tea and bananas. Wharf facilities are modern.

Early 18th-century maps of the Gulf of Mexico show an island recognizable as Galveston. Later maps name it San Luis. In July 1785. the bay was named Galveston (Galveztown) by Don José de Evía, a Spanish pilot who surveyed the Gulf coast by order of Don Bernardo de Gálvez. governor of Louisiana and, later. viceroy of Mexico. From 1817 to 1821 the privateer Jean Laffite made Galveston his headquarters. In 1836 the Republic of Texas granted Michel Branamour Menard land on the east end of the island. Menard platted a town site whose lots were first sold in 1838 by the Galveston City company. The city was incorporated in Jan. 1839.

Galveston grew ateadily until the American Civil War, but expansion after the war was greater. By 1885 the city had great commercial power. Two factors dislodged it from its leading position: the rise of competitive Texas ports, notably Houston, whose ship channel is entered from Galveston bay. and a destructive hurricane on Sept. 8, 1900. in which over 5.000 lives were lost and much of the city was destroyed. After the storm a 17-ft. high protective seawall was built and the city's grade raised proportionately to the wall's height. The wall is about 8 mi. long and is paralleled by a wide boulevard overlooked by the leading resort hotels.

Galveston's educational facilities include schools of medicine and nursing of the University of Texas. A major cultural asset is Rosenberg library, which serves the county. There is a civic symphony orchestra and a little theatre. The climate is humid but rarely brings extremes of temperature. (T. G. R.)

GÁLVEZ, JOSÉ, MARQUÉS DE LA SONORA (1720–1786), Spanish colonial administrator particularly noted for his work as inspector general (visitudor *general*) in New Spain (Mexico), 1765–71, was born in Vélez-Málaga, Spain. Among his important accomplishments were the reorganization of the tax system, the formation of a government tobacco monopoly, the reorganization of the defenses of the northern frontier of the viceroyalty and the Spanish occupation of Upper California. Upon completion of his inspection he recommended further administrative and fiscal reforms, the most important of which, the intendancy system, was introduced in 1786. Subsequently he was named minister of the Indies (1775) and was granted the title of marquis of Sonora (1785). (L. N. McA.)

GÁLVEZ, MANUEL (1882–), Argentinian novelist and biographer, was born in Paraná on July 18, 1882. Leaving the provincial milieu of his boyhood, he went to Buenos Aires to attend the university. and made that city his perfnanent residence. The founding of the literary magazine Ideas, residence in Europe and an appointment as inspector of secondary schools further enlarged the scope of his observation. Although he used many literary forms, he is most noted for his realistic novels on Argentinian life, especially his early ones: La *maestra normal* (1914), usually judged his best novel, based on customs in the provincial city of La Rioja; El *mal metafísico* (1916), on the materialism of Buenos Aires; La *sombra del convento* (1917), laid in Córdoba; and *Nacha Regules* (1919), dealing with social injustice in Buenos Aires. With a trilogy, "Scenes From the Paraguayan War" (1928–29), Gálvez began a series of historical novels which, together with novelized biographies of Argentinian figures, constituted his main output aiter 1938. The chief features of Gálvez' novels are conscientious documentation of a remarkably wide range of national scenes; concentration on social situations rather than individual psychology; and the injection of ideas into the fictional framework. (A. Cn.)

GALWAY, HENRI DE MASSUE, Marquis de Ruvigny and Earl of (1648–1720), Huguenot soldier who served Britain in Ireland and on the continent, was born in Paris on April 9, 1648, and saw service under Turenne, who thought very highly of him. At the revocation of the Edict of Nantes (1685) he went into exile with his fellow Huguenots and in 1690 entered the service of William III of England as a major general, thereby forfeiting his French estates. In July 1691 he distinguished himself at the battle of Aughrim, a decisive victory for the British, after mhich Ireland submitted to William, and in 1692 he was for a time commander in chief in Ireland. He was created Viscount Galway and Baron Portarlington, and received a large grant of forfeited estates in Ireland.

In 1693, during the War of the Grand Alliance (*q.v.*), he fought at Neerwinden, Belg., and was wounded, and in 1694, with the rank of lieutenant general, he was sent to command a force in English pay which was to assist the duke of Savoy against the French and at the same time to relieve the distressed Vaudois. But in 1695 the duke changed sides, the Italian peninsula was neutralized and Galway's force was withdrawn to the Netherlands. From 1697 to 1701, a critical period of Irish history, the earl of Galway (he was advanced to that rank in 1697) was practically in control of Irish affairs as lord justice of Ireland. After several years spent in retirement, he was appointed in 1704 to command the allied forces in Portugal during the War of the Spanish Succession (*q.v.*); he sustained the post with honour and success until the battle of Almanza in 1707, in which Galway, in spite of care and skill on his own part, was decisively defeated. But he scraped together a fresh army and, although infirm, served in one more campaign. His last service was rendered in 1715, when he was sent as one of the lords justices to Ireland during the Jacobite insurrection. He died on Sept. 3, 1720.

GALWAY, a county in the west of Ireland, in the province of Connaught, bounded north by Mayo and Roscommon: east by Roscommon, Offaly county and Tipperary; south by Clare and Galway bay; and west by the Atlantic ocean. Pop. (1956) 155,553: area 2,293.2 sq.mi.

To the east of Lough Corrib the surface rests on a limestone base and has extensive bogs. Its southern portion is partly a continuation of the Golden vale of Limerick and partly occupied by the Slieve Aughty mountains (highest points, about 1,200–1,250 ft.) in which Silurian and Devonian rocks appear. A broad mass of ice-morn gneiss and granite lies west of Lough Corrib, and its steep edge toward Galway bay suggests an east to west line of fracture. Quartzites, associated mith limestone and mica schist, stand out in "Beanna Beola," or the Twelve Bens or Pins (highest point, 2,395 ft.). The coast is much indented and studded mith islands.

The Suck, which forms the eastern boundary of the county, rises in Roscommon, and, passing by Ballinasloe, unites with the Shannon near Shannonbridge. The Shannon forms the southeastern boundary and, passing Shannon Harbour, Banagher, Meelick and Portumna, swells into the great expanse of water called Lough Derg, which skirts the county to 5 mi. N. of the village of Mount Shannon. The Clare flows southward through the centre of Galway and enters Lough Corrib 4 mi. above the town of Galway. The Ballynahinch, one of the best salmon-fishing rivers in Connaught, rises in the Twelve Pins, passes through Ballynahinch lake and enters Bertraghboy bay. Lough Corrib extends from Galway town northward for 29 mi. The district west of Lough Corrib is called Connemara arid is famed for its beauty.

History.—Galway was made a county about 1579 by Sir Henry Sydney, lord deputy of Ireland. There are many ancient monuments in the region surrounding Lough Corrib and in the Aran Islands off the west coast. Raths or encampments are numerous, and several cromlechs (prehistoric stone circles) are in good preservation. At Kilmacduagh, near Gort, is a 14th- to 15th-century cathedral, and a round tower 112 it. high, leaning considerably out of the perpendicular. Knockmoy abbey (about 7 mi. S.S.E. of Tuam), probably founded in 1189 by Cathal O'Connor, was adorned mith fresco paintings. The castle of Tuam was built in 1161 by Roderick (Rory) O'Connor, king of Connaught, at the period of the English invasion. The cathedral of Clonfert, mith a Romanesque doorway, is now in ruins.

Industries.—Wheat and sugar beets are grown extensively in the eastern part of the county. In coastal regions seaweed, which is plentiful, is used as manure. Crushed limestone is also used as fertilizer. Sheep are more numerous than cattle.

The splendid mountain, lake and coastal scenery and the excellent facilities for salmon and trout fishing attract many visitors. Salthill near Galway city is a leading holiday resort. Homespun tweeds and hand-knitted woolen goods are made in the western part of the county. Black marble is quarried near Galway city and green marble is found in Connemara. Galway, Cleggan and Kilronan are bases from which fishing trawlers operate. Offshore fishing in currachs is general. Tweeds, hats, chinaware, furniture and agricultural implements are made in Galway, sugar in Tuam, textiles in Louehrea and shoes in Ballinasloe.

Galway city is a borough; Ballinasloe is an urban district; Tuam and Louehrea are towns. The administrative authority for the remainder of the county is the county council which also administers health services. For representation in *dail eireann* the county is divided into three constituencies—West, North and South—each of which elects three members.

GALWAY, a seaport and the county town of County Galway, Ire., on the northern shore of Galway bay and 133 mi. W. of Dublin. Pop. of urban district (1956) 21,219. After the building of its walls by Anglo-Norman settlers (about 1270) it developed as a commercial centre, in later centuries doing much trade with Spain. Richard II's charter of incorporation, confirmed by Henry IV, was extended in 1545 to give the port jurisdiction over the Aran Islands, and to permit exportation of goods other than linens and woolens. A charter from James I formed the town and the land within a 2-mi. radius into a county. In the Civil War the town surrendered to the parliamentary forces, the inhabitants were dispersed and their property given to adventurers and soldiers.

St. Nicholas church, a cruciform building founded in 1320, was collegiate from 1484 until 1840, and Edward VI created the Royal College of Galway in connection with it. University college was founded in 1849 as Queen's college under an act of 1845, and its name was changed when it received a new charter in 1908 as a constituent college of the National University of Ireland.

Claddagh, mhich was the Irish part of the town in Norman times, is now a suburb engaged in sea and salmon fisheries. The harbour is connected with Lough Corrib by the Eglington canal, but the canal trustees have abandoned navigation on the canal. The chief exports are wool, agricultural produce, locally polished marble and china. The main industries are represented by corn mills, an iron foundry, a hat and furniture factories. The famous Galway races are held at the end of July or the beginning of August.

GAMA, VASCO DA (c. 1460–1524), Portuguese navigator and discoverer of the sea route to India, was born *c.* 1460 at Sines, Alentejo, Port. Little is known of Da Gama's early training, but in 1492 he was employed to seize certain French vessels lying in Setúbal and the Algarve. Later John II chose him to complete the work of Bartolomeu Dias (*q.v.*) in opening the sea route to India. Da Gama sailed from Lisbon on July 8, 1497. His fleet comprised four vessels: the flagship "S. Gabriel," which he commanded himself, the "S. Rafael," the "Berrio" and a storeship. Like Dias and Diogo Cam (*q.v.*), he carried *padrões* (stone pillars) which he set up as marks of discovery and overlordship. The expedition passed the Canaries on July 15 and reached the Cape Verde Islands on the 26th; it remained at São Tiago until Aug 3. Then, in order to avoid the currents oi the Gulf of Guinea, Da Gama took a circular course through the South Atlantic to the Cape and reached St. Helena bay (32° 40' S.) on Nov. 7. The expedition weighed anchor again on Nov. 16 but, because of unfavourable winds, did not round the Cape of Good Hope until the

22nd. Three days later Da Gama anchored in Mossel bay, erected a *padrão* on an island and ordered the storeship to be broken up. The fleet sailed again on Dec. 8 and reached the coast of Natal on Christmas day. On Jan 11, 1498. the fleet anchored for five days near the mouth of the Copper river. Rio de Bon Signaes (where another *padrão* was placed) was reached on Jan 25

After 32 days the expedition continued to Mozambique (arriving March 2), nhere the inhabitants believed the Portuguese to be Moslems like themselves. Da Gama learned that they traded nith Arab merchants and that four Arab vessels, laden with gold, jewels, silver and spices, were then in port and that Prester John, the long sought Christian ruler. lived in the interior but held many of the coastal cities. The sultan of Mozambique supplied Da Gama nith two pilots, one of whom deserted on finding that the Portuguese were Christians. The expedition reached Mombasa on April 7. Anchor was dropped at Malindi on April 14 and a pilot who knew the route to Calicut was taken aboard. After a 23-day run across the Indian ocean the Ghats were sighted and Calicut was reached on May 20. There Da Gama erected a *padrão* as proof of his having reached India. He was welcomed by the zamorın or Hindu ruler of Calicut (then the most important trading centre in southern India), but he failed to conclude a treaty because of the hostility of certain Moslem merchants.

Da Gama left Calicut at the end of August, taking with him five or six Hindus in order that King Manuel might learn about their customs. He visited Angediva Island before sailing again for Malindi where he erected a *padrão*. Because of unfavourable winds, the expedition took nearly three months to cross the Arabian sea and many of the crew died of scurvy. At Malindi, because of greatly reduced numbers, Da Gama ordered the "S. Rafael" to be fired. Mozambique (uhere he set up his last *padrão*) was reached on Feb. 1. On March 20 the "S. Gabriel" and the "Berrio" rounded the Cape together, but a month later were parted by a storm, the "Berrio" reaching the Tagus on July 10. Da Gama continued to Terceira Island in the Azores, from where he is said to have dispatched his flagship to Lisbon. He himself reached Lisbon on Sept. 9 and made his triumphal entry into the city nine days later, spending the interval in mourning his brother Paul, who had died on Terceira. Manuel I granted Vasco the title of "dom," an annual pension of 1,000 cruzados and lands.

To further Da Gama's achievement, Manuel I dispatched P. A. Cabral, who left Portugal on March 9, 1500, and succeeded in establishing a factory at Calicut; but the Portuguese whom he left behind were murdered by the Hindus at the instigation of Moslem traders. Da Gama was recalled to India and ordered to avenge this outrage. Shortly before he sailed in 1502, he received the title of admiral of the Indian seas and was granted other favours including the right to import merchandise to the value of zoo cruzados with every royal fleet from India, so that he became one of the richest men in Portugal. On reaching Calicut he bombarded the city and destroyed a fleet sent against him. He then proceeded to Cochin where he concluded a very favourable trade treaty. He returned to Lisbon in Sept. 1503. Soon after his return he retired to Évora but continued to advise Manuel I on Indian and maritime matters until 1505. He was created count of Vidiguerira in 1519 and mas nominated viceroy of India in 1524. He died at Cochin on Dec. 24, 1524.

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(E. M. J. C.)

GAMALIEL. This name, which in Old Testament times figures only as that of a prince of the tribe of Manasseh, mas hereditary among the descendants of Hillel (*q.v.*). Six persons bearing the name are known.

GAMALIEL I, a grandson of Hillel, and like him designated "the elder," by which is apparently indicated that he was a member of the Sanhedrin. According to tradition Gamaliel succeeded his grandfather and his father as nasi, or president of the Sanhedrin. Though this tradition does not correspond with historic fact, and merely reflects later conditions after A.D. 70, it is at any rate certain that Gamaliel took a leading position in the Sanhedrin and enjoyed the highest repute as teacher of the Law. He was the first to whose name was prefixed the title rabban ("master!" "teacher"). It is related in Acts (v, 34 ff.) that he intervened in the Sanhedrin in favour of the disciples of Jesus, and in this connection he is referred to as a Pharisee of wide repute. In the Mishnah (*Gittin* iv, 1–3) he is spoken of as the author of certain legal ordinances affecting the welfare of the community. His function as a teacher is proved by the fact that the Apostle Paul boasts of having sat at the feet of Gamaliel (Acts xxii, 3). Of his teaching, beyond the saying preserved in Aboth i, 16, which enjoins the duty of study and of scrupulousness in the observance of religious ordinances, little is preserved. His renown in later days is summed up in the words (Mishnah, end of Sotah): "When Rabban Gamaliel the Elder died, regard for the Torah (the study of the Law) ceased, and purity and piety died."

GAMALIEL II, grandson of Gamaliel I. To distinguish him from the latter he is also called Gamaliel of Jabneh. In Jabneh (Jamnia), where during the siege of Jerusalem the scribes of the school of Hillel had taken refuge by permission of Vespasian, a new centre of Judaism arose under the leadership of the aged Johanan ben Zakkai (*q.v.*), a school whose members inherited the authority of the Sanhedrin of Jerusalem. Gamaliel II became Johanan ben Zakkai's successor: and rendered immense service in the strengthening and reintegration of Judaism, which had been deprived of its former basis by the destruction of the Temple and by the entire loss of its political autonomy. He put an end to the division which had arisen between the spiritual leaders of Palestinian Judaism by the separation of the scribes into the two schools called respectively after Hillel and Shammai. Gamaliel was recognized by the Roman government as patriarch. He devoted special attention to the regulation of the rite of prayer, which after the cessation of sacrificial worship had become all important. He gave the principal prayer, consisting of 18 benedictions, its final revision, and declared it every Israelite's duty to recite it three times daily. He died before the insurrections under Trajan. His son, Simon, long after his father's death and after the persecutions under Hadrian, inherited his office, which thenceforward his descendants handed on from father to son.

GAMALIEL III, son of Jehuda I, the redactor of the Mishnah (see TALMUD), and his successor as patriarch. The redaction of the Mishnah was completed under him, and some of his sayings are incorporated therein (Aboth ii, 2–4). Gamaliel III lived during the first half of the 3rd century A.D.

GAMALIEL IV, grandson of the above, patriarch in the latter half of the 3rd century; about him very little is known.

GAMALIEL V, son and successor of the patriarch Hillel II. Beyond his name nothing is known of him. He lived in the latter half of the 4th century.

GAMALIEL VI, grandson of the above, the last of the patriarchs, died in 425. (W. BA.; G. H. B.)

GAMBETTA, LÉON (1838–1882), French statesman, was born at Cahors on April 2, 1838. In his sixteenth year young Gambetta lost by an accident the sight of his left eye, which eventually had to be removed. Notnithstanding this privation, he highly distinguished himself at the public school of Cahors, and in 1857 proceeded to Paris to study law. His southern vehemence gave him great influence among the students of the Quartier Latin, and he was soon known as an inveterate enemy of the imperial government. He was called to the bar in 1859. In 1868 he defended the journalist Delescluze, prosecuted for having promoted the erection of a monument to Baudin, who was killed in resisting the coup d'dtat of 1851. Gambetta seized his opportunity and assailed both the coup d'dtat and the government with an eloquence of invective which made him immediately famous.

In May 1869 he was returned to the Assembly, both by the first circumscription of Paris and by Marseilles, defeating Hippolyte Carnot for the former constituency and Thiers and Lesseps for the latter. He elected to sit for Marseilles, and lost no opportunity of attacking the Empire in the Assembly. He was at first opposed to the war with Germany, but when it had become inevitable, he threw himself with all his energy into the work of national defence. After Sedan Gambetta himself proclaimed the fall of the emperor at the *corps législatif,* and the establishment of the republic at the *hôtel de ville.* He was minister of the interior in the new government of national defence. He advised his colleagues to leave Paris and conduct the government from some provincial city. This advice was rejected from dread of another revolution in Paris, and a delegation to organize resistance in the provinces was despatched to Tours, but when this was seen to be inefficient Gambetta himself (Oct. 7) quitted Paris in a balloon, and upon arriving at Tours took the supreme direction of affairs as minister of the interior and of war. Aided by M. de Freycinet, then a young officer of engineers, as his assistant secretary of war, he organized an army, which might possibly have effected the relief of Paris if Metz had held out, but after the surrender of Bazaine and the defeat of the French nezr Orleans early in December the seat of government had to be transferred to Bordeaux. When Paris surrendered at the end of January, Gambetta submitted to the capitulation concluded with Prince Bismarck. He immediately resigned his office. Elected by nine departments to the National Assembly meeting at Bordeaux (March 1, 1871) he chose to sit for Strasbourg, which by the terms of the treaty was to be ceded to Prussia, and when the treaty was adopted by the Assembly he resigned in protest and retired to Spain.

He returned to France in June, was elected by three departments in July, and agitated for the definitive establishment of the Republic. His new journal, *La République française,* soon became the most influential in France. His orations at Bordeaux on his return, and at Grenoble on Nov. 26, 1872, in which he spoke of political power having passed to *les nouvelles couches sociales* showed him at the height of his oratorical powers. But in spite of his republican convictions Gambetta urged moderation on his supporters on the fall of Thiers and the accession to power of the conservative MacMahon. His tact and parliamentary dexterity, no less than his eloquence, secured the voting of the constitution in Feb. 1875 This policy he continued during the early days of the now consolidated Republic, and gave it the appropriate name of "opportunism." It was not until May 4, 1877, when the peril from reactionary intrigues was notorious, and the clerical party had begun a campaign for the restoration of the temporal power of the pope, that he delivered his famous speech denouncing "clericalism" as "the enemy." On May 16 MacMahon perpetrated his parliamentary *coup d'ktat* in support of the clerical reactionaries and on Aug. 15, Gambetta, in a speech at Lille, gave him the alternative *se soumettre ou se dkmettre.* He roused the republican party throughout France in a campaign which culminated in a speech at Romans (Sept. 18, 1878) formulating its programme. MacMahon had no choice but to dismiss his advisers and form a moderate republican ministry under the premiership of Dufaure.

After the abdication of MacMahon, Gambetta declined to become a candidate for the presidency, but gave his support to Grévy; nor did he attempt to form a ministry, but accepted the office of president of the chamber of deputies (Jan. 1879). This position did not prevent his occasionally descending from the presidential chair to make speeches, one of which, advocating an amnesty to the communards, was especially memorable. Although he really directed the policy of the various ministries, he maintained a neutral attitude as far as possible; but events hurried him on, and early in 1881 he placed himself at the head of a movement for restoring the *scrutin de liste* in place of *scrutin d'arrondissement.* A bill to re-establish *scrutin de liste* was passed by the Assembly on May 19, 1881, but rejected by the Senate on June 19.

Gambetta's supporters were in a large majority, and on the reassembling of the chamber, he formed a ministry—known as Le *Grand Ministère.* Every one suspected him of aiming at a dictatorship; attacks, not the less formidable for their injustice, were directed against him from all sides, and his cabinet fell on Jan. 26, 1882, after an existence of only sixty-six days. His declarations leave no doubt that he would have cultivated the British alliance and co-operated with Great Britain in Egypt; and when the Freycinet administration shrank from that enterprise only to see it undertaken with signal success by England alone, Gambetta's foresight was quickly justified. His fortunes were in the balance. At his house in Ville d'Avray, near Sèvres, on Nov. 27, 1882, he was shot in the hand by a revolver which accidentally went off. He died on Dec. 31, as the result of this accident.

REAL STATESMANSHIP

Gambetta rendered France three inestimable services: by preserving her self-respect through the gallantry of the resistance he organized during the German War, by his tact in persuading extreme partisans to accept a moderate Republic, and by his energy in overcoming the usurpation attempted by the advisers of MacMahon. His death cut short a career which had given promise of still greater things, for he had real statesmanship in his conceptions of the future of his country, and a potent eloquence to secure their acceptance. The romance of his life was his liaison with Léonie Léon (d. 1906), with whom Gambetta fell in love in 1871. Gambetta himself constantly urged her to marry him during this period, but she always refused, fearing to compromise his career; she remained, however, his confidante and intimate adviser in all his political plans. The date of the marriage had been fixed, when the accident which caused his death occurred in her presence. It is certain that there was no question of suicide. Their correspondence is of absorbing interest. But in various matters of detail the serious student of political history must be cautious in accepting her later recollections.

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GAMBIA, a British colony and protectorate comprising a narrow strip of land along the lower 288 mi. of the Gambia river, west Africa, reaching a point 200 mi. from the sea. It has an area of 4,003 sq.mi. (of which the protectorate is 3,974 sq.mi.). Pop.: colony (1951 census) 27,297; protectorate 252,389.

The territory is closely bound up with the river, which gives unequalled access to the interior of west Africa. However, apart from its unique but unrealized utility for penetrating a continent notable for its nature-made barriers to ingress, the Gambia valley is a fragment of the western Sudan. differing from the rest only in details. Torrential rains fall from early July to the end of October and average 35–45 in.

In the wet season the valley is subject to malaria and other mosquito-borne diseases, a condition aggravated among the mangrove-fringed marshes of the estuary, where Bathurst, the chief settlement and capital, is located. The rest of the year is rainless, and the temperature mounts toward the end of the dry season. Crop growth is restricted to the wet period, and harvesting takes place in the early weeks of the dry season.

The coastal plain bordering the estuary is flat and penetrated by tidal creeks, which are bordered with mangrove swamps. Larger trees line the low banks of the Gambia for a few miles above the estuary, but elsewhere the country is rolling or hilly, and the natural vegetation consists of coarse grasses with a spotting of low trees. Light soil predominates, and drainage is rapid except on flats near the coast. The land is somewhat subject to drought, and crops are accordingly restricted in variety. There are no valuable minerals in the Gambia.

History.—The Portuguese visited the Gambia in the 1 jth century, and in the beginning of the 16th century were trading in the lower river. Apart from a traffic in slaves their main object was to reach "the land of gold" supposed to be not far distant, and in fact considerable quantities of gold reached the lower Gambia from the interior. In 1588 Dom Antonio, claimant to the throne of Portugal. sold to certain English merchants the exclusive right to trade in the Gambia river. This grant was confirmed by letters patent from Queen Elizabeth I. This company's operations led to no permanent settlement in the Gambia In 1618 James I granted a charter to "the Company of Adventurers of London trading into Africa," formed at the instigation of Sir Robert Rich (afternard earl of Warwick) for trade with the Gambia and the Gold Coast. However, the company's first agent, George Thompson, was murdered by natives after his ship, the "Catherine," had been seized and the crew murdered by Portuguese and half-castes.

In about 1651 James, duke of Courland, acquired from a local chief an island a short distance from the river mouth, where he erected a fort. The island was then known as St. Andrew's Island, but later came to be known as James Island. A year later Prince Rupert entered the river with three royalist ships and captured some shipping belonging to patentees who had received a grant of trading rights from the commonwealth government in England. In 1661 Charles II granted a new patent to a body styled "the Royal Adventurers trading to Africa." The new patentees sent an expedition to the Gambia river under the command of Sir Robert Holmes, who found that the Courlander garrison on James Island had been reduced to seven Europeans. On being threatened with bombardment if they did not at once surrender the fort. the garrison had no alternative but to submit and Holmes took possession of the fort.

In 1677 the French wrested the Island of Goree (near Cape Verde) from the Dutch and about four years later established a small enclave at Albreda on the north bank of the Gambia river opposite to James Island. The history of the next century and a half records a continuous struggle between England and France for political and commercial supremacy in the regions of the Senegal and the Gambia. In the wars with France which followed on the English revolution of 1688 James fort was captured on four occasions by the French (1695, 1702, 1704 and 1708) but no attempt was made by them to occupy the fort permanently. At the treaty of Utrecht (1713) the French recognized the right of the English to James Island, while they in their turn were allowed to continue in occupation of Albreda.

In 1779 the French captured James fort for the fifth and last time. On this occasion they so successfully demolished the fortifications that at the end of the war it was found impossible to rebuild them. The Gambia river was reserved to Great Britain by the treaty of Versailles (1783), but the French were still allowed to retain their enclave at Albreda.

When in 1807 the slave trade was abolished by act of parliament, Great Britain was in possession of Goree. In co-operation with the royal navy the garrison of that place made strenuous efforts to put an end to the traffic in the Gambia river. When at the close of the Napoleonic Wars Goree was returned to the French, the British decided to establish a military post at the mouth of the Gambia river for the purpose of checking the trade. On April 23, 1816. the king of Kombo ceded to Capt. Alexander Grant the Island of Banjol (St. Mary's Island) and the settlement established thereon was called Bathurst after the then secretary of state for the colonies. A number of British traders, who had established themselves at Goree during the war, followed the military garrison to this new settlement.

In 1821 Bathurst was placed under the jurisdiction of the government of Sierra Leone. In 1843 it was made an independent colony, but in 1866 it was made a portion of the officially styled "West African Settlements" with the seat of government at Freetown, Sierra Leone. In 1888 it once more became a separate entity and remained such thereafter.

Soon after the founding of Bathurst in 1816 the local government began extending its territorial acquisitions in the upper reaches of the river by concluding treaties with native chiefs. In 1857 Albreda, a foreign enclave in the middle of British territory, had proved a constant source of friction between the British and French governments, was given to Great Britain, which in exchange renounced certain rights in respect of the gum trade at Portendic. Thereafter the navigable part of the river became solely British.

In 1870 and again in 1876 negotiations were begun between the British and French governments for the exchange of Gambia for other territory in west Africa, but on each occasion the proposal aroused such opposition in parliament and among various mercantile bodies in England as well as the native inhabitants of Gambia that the British government was constrained to break off the negotiations. The French continued to press forward actively in the Senegal and, when in 1889 an agreement was finally drawn up settling the international boundaries. Great Britain was able to secure only a narrow strip of territory on either bank of the river as far as Yarbutenda. Though these strips were somewhat wider in the lower reaches of the Gambia, they were limited in the upper reaches to 6.2 mi. on either side of the river.

Except for some trouble with the slave-raiding chiefs Fodi Silla (in 1894) and Fodi Kabba (in 1901) Gambia enjoyed peace after its final separation from Sierra Leone in 1888. In 1906 an ordinance was passed abolishing slavery throughout the protectorate.

During World War II Gambia proved its value not only by its contribution of fighting men for the Burmese campaign, but also as an air halt on the route to the middle east and far east and as a port of call for convoys.

Population, Education, Government and Judicature.—The African inhabitants of Gambia belong to a number of west African tribes, of whom the Mandinga (about 35% of total population), Fula, Wolof, Jola and Serahuli are the principal. Because of the artificial nature of the international boundary many of them are separated from their kinsfolk in French territory. The Mandinga and Serahuli are mainly Moslem, but the majority of the Jola tribe are pagans; there is a small Christian population, chiefly centred in Bathurst.

The government is responsible for primary education in Bathurst, though the schools have a religious grouping and are administered through management committees. on each of which the appropriate religious authority is represented. Secondary education is in the hands of the Methodist and Roman Catholic missions, which receive substantial grants from the government. A number of village schools were opened in the protectorate and there are also small elementary schools belonging to the Anglican and Roman Catholic missions. There is no postsecondary education in Gambia, except for a teacher-training college at Yundum.

Technically the British colony (29 sq.mi.), administered by a commirsioner, comprises the Island of St. Mary, upon which is the capital, Bathurst (pop., 1951 local census, 19,602), and the adjacent mainland district of Kombo St. Mary. The rest of Gambia was designated a protectorate by a Protectorate ordinance of 1935 and a number of ancillary ordinances. In practice, however, colony and protectorate are administered together on crown colony lines by a governor, executive council and legislative council.

Local government in the island is in the hands of the Bathurst town council, established in 1946 and presided over by the colony commissioner, which includes nominated and elected members, the latter being in the majority. Kombo St. Mary is administered by the Kombo rural authority, set up in 1947. The authority is presided over by the colony commissioner and consists of nominated members, chosen for the most part from the headmen of the villages of the district. There are four divisions of the protectorate administered by commissioners exercising supervision over the native authorities in the districts of each division. These native authorities consist of a district chief (who is president ex-officio) and a number of village heads and advisers in council. Each authority is responsible for the maintenance of law and order within its district and also has a limited power to make local government orders and rules. Each district also has a tribunal exercising a limited civil and criminal jurisdiction. In addition there are a number of higher tribunals, known as group tribunals, exercising a more extended civil and criminal jurisdiction in certain specified groups of districts. In Bathurst there is a police court (dealing with criminal matters), a court of requests (dealing with civil matters), a Mohammedan court (dealing with Mohammedan marriage, succession and guardianship) and a juvenile court (established in 1949). In Kombo St. Mary division and in the protectorate there are subordinate courts consisting of commissioners or assistant commissioners with a more extensive civil and criminal jurisdiction than that granted to native tribunals. The supreme court exercises full jurisdiction (original and appellate) within both the colony and the protectorate.

Economic Conditions.— Gambia is naturally situated to handle overseas trade for a large hinterland. The river, on which steamers ply regularly; is the principal means of communication and there are about 30 river stations in the protectorate. The only seaport is Bathurst; Basse, 240 mi. upstream, is the head of regular river navigation; the chief places between are Georgetown and Kuntaur. These four stations and Mansa Konko, headquarters of the central division. have radio connection with each other.

The output of Gambia is wholly agricultural. Some subsistence crops are raised. chiefly grain sorghum, but not enough to feed the inhabitants. Instead, nearly all the suitable land is planted with peanuts (groundnuts), grown for export (rarely less than 95% of the annual total exports by value, customs duty upon which provides most of Gambia's revenue). The light soil and short season of rains favour this above all other crops marketable overseas. Gambia is merely an arbitrary segment of a much larger peanut-growing region, reaching far into the Sudan. Cultivation of all cash crops is wholly an African enterprise, although it is stimulated by the ease of shipment to the European market and guided by the colonial government. Allotment of land is left in the hands of the headmen, including the right to grant short-term tenancy to "strange" nonindigenous farmers. who usually grow peanuts. Peanuts were exported as early as 1836, and by 1850 peanut-growing was the chief business of the country.

The only other exports usually listed are palm kernels, hides and beeswax. Cattle are moved with the seasons, and are frequently driven across the political boundary of Gambia in both directions. a practice that hampered efforts begun in 1933 to control rinderpest by inoculating the animals.

The cash crops buy most of the inhabitants' requirements, including rice, a staple of their diet, and kola nuts. The leading import by value is cotton cloth. followed by foodstuffs. Hardware ranks next below foodstuffs. Local industries are limited to'cotton weaving. garment making and fishing. The need to purchase food as well as manufactured goods raises the annual per capita import to a high figure for tropical Africa, about £9 in 1953. Most of the overseas trade is carried in British ships. There is a British preferential tariff on imports. The monetary unit is the West African pound. at par with sterling.

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GAMBIA, a large river of West Africa, and the only river of Africa navigable by ocean-going vessels at all seasons for more than 200 mi. from its mouth. It rises about 11° 25′ N. and 12° 1j' W., within 150 mi. of the sea on the northeastern escarpment of the Futa Jallon highlands. Although the distance from the source to the mouth of the river is little more than 300 mi. in a direct line, the length of the stream because of its serpentine course is about 500 mi. It flows first north-northeast, receiving many left-hand tributaries, but about 12° 35′ N. takes a sharp bend northwest and maintains this direction until it leaves the fertile and hilly region of Bondu. The descent to the lower district is marked by the Earrakunda rapids, formed by a ledge of rock stretching across the river. From the Barrakunda rapids to the Atlantic the Gambia has a course of about 3jo mi. Throughout this distance the waters are tidal. At Yarboutenda, a few miles below Barrakunda the river has a breadth, even at the dry season, of over 300 ft. with a depth of 13 to 20 ft. From the falls to MacCarthy Island, a distance of 200 mi. the river valley; which here presents a parklike appearance, is enclosed by low rocky hills of volcanic character. For 50 mi. below the island, n-here the stream is about 800 yd. wide, the banks of the river are steep and thickly wooded. They then become low and are fringed with mangrove swamps. From Devil's point, a sharp promontory on the north bank. the river nidens and enters the Atlantic at about 13° 30' N. and 16" 30' W., by a broad estuary. Near the mouth on the south side is St. Mary's Island ($3\frac{1}{2}$ mi. long by $1\frac{1}{2}$ broad), and opposite is Barra point, the river being here contracted to $2\frac{1}{2}$ mi. Eighteen miles loner down the distance from shore to shore is 27 mi. There is a sand bar at the entrance to the river, but at the lowest state of the tide there are 26 ft. of water over the bar. Vessels draming 13 ft. can ascend to MacCarthy Island and those draming 6 ft, to Barrakunda all the year round. The Gambia is in flood from June to November, when the Barrakunda rapids can be passed by small boats, nhile above the rapids the stream is navigable for 160 mi. Politically the Gambia is divided betneen Great Britain and France —Britain possessing both banks of the river up to, but not including, Yarboutenda.

The Gambia was one of the rivers passed by Hanno the Carthaginian in his voyage along the west coast of Africa. It was known to Ptolemy and the Arabian geographers, and was at one time supposed to be a mouth of the Nile, and, later (18th century). a branch of the Niger. It nas possibly visited by Genoese navigators in 1291, and was certainly discovered by the Portuguese c. 1446, but was first explored for any distance from its mouth (1455) by the Venetian Alvise Cadamosto, who published an account of his travels at Yicenza in 1507 *(La Prima Navigazione per l'Oceano alle terre de' Negri della Bassa Ethiopia*). Afterwards the Gambia became a starting-place for explorers of the interior, among them Mungo Park. who began both his journeys (1795 and 1805) from this river. It was not until 1818 that the sources of the Gambia were reached. the discovery being made by a Frenchman, Gaspard Mollien, who had travelled by nay of the Senegal and Bondu. The middle course of the river was explored in 1851 by R. G. MacDonnell then governor of the Gambia colony, and in 1881 V. S. Gouldsbury also navigated its middle course. No native craft of any kind nas seen above Bairakunda.

GAMBIER, JAMES GAMBIER, Baron (1756–1833), British admiral, nas son of John Gambier. lieutenant-governor of the Bahamas. John Gambier nas the brother of Capt. (afterwards Yice-Admiral) James Gambier (1723–1839); of Samuel Gambier (1752–1813), first commissioner of the navy; and of Margaret, who married Capt. Charles Middleton R.N., comptroller of the navy 1j78–1790, and afterwards Admiral Lord Barham John Gambier's daughter, Margaret, married William Morton Pitt (1;54–1836). James Gambier nas therefore connected by marriage nith the Pitt family (and distantly with the prime minister) and also, through his aunt, nith Middleton. a relative of Henry Dundas, secretary of state and treasurer of the navy. He entered the navy by entry in the books of the guardship that his uncle commanded (1767) and reached post rank in America in 1778 nhen his uncle was rear admiral at New York under Lord Howe. His interest mas overnhelming but he chose to remain ashore between 1783 and 1793, gaining a reputation chiefly for piety. His ship the "Defence" was badly damaged in breaking the French line at the battle of the First of June. 1794. He then became a naval member of the board of admiralty, remaining there until 1801. by which date he was vice-admiral. He served for short periods afloat but was back at the admiralty again in 1804–06.

Gambier was appointed commander in chief in the Baltic in 1807 and directed the second bombardment of Copenhagen, after which he shared £300 000 prize money nith Lord Cathcart and returned to the admiralty nith a peerage. He was commander in chief of the Channel fleet in 1809 when Lord Cochrane came with orders to make a fireship attack on a French squadron in the Basque Roads. He disliked and disapproved of Cochrane and his methods and gave only halfhearted support to the attack. Cochrane's subsequent remarks induced Gambier to ask for a court-martial, by which he was acquitted, remaining nith the Channel fleet until 1811 and receiving further honours as G.C.B. in 1815 and admiral of the fleet in 1830. For an officer of such high rank he had exceptionally little sea experience; but the accounts most readily available of the Basque Roads episode came mainly from Lord Cochrane, and Gambler nas not the only flag-officer to think

Cochrane an intolerable nuisance.

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GAMBLING AND BETTING. Terms related to gambling and betting require clarification. In United States usage. "gaming" is archaic, except in law. A wager (synonymous with "bet") may be prompted by knowledge, opinion or conjecture as well as by reliance on chance. Unless otherwise qualified. however, these terms all imply gambling. which has become the comprehensive term to denote any gaming. wagering or undertaking (whether or not lawful or respectable) n-hose determination is controlled or influenced by chance or .accident and nhich is undertaken with consciousness of risk. Nongambling contests are generally termed play, pastime or sport. Gambling in business is speculation.

Derivations.— Gambling has sometimes been called instinctive in man. but this view is not widely held. It is more usual to consider gambling unnatural. though an inevitable concomitant of man's basic cultural patterns.

The bushmen of Australia and South Africa had competitions for prizes. sometimes guessing games—rude intellectual contests. The most primitive aboriginals of the western hemisphere had crude dice (*q.v.*) and gambled on "bowl" games. Tacitus remarked that the Teutons ("without the excuse of liquor") gambled themselves into slavery. Sudanese and West African natives. after gambling away their wives and children (as did many peoples)! likewise staked their own liberty. Instances are reported in which Chinese gamblers staked their right hands and, losing them. cut them off. Great emotional response, as of religious fervour or superstitious fear. marks the behaviour of the participants in these primitive peoples' games.

The identification of gambling with religion is invariable in primitive societies. The Hebrews cast lots before the Lord (Joshua xviii. 10), hut the Lord decided (Proverbs xvi. 33). The earliest designs of dice and playing cards (*see* CARDS, PLAYING) have been convincingly related to contemporary divinatory devices. The games of the Germans were probably inspired by their trials. which were grounded on belief in divine intercession in matters of chance.

There is nevertheless no indication that belief in supernatural agency had a causative effect on the emergence of the gambling spirit. The rise of rationalism produced no discernible decrease in gambling. In the higher cultures the emotional response to gambling has not been so marked, but the degree of risk accepted has been no less. In Tacitus' own time wealthy Romans bet so heavily on chariot races that they lost their entire fortunes and their respectability. In modern times, when the betting is on horse racing, similar phenomena are common and there are frequent reports of embezzlement induced by gambling losses. The forfeit in either case is subjectively as great as the liberty which, according to Tacitus, the Germans gambled away.

In psychology. given the assumption that it is not in the nature of man to gamble. various suggestions have been advanced to explain the gambling urge. One such suggestion—that the gambler is maladjusted to society and is impelled by a feeling of insecurity —is not inconsistent with the identification of gambling with superstitious fear, but it can be reasonably argued that gambling and superstition are merely coincidental. A more or less standard explanation of the psychology of the playing of games—sublimation of a mock struggle for want of. or for fear of, the real one—does not necessarily apply to gambling. A child enjoys competition but does not willingly accept risk.

Moral and Juridical Sanctions.— Gambling has been generally opposed in philosophy. as wasteful.

There is no direct biblical injunction against gambling. A tract attributed to St. Cyprian held that gaming violates the First Commandment and charged Lucifer with inspiring dice, and the Christian Church generally has held gambling to be sinful. Among the English clergy the popular view has conformed to that of Jeremy Taylor. who defended the playing of games for amusement but held gambling to be immoral. The talmudic law holds the acceptance of gambling winnings to be thievery. The Koran forbids all games except chess.

The Puritans asserted the identity of chance with Providence and condemned all games as blasphemous in that they violate the Third Commandment. Most Protestant churches adhered to this dictum. but in the 1920s many of them began to relax their objection to games played for amusement only. Roman Catholic churches have frequently sought funds for parish uses by conducting card and lottery games for money and other prizes.

There is a long record of legislation against gambling. This has been inspired partly by the attitude of the church, but more by political and economic expedient. To promote military efficiency, ancient Rome forbade gambling on the grounds that it was effeminating. and the earliest English law (1388) discouraged other games in the interest of archery. An ancient Egyptian law had the same purpose as edicts in France (139;) and England (1495): to forbid gaming by workmen at the expense of their productiveness.

Other English legislation sought to prohibit or discourage gambling. Games used only for gambling. such as faro (*q.v.*), all dice games. roulette (*q.v.*) and others, were declared illegal in a series of statutes dating from 1739. Other statutes sought to discourage betting by making gambling debts uncollectible by law (1710, 1845) and to make it more difficult by punishing the gaming-house keeper (1853) and the common gambler (1867, 1906).

Antigambling legislation in the United States has followed the English pattern but is complicated by the fact that the power to regulate gambling is reserved to the respective states; there are different sets of laws in each state, not to mention countless local ordinances. which usually vary in severity with the moral pressure brought to bear by lay agencies on legislators.

In England and the United States a general distinction between lawful and unlawful gambling seems to be that where skill predominates. the gambling is lan-ful; where chance does. it is unlawful. A court must decide which is the predominant factor in the case of each game in question. Cases show that one cannot rely on the record. for it is full of reversals and contradictions.

There has been controversy for nearly 300 years on whether or not gambling should be legalized and state-controlled. The affirmative argument is that antigambling legislation is ineffectual because Ian.-enforcement officers are reluctant or unable to prevent minor gambling. while the profits of major gambling are so great that professional gamblers purchase immunity from prosecution with bribes. Legal gambling, its proponents say, would provide huge state revenues and reduce taxes: eliminate corruption of the police: and protect the public against dishonesty. exorbitant advantages retained by professional gamblers and other abuses. Opponents of legal gambling argue not only on moral grounds but also on statistics which, they say, indicate that licensed gambling stamps out no abuses and merely aggravates the problem by fostering the betting habit. The German princes maintained gambling as a state monopoly through the 18th and part of the 19th centuries, but this practice survived only in Monte Carlo.

Betting on horse races, the principal form of gambling in the English-speaking countries, grew in popularity so rapidly that legislation proved powerless to prevent it, and eventually it came to be legalized to a certain extent. The pari-mutuel system (which term will be used here to designate any mechanical device for betting on races; see HORSE RACING AND BREEDING) originated in France in the 1860s and was authorized by Kentucky a few years later (though it was not put into use there until 1908). It was adopted by Australia, New Zealand and by most states of the United States.

In England, despite long agitation for pari-mutuel betting, other expedients were tried first. An effort was made (by act of 1926) to license bookmakers and impose a tax on betting. Evasion of the tax was so general. however, that in 1928 the Race-course Betting act was passed, permitting the use of totalizators.

When the pari-mutuel system is used. deductions of as much as 8% of the total amount bet are taken for the state and an equal or larger percentage for the operators of the race track. This does not include. however, the large sums bet with bookmakers.

U.S. pari-mutuel machines by the late 19jos handled more than $2,000,000,000 yearly. When a bettor wishes to place a large bet he may prefer to do so with a bookmaker and not through the pari-mutuel machines. The reason will become apparent from an illustration of the operation of the pari-mutuel system. A bettor places $100 on the winning horse in a race. In that race the total of bets is $10,000, of which $2,700 was bet on the winning horse. From the $10,000 the state and track first take their cut: assume it in this case to be only 10%. This leaves $9,000, or $6.67 for each $2 bet on the winning horse. But the track also retains odd pennies (called breakage), so the actual pay-oti is $6.60 for every $2 bet. The bettor of $100 therefore receives $330. If this bettor had placed an additional $1,000 on the winning horse. however, he would have received considerably less per dollar bet. The total of bets would then have been $I I.000, which the 10% cut would have reduced to $9.900. This amount would have been divided among a total of $3,700 in winning bets, and the bettor of $1,100 would have received $2.915. Therefore the big hettor would place his $1,000 bet with a bookmaker, who would guarantee him track odds. In this case the bettor would then receive $330 for his $100 bet at the track and $3.300 for his $1.000 bet with the bookmaker, a total of $3.630. Because of the deductions plus the breakage, the bettor must be at least a 20% better handicapper than the average bettor if he is to escape loss.

In England and the U.S.S.R. racing continued with few interruptions even during World War II. In the United States it was temporarily discontinued in 194j on the unannounced grounds that it caused absence from factories engaged in war work. Racing employs thousands of persons directly and many more indirectly through its well-developed press. extensive statistical services. self-styled experts nho sell advice on how to bet, networks of telephone and telegraph wires which furnish to betting centres prompt information on results, bookmakers and their employees and hangers-on. and workers incidental to the care and breeding of the horses. (See also HORSE RACING AND BREEDING.)

Lottery has the longest record of legality. It was used by Augustus, Nero and other Roman emperors to finance building projects and increase imperial revenue. Lotteries were held in Europe from the 1jth century on; in England. the first lottery of record was announced in 1j69 with Queen Elizabeth I as patroness; and in the new world there were lotteries as early as the 17th century, chiefly for the benefit of schools, churches and public works.

The mechanics of a lottery are essentially as follows: Tickets bearing different numbers are placed on sale, and a date is set for a drawing. On that date is set up a device which contains numbered duplicates of all the tickets sold, and one or more numbers are drawn at random. From the money realized by the sale of tickets. the proprietors of the lottery deduct some amount, arbitrarily determined, for expenses and profits; the remainder is paid to the holders of tickets corresponding to those drawn.

The principal charge against lotteries is that they penalize the poor, who in ill-advised hope or desperation buy most of the tickets; Count Camillo Benso Cavour called lottery "a tax upon imbeciles.'! Even more valid is the complaint that very few ticket holders are at the drawing; those who are present cannot conveniently assure themselves that the device contains the numbers of all ticket holders, and therefore it is very difficult to safeguard a lottery against chicanery.

For these and other reasons. England prohibited private (unlicensed) lotteries in 1698 and did not license a lottery after 1824. Most states of the United States had outlawed private lotteries by IS50, and no state licensed a lottery after 1893. In Ireland and in Central America lotteries were permitted. however. and some European countries authorized occasional or regular state-operated lotteries. During World War II the U.S.S.R. used the lottery for war financing; a ticket was issued free to any purchaser of a war bond, and prizes were as high as 100,000 roubles.

The largest of the U.S. lotteries was the Louisiana state lottery. The state legislature licensed it in 1868 in consideration of an annual fee of $40,000, and the operators averaged almost $2,000,000 in ticket sales for each monthly drawing at the peak of the lottery's success. Charges of corruption were so widespread, however, that in 1890 the state refused $1,125,000 per year offered by the operators for a renewal of the licence.

The amount staked in the three sweepstakes sponsored annually by the Irish Hospitals trust totalled about £9.000,000 in 1954.

Despite their illegality and the iact that lottery tickets are barred from the mails. lotteries in various guises flourish on both sides of the Atlantic. In the United States, the popular forms came to be bingo and, in the big cities, policy or the numbers game.

The numbers game was devised to appeal to members of the lowest-income group, and it achieved its greatest popularity among Negroes, to many of whom a daily investment of one to ten cents became so habitual that it was looked upon as a normal expense of living rather than a gambling bet. While several methods were developed for the numbers game, in its usual form the player tried to guess three numbers (such as the three final digits of the daily clearinghouse receipts) which would surely appear in the daily newspapers and could not possibly be influenced by the operators of the game. When newspapers, co-operating with law-enforcement officers. omitted publication of these figures. others were substituted and the game went on. For guessing the three numbers in proper order, for example, the player might receive j39 to 1, whereas actual odds would be 999 to I.

Pools on football and (in the United States) professional baseball became popular in various forms. Usually the bettor's task is to name the winning teams in three or more games: or, in baseball, to predict the number of hits or runs a named team will make during the week. The payoff ranged from 3 to 1, when the actual odds were 1j or 16 to 1, up to 100 to 1 when the actual odds were 300 to I. In Great Britain the Pool Betting act of 1954 set certain requirements for the conduct of pool betting. including the registration of operators and inspection and publication of financial details. It also legalized ready-money pool betting conducted by mail by registered promoters.

Gambling houses on the order of the European casino spread through the United States: a survey made in 1944 by S. Michael MacDougall, a professional investigator of dishonest gambling practices, indicated that except in a few sparsely settled sections it was possible to find a gambling house within a go-mi. radius of any point. In these houses players may not bet among themselves but only against the house. which retains a mathematical advantage. often exorbitant. Crap shooting (see DICE) is the principal game; black jack (*q.v.*) is the leading card game played, and roulette (*q.v.*) is popular. Gambling houses must usually operate secretly or by bribery of governmental officers.

Slot machines, a sort of mechanical lottery device. help to support the gambling houses (many of which display rows of 2j to 50 such machines) and. when the police permit. add to the income of taverns, retail stores, clubs. restaurants. etc. In playing these machines the player inserts a coin in a slot..thus setting the machinery in motion, and gets back from 2 to 200 coins if a winning combination shows; such machines generally pay out about two-thirds of the money taken in.

Wagering on the results of boxing matches, other sporting events and miscellaneous contingencies is general. In the United States, bookmakers' odds on such events are often quoted in the newspapers several days in advance.

Card games are usually played for very low stakes. and in the United States they are commonly played for no stakes at all. Therefore the amount bet on such games is an insignificant part of the total. Nevertheless there are irequent prosecutions of clubs for permitting low-stake games of contract bridge and poker to be played. In the United States most courts have held that contract bridge is a game of skill and not subject to the antigambling laws, and some courts have held the same of poker: but convictions have been brought in connection with the operation of both these games. In England the courts have held poker .and occasionally contract bridge to be games of chance.

Speculation in stocks, shares and commodities is not illegal when the transaction is a bona fide purchase or sale. The once-prevalent bucket shops and quasi-legal brokers who did not in all cases complete the transactions for which they were commissioned were generally held to be in violation of gambling starutes and were largely eliminated by successful prosecution. To many persons. however. "playing the market" is merely a means by which they can gamble within the law. When they trade in the stock exchange they are in effect betting on the fluctuations in price. in that they have no intention to accept or make actual delivery unless it becomes necessary. Governmental regulation of buying and selling on margin tended to inhibit this practice but did not succeed in eradicating it.

Kefauver Committee. — In 1951 the U.S. senate special committee to investigate organized crime in interstate commerce: headed by Sen. Estes Kefauver of Tennessee, reported that illegal gambling in the United States totalled $20,000,000,000 annually. Evidence of political-criminal alliances reaching into city. state and federal offices was presented. Legislation resulting from the investigations required gamblers to register with the bureau of internal revenue, to pay a tax prorated at $50 a year and thereafter remit as tax 10% of their gross receipts. (See also CRIME: *United States.*j

Royal Commission on Betting, Lotteries and Gaming in Great Britain. — This commission reported in 1951 that net expenditures on gambling were approximately £70,000,000 a year. In comparison with the amounts spent on tobacco, drink or entertainment! however. the commission pointed out that the total amount spent on gambling was about 8% of the total personal expenditure. The commission's recommendations led to the enactment of the Pool Betting act of 1954 (see Pools, above).

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(A. H. MD.; X.)

GAMBOGE, a gum resin from *Garcinia hanburii,* a dioecious tree with leathery, laurel-like leaves, small yellow flowers and usually square-shaped and four-seeded fruit. indigenous to Cambodia and parts of Thailand and South Vietnam. The juice, which when hardened constitutes gamboge, is contained in ducts in the middle layer of the bark, and from this it is procured by making incisions. bamboo joints being placed to receive it as it exudes. Gamboge occurs in commerce in cylindrical pieces, known as pipe or roll gamboge, and also, usually of inferior quality, in cakes or amorphous masses. It is of a dirty orange colour externally, is hard and brittle, breaks with a conchoidal and reddish-yellow, glistening fracture, and affords a brilliant yellow powder; is odourless and has a taste at first slight but subsequently acrid; forms an emulsion with water; and consists of from 20% to 25% of gum soluble in water and from 70% to 75% of a resin. Its commonest adulterants are rice flour and pulverized bark.

Gamboge is a drastic hydragogue cathartic, less active only than croton oil and elaterium. A small quantity is absorbed, adding a yellow ingredient to the urine and acting as a mild diuretic. Its irritant action on the skin may cause the formation of pustules. Gamboge is used as a pigment and as a colouring matter for varnishes. It appears to have been first brought into Europe by merchants from the east at the close of the 16th century.

GAMBREL ROOF, a roof which has on each side of the ridge two slopes, the lower more steep, the upper less so. and which has gables at the end walls. It is particularly characteristic of American colonial work in New England, New York and New Jersey. although found in many parts of the world. The origin of its common use in America is not definitely known; it may have been purely an invention in the effort to obtain greater head room in the attic or upper floor.

In the New England examples the slope of the lower portion approximates 60°, that of the upper portion varying from 30° to 40°; in places where Dutch influence was strong, the lower slope was more nearly 45°, and the upper about 30°, and frequently there was a large projection at the eaves. In Europe the form occurred spasmodically in work of the 17th century and later throughout the Teutonic countries, especially in Scandinavia. There are also rare examples which may be seen in the south of England.

See ROOFS.

GAMBRINUS, a mythical Flemish king who is credited with the first brewing of beer. His name is usually derived from that of Jan Primus (*i.e.*, Jan [John] *I.* the victorious duke of Brabant, 1261–94), who was president of the Brussels guild of brewers; his portrait with a foaming glass of ale in his hand had the place of honour in the guildhall, and this led in time, it is suggested, to the myth of the beer king who is usually represented with a tankard in his hand.

See A. I. Kuprin, *Gambrinus* and *Other Stories* (1925).

END OF VOLUME NINE

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